PERI-URBAN FARMERS' MITIGATION AND ADAPTATION MEASURES AGAINST CLIMATE CHANGE IN TANZANIA: *A CASE OF TEMEKE DISTRICT, DAR ES SALAAM REGION*

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EXTENDED ABSTRACT

Although climate change has posed challenges among the farming communities in different places, it is yet not sufficiently known how peri-urban farmers of Temeke District mitigate and adapt to this phenomenon. This study was set to contribute in addressing this gap. Specifically , the study: i) assessed awareness of peri-urban farmers and the effects of climate change on peri-urban farming; ii) examined mitigation and adaptation measures of peri-urban farmers as a response to climate change; iii) compared gendered determinants of mitigation and adaptation measures; and iv) assessed policy implementation challenges on mitigation and adaptation measures. Data collection involved administering household questionnaire among 240 heads of the households, focus group discussions and key informants' interviews. Quantitative data from the household surveys was analysed through Statistical Package for Social Sciences while qualitative data was subjected to content analysis. The results revealed that, peri-urban farmers were aware of climate change. Farmers were able to identify indicators like decreased rainy cycles, rising temperatures and rainfall fluctuations. Similarly, farmers were able to describe the main drivers of climate change, notably, cutting of trees for fuel wood and charcoal. Also, farmers mentioned the effects of climate change which included shortened in the growing seasons, perceived decrease in crop yields and decreased vegetation cover. These triggered the implementation of mitigation and adaptation measures including cover cropping, alternative energy sources, and agroforestry. Others included drought resistant crop cultivation, economic diversification and mixed farming. The level of mitigating climate change was high as 60.8% exhibited the highest level. The level of mitigation across three age groups (20 – 34, 35 – 59 and 60+) was statistically significantly differently at $p< 0.05$). The level of adaptation measures was also high as 72.5% exhibited the highest level. The level of adaptation across three age groups was almost similar ($p> 0.05$). Gender wise, the findings showed that the level mitigation and

adaptation measures between men and women was similar ($p>0.05$). With regard to determinants of mitigation measures, there were no statistically significantly differences in household's income between men and women at $p=0.051$. For adaptation measures, geographical locations were statistically significantly differently across gender at $p=0.031$, while tradition and customs were statistically significantly differently at $p=0.043$. Furthermore, the study revealed success of the National Climate Change Strategy such as identification of interventions among the local communities. The challenges of the Strategy were associated with low implementation of the priotised interventions among peri-urban farmers. The study concludes that, climate change impacts necessitated implementation of mitigation and adaptation measures across gender so as to sustain farming activities. Nonetheless, the study exhibited differences in the gendered determinants in adaptation measures which indicate the need to upscale gender concern on interventions. The Government should assist local communities by building capacity to intervene in climate change. Also, more studies should be carried out to determine factors for climate change interventions, examination of policy implementation in other agricultural settings and the production changes due to interventions. The study contributes to the empirical information on climate change interventions of peri-urban farmers. The study has a theoretical application of Disaster Crunch Model. Also, the study addresses climate change which is also a core concern of both global and national policy frameworks such as UNFCCC, NCCS, SDGs and Tanzania Development Vision 2015.

DECLARATION

I, Samwel Peter Lunyelele, do hereby declare to the Senate of Sokoine University of Agriculture that, this thesis is my own original work done within the period of registration and that it has neither been submitted nor concurrently being submitted to any other institution.

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DEDICATION

This thesis is dedicated to my parents: Dr. Peter Lunyelele and the late, Mary Mlenga for their immeasurable contribution. It is also dedicated to my wife, Julitha; my children: Marygrace, Goodluck and Johanes. Likewise, dedication is due to my aunt, the late Tabu Ndziku.

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LIST OF ABBREVIATIONS AND ACRONYMS

CDM	-	Clean Development Mechanism
CFCs	-	Chlorofluocarbons
FAO	-	Food and Agriculture Organisation
FGDs	-	Focus Group Discussions
GHGs	-	Greenhouse Gases
HESLB	-	Higher Education Students Loans Board
IPCC	-	Intergovernmental Panel on Climate Change
LS	-	Likert Scale
MDGs	-	Millennium Development Goals
MNMA	-	The Mwalimu Nyerere Memorial Academy
NAPA	-	National Adaptation Plan of Action
NCCS	-	National Climate Change Strategy
PUF	-	Peri-urban Farming
REDD+	-	Reduced Emissions from Deforestation and Forest Degradation
SDGs	-	Sustainable Development Goals
SPSS	-	Statistical Package for Social Sciences
START	-	System Analysis for Research and Training
UNAIDS	-	United Nations AIDS Control Programme
UNDP	-	United Nations Development Programme
UNFCCC	-	United Nations Framework Convention on Climate Change
URT	-	United Republic of Tanzania

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

Climate change is one among the greatest development challenges in the world (UNDP, 2007). The fourth assessment report of Intergovernmental Panel on Climate Change (IPCC) confirmed an increase of the global average air and ocean temperatures for approximately 0.74ºC. This increase led to a wide spread snow and ice melting as well as global rising sea level for about 17cm over the past 100 years (IPCC, 2007). Climate change results from the increased atmospheric concentration of Greenhouse Gases (GHGs) such as Carbon Dioxide, Methane, Nitrous Oxides and Chlorofluocarbons. The increase in concentration of GHGs is primarily due to industrialization, deforestation and increased use of fossil fuels of which the industrialized countries contribute much to the total global emissions (IPCC, 2007).

In view of this trend, climate change has received attention among different stakeholders where international and national communities are scaling up efforts to address consequences associated with it (IPCC, 2014). Some of the global initiatives are the “Rio Earth Summit” which signed the United Nations’ Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol which have addressed mitigation and adaptation measures (Pelling, 2002). Those forums emphasized mitigation measures such as sustainable forest management for carbon sequestration and Land Fill Gas Methane Recovery (IPCC, 2007). The emphasis on adaptation measures is focused on priotizing food security project which encompasses; introducing drought and saline resistant crops, developing local food banks, and improving farming systems to reduce dependence on climate sensitive crops. Others are non-farming options such as economic diversification (IPCC, 2007; FAO, 2008).

In developing countries, climate change is already having significant impacts and has affected their ability to achieve Millennium Development Goals (MDGs) (IPCC, 2007; UNDP, 2007). In Africa, large part of the continent has experienced the decrease in rainfall which is coupled with the increase in the incidences of extreme events such as extreme temperatures, droughts, recurrent floods and pests and diseases (Boko *et al*., 2007). Tanzania is not immune to the consequences of climate change**.** The most notable indicators in Tanzania include rise in temperature and sea level, decrease in the amount of rainfall and increase in drought period which trigger recurrences in food shortages (Kaufman and Cleveland, 2008; Lyimo and Kangalawe, 2010). The other known indicators in the country include the extreme drop of water levels in Lake Victoria, Lake Tanganyika and Lake Jipe in recent years and the dramatic recession of 7km of Lake Rukwa in about 50 years. Furthermore, climate change is typified by the loss of the glacier of Mount Kilimanjaro by eighty per cent since 1912 and it was projected that the entire glacier will be gone by 2025 (URT, 2007). Besides the aforementioned evidences, Matari *et al*. (2008) projected an increase in mean and annual temperature by 1.7°C by 2100 especially over the Northern Coast, including areas around Dar es Salaam.

Climate change has particularly affected agricultural sector in Tanzania since it is largely rain-fed. The National Adaptation Plan of Action (NAPA) has earmarked agriculture as one among the most vulnerable sectors in Tanzania (URT, 2007). In addition, Lema and Majule (2009) and Kihupi *et al*.(2015) stress that climate change has jeorpadised the growing seasons for different crops which subsequently plagued total harvests. Apparently, studies reported that between 1996 and 2003 climate change resulted into severe decline in food production in Tanzania (Thompson *et al.*, 2002; URT, 2008). The Dar es Salaam Region and Temeke District in particular have experienced consequences of climate change. This is manifested by the decrease in the mean annual rainfall over the

past five decades, changes in the characteristics of the rainy seasons as well as decrease in number of consecutive wet days (Mlozi *et al*., 2014). These changes have direct negative implication on farming activities including peri-urban farming (PUF) undertaken in Temeke District. This is because farming systems undertaken in the District are largely rainfed and partly irrigated which also depends on the amount and intensity of precipitation. Therefore, the changing climate directly affects both rainfed as well as irrigation farming.

As reported by UNFCCC (2007), developing countries including Tanzania are more vulnerable to the negative impacts of climate change due to low adaptive capacities coupled with over dependence on resources which are sensitive to climate. Therefore, the growing trends of decreasing rainfall coupled with rising temperature continue to affect the availability of surface and ground water. This situation has subjected farming activities including PUF of Temeke District into a more vulnerable situation. Due to these challenges, responses on climate change across different locations appear to be necessary and inevitable in order to sustain farming practices. Peri-urban areas in Temeke District are among the locations where initiatives were pursued to sustain PUF against climate change.

Peri-urban areas refer to areas found in the fringes of the city or towns. These areas are characterized by urbanization influences which amplify land competition from other economic activities such as human settlement and industries (Choy *et al.*, 2007; Simon, 2008). Peri-urban areas are composed of a mixture of urban and rural characteristics (Nelson, 2007). The rural characteristics include features like the dominance of farming at the expense of other activities. Meanwhile, peri-urban areas enjoy the proximity of the urban areas they area bordered with. Peri-urban areas are also characterized by transitions

from rural to urban livelihood. Due to this, they tend to undergo more dramatic changes in land use than either in the city or the nearby rural areas (Mougeot, 2000). Also, an expansion of human settlement due to the increase in city's population triggers land shortages in peri-urban areas (Mlozi *et al*., 2014). Temeke District is also characterized by having peri-urban areas. These areas have the dominance of farming with large farm area and large number of farming households compared to the other districts in the region. The dominance of farming activities in Temeke is also evidenced by its large contribution to the city food supply as compared to the other districts (URT, 2012).

PUF is therefore the type of farming that takes place in peri-urban areas. It is more complex and vulnerable to environmental and other socio-economic changes. This is because of transitional nature of peri-urban areas where PUF is practiced. This indicates that mitigation and adaptation measures in these settings align to transitional nature of peri-urban areas. On the other hand, peri urban farmers comprise of the farming community who practice crop cultivation and livestock keeping or others either practice crop cultivation or livestock keeping. All these activities are taking place in the fringes of the city where transition from rural and urban areas can be observed.

PUF is important in various ways including employment creation, households' economy and nutritional value addition. This is indicated in a number of studies. Fellman *et al.* (2007) noted that, worldwide, about 800 million urban and peri urban farmers provide one seventh of the total food production, whereas in Accra Ghana, the same provides the city with 90% of its fresh vegetables. Racodi (1995) documented PUF as a response to food shortages in Zimbabwe due to severe drought of 1991-92. In Kano, Nigeria, the amount of horticultural production among peri urban farmers had increased significantly as a result of government policies and increased urban poverty (Bins and Lynch, 1998).

Furthermore, in Tanzania and Kenya 2 of 3 peri urban families engage in farming (Fellman *et al*., 2007). A study by Lanjouw *et al*. (2001) revealed that about 54% of urban dwellers' income in Dar es Salaam, Lindi, Mbeya, Mwanza, Arusha and Moshi was from crop output through peri-urban farming. Jacobi *et al.* (2000) estimated that about 35,000 farming households in Dar es Salaam depend on peri urban fruit and vegetable production for their income. Sumberg (1997) found that about 44% of daily milk consumption in Dar es Salaam city is produced in its peri-urban areas. Likewise, notable quantities of vegetables and fruits consumed in cities like Dar es Salaam are produced by peri-urban farmers (Tesha, 1996; Jacobi, 1997). Other studies (Stephenson *et al*., 1996; Mlozi *et al*., 2013) mentioned peri urban farming as a primary economic activity for majority of peri urban dwellers of Dar es Salaam Region. Mlozi *et al*. (2014) revealed that peri-urban farming contributes much to the city food basket. Thus, it is clear from those evidences that the important role of PUF as a life strategy and nutritional benefits within peri-urban context and in urban areas is undeniable.

PUF is prone to climate change (Mlozi *et al*., 2013; Shretha and Sada, 2013; Mlozi *et al*., 2014). Shretha and Sada (2013) indicate that climate change in PUF in Nepal negatively affected crop production and increased pests and diseases. Ricci (2012) links climate change in peri-urban areas of Kinondoni District of Dar es Salaam Region with declining water availability, decrease in the amount of water from shallow pits, decreasing river flow as well as changes in the amount of rainfall. In case of Temeke District and Dar es Salaam as whole, climate change is already having a toll. This is evidenced by the decrease in rain cycles in both rain seasons (START, 2011). These consequences have strong negative implications in PUF undertaken in the study area because it depends on climate sensitive resource which is rainfall (Mlozi *et al*., 2013). Therefore, decreasing in the amount and intensity of rainfall negatively affect peri-urban farming practices.

Despite the growing importance of PUF and its susceptibility to climate change, mitigation and adaptation measures implemented by peri-urban farmers have not received sufficient attention. This is because, this area is less researched and that, farmers' intervention practices are empirically little known. As opposed, much effort has been directed to address initiatives undertaken by farmers in the other settings particularly semi-arid and rural areas (Lema and Majule, 2009; Lyimo and Kangalawe, 2010; Dungumaro and Hyden, 2010; Kihupi *et al*., 2015). Assessment of peri-urban farmers' mitigation and adaptation measures against climate change is an essential step to identify community level initiatives to sustain PUF. Therefore, this study has been set to explore mitigation and adaptation measures implemented by peri urban farmers of Temeke District as a response to climate change.

1.2 Problem Statement and Justification

Initiatives to address climate change have been implemented by different stakeholders in many geographical and environmental settings including semi-arid and rural areas (Lema and Majule, 2009; Lyimo and Kangalawe, 2010; Dungumaro and Hyden, 2010; Kihupi *et al*., 2015). With all those efforts, mitigation and adaptation implemented by peri-urban farmers to intervene climate change have received little attention. Likewise, awareness of climate change among peri-urban farmers is not sufficiently studied. Therefore, it is not well known despite farmers' understanding on climate change that is imperative to create practical strategies in responding to climate change (Kusakari *et al*., 2014). Apparently, comparison of gendered determinants of climate change mitigation and adaptation measures among peri-urban farmers are not sufficiently explored.

Studies on climate change adaptation conducted in the setting of peri-urban have paid little emphasis on initiatives of peri-urban farmers to mitigate and adapt to climate change

(Mlozi *et al*., 2013). In the other vein, studies which addressed climate change along the coast where Temeke District is situated were not specifically focusing on peri-urban farming (Kashaigili *et al*., 2014). Because of limited studies, little facts exist about mitigation and adaptation measures on PUF as compared to other settings. Despite the little emphasis received, PUF has been recognized to be a significant source of livelihood for a good number of the poor peri urban and urban households. It serves as an important source of employment, income and stimulant of small and medium enterprises leaving aside nutritional benefits (Mascarenhas, 1995; Bins and Lynch, 1998; van Veenhuizen, 2012; Mlozi *et al*., 2014). The earlier study by Bins and Lynch (1998) found that 54% of the households in Dar es Salaam were involved in farming whereby 24% were farming within the city and 30% in peri urban areas. Nonetheless, PUF in Temeke District is not spared from climate change consequences (Mlozi *et al*., 2013; Kashaigili *et al*., 2014). This situation and other evidence mentioned above indicate that farmers in the setting of peri-urban areas strive to mitigate and adapt to climate change to sustain their livelihood.

The importance of assessing location specific mitigation and adaptation measures as it was done specifically among peri-urban farmers of Temeke District was also emphasized in the other studies (IPCC, 2007; FAO, 2008). In Tanzania, the Tanzania National Climate Change Strategy of 2012 was adopted for addressing country level climate change mitigation and adaptation measures. However, the Strategy does not specify location specific measures including those implemented in peri-urban setting such as Temeke District. Based on these observation, the study investigated mitigation and adaptation measures due to climate change that peri-urban farmers used. Likewise, this study assessed awareness of peri-urban farmers on the concept of climate change. This is because awareness is an entry step towards climate change interventions among the local communities including peri-urban farmers of Temeke District.

Furthermore, the study compared gendered determinants of mitigation and adaptation measures among peri-urban farmers. This is because farming is gendered and gender roles vary across different locations and also climate change affects women and men differently (Carvajal-Escobar *et al.,* 2008). Finally, the study made comparative analysis of mitigation and adaptation measures implemented by peri-urban farmers of Temeke District with those mentioned in the national frameworks particularly the National Climate Change Strategy. The rationale for this analysis was to find out whether the measures implemented by peri-urban farmers are compatible to the measures priotised in the existing national policy framework. It was imperative to focus on NCCS because it is a national policy framework on climate change which guides holistically mitigation and adaptation measures at the national level.

The study is justifiable because in Tanzania, over 70% of its population depends on subsistence rain fed farming system (Lema and Majule, 2009). In particular, PUF is one of the forms of farming which is important among communities in Temeke District and the rest of the Region (Mlozi *et al*., 2013; Mlozi *et al*., 2014). Similarly, the Region's escalating population growth rate of about 5.6% (URT, 2013; URT; 2016) triggers demands for perishable foods including leafy vegetables produced in peri-urban areas of Temeke District. Due to this demographic trend, climate change mitigation and adaptation measures will continue to be useful interventions for PUF's sustenance.

Assessing mitigation and adaptation measures pursued by peri-urban farmers is also paramount since measures implemented in other settings such as change of cultivation areas, crop switching, mixing of crops and out migration to the cities for wage employment (O'Brien, 2000; URT, 2003; Paavola, 2004) may not be appropriate for PUF. This is due to the fact that peri urban areas are unique and complex which implies that

mitigation and adaptation measures implemented are also not very similar to the other contexts. In the other vein, as stated earlier in this chapter PUF forms an important source of livelihood, yet, it is affected by climate change (Mlozi *et al.*, 2013; Mlozi *et al*., 2014). Arguably, climate change also affects households that are not involved in PUF in surrounding areas because of the decrease in the supply of perishable foods such as green leafy vegetables produced in the study area. In this view, there is no doubt that PUF will continue to be practiced to sustain farmers' livelihood in the face of climate change. Assessing mitigation and adaptation measures is equally imperative because it can form a road map for policy makers, planners and other stakeholders to revise policies, plans and programmes geared towards sustaining peri urban farming. Proper interventions from the relevant authorities will add value if they take into account local communities' initiatives including those of peri-urban farmers in Temeke District.

1.3 Objectives

1.3.1 Overall objective

To investigate mitigation and adaptation measures that peri urban farmers take against climate change.

1.3.2 Specific objectives

Specific objectives were to:

i) Determine awareness of peri urban farmers and effects of climate change on peri-urban farming;

ii) Assess mitigation and adaptation measures that peri urban farmers use against impacts of climate change.

iii) Compare gendered determinants of climate change mitigation and adaptation measures among peri-urban farmers.

iv) Examine policy implementation challenges on mitigation and adaptation measures among peri-urban farmers.

1.4 Research Questions

i) How do peri urban farmers define climate change in terms of causes, indicators and effects?

ii) How do per-urban farmers apply farm and nonfarm measures to mitigate and adapt to climate change?

iii) What are the existing gendered differences in the determinants of mitigation and adaptation measures among peri-urban farmers?

iv) What are success and challenges of policy implementation among peri-urban farmers of Temeke District?

1.5 Conceptual Framework

A conceptual framework is a set of broad ideas and principles taken from relevant fields of enquiry and used to structure a subsequent presentation (Reichel and Ramey, 1987). Conceptual framework strengthens the research and keeps it on track (Goetz and LeCompte, 1984). The framework for this study was constructed based on theoretical and empirical review of literature. The framework shows the study variables and their relationship. As revealed in Figure 1.1, the framework establishes the linkage between study variables and the way independent variables influence dependent variables. These variables range from the causes indicators, effects and finally to the outcome of interventions of peri-urban farmers for climate change mitigation and adaptation measures.

The framework shows that climate change is common in the study area. The causes are more related to the common livelihood practices in the study area. Also, indicators and effects of climate change are real and evident among peri-urban farmers of Temeke District. The obvious indicators and effects which are directly related to farming include the rising temperatures, decreasing rainfall and recurrent droughts. These challenges especially prolonged droughts, due to the decrease in short rainy cycles, have negative impacts on peri-urban farming.

In order to sustain peri-urban farming, farmers need to device mitigation and adaptation measures specific for peri-urban setting because climate change effects are location specific and vary across different population categories. However, implementation of mitigation and adaptation measures is not an automatic thing since it is gender based. Thus, involvement of men and women in farming also varies across different contexts. Apart from that, mitigation and adaptation measures among peri-urban farmers are influenced by awareness of policies. The devised mitigation and adaptation measures may reduce or enhance the impacts of climate change depending on whether they are implemented well or not. If well implemented, mitigation and adaptation measures may reduce climate change impacts, hence; sustain peri-urban farming. If not well implemented, the interventions may accelerate the impacts and consequently undermine farming practices undertaken in the setting of peri-urban. This thesis reports on the hypothesized relationship among the study variables starting with indicators through gendered determinants of mitigation and adaptation measures in peri-urban areas of Temeke District.

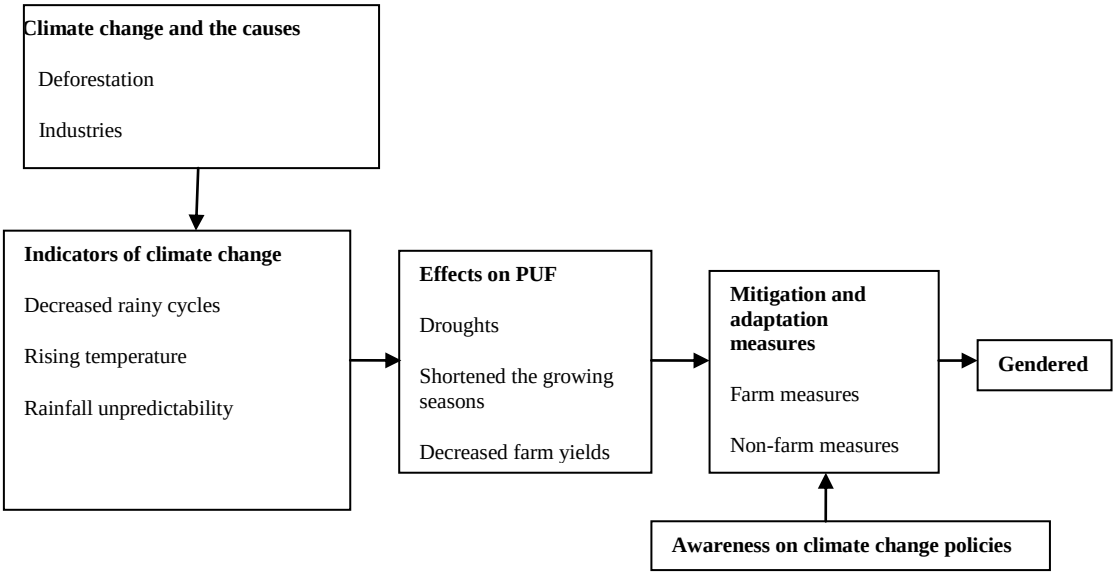

Figure 1.1: Conceptual Framework

1.6 General Methodology

1.6.1 Selection of the study area

It sounds inappropriate to select the study area by using random sampling technique. Instead of that, it is important to select the study area based on the available empirical information (Wilson, 2002). The available empirical information for this study included information on the importance of peri-urban and urban farming and climate change. In Tanzania, agriculture is practiced in most of the urban areas (Tesha, 1996; Lanjouw *et al*., 2001). Selection of Dar es Salaam Region was guided by different literature which established that farming is practised in the region as a livelihood strategy (Nelson, 2007; Ricci, 2012; Mlozi *et al*., 2013; Mlozi *et al*., 2014; Kiduanga and Shomari, 2016). However, farming undertaken in the region is vulnerable from climate change point of view (Mlozi *et al*, 2013). Besides climate change, land tenure issues also plague farming in the region (Kiduanga and Shomari, 2016).

The choice of Temeke District was logical because of the presence of empirical evidence that farming is more dominant in terms of the area under cultivation and the number of

farming households compared to the other districts in the region. In addition to this, the contribution of the district to the entire city food supply is significant compared to the other districts (URT, 2012). It is also evident that, Dar es Salaam is the country's largest city with rapidly growing population (URT, 2016). Therefore, the existing demographic trend raises a sustained higher demand for food, especially perishables such as green leafy vegetables produced in Temeke District to feed the growing population. The first step involved in the selection of the wards was to review a list of all wards of Temeke District so as to segregate urban from peripheral wards. Urban wards were excluded from the list and remained with peri-urban wards. From this list, four wards where farming was considered more dominant according to the district authorities were purposefully chosen. These were Kimbiji, Kisarawe II, Pembamnazi and Somangila.The map of Temeke District which shows the selected wards is provided as Figure 1.2

Figure 1.2: A Map of Temeke District showing the Study Area

1.6.2 The study design

The study adopted a cross sectional survey design. It is a cross sectional study because it examined the current mitigation and adaptation initiatives. This means, in this study, data were collected at a single point in time.

1.6.3 Sampling procedures

Due to time and financial limitations, it was not possible to include all wards in the District. With the help of the District Agricultural Officer four peri-urban wards namely: Kimbiji, Kisarawe II, Pembamnazi and Somangila were purposively selected. In these wards, there were more farming activities than their counterparts. From these wards, lists of streets were prepared as sampling frames of which four streets were randomly selected from each wards. Later on, all households involved in farming were listed with the aid of street leaders where 15 households were selected randomly from each street. This is because, the target population for this study comprised of peri-urban farming households residing in peri-urban wards of Temeke District. Having selected randomly 15 households from a list established in each street, the heads of households were contacted for interview. This led to a total of 60 respondents from each ward. Thus, the total sample size from the entire study area was 240 respondents.

1.6.4 Research instruments and data collection

The main research instruments used in this study were the households' questionnaires (for household surveys), discussion guide (for focus group discussions) and interview checklist (for key informants' interviews). Construction of instruments (mainly a household questionnaire) began by defining the type and scope of information. To achieve this, rigorous literature search was done. Different question formats including closed and open ended questions were used. A household questionnaire was applied to the heads of households to elicit data on socio-economic and demographic characteristics, awareness on climate change in terms of indicators, causes, sources of information and effects on PUF. Others data included those on the application of mitigation and adaptation measures, and perception on the effectiveness and determinants of mitigation and adaptation measures (Appendix 1).

Also, a discussion guide was applied during focus group discussions (FGDs) (Appendix 3). One FGD consisting of 10 to 12 participants was conducted in each ward upon completion of household questionnaire survey in the respective ward. Participants were farmers of both sexes whose households were not involved in surveys. Location specific information on various climate change aspects including farmers' general understanding on the concept, indicators and causes of climate change were elicited from FGDs. Other information included data on mitigation and adaptation measures pursued in the study area.

The third instrument was an interview checklist which was used for key informants' interviews in each ward (Appendix 2). Ward Executive Officers, Extension and Livestock Officers were interviewed as key informants. This was purposefully done among these officials because they could provide technical information on climate change. Such information was useful to support on the information elicited from the household surveys and FGDs, hence; strengthening the analysis and discussions.

1.6.5 Data analysis

Data analysis was done through the SPSS computer programme (quantitative data) and content analysis (qualitative data).

Objective one: To determine the level of awareness of peri-urban farmers and effects of climate change on peri-urban farming.

Descriptive statistics were applied to analyse quantitative data on awareness. The level of awareness on climate change was organised into three levels: the highest level was assigned a score of 30, neutral (20) and the lowest level (10 scores). Descriptive tools such as frequencies and scores were produced on indicators, causes and effects of climate

change. Content analysis was applied to analyse qualitative data elicited through key informants interviews and focus group discussions.

Objective two: To assess mitigation and adaptation measures used by peri-urban farmers against impacts of climate change.

Kruskal Wallis Test was applied to establish whether the level of mitigation and adaptation measures was significantly different across three age groups involved in farming in the study area (20 – 34, 35 – 59 and 60+). Descriptive statistics were applied to assess mitigation and adaptation measures implemented by peri-urban farmers of which frequencies were produced in each applied measure. Content analysis was applied to analyse qualitative data from the focus group discussions.

Objective three: Comparison of gendered determinants of mitigation and adaptation measures among peri-urban farmers.

Socio-economic and demographic characteristics of the respondents were analysed through descriptive statistics which produced frequencies. Likewise, a Chi square test was performed to establish association between education levels and gender as well as land ownership between men and women. Comparison of gendered determinants of mitigation and adaptation measures was subjected to Mann Whitney U Test. Content analysis was applied to analyse qualitative data whose interpretation was used to support quantitative data during discussions.

Objective four: To examine policy implementation challenges on mitigation and adaptation measures among peri-urban farmers.

Descriptive statistics were applied to analyse farmers' mitigation and adaptation measures. Descriptive tools such as frequencies were produced. Mitigation and adaptation measures

were subjected to Kendall's W test, which produced the ranking scores on each individual measures. Comparative analysis was done to establish whether measures applied by the farmers were compatible to the ones priotised by the National Climate Change Strategy. Content analysis was applied to analyse qualitative data so as to enrich quantitative analysis and discussions.

1.7 Ethical Consideration

Ethical considerations were observed throughout the research activities which ranged from data collection to report writing. Before embarking on data collection, a research clearance permit was obtained from the Vice Chancellor's Office that introduced the researcher to the Municipal Director of Temeke District Council. This permit had important information including the research title, purpose and duration of the research. Then a legal permit to carry out research in the study area was given by the Municipal Director who introduced the researcher to the Ward Executive Officers in the selected wards. These officials introduced the researcher to street leaders where data collection such as household surveys and focus group discussions were conducted.

During the actual data collection, the purpose of the survey was introduced to the respective leaders and individuals consulted during the study. Consent was sought from the respondents to participate in the survey. After introducing the purpose of the survey, a respondent was informed that he/she was free to participate in the survey. Respondents remained anonymous. As an ethical issue, respondents were told that there was no any payment of being involved in the survey.

1.8 Validity and Reliability

The study strived to ensure that validity of research tools mainly a household questionnaire is achieved. This was done first through pre testing of a research tool. A household questionnaire was developed after doing rigorous literature review. It was further revised to ensure that it was accurate and could elicit the intended information. After incorporating the comments raised during pre-testing, the revised version was resubmitted to supervisors who provided the comments on likely problems and proposed ways of addressing them. Incorporation of the final comments resulted into the final draft which was used in the pilot testing. A pilot- test was done to 10 respondents randomly selected in Kibada Ward which was not sampled for this study. Respondents who were involved in a pilot test were not part of the sample, therefore, were not included in the actual household survey.

Furthermore, efforts were made to ensure reliability of the research tool (household questionnaire). The aim was to ensure stability and objectivity of a research tool. Eleven items in the household questionnaire, particularly those directly addressed mitigation and adaptation measures were subjected to an internal consistency test using Cronbach's Alpha coefficient. Results indicated that the research tool was internally consistent based on eleven items selected for testing (Cronbach's $\alpha = 0.77$). For these results, it was established that, the research tool could objectively elicit the intended information. This is supported by Kennet *et al*. (2006) who argue that for data to be accurate, there must be high reliability and that the responses must reflect the truly state of affairs.

1.9 Organisation of Thesis

This thesis presents four manuscripts which are organized into chapters. The whole thesis is composed of six chapters and begins with the general introduction presented in Chapter

One. This sets up background information of the thesis. Chapter Two presents published paper number one, which is titled: awareness of peri-urban farmers on the concept and effects of climate change: a case of Temeke District, Dar es Salaam Region, Tanzania. This is followed by Chapter Three, which is paper number two. This is titled: mitigation and adaptation measures of peri-urban farmers as a response to climate change in Temeke District, Dar es Salaam Region. Chapter Four is a paper titled: comparison of gendered determinants of mitigation and adaptation measures among peri-urban farmers of Temeke District, Dar es Salaam Region. Chapter Five forms a paper which is titled: policy implementation success and challenges on climate change mitigation and adaptation measures pursued by peri-urban farmers of Temeke District, Dar es Salaam Region, Tanzania. Finally, Chapter Six presents a summary of the results and discussions from all papers, and lastly draws out conclusions and recommendations. Also, the chapter offers contribution of the study in terms of: contribution to body of knowledge, explanation to the model of Disaster Crunch Model and practical one.

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CHAPTER TWO

2.0 Awareness of Peri-urban Farmers on the Concept and Effects of Climate Change: A Case of Temeke District, Dar es Salaam Region, Tanzania

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Abstract

The study assessed peri-urban farmers' awareness on the concept and effects of climate change on peri-urban farming in Temeke District, Dar es Salaam Region, Tanzania. A total of 240 questionnaire copies were administered to the heads of household in four wards of the study area. Descriptive statistics mainly frequency distribution, percentages and averages were computed to analyse socio-economic characteristics of the respondents. Perceived indicators and effects of climate change were measured through a five point Likert Scale. Of the interviewed respondents, 97.9% were generally aware of climate change. The respondents' awareness was manifested through locally perceived indicators: increase in drought which had a mean score ($\bar{X}$) of 4.4, decline in rainfall ($\bar{X}$ =3.83), recurrent floods ($\bar{X}$ =3.83) and rainfall fluctuations ($\bar{X}$=3.1). Respondents linked climate change with human activities largely cutting and burning of trees. Farmers'

perceptions are not directly linked with scientific understanding of climate change. The study recommends to the Government intervention based on farmers' specific needs. In the same vein, more research on climate change awareness is recommended in order to enhance local communities' adaptive capacity.

Key Words: Peri-urban farmers, awareness, climate change, Temeke District.

2.1 INTRODUCTION

Peri-urban farming has drawn much attention in the body of academic and research. However, the extent to which peri-urban farmers in developing countries are aware of climate change is still not clearly understood (Binns and Lynch, 1998; Kashaigili *et al.,* 2014). Peri-urban farming is a type of farming taking place at the fringes of the city where transition from urban to rural can be observed and is affected by the presence and expansion of the city (Nelson, 2007). This form of farming operates semi-intensive or fully commercial farms of vegetables, crops and livestock. Due to this observed transition, it tends to undergo more dramatic changes in land use than either the city or the rural area it borders with (Komiremko and Hoemann, 2008). Peri-urban farmers range from the poor population category, mid-level government officials and rich people who are investing in order to expand their capital (van Veenhuizen, 2007).

The existing body of literature in Tanzania and elsewhere substantiates significant roles of peri-urban farming in enhancing livelihoods of the poor peri-urban and urban households. The farming serves as an important source of employment, income and stimulant of small and medium enterprises and nutritional benefits (Mascarenhas, 1995; UNDP, 1996; Bins and Lynch, 1998; Komirenko and Hoermann, 2008; van Veenhuizen, 2012). In Tanzania, the importance of peri-urban is underpinned by a number of literature

sources; for example, it was reported that peri-urban farming was contributing an average of 17% of the total Dar es Salaam food requirements (URT, 2010).

Peri-urban farming was also reported as the main producer of large quantities of perishable food stuffs consumed in cities like Dar es Salaam (Sumberg, 1997; Tesha, 1996; Jacobi, 1997). In a study done in Dar es Salaam, Stevenson *et al.* (1996) mentioned peri-urban farming as a primary economic activity for the majority of peri-urban farmers of the region. The study showed that about 35 000 farming households were depending on peri-urban fruit and vegetable production for their income.

The importance of peri-urban farming in Tanzania has also been reported in Lindi, Mbeya, Mwanza, Arusha and Moshi (Lanjouw *et al.,* 2001). Besides those evidences, population increase in Dar es Salaam Region between two census periods (2002 to 2012) had an implication on the demand for peri-urban food production. According to the 2012 National Population and Housing Census, the region has a total population of 4 364 541 having increased from 2 487 288 as recorded in the 2002 Census (URT, 2013). An increase of 1 877 253 people among others implies an increase in the demand for perishable food stuffs (mainly fruits and vegetables) from peri-urban areas.

Peri-urban farming is not spared from phenomenon of climate change. Studies done by Dubbeling (2011) and Padgam (2012) claimed that peri-urban farming is vulnerable to climate change which results into heavy storms, floods and outbreak of pests and diseases. This subsequently affects production which in turn raises the prices of agricultural products and eventually increases the burden of food security. Likewise, Dar es Salaam Region where Temeke District is found had experienced decline in mean annual rainfall with substantial decline in a number of rain days over the previous five decades (START,

2011). This portrays a substantial impact in farming activities on the region including peri-urban farming which is undertaken in Temeke District.

Rigorous literature search has shown that, most of the studies on peri-urban farming in Tanzania have focused on economic importance, employment creation and dietary contribution (Stevenson *et al*., 1996; Tesha, 1996; Jacobi, 1997; Sumberg, 1997; Jacobi *et al*., 2000; Lanjouw *et al*. 2001). Few scholars have contributed to knowledge on the effects of climate change on livestock keeping in urban and peri-urban areas (Mlozi *et al*., 2013). Equally, few researches have focused on perceptions of local communities on climate change along the coastal regions (Kashaigili *et al.*, 2014). Therefore, awareness on climate change concept among peri-urban farmers is not clearly understood. This was also revealed by different studies undertaken in Tanzania and elsewhere. For example, Jan and Anja (2007) reported that most of studies on people's perception on climate change were carried out in developed countries where extension services are well developed. Besides that, most of studies on climate change are either national or regional, but very little is known to what extent indigenous farmers perceive climate change (Okonya *et al.*, 2013).

Local peoples' perception is also widely reported as a key factor in addressing climate change (Doss and Morris, 2001; Maharjan *et al*, 2011; Bello *et al.*, 2013; Kihupi *et al*., 2015). Despite the aforementioned observations, local community's information and knowledge are core concerns of climate change policy (Eakin *et al*., 2015). Equally, Kweka (2011) stressed that awareness is part of empowerment and an important decision making tool. Adebayo *et al*. (2012) asserted that awareness on climate change is a tool which assists farmers to plan for farming and thereafter reduces risks associated with farming. Thus, this demonstrates the imperativeness of an assessment of local

communities' awareness on the concept of climate change and the existing information gaps pertaining to it.

With all the initiatives from scientific views, little is known about awareness of farmers on climate change (Ishaya and Abaje, 2008). Equally, little is known by scientists on how peri-urban farmers describe the concept of climate change (Kashaigili *et al.*, 2014). Therefore, this study assessed awareness of peri-urban farmers on the concept of climate change in Temeke District. This paper intended to answer the following research questions: i) what is the level of awareness of climate change concept among peri-urban farmers? ii) Which indicators do peri-urban farmers use to describe climate change? iii) What are peri-urban farmers' perceived causes of climate change? iv)which are the perceived effects of climate change in the study area?

The findings of this study contribute to efforts of addressing climate change so far made through the national and global programmes and strategies such as United Nations' Framework Convention on Climate Change and the Tanzanian Vision 2025. Secondly, the study is also in line with and contributing to the Government's initiatives through the National Climate Change Strategy for Tanzania (NCCS). Two amongst the objectives of NCCS emphasises on enhancing public awareness and information management on climate change (URT, 2012). Further, the findings from this study are useful among policy, decision makers and development practitioners in their bid to devise policies, programmes and strategies. Furthermore, the study enhances scientific understanding on climate change among different stakeholders including policy makers, academicians and researchers.

2.2 STUDY AREA AND METHODOLOGY

2.2.1 The Study Area

The study was conducted in Temeke District, Dar es Salaam which lies between latitudes 6º 55' to 6º 90' South and longitudes 39º25' to 39º33' East (UNAIDS, 2010). Administratively, the District has a total of 30 wards: 21 urban and 9 peri-urban with a total land area of 652 km^2 (URT, 2013). According to the National Population and Housing Census of 2012, the district has a total population of 1,368,881 with 669,056 males and 699,825 females (URT, 2013). The area is characterized by a modified type of equatorial climate which is generally hot and humid throughout the year with an average temperature of 29º C and humidity of around 96% in the mornings and 67% in the afternoons (URT, 2004).

The area receives the average rainfall of 1000 mm with a bimodal rainfall pattern: long and short rains. The long rains start from mid-March to the end of May while the short rains start from mid-October to late December (START, 2011). Land and sea breezes have modified the spatial and temporal distribution of rainfall in the coastal regions including Dar es Salaam. Rainfall in the study area and in the entire region was reported to decline (START, 2011; Mdemu *et al*., 2012). The natural vegetation found in the region consists of coastal shrubs, miombo woodland, coastal swamps and mangrove trees (URT, 2004). However, the diversity of the natural vegetation has been significantly reduced by the surrounding communities (Mlozi *et al.*, 2013).

2.2.2 Methodology

The study employed a cross sectional research design to assess peri-urban farmers' awareness on the concept of climate change across four wards of Temeke District. This study design allows data collection at a single point in time (Babbie, 1990). Therefore, it

was considered that this design was suitable to assess the existing level of awareness of peri-urban farmers of Temeke District.

This study used a series of sampling techniques. The first stage involved purposive sampling of four wards namely: Kisarawe II, Somangila, Pemba Mnazi and Kimbiji based on the dominance of farming activities. Then, through a table of random numbers, four streets were selected from each ward; hence a total of 16 streets. Lastly, in each street a total of 15 households were randomly selected, hence ending up with 240 respondents.

Primary data were collected through household surveys, interviews of key informants and Focus Group Discussions. Household surveys were conducted through a pre-tested semi-structured questionnaire which combined both closed and open ended questions. Household questionnaire captured information on respondents' socio-economic and demographic characteristics related with awareness (age, sex, education levels and occupation). Indicators, causes and effects of climate change in the study area were also captured through household questionnaire. Four focus group discussions were conducted (one in each ward) comprising of 10 to 12 mixed (in terms of age and sex) peri-urban farmers. FGDs were designed to capture farmers' general understanding of climate change, causes and its linkage with farming activities. Besides the aforementioned techniques, key informant interviews were done in each ward. Ward Executive Officers, Extension and Livestock Officers were interviewed as key informants.

Secondary data collection was based on desk work by reviewing different literature sources relevant to the study. The main sources were journal articles, Government reports and online resources. The information from the literature sources strengthened and

justified the study based on what is empirically known and what remains to be documented as far as climate change awareness is concerned.

The general level of awareness on climate change of peri-urban farmers was organised into three levels. The highest level of awareness was assigned a score of 30, neutral level 20 whereas the lowest level was assigned 10. Awareness on the indicators of climate change was measured through a five point Likert Scale (LS). In this study, awareness implies the state of being familiar with climate change, which includes having knowledge, facts or skills through experience or education. The values assigned to these indicators were: 1= strongly disagree, 2= disagree, 3=undecided, 4=agree, and 5=strongly agree. Any response with a mean score equal or above 3.0 was regarded as being more important in describing the analyzed item. Options with less than 3.0 were considered less important.

Quantitative data were analyzed through Statistical Package for Social Sciences (SPSS) programme. Descriptive statistical tools (frequency and percentages) were used to categorize the respondents based on socio-economic characteristics related with awareness on climate change: age, sex, education level and occupation**.** Views aired out during Focus Group Discussions and key informant interviews were analyzed qualitatively through content analysis.

2.3 RESULTS AND DISCUSSIONS

2.3.1 Peri-urban farmers' socio-economic and demographic characteristics

The study assessed these components in order to ascertain the link with farming practices and consequently awareness on climate change concept. Specifically, this part assessed the distribution of the respondents of varying age groups as well as the proportion of both: male versus female headed households involving in farming. Similarly, the study assessed

respondents' level of education as an important component which may trigger an understanding on climate change (Table 2.1).

2.3.1.1 Age of the respondents

The study assessed age so as to find out the proportion of farmers with different age groups involved in farming practices. This study arranged age of the respondents into three groups: youths, adults and elders. The findings reveal that age group 21 to 34 comprised of 25.42%, while 61.66% were between 35 to 60 years. In this study majority of the respondents were adults. This implies that adults are energetic and are more committed with households' chores. As such, this indicates that they are more involved in farming than the other age groups. Equally, this increases the possibility of being more aware on climate change than their counterparts. Besides that, the findings also imply that in the study area the economy is dominated by adults.

The findings somehow conform to other studies (Ishaya and Abaje, 2008; Badi, 2010; Varadan and Kumar, 2014) which revealed an association between elderly farmers, more farming experience and more understanding of climate change. Contrary to that, Abaje *et al.* (2014) reported that, young farmers are more active and commit more of their energy in farming practices. This study emphasizes the importance of age in assessing awareness on climate change issues.

2.3.1.2 Sex of the respondents

Sex is an important demographic component which indicates the proportion of male and female headed households involved in farming and which in turn trigger awareness on climate change. The findings show that male constituted 59.2% with 40.8% females. Even though the percent of male headed households is higher than that of female headed

households, the gap between those categories is fairly low in comparison with other studies in developing countries (Ishaya and Abaje, 2008; URT, 2013; Abaje *et al*., 2014). In these studies, the gap was higher at 33.4% and 66.6%, 34 to 66% and 13 to 87% respectively. However, these studies were carried out in rural areas with a large gap between male versus female headed households.

The low difference found in this study might be associated with a higher degree of women's exposure in relation with household's power distribution. This is more pronounced in urban and peri-urban areas than in rural areas. Nonetheless, the study holds that despite this, farming and the entire household's economy is dominated by males. This might also trigger more awareness on climate change concept among male headed households.

2.2.1.3 Education level of the respondents

Education offers essential skills for an individual to master his environment including skills which may enhance awareness on the concept of climate change. In this paper, distribution of the respondents by level of education is presented in Table 2.1. The findings show that 68.8% of respondents have attained primary education, 12.9 had no formal education while 0.4% had ordinary certificates attained upon completion of form four. According to the results about 86.7% of the respondents had formal education. This reveals that majority had the basic education skills of reading, writing and counting. This implies that majority are likely to have a higher possibility of being aware of climate change by reading newspapers, books, posters, fliers and other documents.

2.3.1.4 Occupation of the respondents

This assessment intended to determine whether or not farmers in the study area engage in additional income opportunities to sustain their livelihoods. The findings show that 49.2% of respondents claimed that farming was their main economic activity, while 48.3% indicated that they were also doing businesses. In addition, 2.4% were absorbed in formal employment while engaging in farming. As indicated earlier, majority of the respondents had attained primary education. This reduces the possibility of majority of the farmers in the study area to be absorbed in formal employment. However, this does not necessarily deny the possibility of the farmers with low education levels to be absorbed in a formal employment system.

Farmers reported that the major crops grown in the area include cassava, paddy, maize, sweet potatoes and vegetables. This study underscores the importance of peri-urban farming among the households of peri-urban areas of Temeke District. Equally, the results imply that the livelihood of the interviewed peri-urban households depends on rain fed agriculture. Therefore, the observed and/or perceived climatic changes directly or indirectly affect their livelihood. The findings agree with an earlier study done in Dar es Salaam by Stevenson *et al.* (1996) who reported that farming is the reliable economic activity for the interviewed peri-urban farmers.

Respondents who were reported to be involved in farming and businesses mentioned different types of businesses such as fishing, food vending, mini groceries and charcoal selling. This indicates that in the study area farming is not sufficient to sustain their livelihoods. Hence, this triggers farmers to supplement farming with other income generating activities including petty businesses. The other possible reason might be related with the frequent land use changes coupled with land competitions in peri-urban areas.

These challenges hinder intensive farming practices but also favor other activities such as petty businesses. On the other hand, farmers' involvement into non farming activities also indicates that they are coping against climatic changes which they are aware of, and which affect agricultural performance. The findings are also in line with the other studies (Macchi *et al.*, 2013; Mlozi *et al*., 2013). This study holds that farmers in the study area are flexible and exploit the interactive nature of peri-urban environment.

Table 2.1: Demographic and socio-economic characteristics of the respondents (n = 240)

Age group	**Percentage**
21 – 34	25.42
35 – 59	61.66
60+	12.92
Total	**100**
Education Level	
No formal education	12.9
Primary	68.8
Secondary	5.4
Ordinary Certificates	. 4
Adult education	12.5
Total	**100**

2.4 The Level of Awareness on Climate Change

This study measured awareness in order to ascertain the extent to which farmers in the study area understand the concept of climate change. Awareness is an important tool which may assist farmers to plan appropriately for their farming activities. The study revealed that 97.9% of the respondents claimed to be aware of climate change with only 2.1% who were not aware of climate change. Also, the findings showed that the highest level of awareness was 25.97 while the lowest level was 0.5. This implies that in the study area farmers were more aware of climate change regardless of education or age categories. The results are somehow in agreement with results of some other studies on awareness such as Ishaya and Abaje (2008), Kashaigili *et al*. (2014) and Kihupi *et al*. (2015). However, these studies were carried out in different settings with somewhat different

socio-economic and ecological characteristics from the study area. These observations reveal that local communities in different places perceive the changes in climate at local levels.

2.5 Awareness on the Indicators of Climate Change

This assessment was done to establish the degree at which farmers were able to describe climate change based on the locally perceived components. This assessment is presented in Table 2.2. The results show that the most commonly known indicators of climate change is an increase in the incidences of droughts with a mean score ($\bar{X}$) of 4.4. The results further show that there is a decline in rainfall which is reflected by delaying in the onset of rainfall season with an early cessation ($\bar{X}$ =3.83). In this category, an increase in rainfall fluctuations was the least in the order of ranking which had a mean score ($\bar{X}$) of 3.1 the respondents reported that some years had been receiving above normal rainfall which lasted for short periods while in many years rainfall below normal was observed.

Farmers reported the incidences of very high rainfall intensity that lasted for short periods in some years which were associated with floods. Incidences associated with rainfall unpredictability particularly the short rains *"vuli"* were also reported**.** The findings are complemented by secondary climatological data which showed the decline in the amount of rainfall coupled with rise in temperature in the whole of Dar es Salaam region over the previous five decades (START, 2011). A study by Tadross and Johnston (2012) also showed significant detectable trends in total decline in rainfall at the annual timescale in the region. These findings imply the total decrease in crop production in the area.

The findings conform to findings of some other studies done in Dar es Salaam and in the Coastal Region (Kashaigili *et al.*, 2014). These studies revealed local communities

perceptions' through decreasing trend of rainfall in the past 10 years, increasing incidences of droughts, heavy storms, floods (1989/90) and extreme high temperature. Opinion regarding local communities' perceptions on the changes in climatic components were also revealed in the other studies done in other parts of Tanzania (Kihupi *et al.,* 2007; Lema and Majule, 2009; Lyimo and Kangalawe, 2010; Mongi *et al.,* 2010; Kihupi *et al.,* 2015).

The findings also corroborate findings from studies done in other parts of Africa (e.g. Ishaya and Abaje, 2008; Ogalleh *et al.*, 2012; Simbarashe, 2013). Nonetheless, all these studies were carried out in rural areas with heterogeneous characteristics from those of peri-urban areas. Thus, experience from rural areas cannot be used to generalize with the other settings such as peri-urban areas where this study was done. However, local communities' perceptions on declining amount of rainfall indicate that this is a more pronounced indicator observed in many parts of the country and elsewhere. In the other vein, the study contradicts with the study done by Matari *et al.* (2008) which projected an increase in mean rainfall during the long rain season over the entire coast. This increase was estimated to be up to 6 percent by 2100.

Focus Group Discussion results' showed that besides droughts, temperature and heavy winds were reported to be on increase. Based on the findings peri-urban farmers are generally aware of climate change through the locally based indicators. Knowledge of the farmers on the aforementioned indicators implies that climate change has affected farming practices in the study area.

Table 1.1: Awareness of the respondents on the indicators of climate change

Indicators of climate change	Mean Score	Rank
Increases in drought incidences	4.4	1
Decreases in precipitation	3.83	2
Increases in floods	3.83	3
Increase in the incidences of rainfall fluctuations	3.1	4

2.6 Sources of Information of Climate Change

A source of information is an important tool in disseminating knowledge on climate change in local areas and in other places. In the study area, this depends on farmers' exposure and experience on the subject matter. The findings from this study revealed that about 86.5% of the respondents reported that they got information on climate change through radio broadcasting while few of them (7.6%) mentioned newspapers. The findings also reveal that 74.3% of the respondents owned radio while 14.2% owned television. Radio broadcasting is the major source of information on climate change in the study area as compared to other sources of information such as Television and Newspapers. Even those respondents who did not own radio could still get information through other means such as mobile phones which are also used as radio. Now days, technological advancement has influenced a number of people to use mobile phones as radio since they have radio programmes. Besides that, mobile phones are more portable than the normal radio.

The findings also revealed that out of the total respondents who reported to get information about climate change through radio broadcasting 62.5% stated that they receive information everyday, 16.2% reported to get information at least once per week while 7.5% claimed to get information on the same phenomenon at least once a month. More respondents who reported to get information through radio broadcasting daily also revealed the importance of this media in climate change information dissemination.

The study therefore, underscores the importance of radio broadcasting in disseminating information about climate change among peri-urban farmers regardless of their socio-economic status. The possible reason might be easier availability of radio as opposed to other media such as television and newspapers. Radio ownership is affordable with different categories of people regardless of socio-economic status. As opposed to radio, television ownership and running is costly. The running of a TV set needs some appliances such as decoders and electricity which are expensive, hence**;** less affordable by majority. In contrast to TV set, radio also uses normal batteries which are more affordable. In addition to the aforementioned, few respondents reported to own television. This definitely lowers climate change information dissemination through this device. In the other vein, accessibility of information from newspapers has the direct cost of buying a copy.

Other studies have also shown the role of media in informing farmers and livestock keepers about climate change although they did not specify which media are more influential than others (Kandlinkar and Risbey, 2000; Weber, 2010). However, the findings are contrary to the study done in Nigeria by Idrisa *et al.* (2012). The study ranked the role of extension agents as the most popular source of climate change awareness enhancement. This is not applicable in Tanzania since extension officers are few. For example, Daniel (2013) reported of an insufficiency of extension agents as well as a poor linkage between farmers and extension agents. This generally implies that sources of information on climate change differ considerably with respect to countries. This study emphasizes the important role of formal media particularly radio in enhancing climate change awareness among the local communities.

2.7 Awareness on Causes of Climate Change

Assessment on peri-urban farmers' perceived causes of climate change intended to find out whether their perceptions are directly linked with scientific understanding or not. Respondents' perceived causes of climate change are presented in Table 2.3. The findings show that 74.6% of the respondents reported unregulated cutting of trees for fuel wood and charcoal as causes climate change while 16.6% mentioned industrial activities. They were very few respondents (0.4%) who linked climate change with expansion of settlements.

Discussions with the key informants and in FGDs added that destruction of natural vegetation especially coastal swamps and mangrove trees has been on increase. This is done in search for fuel wood and charcoal which are the main sources of energy. It was also reported that emission from industries increases temperature, declines rainfall and also disturb the trends of rainfall. Consequently, this accelerates soil erosion and reduces crop yields.

More awareness of the respondents on the destruction of natural vegetation on the perceived climate change is justified by their livelihood practices. Destruction of the natural vegetation mainly woodland and shrubs has been part and parcel of the life of the local communities in the study area. As reported earlier, this is purposely done in order to obtain wood and charcoal as energy sources. This situation necessitates initiatives from different stakeholders to reduce the rate of forest degradation by creating enabling environment for alternative energy sources. In the study area, farmers are not aware of real scientific and natural causes of climate change as they were reported by IPCC (2007a). FAO (2008) reported that climate change is a natural phenomenon which has been taking place since the origin of the earth. Nonetheless, local communities' daily activities have

little connection with the natural processes. Hence, this reduces the possibility of peri-urban farmers in the study area to be aware of such processes.

The findings from this study are in conformity with the other studies such as Mlozi *et al*. (2013) and Abaje *et al*. (2014). In the other vein, the findings are in contradiction with other studies (Nyanga *et al.*, 2011; Abaje *et al.*, 2014). In their assessment of local communities' beliefs destined in community's disobeying God was perceived as the major driver for climate change while environmental drivers were considered less important. In the other vein, this study is also in contradiction with the findings from a study done in Oman by Al Buloshi and Ramadan (2015) which ranked transport sector as the major cause of climate change. However, their assessment was done in the Oman which is different with Temeke District in terms of economic activities. This study emphasizes on environmental drivers of climate change destined on farmers' daily livelihood needs.

Scientifically, climate change is directly linked with the atmospheric concentration of greenhouse gases (GHGs) primarily carbon dioxide. Others are: methane, nitrous oxides and chlorofluocarbons (IPCC, 1990). These have increased since pre-industrial era (IPCC, 2014). The concentration of GHGs destructs the ozone layer which is responsible to absorb extra violet radiation from the sun. GHGs are generated by human activities and natural processes (IPCC, 2007a). Human activities responsible for the emission include: burning of fossil fuels, biomass burning, deforestation, fertilizers and the release of aerosols, refrigerants and solvents (McGregor, 2002; Enger and Smith, 2008). IPCC (1990) reported that industrialized countries from the North were the major producers of carbon dioxide with US alone accounted for 23% of the total global emissions. Africa was also projected to release about 7bn tons of carbon by 2050 (Kevin, 2005).

Natural processes responsible for emissions include volcanic eruptions and changes in solar energy. From these observations, the dominant causes of climate change perceived by the local communities vary across different places depending on location's livelihood practices. For example, as reported earlier, destruction of the natural vegetation cover in search for fuel wood and charcoal triggered farmers to be more aware of its contribution on climate change consequences. Additionally, local communities' perception and understanding is insufficient to adequately address the causes of climate change. This necessitates the need for awareness enhancement among the local communities in order to help them in addressing the emerging challenges of climate change.

Table 2.3: Respondents' awareness on the causes of climate change

Causes	Frequency	Percentage
Deforestation and bush burning	179	74.7
Industrial activities	40	16.7
Agricultural malpractices	15	6.2
Population increase	2	0.8
Natural causes	1	0.4
Expansion of settlements	1	0.4
Total	**240**	**100**

2.8 Peri-urban Farmers' Awareness on Effects of Climate Change

The perceived effects of climate change on peri-urban farming are presented in Table 2.4. The findings show that more important effect is the decrease in crop yields with a mean score ($\bar{X}$) of 4.45 followed by the decline in vegetation cover ($\bar{X}$= 4.41). The other important effects were shortening in the growing season and uncertainty of the growing season due to unreliable rainfall. In the other vein, land use changes were less perceived effects of climate change.

The perceived higher effects (decrease in crop yields and decline in vegetation cover) are linked to the perceived decrease in precipitation coupled with an increase in the incidences of droughts. These challenges hinder sustainability of peri-urban farming. This also

translates into an increase in the cost of crop production in terms of the burden of increasing in the use of agricultural inputs. In addition, it triggers a general increase in living expenses among the households involved in farming. Besides the aforementioned ones, this constrains Government and other stakeholders' efforts on attaining sustainable development through poverty reduction.

Table 2.4: The effects of climate change

Effects of climate change	Mean Score	Rank
Climate change has decreased the crop yields	4.45	1
There is the decline in vegetation cover	4.41	2
Climate change has shortened the growing season	3.4	3
Climate change causes uncertainties in the growing seasons	3.0	4
Climate change has triggered changes from farming into other land uses	2.97	5

2.9 CONCLUSIONS AND RECOMMENDATIONS

It is apparent that peri-urban farmers are generally aware of climate change regardless of varying education and age categories. This is manifested through locally perceived indicators such as increasing in the incidences of droughts and floods, among others. These are based on the locally observed indicators and not the general indicators. In turn these affect their farming practices and the entire livelihood. Peri-urban farmers perceived causes of climate change are also based on the local livelihood practices (destruction of vegetation cover for fuel wood and charcoal). However, they are not capable of mentioning the real scientific causes (greenhouse gases' emission). Therefore, farmers' awareness is not enough to enable them cope with climate change. For this reason, awareness enhancement remains a key component in addressing climate in order to build a more adaptive farming community.

The study recommends to the Government to devise interventions on climate change based on the local communities' specific needs. In the same line, more researches should

be directed towards climate change awareness in order to enhance an understanding on climate change which will assist the local communities to device appropriate coping mechanisms. Further, joint efforts is recommended among the relevant stakeholders such as the Government, development practitioners, researchers and the local communities in addressing climate change.

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CHAPTER THREE

3.0 Mitigation and Adaptation Measures of Peri-urban Farmers as a Response to Climate Change in Temeke District, Dar es Salaam Region

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Abstract

This paper assessed mitigation and adaptation measures used by peri-urban farmers of Temeke District against climate change. Specifically, the study intended to answer the following research questions: i) which mitigation measures are applied by peri-urban farmers to mediate climate change effects? ii) which adaptation measures are implemented by peri-urban farmers against climate change? iii) What is the level of adoption of mitigation and adaptation measures? In order to address these questions, cross-sectional research design was applied of which a total of 240 households from four

wards were selected randomly for the household survey and focus group discussions in each ward. Quantitative data were subjected to descriptive and inferential statistics while, content analysis was used for qualitative data analysis. Mitigation measures used in the study area include cultivating cover crops, alternative energy sources, mixed farming and agroforestry. Adaptation measures comprised of drought resistant crops, economic diversification, irrigation, mixed farming, cover crops sequential cropping and intercropping. 60.8% of the respondents had high level of mitigating climate change, 32.5% medium level and 6.7% low level. In terms of adaptation measures, about 73% had high level while 27% had a medium level. Kruskal Wallis Test results suggested statistically significantly differences in the level of mitigation measures across three groups at p< 0.05. Nonetheless, there was no statistically significant differences in adaptation measures across three age groups at p>0.05. The study revealed that peri-urban farmers devised different mitigation and adaptation measures against climate change. Some of adaptation measures are also used as mitigation measures which indicate that they are complementary to each other. There was a high level of mitigation and adaptation measures indicating that they are inevitable interventions in the course of addressing climate change. The study recommends on enhancement of existing mitigation and adaptation measures and empowerment of smallholder farmers in order to sustain peri-urban farming. More studies on determinants of mitigation and adaptation are also recommended.

Key words: Climate change, mitigation, adaptation, peri urban farmers, Temeke.

3.1 INTRODUCTION

Peri-urban farming (PUF) refers to production units close to town, which operate semi intensive or fully commercial farms of vegetables, crops and livestock (Komirenko and

Hoermann, 2008). PUF is influenced by changes in peri-urban areas such as expansion/influence of the city, high rate of land use, land cover changes and loss of agricultural land. Other features of PUF are associated with opportunities for commercial or market-oriented cultivation of high-value crops (Choy *et al.,* 2007; Simon, 2008). Besides that, PUF is constrained by increase in land prices in peri-urban areas which poses insecurity for farmers (Mlozi *et al*., 2014). These features indicate that PUF is always in transition with implication on environmental changes particularly climate change.

In Tanzania, the impacts of climate change are obvious, which include the drop in water levels of Lake Tanganyika, Lake Victoria and Lake Jipe, melting of eighty percent of glacier of Mount Kilimanjaro and the inundation of Maziwe Island in Pangani District (Boko *et al*., 2007). Equally, the impacts are manifested in terms of the prolonged droughts and unpredictable rain cycles experienced in different parts of the country such as semi-arid areas as well as Dar es Salaam Region (Kassenga and Mbuligwe, 2013; Mlozi *et al*., 2014). These impacts necessitated assessment of mitigation and adaptation measures among peri-urban farmers of Temeke District.

Mitigation measures mean initiatives to reduce emission and/or enhance the sinks of greenhouse gases such as carbon dioxide, methane, nitrous oxides and chlorofluocarbons (IPCC, 2007). These measures include sustainable forest management and Land Fill Gas Methane Recovery (IPCC, 2007). On the other hand, adaptation refers to human adjustment in response to climate change in order to moderate harm or exploit their beneficial opportunities. Adaptation measures include: food security issues, introducing drought and saline resistant crops, developing local food banks, improving farming systems and non-farming options such as economic diversification (IPCC, 2007; FAO, 2008).

Adaptation measures as one of the focus of this study include long-term adjustments to more permanent changes in the climate. Adaptation measures embrace planned initiatives which help farmers to adjust their livelihood in the long-term observed changing climate situation. This is contrary to coping strategies which refer to short-term responses to the impacts of sudden or unusual events (Van de Geest and Warner, 2015).

Different stakeholders have scaled up efforts to address mitigation and adaptation measures. Globally, United Nations Framework on Climate Change (UNFCCC) and the Kyoto Protocol has placed much emphasis on mitigation and adaptation on climate change (IPCC, 2007). In Tanzania, the initiatives are evidenced by the adoption of National Adaptation Plan of Action (NAPA) of 2007 and development of the National Climate Change Strategy (NCCS) in 2012 (URT, 2007; URT, 2012**)**. Others are: the National REDD+ Strategy and its Action Plan of 2013. This Strategy provides incentive to reduce emission from deforestation and forest degradation at the national level (URT, 2013).

The Government of Tanzania for a long time has given much attention on forest conservation and has reserved 16 million ha of forests; with 2 million ha of forests in national parks. This went hand in hand with identification of the drivers of deforestation and forest degradation alongside adoption of legal frameworks and participatory forest management (URT, 2012). In Dar es Salaam, the Government is implementing a climate change mitigation project at the closed solid waste dump site in Mtoni where methane is captured for the sake of generating 2.5 to 5 MW of electricity. In addition, the city has constructed a sea wall near the Ocean Road hospital to protect the road from being eroded by sea waves (Kiunsi, 2013).

Various studies on climate change mitigation and adaptation in agriculture have been conducted in different settings such as semi-arid and rural areas (Yanda *et al.*, 2006; Lema and Majule, 2009; Mongi *et al*., 2010; Lyimo and Kangarawe, 2010). Few researches have addressed mitigation and adaptation measures in peri-urban setting. They addressed the effects of climate change due to keeping livestock and institutional activities related to climate change in Dar es Salaam Region (Kassenga and Mbuligwe, 2013; Mlozi *et al.*, 2013). However, peri-urban settings are likely to accelerate consequences of climate change due to a growing demand of land resources that does not match with the available land size. Hence, the threat of climate change in peri-urban settings has not been given much attention in developing countries including Tanzania. While it is crucial to understand the dynamics of supply and demand of the land resource and the consequences of climate change in peri-urban, unfortunately, the mitigation and adaptation initiatives undertaken by peri-urban farmers are not well known (Mlozi *et al.*, 2013; Kashaigili *et al*., 2014) .

Other studies (Sumberg, 1996; Tesha, 1996; Nelson, 2007; Ricci, 2012) have emphasised the important role of PUF; but, have not addressed climate change mitigation and adaptation strategies among those farming communities. The unique features of peri-urban areas also indicate that mitigation and adaptation measures used will equally be unique as opposed to the other settings such as rural and semi-arid areas. This is also underpinned by different studies: For example, IPCC (2007) and FAO (2008) revealed the importance of location specific measures due to the fact that the impacts of climate change vary from place to place. The Tanzania National Climate Change Strategy (URT, 2012) provides framework on mitigation and adaptation measures. However, the strategy does not specify measures that suit different geographical locations including peri-urban areas. Similarly,

NAPA stresses on communities taking adaptation measures but does not specify location specific adaptation measures.

Some studies have shown that local people are the ones who know what works better on their environment, hence, mitigation and adaptation measures must suit locational specific environment (Ishaya and Abaje, 2008; Dungumaro and Hyden, 2010; Abaje *et al*., 2015). According to Jan and Anja (2007), local communities are successful in managing their environment, but they are rarely considered in policies and other interventions. Most studies on climate change in African agriculture are regional or national, yet, mitigation and adaptation are place based which consequently necessitates having location specific measures (Kurukusariya and Mendersohn, 2008 and Deressa *et al.*, 2009).

Furthermore, it is important to assess the local communities' responses to climate change because they are rarely documented, but handed down through local expertise and oral history (Lema and Majule, 2009). Therefore, this paper reports on mitigation and adaptation measures undertaken by peri-urban farmers in mediating the effects of climate change. Specifically, the study answers the following research questions: i) which mitigation measures are applied by peri-urban farmers to mediate climate change? ii) which adaptation measures have been devised by peri-urban farmers against climate change? iii) what is the level of mitigation and adaptation measures among peri-urban farmers?

3.1.1 Theoretical Framework

This study draws from the Disaster Crunch Model which links occurrence of a disaster and community's response on the situation. Specifically, the model offers a systematic approach for understanding the occurrence of a disaster and individuals' response to it

(Blaikie *et al*., 1994). Disasters like droughts, food shortages and recurrent floods affect various population groups differently on the basis of their gender, age or economic class (Blaikie, 2002). According to the model, vulnerability to a disaster is rooted in the socio-economic processes like economic hardships, which trigger communities to take a pressure release or disaster risk reduction.

For this study, severity of climate change is a function of the resilience or economic capability of vulnerable communities in responding to the disaster and in sustaining the livelihoods (IPCC, 2001). The study postulates that climate change in forms of droughts and unreliable rainfall has affected farming practices in the study area. The prevalence of droughts and the decrease in rain cycles in the study area was also revealed in the other study. Hence, this study intends to examine how peri-urban farmers have been prompted to adjust their livelihood by devising appropriate mitigation and adaptation measures so as to sustain their farming practices in the face of climate change situation.

3.1.2 Literature review

3.1.2.1 Peri-urban farming and climate change

Peri-urban farming is part and parcel of the phenomenon of climate change. Limited land due to urban expansion trigger farming through intensive application of chemical fertilizers and other inputs (Choy *et al.*, 2007). When land scarcity is combined with climate change, the application of intensive agriculture become more paramount. However, intensive application of chemical fertilizers increases emission of methane (one of greenhouse gases). PUF is affected by the incidences of the rising temperature, decreased amount of rainfall and the prevalence of droughts (Shretha and Sada, 2013). Urban farming particularly livestock sector is also vulnerable from the decrease in rain cycles, especially in Dar es Salaam Region (Mlozi *et al*., 2013). Agricultural production in

urban and peri-urban areas depends on cheap water and cheap energy for nitrogen based fertilizers and agricultural processes all of which contribute to climate change (Havaligi, 2009).

In Dar es Salaam Region, incidences of rising temperatures coupled with decreasing in rainfall amounts (START, 2011; Mlozi *et al.,* 2014) pose a direct impact on peri-urban farming. This situation is likely to exacerbate further vulnerability of climate change among peri-urban farmers if there would be mitigation and adaptation deficits. Nonetheless, PUF is also viewed as a source of improving urban micro climate through reducing methane emission from the landfills. This indicates that improving PUF practices improves environmental condition while poor farming practices have an imminent impact on increasing emission of greenhouse gases.

3.1.2.2 Mitigation and adaptation measures

Mitigation and adaptation measures have raised concern in different settings. In the context of peri-urban settings, debates on mitigation and adaptation measures are more focused on other issues rather than farming versus climate change (Mdemu *et al*., 2012; Kashaigili *et al*., 2014). For example, Kashaigili *et al.* (2014) attempted to examine the best adaptation practices due to land cover changes. They observed that land cover changes trigger a shift in land use into the production of high value horticultural products and the use of forest products.

Another attempt indicated that livestock keepers of urban and peri-urban areas in the Region were vulnerable to climate change consequences and they were planning to implement adaptation strategies (Mlozi *et al.,* 2013)**.** Debate which has partially focused on peri-urban farmers addressed climate change adaptation on coastal Dar es Salaam

(Kassenga and Mbuligwe, 2013). Although issues related to environmental changes in Africa and least developed countries are broadly studied, it is important to note that response to climate change in peri-urban areas have received little attention despite the fact that these places constitute risk parts of Africa (Ricci, 2012).

Despite little attention given on mitigation and adaptation measures of climate change, PUF has been reported to be of greater importance for the livelihood of the local communities of Dar es Salaam, Tanzania and other parts of the world (Sumberg, 1996; Tesha, 1996; Gündel, 2006). Meanwhile, it is emphasised in different literature that climate change affects different communities differently. Due to this situation, local communities in different places create their own ways of addressing climate change. However, in Tanzania and elsewhere, most of studies to examine local communities' initiatives to address climate change have concentrated in rural and semi-arid areas (e.g. Ishaya and Abaje, 2008; Lema and Majule, 2008; Sani *et al*., 2016).

Those debates are supported by the findings discussed by Smith *et al.* (2007) who asserted that the best approaches to reduce emissions depend on local conditions of a particular setting. In connection to the aforementioned evidence, peri-urban areas have unique local conditions as opposed to other areas including rural, urban and semi arid areas. However, peri-urban farmers in Dar-es Salaam Region are vulnerable from climate change (Ricci, 2012; Mlozi *et al*., 2013; Mlozi, *et al.*, 2014) despite the fact that empirical information on appropriate responses remains scanty. This situation created the need to investigate initiatives of peri-urban farmers to address climate change.

3.2 METHODOLOGY

3.2.1 The study area

The study was done in Temeke District in Dar es Salaam Region which is located between latitudes 6 º55’ to 6º 90’ South and longitudes 39º25’ and 39º 33’ East (UNAIDS, 2010). The district was chosen because it has the large land under cultivation (33 000ha) as compared to Kinondoni (13 600ha) and Ilala (11 678ha). Also, agriculture in the district provides the Region with more tons of food in comparison with the counterpart districts of Kinondoni and Ilala (URT, 2014). According to the National Population and Housing Census of 2012, the total population in the district was about 1 368 881 people (URT, 2013). Based on these data and the average annual intercensal growth rate (5.6%) (URT, 2016), the total population at 2017 is projected to be 1 797 568 people. The District is characterized by a modified type of equatorial climate which is generally hot and humid throughout the year. The average annual temperature is 29ºC while humidity is around 96% in the morning and 67% in the afternoon (URT, 2004).

Rainfall is segmented into two seasons: long rains and short rains. The long rains start from mid-March to the end of May while short rains start from mid-October to late December (Mlozi *et al*., 2013). Nonetheless, there are empirical evidences indicating the decline in rainfall in both seasons in the whole of Dar es Salaam Region where the study area is found (START, 2011).

Natural vegetation includes coastal shrubs, miombo woodland, coastal swamps and mangrove trees. However, these vegetation cover have been significantly destructed by human activities (Mlozi *et al.*, 2013). Economic activities carried out in Temeke District include farming, businesses as well as wages employment. The main sources of income among the local communities include; sales of food crops, forest products, livestock and

associated products and fishing. The performance of crop sub sector in recent years has been inadequate to ensure good food security due to heavy dependency on unreliable climatic condition particularly rainfall (URT, 2014).

3. 2.2 Research design

The study used a cross sectional research design to examine mitigation and adaptation measures across four selected peri-urban wards of Temeke District. This design was opted since it allows data to be collected at a single point in time (Babbie, 1990). Therefore, this design was appropriate for this study due to the fact that the study was set up to assess existing mitigation and adaptation practices undertaken by peri-urban farmers in the study area.

3.2.3 Sampling design and sample size

The target population for this study included peri-urban farmers within the selected study sites. The study used multiple sampling procedures. Purposive sampling was applied to select Temeke district based on two grounds: First, farming is more dominant in terms of the area under cultivation and the number of farmers than the other districts. Also, the district has more contribution to the city's food supply as compared to the other districts. The choice of the four wards namely: Kisarawe II, Somangila, Pemba Mnazi and Kimbiji involved purposive sampling in order to include wards which are dominant in farming activities. Furthermore, four streets were chosen randomly from each ward; making a total of 16 streets. In this study, the study population comprised of farming households of peri-urban wards in the district. In each street a list of farming households was established with the aid of street leaders of which a total of 15 households were randomly selected, making

a total of 240 households. This was considered adequate in terms of information richness and for a meaningful statistical analysis.

3.2.4 Data collection

The study utilized data mainly collected through household surveys which used semi structured questionnaire to 240 households in the four sampled wards. In addition, one focus group discussion consisting 10 to 12 respondents was conducted in each ward. Farmers of both sexes were involved in the focus group discussions.

Nonetheless, a critical review of published and unpublished literature was done from various sources including the study area, SUA National Agricultural Library, Kibaha Public Library, Tanganyika Library and online. This review solicited information on various aspects including mitigation and adaptation measures, population trends, climatic records and land use patterns.

3.2.5 Data analysis

Quantitative data were analyzed through Statistical Package for Social Sciences (SPSS) programme while qualitative data from Focus Group Discussions were analyzed through content analysis. Selected socio-economic and demographic characteristics were analysed by calculating frequencies and percent. The level of mitigating and adapting to climate change was measured by calculating scores obtained by each individual farming household. The scores was based on Likert Scale (LS) statements weighed 1 – 5 in which 1= Strongly Disagree to 5= Strongly Agree. In terms of mitigation measures, a respondent who scored 5 in all cases would have a total score of 20 while the respondent who scored 1 would yield a total of 4 scores.

In adaptation measures, a respondent who scored a total of 5 in all items would have a total of 35 points while one who scored 1 in all cases would have 7 points. In both cases, the final score for every respondent was divided by the total score resulting into an interval scale ranging from 1 to 5 described as follows: i) Low level of adoption (1 - 2): in this category a respondent would score a maximum of 8 (2*4 items) in the adoption of mitigation measures or 14 (2*7 items) in adopting to adaptation measures. ii) Medium level of adoption (2.01 – 3.99): iii) High level of adoption (4 - 5): Descriptive statistics were applied to calculate frequencies and percent of the scores obtained from each individual level. The obtained percent indicated the level of adoption based on which level scored the highest and vice versa. In addition, inferential statistics entailed the application of a Kruskal Wallis Test to explore the differences in the level of mitigation and adaptation measures across three age groups.

3.3 RESULTS AND DISCUSSIONS

3.3.1 Selected socio-economic and demographic characteristics of the respondents

Socio-economic and demographic characteristics were assessed to reveal the baseline information and establish characteristics of interest of the study population in relation to mitigation and adaptation measures. These characteristics are presented in Table 3.1. The findings showed that 59.2% of the respondents were males while 40.8% were females. Respondents were distributed in different age groups which included 21 – 34 (25.4%), 35 – 59 years (61.6%) and above 60 years (12.9%). The mean age was 43.3 indicating that majority of the farmers were more energetic and that they are likely to devote to more time on farming besides other economic activities.

Of all the respondents, 68.8% indicated that they had completed primary education, 5.4% had secondary education while less than 1% had ordinary certificates attained upon

completion of form four. In terms of occupation, 49.2% reported that they were engaging in farming, while 48.3 were also doing commercial activities in addition to farming. Based on the findings, PUF is more practiced by middle age people and with low education level. About 88% of the respondents owned land and about 13% either rented or were permitted by land owners to use for farming.

Table 3.1: Socio- economic and demographic characteristics of the respondents (n=240)

Education	**Percent**
No formal education	12.9
Primary	68.8
Secondary	5.4
Ordinary certificates	0.4
Adult education	12.5
Total	**100**
Occupation	
Farming only	49.2
Farming with petty business	48.3
Formal employment with farming	2.5
Total	**100**

3.3.2 Mitigation measures

Peri-urban farmers implement several mitigation measures including the use of cover crops, adoption of alternative sources of energy, mixed farming and agroforestry. Those mitigation measures are summarized in Table 3.2.

3.3.2.1 Cover crops

Cover crops appeared to have a unique importance in soil fertility improvement. The study sought to establish the extent to which cover crops were applied in climate change mitigation. The findings revealed that 81.6% of the respondents indicated that they use cover crops to mitigate climate change effects. Farmers cultivate leguminous cover crops mainly for food purposes. The respondents explained how cover crops improved soil fertility, which consequently increases yields per unit area.

Table 3.2: Mitigation measures used by peri-urban farmers against climate change (n= 240)

Mitigation measure	Percent (%)
Cover crops	81.6
Alternative energy sources**	72.1
Mixed farming*	82.4
Agroforestry	60.9

Note: * crop production and animal husbandry
**gas instead of fuel wood and charcoal

According to Barthes *et al.* (2004) cover crops add and retain carbon to the soil. This subsequently reduces atmospheric emission of carbon dioxide. Paustian *et al.* (2004) also showed that cover crops such as legumes mitigate climate change through reducing reliance on fertilizers, pesticides and other inputs. Enhancing cover crops cultivation implies a positive contribution towards mitigating climate change. Similar concern was raised in other studies (Adger *et al*. 2003; Parry *et al.,* 2007). It is clear from those evidences that enhancing cover cropping has a potential positive implication in reducing atmospheric carbon emissions despite the fact that they are of greater importance in improving soil fertility.

3.3.2.2 Alternative energy sources

The study intended to ascertain the extent to which adoption of alternative energy sources by farmers in the study area in relation to mitigation purposes. The findings showed that 72.1% of respondents mentioned gas stoves as alternative sources of energy mitigation measures of climate change. This indicates that farmers in the study area took initiatives of shifting from using forest based resources to the modern sources. This consequently reduces forest degradation, hence; reduces emissions meanwhile increases carbon sinks. The importance of alternative sources of energy in reducing tree cutting and mitigating of climate change was also emphasised in other studies such as Moomaw *et al*. (2011) and Kiunsi (2013).

Apart from mitigation, the increasing use of alternative sources of energy for cooking is because the surrounding communities have destroyed the natural vegetation and they do not have adequate fuel woods. Focus group discussions revealed that the pace of clearance of tree was very high to the extent of affecting efforts geared towards environmental management. This is supported by Mlozi *et al.* (2013) who found that that the local communities of Dar es Salaam Region have significantly destroyed the natural vegetation in search for fuel wood and charcoal. Promotion of alternative sources of energy is therefore important for domestic purposes with an imminent value in mitigating climate.

3.3.2.3 Mixed farming

The study findings showed that 82.4% of the respondents practiced mixed farming to mitigate climate change effects. This might be due to the fact that a good combination of crop cultivation and animal rearing reduced emissions, while improving environmental condition through the application of animal fertilizers into the fields. Although ruminant animals such as cattle and sheep produce methane, farmers in the study area keep ruminant animals mainly dairy cattle on small scale. Meanwhile, they invest more on indigenous chicken which have less environmental impacts. This practice decreases the emission of methane which could be produced by ruminant animals such as cattle and sheep if they would be kept in a large scale. For example, Opio *et al*. (2005) showed that in the year 2005 about 4255.9 million tonnes of carbon dioxide were emitted by the global cattle sector. This implies that increasing in cattle rearing increases carbon emission. In contrast, low cattle stocking done in the study area has an implication in the reduction of methane emission (greenhouse gas) per unit of area.

3.3.2.4 Agroforestry

Agroforestry involves planned initiatives of growing of woody perennials with crops and/or animals, either in some form of spatial mixture or sequence in the same field (Nair, 1993). In the context of this study, assessment of agroforestry focused on the system in which growing of woods or wood fruits and crops are grown in the same field. Study results indicated that, 60.9% of the respondents reported that agroforestry was amongst mitigation measures used in the study area. Based on the percentage of the respondents acknowledging this measure, agroforestry appears to be a least mitigation measure practiced as compared to the other mitigation measures. This is perhaps due to dramatic land use changes which take place in the study area, and which subsequently continue to seize farmlands. During the focus group discussions it was reported that the increased human settlement trigger higher demand for land which trigger tree clearance. Incidences of tree cutting at higher pace in search for fuel wood, charcoal and expansion of farms and human settlement were also reported in the other study (Ringo *et al*., 2018b). These land use practices have impaired sustainability of agroforestry in the study area.

Despite these findings, the importance of forests in reducing emission and enhancing carbon sinks is well acknowledged in other studies (Kandji *et al.,* 2006; Oke and Odebiyi, 2007; Smith and Olesen, 2010; Dubelling, 2011; URT, 2012; Mbow *et al.,* 2014). Agroforestry is also emphasised as an important component in climate-smart agriculture due to its multiple roles of mitigation and adaptation on climate change (Thorlakson and Neufeld, 2012). This indicates that in order to gain the multiple benefits initiatives on agroforestry are more paramount.

3.3.3 Adaptation to climate change

Peri-urban farmers implement different adaptation measures including the use of drought resistant crops, economic diversification, irrigation, mixed farming, intercropping and the use of cover crops (Table 3.3).

3.3.3.1 Drought resistant crops

Drought resistant crops are crucial to increase resilience of the farmers against the incidences of drought. This study has revealed that 94.5% of the respondents use drought resistant crops in adapting to climate change. This indicates that it is the most appropriate adaptation measure in the study area probably due to the long dry spells brought about by the decrease in rainfall especially the short rains. Drought resistant crops used in adapting to climate change in the study area are mainly cassava and sweet potatoes. Results from FGDs indicated that drought resistant crops are of greater importance due to their resistance against climatic stressors than the other crops like maize. Kassenga and Mbuligwe (2013) also showed agronomic shift of peri-urban farmers of Dar es Salaam Region from maize to cassava cropping. The use of drought resistant crops was also observed in the other studies done among smallholder farmers and rural households in semi-arid areas of Tanzania and Sahel Savanna, Agro-ecological zone of Bone State Nigeria (Lyimo and Kangarawe, 2010; Idrisa *et al.*, 2012; Niang *et al.*, 2014; Komba and Muchapondwa, 2015).

Nonetheless, this finding contradicts a study done by Oruonye (2014) which showed adaptation measures related with drought resistant crop selection was the least important measure. As observed from different studies, it appears that the use of drought resistant crops is a common adaptation measures. However, drought resistant crops reported in other studies were not very similar with those found in this study possibly due to

variations in farming experience across different settings. Crops such as sorghum, millet and sunflower were reported in the other studies done in other settings (e.g. Lema and Majule, 2009; Lyimo and Kangarawe, 2010; Kihupi *et al.,* 2015). This indicates that other factors such as local consumers' taste preferences influence cultivation of particular drought tolerant crops (Lobell and Marshal, 2010; Kalungu *et al*., 2013). This reinforces the notion that adaptation on climate change is location specific initiative grounded on the prevailing local circumstances as it is practiced in the study area.

3.3.3.2 Economic diversification

The findings show that, 90.8% of the respondents identified economic diversification as one of the climate change adaptation measure used in the study area and is the second most important adaptation measure next to drought resistant crops. Focus group discussions with the farmers revealed that climate change had clearly caused decreased crop yields and the overall ability of farming to sustain farmers' livelihood. Due to the situation and proximity of the study area to the city centre, economic diversification into commercial related activities becomes a more paramount adaptation measure. The types of petty businesses that the respondents mentioned included food vending, selling fish, selling charcoal and mini groceries among others. The results are complimentary to another different study which indicated livelihood diversification towards lower dependency on natural resources and increased reliance on urban opportunities as adaptation used by peri-urban dwellers (Ricci, 2012).

In contrast to this study, Mongi *et al.* (2010) study in semi-arid areas, Tanzania showed that farmers in semi-arid areas adapt to climate change effects by expanding areas under cultivation. This is obviously not possible in settings with limited land sizes such as Temeke District. However, frequent land use changes coupled with rapid population

increase in peri-urban areas create enabling environment for additional income generating opportunities which are not much sensitive to climate change. Other opportunity due to the interaction is the market for products produced in peri-urban areas. Similar results were reported by Kassenga and Mbuligwe (2013). The results are also supported by the other studies done in Western Europe and in Kathmandu Valley, Nepal. These studies indicated that the advantage of proximity to urban was for its diversification of income generating activities and markets (Antrop, 2000; Shretha and Sada, 2013). Thus, economic diversification seems to be more pronounced in peri-urban areas as opposed to other settings such as rural areas, which face climate change episodes.

Table 3.3: Adaptation measures used by peri-urban farmers against climate change (n= 240)

Adaptation measure	Percent (%)
Drought resistant varieties	94.5
Economic diversification*	90.8
Irrigation farming	85
Mixed farming **	79.5
Sequential cropping	73.7
Intercropping strategy	74.5
Cover crops	72.1

Note: *petty trade, food vending, selling fish, groceries etc
**farming and animal husbandry

3.3.3.3 Irrigation farming

Irrigation is an important farming practice especially in areas characterized by inadequate amount of rainfall such as desert and semi desert areas. Of the respondents, 85% mentioned that irrigation farming as an adaptation measure against climate change. Farmers reported that they used to cultivate paddy rice in ponds which reserve water for a period of time. FGDs added that, green leafy vegetables including tomatoes, chinese cabbage, ladies finger, green potatoes' leaves, amaranths and pepper were mainly cultivated through irrigation. The results are in line with a study by Ricci (2012) which

showed that most peri-urban households in Dar es Salaam Region were depending on water from boreholes to irrigate their farms.

Similar results were reported in previous studies done in semi-arid areas of Ethiopia and Iringa District (Deressa *et al*., 2009; Kihupi *et al*., 2015; Sani *et al*., 2016) which indicated irrigation as an important adaptation measure. However, the mode of irrigation presented in those studies differs from this study. Kihupi *et al.* (2015) reported that farmers in Pawaga ward were irrigating their farms using water from rivers. The importance of irrigation farming was also revealed in other study on climate change adaptation on peri-urban farming (Shretha and Sada, 2013). The mode of irrigation reported in that study was involving the use of electric water pumps for lifting water from the river to farmlands which involves charging irrigation fees to the farmers. Despite the difference in mode of irrigation in the different locations, this adaptation measure increases farmers' ability to adapt and output accrued from farming practices.

In this study, the rapid population increases in Dar es Salaam Region increases the demand for perishable foods, mainly green leaves produced in peri-urban areas. This situation increases the potential of irrigation in the study area in order to ensure a continuous supply of commodities from peri-urban areas. Green leafy vegetables are also not able to resist transport related complications from the countryside. Thus, the short distance from peri-urban areas to consumers (urban centre) assures the farmers with the reliable market for their products. Equally, as opposed to other settings like rural areas which are flexible to as much adaptation measures as possible, in peri-urban areas land use changes and competitions limit a number of adaptation options such as shifting cultivation, fallowing and migration to resource rich areas. Therefore, this makes irrigation more paramount in peri-urban farming.

3.3.3.4 Mixed farming

Mixed farming is also adaptation measure used by peri-urban farmers to mediate climate change and it was acknowledged by 79.5% of the respondents in the study area. In the study area, mixed farming involved crop cultivation and keeping domestic animals mainly dairy cattle, goats, layers and indigenous chicken. The respondents reported that mixed farming increased farmers' cushioning against climate change. That is, when climate change affects crop cultivation, livestock kept substitute the risk due to crop failures. During focus group discussions it was emphasised that, animal manure is of greater importance as it assists crops to flourish well and increase yields per unit area of land.

On the other hand, plant residues act as fodder for livestock feeds. Thus, a synergy between crops and livestock increases ecological cum-economic benefits and assurance against climatic stressors. Nonetheless, this practice was also reported as a mitigation measure. This indicates that, adaptation measures also contribute to mitigation, or in other words they are mutually interrelated. Interrelations between mitigation and adaptation were also reported in the other studies (FAO, 2009; Smith and Olesen, 2010). This implies that improving farmers' adaptive capacity has a positive implication in mitigation of climate change.

3.3.3.5 Intercropping

Intercropping is also practiced in the study area as adaptation measure against climate change. The study findings revealed that 74.5% of the respondents mentioned that intercropping as a strategy used by the farmers in climate change adaptation. The types of crops involved in intercropping in the study area include early maturing maize seeds, and vegetables such as okra, peppers, tomatoes and water melon. Such crops take short time to mature, thus; they are suitable in adjusting farming practices against short rain cycles

experienced in the study area. The practice is also important because it reduces risks associated with a failure of a particular crop in a given season or a year. Intercropping was also emphasised by Adger and Vicent (2005); Orindi and Eriksen (2005), and Kurukulasuriya and Mendelsohn (2006). Niang *et al.* (2014) also reported shorter maturing crops as adaptation on increasing incidences of rainfall variability. Nonetheless, these studies were carried out in other parts of Africa with different geographical characteristics from Temeke District. Equally, not very similar intercropping techniques reported in the study area were also reported in those studies. The other studies showed a combination of sorghum, maize and millet as well as millet and groundnuts which are not applied in Temeke District. This is more likely associated with farming experiences inherited from previous generations which differ across different geographical settings. It is clear from this study and others that intercropping can differ from one location to another.

3.3.3.6 Cover crops

The findings indicated that cover crops, mainly leguminous were also reported by peri-urban farmers as adaptation measure by 72.1% of the respondents. Although, this was also reported as a mitigation measures it is not surprising to be mentioned as adaptation measure. Scientifically, among the benefits of cover crops include prevention of soil erosion and surface run off which consequently increases soil fertility as well as soil moisture content. These are important inputs for the growth and wellbeing of other crops against climatic shocks such as shortages of rainfall. Therefore, cover crops were mentioned as adaptation measures probably because of their scientific potential of improving soil fertility through nutrient retention. This implies that, other crops grown in the same field with cover crops flourish well and increase yields through the nutrients generated by the cover crops.

The importance of cover crops in adapting to climatic stressors was also observed in the U.S Corn Belt (Roesch-Mcnally, 2016). On the other hand, what makes cover crops to be regarded as a mitigation measure is through another scientific role of retaining soil carbon resulting into reducing atmospheric carbon emissions. This finding is concomitant with the findings by Somorin *et al.* (2016) which revealed the importance of a synergy between mitigation and adaptation measures. Therefore, enhancing cover cropping implies taping both climate change mitigation and adaptation benefits.

3.4 The level of mitigation and adaptation measures

The study assessed the level of mitigation and adaptation among the farming households in order to ascertain an overview of the farmers' initiatives to address climate change in peri-urban areas. In terms of mitigation measures, the findings reveal that 60.8% of the respondents had the highest level of adoption, 32.5% had medium level and 6.7% had the lowest level. This indicates that the level of mitigation measures pursued by the households in mediating climate change is reasonably high. This is because most of farmers use more than one mitigation measure to mediate climate change effects. Equally, this implies that local level initiatives are useful in the bid to reduce global greenhouse gas emissions.

The level of mitigation measures among the farming households was correlated with the age groups. Results from a Kruskal Wallis Test suggested that there were statistically significantly differences in mitigation measures across three age groups at $p< 0.05$. Mean ranks for the groups suggested that the older group (60 years and above) had the highest level of adoption with the younger group reporting the lowest level of adoption. The possible reason for the findings is that the older farmers have more experience on farming

implying that they have more experience in activities translating to mitigating climate change.

The respondents in the study area have shown different adoption levels for adaptation to climate change. About 73% of the respondents had the highest level of adoption of adaptation measures while 27% and 0.41% had medium and lowest level respectively. High level of adaptation is likely to be associated with the high level of climate change awareness and the resultant effects in the study area as reported earlier in Chapter Two of this thesis. High level of adaptation was also raised by the other researchers in semi- arid areas of Tanzania and outside the country (Kihupi *et al*., 2015; Abaje *et al*., 2014; Lema and Majule, 2009). In the present study, farming also appears to be an important economic activity necessitating farmers to take firm decision to adopt mitigation and adaptation measures as key options to sustain PUF. The findings from Kruskal Wallis Test revealed that there were no statistically significantly differences in the adoption of adaptation measures across three age groups at $p > 0.05$. This indicates that different age groups take similar initiatives to implement adaptation measures.

3.5 CONCLUSIONS AND RECOMMENDATIONS

Peri-urban farmers in the study area use different mitigation and adaptation measures in response to climate. Furthermore, some mitigation and adaptation measures applied in the study area appeared to be similar suggesting that there was a synergic role between these climate change interventions: a complementary role. Thus, enhancing farmers' adaptive capacity has a potential and long-term implication on mitigating climate change. Therefore, in order to address climate change, mitigation and adaptation measures should be pursued simultaneously. The level of mitigation and adaptation measures in the study area was generally high. This indicates that in the bid to address climate change and

sustaining peri-urban farming mitigation and adaptation measures are inevitable interventions.

Farmers in the study area should enhance the use of existing adaptation measures with the Government providing the required assistance including agricultural extension services. Moreover, the study recommends more studies on mitigation and adaptation measures in order to find appropriate ways of helping farmers to address successfully climate change stressors. Further to that, more studies on determining factors for mitigation and adaptation are also recommended in order to enable interventions which will improve adaptive capacity among the local communities including peri-urban farmers.

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CHAPTER FOUR

4.0 Comparison of Gendered Determinants of Climate Change Mitigation and Adaptation Measures among Peri-urban Farmers of Temeke District, Dar es Salaam Region

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Abstract

This study aimed to assess gendered determinants of mitigation and adaptation measures among peri-urban farmers of Temeke District, Dar es Salaam Region. A cross-sectional research design was employed and a total of 240 households were randomly selected from four wards. One focus group discussion for each gender category of men and women was conducted in each ward. Quantitative data were analyzed through descriptive and inferential statistics whereas content analysis was applied to analyze qualitative data. The findings showed that there were no statistically significantly differences in mitigation measures pursued by men and women at $p>0.05$. Similarly, there were no significant

difference in adaptation measures between men and women at p>0.05. Furthermore, there were no statistical significant differences in the determinants of mitigation measures between men and women. This is underpinned by the following results: households' income was not statistically significantly differently at p=0.051, geographical location (p=0.341) as well as tradition and customs (p=0.719). In terms of determinants of adaptation measures, geographical location was statistically significantly different at p=0.031 while tradition and customs was statistically significantly different at p=0.043. However, households' income and literacy level were not statistically significantly different. Thus, the revealed results indicate that for the sake of sustaining peri-urban farming adoption of mitigation and adaptation measures is a prerequisite for all farmers. Nonetheless, the revealed results in some of the determinants of adaptation measures raise the need for upholding gender concerns in addressing climate change interventions. These outcomes hint an emphasis on policy review to address well climate change interventions. More studies on climate change intervention policies are also recommended.

***Keywords**: Gender, mitigation, adaptation, peri-urban farmers, Temeke District.*

4.1 INTRODUCTION

Climate change has raised attention among different stakeholders such as scientists, academic community, policy makers, development partners and the local communities. According to Intergovernmental Panel for Climate Change (IPCC) the impacts of climate change vary from place to place with varying responses depending on various factors including socio economic profile of a particular community (IPCC, 2001; IPCC, 2007)**.** The phenomenon is particularly an issue of gender concern since it increases the burden of life disproportionately between men and women (Lambrou and Piana, 2006; Matheson and McIntyre, 2013; Kalungu, 2014).

The term gender has been defined differently by different scholars. According to Röhr (2007), the concept refers to social construction of men's and women's roles in a given culture or location. Gender roles are distinguished from sex roles, which are biologically determined. Due to this situation, differences exist in most societies between the rights and opportunities of men and women, including rights to land, resources, work opportunities and wages, and participation in decision making processes. On the other hand, UN WOMEN (2001) defines gender to include other cross cutting variables including race, class, age, physical capabilities and ethnic groups. In the context of this study, the definition by Röhr (2007) has been adopted to compare gendered determinants of mitigation and adaptation measures. This is because issues of gender and decision making including agricultural performance categorically distinguish differential roles played by men and women rather than the other groups including the elders, youth and disabled. Also, peri-urban farming is a form of farming which is on transition due to the dynamic nature of peri-urban setting, hence; poses complex socio-economic characteristics as compared to rural areas and the town proper. These characteristics can have implications on gender relations in mitigation and adaptation measures pursued by peri-urban farmers.

Consequences of climate change are not gender neutral since they affect women and men differently. This is underpinned by different literatures such as Carvajal-Escobar *et al.* (2008) who report that climate change affect men and women differently due to their ethnic groups, social classes and age groups. Kalungu (2014) asserts that climate change has particularly increased workload among illiterate women involved in farming in rural areas, as men migrate to urban areas to look for alternative livelihood options. Climate change consequences have also negative consequences on women time management. For example, drying of nearby wells and water sources directly increases the distance to and time spent in searching water for domestic uses (Lambrou and Piana, 2006). Likewise,

Nombo *et al*. (2013), assert that climate change effects are not gender neutral as they affect sectors that are traditionally as women sectors

Furthermore, socio-cultural set-up has aggravated variation in climate change impacts between men and women. For example, Carvajal-Escobar *et al*. (2008) reported that differential in the social roles, inequality in the access to and control of resources and low participation in decision making make climate change impacts different between men and women with women impacted the most. Zilihona *et al.* (2011) noted that women and children could walk up to eight kilometres in search for households' fire wood. Matheson and McIntyre (2013) have reported that women are more vulnerable from food insecurity due to climate change.

In Tanzania, agriculture as seen earlier provides employment to over two thirds of the country's population. It is specifically a gender issue, of which women comprise almost 54% of the labour force (Leavens and Anderson, 2011). Furthermore, Nhemachena *et al.* (2014) indicated the differences in farming practices between men and women. In case of Dar es Salaam Region, Jacobi and Amend (1997) found that there were existing variations between women and men involved in farming practices. They asserted that women are more active in community gardens and gardens in high-density areas than their men counterparts. More involvement of women in farming increases the likelihood of being more vulnerable from climate change consequences than men. This is because in most of the local communities, cultural ties appear to be biased in favour of men. While women are involved more in farming activities, they have been earning less income as compared to their counterparts (Kalungu, 2014). This situation translates to another burden for women in executing farming and in sustaining their livelihoods. These can also undermine women's adaptive capacity as compared to men.

A handful of literature shows different factors which affect mitigation and adaptation measures in Tanzania and elsewhere (Adger and Vincent, 2005; Brooks *et al*., 2005; Hassan and Nhemachena, 2008).These studies focused on farm level adaptation strategies and determinants of vulnerability and adaptive capacity at the national level. Some studies have examined determinants of mitigation and adaptation among male and female headed households in rural areas out of Tanzania (Nabikolo *et al.*, 2012; Nhemachena *et al.*, 2014). These studies uphold that adaptation decisions vary across gender in rural areas where adaptation among women is influenced by household's assets while adaptation among men is indicated to be influenced by the land. In addition, women in rural areas were more likely to adapt to climate change than men because of their significant experience in farming than their counterparts. Very little attention has been directed to assess gendered determinants of climate change mitigation and adaptation in peri-urban areas of Tanzania despite the fact that the level of participation in farming varies in different communities based on gender (Mlozi *et al*., 2014).

Carvajal-Escobar *et al*. (2008) point out that despite their crucial roles in adaptation and mitigation, gender perspectives are often neglected in climate change responses. Swai *et al.* (2012) show that gender blind policies may accelerate climate change related problems, and that effective response on the same problems needs an integration of both men and women in policies and plans. Furthermore, Kalungu (2014) asserts that smallholder farmers strongly believe in gender division in farming practices. These few examples justify a paucity of information on the determinants of mitigation and adaptation measures based on gender among peri-urban farmers.

Based on the aforementioned evidence gendered analysis on determinants of climate change mitigation and adaptation measures is crucial but in practice is highly neglected in

addressing climate change. This situation raises the need to compare gendered determinants of mitigation and adaptation measures among peri-urban farmers of Temeke District, Dar es Salaam Region. This study intended to answer the following questions: i) what are the differences in mitigation and adaptation measures pursued by male and female headed households? ii) what are the differences in the determinants of mitigation and adaptation measures undertaken by male and female headed households?

This study, at a global level tries to address some issues emphasized in the global sustainable development goals (SDGs) specifically the fifth goal which has given attention on gender as well as the thirteen's goal which emphasizes on taking urgent action to combat climate change. At a national level, the information is useful among policy makers and planners in their bid to revise policy and planning incentives which take into account gender dimensions in farming practices and climate change interventions. Furthermore, the results generated from this study contribute to the knowledge on the peri-urban farming contextual understanding of the gendered determinants of mitigation and adaptation measures.

4.2 METHODOLOGY

4.2.1 The study area

The study was conducted in four peri-urban wards of Temeke District which is one of the districts in Dar es Salaam Region. The choice of Temeke District was based on two grounds: The district has the large land under cultivation (33 000ha) compared to Kinondoni (13 600ha) and Ilala (11 678ha). Also, the district has the largest number of households involved in agriculture, particularly smallholder agriculturalists as compared to the other districts in the Region. Likewise, agriculture in the district contributes much to the overall City food basket as compared to its counterparts (URT, 2012). Moreover, the

study focused on peri-urban areas because much of perishable foods such as vegetables are produced in this setting. Meanwhile, Dar es Salaam being the city with municipal authorities, there are no villages rather than peri-urban wards with streets. Gender wise, agriculture in Temeke District is characterized by the dominance of male superiority (Kisanga, 2012).

The district is located between latitudes 6º 55' to 6º 90' South and longitudes 39º25' to 39º33' East (UNAIDS, 2010). According to Population and Housing Census' data for 2012, the district had a total population of 1 368 881 of which males were 669 056 and 699 825 females (URT, 2013). In view of the existing population trend with an annual intercensal growth rate of 5.6% (URT, 2013; URT, 2016), the projected total population for the year 2017 is 1 797 568. Climatic condition of the area is a modified type of equatorial climate which is generally hot and humid throughout the year. The average annual temperature is 29ºC while humidity is around 96% in the morning and 67% in the afternoon (URT, 2004).

Rainfall is segmented into two seasons, long rains and short rains. The long rains start from mid-March to the late May while short rains start from mid-October to late December. Besides the study area, the whole of coastal regions including Dar es Salaam Region have experienced rainfall deficiencies (START, 2011). The observed deficiencies have impaired peri-urban farming undertaken in Temeke District. This is a gender issue because it implies an increase in women's workload through an increase in the time of finding water for domestic purposes.

Natural vegetations found in the area include coastal shrubs, miombo woodland, coastal swamps and mangrove trees (URT, 2004). Vegetation cover has been significantly

destroyed by human activities (Mlozi *et al.*, 2013). Sources of income in the study area include: farming, formal employment and petty business which embraces sale of food crops, forest products, livestock products and fish. These activities are performed differently across gender. For example, while fishing activities are dominated by men, food vending is mostly performed by women. Charcoal making is mainly performed by men while selling of charcoal at the households is performed by both men and women. However, in recent years farming has been inadequate to ensure food security because of dependency on unreliable rainfall (URT, 2014). Climatic stressors in forms of unreliable rainfall and decline in rain cycles have culminated into development of mitigation and adaptation measures among the farmers to sustain farming practices.

4.2.2 Research design

The study adopted a cross-sectional research design to examine the existing gendered differences in the determinants of mitigation and adaptation measures. Babbie (1990) argues that a cross-sectional design allows data to be collected at a single point in time. The design was appropriate for this study as it was compatible to the time and available financial resource allocated for a study. The design enabled the data to be collected and examined once rather than gauging variation in peri-urban farmers' interventions over time.

4.2.3 Sampling design and sample size

Sampling started by identification of four wards namely Kisarawe II, Somangila, Pemba Mnazi and Kimbiji purposively, because farming was more dominant as compared to the other wards. Then, four streets were chosen randomly from each ward. The study population comprised of peri-urban farmers residing in peri-urban wards of Temeke District with the unit of analysis being a household's head. From each street, a list of

farming households was constructed with the aid of street leaders of which, a total of 15 households were identified. Household heads were contacted for interviews. This sample size resulted into 60 respondents in each ward, and a total of 240 households for the four wards. In addition, more experienced farmers (with farming experience of 15 years and above) of both sexes were chosen from two streets in each ward for inclusion into Focus Group Discussions. The aim of separating women from men in FGDs was to capture separately gendered experiences and lessons regarding mitigation and adaptation measures.

4.2.4 Data collection methods

Primary and secondary data, both quantitative and qualitative, were collected. Primary data were collected through household surveys (HSs) which used semi structured questionnaire administered to 240 households. HSs captured information on socio-economic characteristics of the respondents through open and closed ended questions. In addition, the HSs collected information on gendered disaggregated mitigation and adaptation measures as well as determinants of the same. Responses on those items were assigned scores ranging from 1 for strongly disagree (lowest score) to 5 strongly agree (highest score) since they were Likert scale data. Focus Group Discussions (FGDs) for men and women farmers were conducted using check list and mainly collected qualitative data. Each FGD included 10 to 12 participants.

4.2.5 Data analysis

Descriptive statistics were applied to analyze selected socio-economic characteristics of the respondents of which frequencies were produced. The study also performed a Chi Square Test to establish association between education level and gender as well as land ownership between men and women. These variables were tested because they are more

important in the course of implementing mitigation and adaptation measures. Comparison of gendered determinants of mitigation and adaptation measures was subjected to inferential statistics where Mann – Whitney U Test was applied. This is a non-parametric test which is appropriate to compare two independent groups when data are categorical or ordinal in nature (Pallant, 2005). In this study, gender was an independent variable categorized as 1 for men and 2 for a woman.

Dependent variables comprised of a list of individual mitigation and adaptation measures which were identified from the literature. In this case, perception of the respondents in each individual mitigation and adaptation measures is being affected by gender. Other dependent variables were income of the household head, geographical location (streets) where farmers were living as well as tradition and customs. The responses on each dependent variable were measured through Likert scale which ranged from 1 (strongly disagree) to 5 (strongly agree). Each of the dependent variables was tested against independent variable (gender) in order to establish whether there was significant difference in each of them across gender. Qualitative data from FGDs were analysed through content analysis with its interpretation used to support quantitative data and discussions.

4.3 RESULTS AND DISCUSSIONS

4.3.1 Selected socio-economic and demographic characteristics of the respondents

The study assessed socio-economic and demographic characteristics of respondents in order to show the gendered desegregated characteristics of interest of the study population. These characteristics are summarized in Table 4.1. Genderwise, the study results revealed that, 59.2% of the respondents were men while 40.8% were women. This implies a good representation of both men and women and their differences could be easily captured. In

terms of age composition, in age group 35 - 59 years was represented by 61.7% of respondents, followed by 20 – 34 (25.4%) and 60 years and above (12.9%). The implication of the results is that farming and the entire economy is dominated by energetic men and women. However, men appear to dominate PUF and the gap is more pronounced in age group 60 and above. This indicates that men constitute more experienced and matured farmers in the study area. This has an added advantage on mitigation and adaptation measures. It is also very possible that those groups which participate more in farming comprise of most dependent respondents. Therefore, income from PUF is possibly used to cover living expenses for their households in terms of education for children, health expenses as well as dietary demands.

Table 4.1 indicates that majority (68%) of the respondents had completed primary education. The study performed a Chi Square Test to establish association between education levels and gender. The results revealed that association between education levels and gender was not statistically significantly different at p= 0.137. This indicates that PUF is more dependable by less educated people across gender. The study's findings are supported by a study done by Mlozi *et al*. (2014) which showed that majority of the farmers across all districts in Dar es Salaam Region had primary education with few having completed secondary education. The findings imply that peri-urban farming offers an important livelihood option among the people with low education levels. The possible reason is that lack of employment opportunities in formal sector drive less educated people into farming activities. On the other hand, the possible explanation for the low participation of educated people in PUF is that majority of them are employed in non-farming sectors and utilize most of their time in economic activities associated to those sectors.

Table 4.1: Socio- demographic characteristics of the respondents

	Men		Women			
Age Group	**Frequency**	**Percent**	**Frequency**	**Percent**	**Total Frequency**	**Total Percent**
18 - 34	37	26.1	24	24.5	61	25.4
35 - 59	83	58.5	65	66.3	148	61.7
60+	22	15.5	9	9.2	31	12.9
Total	**142**	**100**	**98**	**100**	**240**	**100**
Education Level						
No formal education	20	66	11	35	31	12.9
Adult	12	40	18	60	30	12.5
Primary	100	60.6	65	39.4	165	68.8
Secondary	9	69.2	4	30.8	13	5.4
Certificates	1	100	0	0	1	.4
Total	**142**	**59.2**	**98**	**40.8**	**240**	**100**
Occupation						
Farming	67	56.77	51	43.23	118	49.2
Farming with commercial Activities	80	68.4	37	31.6	117	48.8
Formal employment with farming	3	60	2	40	5	2.4
Total	**150**	**62.5**	**90**	**37.5**	**240**	**100**
Ownership of land						
Owning	123	58.6	87	41.4	210	87.5
Not owning	19	63.3	11	36.7	30	12.5
Total	**142**	**59.2**	**98**	**40.8**	**240**	**100**

In terms of occupation, it was shown that 49.2% of the respondents were doing farming and only 2.4% practiced both farming alongside formal employment. Low percent of formal employees among the respondents can be associated with the results on education levels which generally revealed the dominance of less educated respondents. This undermines their possibility of being engaged in formal employment.

Furthermore, 87.5% of the respondents owned land which they used for farming while 12.5% either rented land or were permitted to use by land owners. Although 58.6% of men owned land as opposed to 41.6% of women, Chi Square Test results demonstrated that the association between land ownership and gender was not statistically significantly differently at $p = 0.766$. This means, in peri-urban areas the access to and ownership of land between men and women is almost similar. Therefore, gender disaggregation in

ownership of land in the setting of peri-urban is less biased against gender category. This finding is in contradiction to the generalization raised by Leavens and Anderson (2011) which reported that 19% of women owned land in Tanzania with the average land holding size less than half of land owned by men. Their study included rural areas where cultural ties sideline women in various issues including access to and control of land which is a basic resource for farming.

4.3.2 Comparison of mitigation measures between men and women

Climate change has been identified as a gender sensitive issue since it increases vulnerability differently between men and women. Based on that, the study assessed mitigation measures in order to ascertain if there are significant differences in mitigation measures across gender. These include cover crop farming, mixed farming, alternative energy sources and agroforestry. Responses on mitigation measures between men and women are presented in Table 4.2. The findings from Mann Whitney test revealed that there were no statistical significant differences in mitigation measures undertaken by men and women. This is underpinned by the following results: mixed farming was not statistically significantly differently between men and women at $p = 0.886$, agroforesty $p = 0.525$, cover crops $p = 0.745$, and alternative energy sources $p = 0.390$. This implies that both men and women headed farming households take similar initiatives to mitigate climate change probably because mitigation is a prerequisite intervention for all the farmers given that farming forms an important part of their livelihood.

Despite non significant differences in mitigation measures across gender, it is still emphasized that strategies to mitigate climate change need to uphold gender concerns. This is because gender is paramount in climate change interventions although it is subjected to change across time and location. This was also emphasized in another study

done by Bäthge (2010) which found that the use of efficient energy system at the household level was one of the strategies for enhancing gender concerns through harnessing the potential of women as actors of mitigation measures.

Table 4.2: Responses on mitigation measures pursued by men and women headed households (n = 240)

Mitigation Measure	Respondents' Gender	Counts	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	P-Value
Agroforestry	Men	142	116.49	6 439.000	16 309.000	-0.846	.321
	Women	98	123.80				
Mixed farming	Men	142	118.93	6 757.500	16 769.500	-0.320	.749
	Women	98	121.55				
Cover crops	Men	142	116.90	6 471.500	16 482.500	-0.992	.321
	Women	98	124.46				
Alternative energy Sources	Men	142	118.94	6 759.000	16 770.000	-0.336	.737
	Women	98	121.53				

4.3.3 Comparison of adaptation measures between men and women

The findings from Mann Whitney U test are presented in Table 4.3. The findings revealed that there were no statistically significantly differences in adaptation measures between men and women as shown by p values in the table. This translates into similar adaptation measures pursued by both men and women. These results imply that no matter the gender, adaptation measures are crucial and inevitable interventions for sustaining farming practices and the entire livelihood of the respondents in the study area.

Table 4.3: Responses on adaptation measures between men and women (n=240)

Adaptation Measure	Respondents' Gender	Counts	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	P-Value
Drought resistant crops	Men	142	120.08	6 898.000	17 051.000	-0.179	0.276
	Women	98	121.11				
Irrigation farming	Men	142	115.65	6 270.000	16 423.000	-1.771	0.077
	Women	98	127.52				
Economic diversification	Men	142	120.66	6 935.500	11 786.500	-0.064	0.949
	Women	98	120.27				
Mixed farming	Men	142	118.87	6 771.000	16 641.500	-0.208	0.835
	Women	98	120.40				
Intercropping	Men	142	112.63	6 001.000	15 317.000	-0.227	0.220
	Women	98	123.13				
Cover crops	Men	142	117.01	6 488.000	16 499.000	-0.957	0.338
	Women	98	124.30				
Sequential cropping	Men	142	115.91	6 357.500	16 227.500	-1.024	0.306
	Women	98	124.63				

The results concur with the findings by Danda *et al*. (2014) which revealed that adaptation measures pursued by men and women were more or less similar. Nonetheless, measures which were pursued in that area were different to those pursued by peri-urban farmers of Temeke District. The study contradicts with a study by Nabikolo *et al.* (2012), which indicated that women headed households were less likely to take up adaptation measures as compared to men headed farming households.

Also, the results of this study differ from a study by Mersha and Laerhoven (2016) which presented petty trade, hairdressing, selling of local drinks, spices, charcoal and fuel wood as adaptation measures widely used by women, while local and international migration were for men. However, their study was carried out in rural Ethiopia where location differences with peri-urban areas of Temeke District might have accounted to those differences. As opposed to rural Ethiopia, the proximity of peri-urban farmers of Temeke District to the city centre of Dar es Salaam can influence farmers' behavior and perception on adaptation measures differently from the rural areas. Those evidence justify that, the

practice of rural Ethiopia might not be applicable in Temeke District since gender roles vary across contexts.

Other studies (Jacobi and Amend, 1997; Ogato *et al*., 2009; Leavens and Anderson, 2011; Kalungu, 2014) indicate that the involvement in agriculture in different settings varies between men and women. This subsequently implies that there is a difference in adaptation measures pursued by men and women across different settings. Similarities in adaptation measures observed in this study might be caused by the nature of gender relations in peri-urban areas, especially in large cities like Dar es Salaam. Obvious, gender relations in peri-urban areas of Dar es Salaam are influenced by complexity of the city. The City is characterised by cultural interaction due to mixture of people from different places including foreign and upcountry, a situation which does not really exist in rural areas. These variations trigger the differences in adaptation measures across gender between peri-urban and rural areas.

4.3.4 Gendered determinants of mitigation and adaptation measures

The findings on the gendered determinants of mitigation measures are presented in Table 4.4. The findings show that of three determinants of mitigation measures, household's income was not statistically significant different between men and women at $p = 0.051$. Also, other determinants which were not statistically significantly differently were geographical location ($p=0.341$) and tradition and customs ($p=0.719$). The results suggested that determinants of mitigation measures between men and women were similar. During focus group discussions, participants regardless of their sex reported that low income was an obstacle in their farming practices. Participants in FGDs maintained that low income was constraining their farming to the extent that, they were unable to invest much in farming. However, the findings contradict with a study by Fortman and

Rocheleau (1997) who argued that lack of access to income is a common obstacle facing women to perform different activities in the world. This is perhaps caused by locational differences which influence differently gender relations between men and women.

Table 4.4: Gendered determinants of mitigation measures (n=240)

Determinants of mitigation	Respondents' Gender	Counts	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	P-Value
Household's income	Men	142	17 167.50	5 862.5	10 327.5	-1.948	0.051
	Women	98	10 327.50				
Geographical location	Men	142	16 489.0	6 336.0	16 489.0	-0.951	0.341
	Women	98	11 952.00				
Tradition and customs	Men	142	16 974	6 821.0	16 974.0	0.360	0.719
	Women	98	11 946				

Determinants of adaptation measures between men and women are presented in Table 4.5. The results illustrate that geographical location was statistically significantly differently at p=0.031 while tradition and customs were statistically significantly differently at (p=0.043). Geographical location can influence information sharing on adaptation measures differently based on gender which subsequently triggers differences in attitudes towards adaptation between men and women. It was observed in the study area that, there were dominant ethnic groups actively engaged in farming with a mixture of other ethnic groups from upcountry. This observation is supported by Kisanga (2012) who identified Ndengereko, Zaramo and Makonde as the major ethnic groups inhabiting peri-urban areas of Temeke District. The nature of farming of these ethnic groups is characterised by the dominance of males.

Tradition and culture of different ethnic groups influence perceptions on adaptive capacity between men and women. Consequently, these differences affect the entire practices linked to adaptation to climate change between men and women. Similarly, while

adaptation to climate change is inevitable in all gender settings, access and control to resources varies considerably between one location to the other due to inherited tradition and customs.

Furthermore, tradition and customs are linked to perpetuation of cultural and social marginalization of women which undermine their adaptive capacity. This conclusion is supported by the comprehensive study that covered the continents of Africa, Asia and Latin America (Porro, 2010). Perpetuation of women's marginalization was also revealed in other studies (UNFPA and WEDO, 2009; Djoudi and Brockhaus, 2011). Those studies reported that women's exclusion was reflected even in the emerging National Adaptation Plans of Action. Determinants which did not show statistically significantly differences in adaptation measures between men and women were head's of the household's income (p=0.284) and literacy level (p= 0.088).

Table 4.5. Gendered determinants of adaptation measures (n=240)

Determinants of adaptation	Respondents' Gender	Counts	Mean Rank	Mann-Whitney U	Wilcoxon W	Z	P-Value
Household's income	Men	142	121.33	6 727.500	11 572.500	-0.561	0.284
	Women	98	118.09				
Geographical location	Men	142	126.37	6 010.500	10 861.500	-1.857	0.031
	Women	98	110.83				
Farmer's literacy level	Men	142	123.68	6 389.500	11 240.500	-1.371	0.088
	Women	98	114.70				
Tradition and customs	Men	142	125.96	6 068.000	10 919.000	-1.700	0.043
	Women	98	111.42				

Focus group discussions also revealed that income levels between male and female headed households were more or less similar. During the discussions, it was noted that, shortage of capital limit farmers to access agricultural inputs. For example, during one of the FGDs, a participant said:

"Most of us have low income; therefore, it is difficult for us to purchase pesticides to control crop diseases and improved seeds, leaving aside meeting the costs for farm preparations".

These observations indicate that the levels of income of the household heads were more or less similar irrespective of gender. This is evidenced by the type of economic activities supporting their livelihood including small-scale farming activities and petty businesses, which all yield low incomes. This is similar to Mlozi *et al*. (2014) who showed that, majority of farmers in Dar es Salaam Region were poor and middle income earners who were lacking formal employment.

In terms of education, it is clear from the findings that the levels among the respondents were low and as revealed from Chi Square test results which were not statistically significant between men and women. Low education attainment undermines the possibility of majority of the farmers to engage in formal employment which is a guaranteed source of additional income to farming. Other privileges linked to formal employment include easy access to loans and social networks. These assets can facilitate farming activities in a number of ways including purchasing of modern agricultural inputs. Besides farming, access to loans has a positive implication in farmers' ability to adapt to climate change. Results on low education among the household heads are in agreement with the findings from other studies (Mlozi *et al*., 2014; URT, 2012; URT, 2014) which indicated that majority of the dwellers in Dar es Salaam Region had primary education with few having attained secondary education.

The findings on non significant differences in income between men and women contradict with Meinzen-Dick *et al*. (2010) and FAO (2011). These studies earmarked differences in

capital and ownership of assets of women farmers compared to men. This situation affected women's ability to adapt to climate change as compared to men. Although these studies focused in rural areas, the differences are likely to be associated with those locations on which the studies were conducted. It is therefore, apparent that gender is paramount in addressing determinants of mitigation and adaptation measures.

4.4 CONCLUSIONS AND RECOMMENDATIONS

The study findings revealed that there were no statistical significant differences in both mitigation and adaptation measures across gender. This leads to the conclusion that, climate change interventions, regardless gender, are key issues to be considered to sustain farming activities. Nonetheless, the study revealed significant differences in some of the determinants of adaptation measures. This indicates perpetuation of unequal gender relations, which consequently implies that women are negatively affected by the resultant consequences of unequal relations in issues linked to mitigation and adaptation measures.

Due to the observed differences in the determinants of adaptation measures, it is pertinent for the Government to revise policies and programmes to address realistically gender issues in mitigation and adaptation to climate change. This will make policies and programmes on climate change mitigation and adaptation fairer and more practical.

Furthermore, the study recommends to the academic community to do more researches on policies for addressing mitigation and adaptation measures in order to address the implementation gaps.

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CHAPTER FIVE

5.0 Policy Implementation Success and Challenges on Climate Change Mitigation and Adaptation Measures Pursued by Peri-urban Farmers of Temeke District, Dar es Salaam Region, Tanzania

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Abstract

The study examined policy implementation success and challenges on climate change mitigation and adaptation measures among peri-urban farmers of Temeke District, Dar es Salaam Region. A cross-sectional research design was applied and a total of 240 farming households were randomly selected from four wards for the household questionnaire surveys. The study also conducted one focus group discussion in each ward. Quantitative data were subjected to descriptive and inferential statistical analysis which produced frequencies and mean scores while content analysis was applied for qualitative data. Results reveal that most of mitigation measures pursued by peri-urban farmers against climate change were not compatible to those indicated in the National Climate Change

Strategy. Also, most of adaptation measures indicated in the Strategy were not similar to the locally developed measures of peri-urban farmers in the study area. Irrigation was the only adaptation measures applied in the study area that was both indicated in the Strategy and locally developed. The study findings revealed that, the Government has adopted a policy framework to guide mitigation and adaptation initiatives. The framework recognises climate change as a socio-economic challenge and it has priotised mitigation and adaptation measures linked to agriculture. However, results note low implementation of the Strategy's priotised measures among peri-urban farmers. The study recommends the Government to assist farmers to implement the priotised measures. It should also create enabling environment to farmers to enhance their own developed measures. Lastly, the study calls for more studies on policy implementation challenges among the farming communities in the other settings.

Key Words: Mitigation, adaptation, policy implementation, peri-urban

5. 1 INTRODUCTION

Climate change has posed impacts in all economic sectors. The impacts of climate change have raised concern among different stakeholders all over the world to address the phenomenon. Among of the global concerns include development/adoption of policy frameworks such as the United Nations Framework Convention on Climate Change (UNFCCC). This framework was signed in 1992 at the Rio Earth Summit to facilitate national level adaptation initiatives (Ampaire *et al.,* 2017). UNFCCC committed the member countries to launch national strategies on climate change adaptation (Schipper *et al*., 2008). Along with UNFCCC, the Rio Summit signed Agreement on Biodiversity Convention and Forest Principles which are also important efforts to address climate change (Pelling, 2002). Besides those, the governments all over the world have formulated

policies to address country specific climate change problems (Hoppe *et al*., 2014). The reason behind is that, the impacts of climate change vary across different countries; therefore, response on the same also varies along the same dimension.

In Tanzania, mitigation and adaptation measures have been identified in different policy frameworks. Mitigation comprises of initiatives geared towards emission reduction and/or enhances the sinks of greenhouse gases such as carbon dioxide, methane, nitrous oxides and chlorofluocarbons (IPCC, 2007). Adaptation measures refer to human adjustment to moderate harm on climate change which covers farming and non-farming strategic measures (IPCC, 2007; FAO, 2008). Nonetheless, there is a mutual relationship between mitigation and adaptation measures indicating that initiatives to mitigate climate change may positively contribute to adaptation (Smith and Olesen, 2010).

The first major initiative undertaken by the Government of Tanzania was the signing and ratification of UNFCCC in 1996. This formed the basis for the adoption/development of different climate change intervention frameworks such as the National Adaptation Plan of Action (NAPA) and its Action Plan in 2007 (URT, 2007). NAPA priotized eleven agricultural adaptation projects including; increase irrigation to boost maize production in all areas, alternative farming systems, use of weather data and promotion of indigenous knowledge (URT, 2007). In addition to NAPA, the Government of Tanzania adopted the National REDD+ Strategy and Clean Development Mechanism (CMD) (URT, 2010). The REDD+ process in the country began in 2008 when Tanzania and Norway signed a letter of intent and made the formal commitment of Norway to support REDD+ in the country (Kweka *et al*., 2015).

Despite the aforementioned policies, the Government of Tanzania developed the National Climate Change Strategy of 2012 and REDD+ Strategy and its Action Plan. The National Climate Change was developed to comprehensively address climate change consequences. The goal of the Strategy is to enable the country to join the global efforts of effectively addressing climate change for the sake of achieving sustainable development (URT, 2012). Generally, the Strategy is the major policy framework guiding the Government and other stakeholders, such as farming communities like peri-urban farmers of Temeke District, in addressing climate change issues. This study focused on this policy framework because to date the country does not have a specific policy for climate change. Meanwhile, climate change is prevalent with negative consequences among peri-urban farmers and other communities, hence; interventions must continue despite lacking the actual national climate change policy.

Apart from Government initiatives, farming communities in different places have been addressing climate change by devising or adopting different mitigation and adaptation measures (Kihupi *et al*., 2015; Lema and Majule, 2009; Hassan and Nhemachena, 2008; Nhemachena *et al*., 2014). Peri-urban farmers in Temeke District are also part and parcel of the global efforts to mitigate and adapt to climate change because they are prone to climate change (Mlozi *et al*., 2013; Mlozi *et al*., 2014). Despite the effects of climate change, farming appears to be one of the important livelihood strategies among peri-urban farmers of Temeke District. This is because farming contributes much in employment and overall city' food basket (Mlozi *et al*., 2014).

In addition, tremendous population growth rate recorded in Temeke District and the whole region (5.6%) which is above the national growth rate of 2.7% (URT, 2016) has a strong implication on increasing demand of perishable foods produced in peri-urban areas.

Therefore, mitigation and adaptation measures are essential in sustaining peri-urban farming so as to capture the existing and future market opportunities arising from the given demographic trend.

However, with all the mentioned efforts, policy implementation success and challenges on mitigation and adaptation measures particularly among peri-urban farming communities in Temeke District are less documented, hence, they are not well known. Therefore, it is rather not well understood whether mitigation and adaptation measures pursued by peri-urban farmers are reflected and well captured in the existing policies particularly the National Climate Change Strategy. Efforts to address peri-urban farming have been focusing on other issues rather than those related to climate change policy implementation challenges. These issues include economic importance, awareness and effects on climate change (Sumberg, 1997; Kassenga and Mbuligwe, 2012; Mlozi *et al*., 2013). Other issues are policy and legal frameworks influencing urban and peri-urban farming practices (Mlozi *et al*., 2014).

Studies outside Tanzania also report about policy implementation challenges among the farming communities. For example, a study done in Uganda by Ampaire *et al*. (2017) report that, with all the progress made towards achieving governance systems on the intervention of climate change, the implementation of policies still encounters the challenges. Another study done in Portugal reported that, despite having in place adaptation policies, their implementation is not fully realised (Carvalho *et al*., 2013). Mansanet-Bataller (2010) reported that while the emphasis on policy implementation is done at the national level, mitigation and adaptation measures are largely undertaken at the local levels. Nonetheless, despite facing challenges in policy implementation, a study done in Portugal emphasized that local communities have an important role in responding

appropriately to climate change (Carvalho *et al*., 2013). Therefore, the local communities with their knowledge and experience are crucial to spearhead the implementation of public policy including climate change policies. This emphasizes the need to address challenges associated with policy implementation among local communities including peri-urban farmers in Temeke District.

Therefore, this paper examines policy implementation success and challenges on peri-urban farming in Temeke District. This assessed on whether mitigation and adaptation measures of peri-urban farmers of Temeke District are compatible to those proposed in the National Climate Change Strategy as a national policy framework. The study intended to address the following questions: i) what is the extent of implementation of the Strategy's priotised mitigation and adaptation measures among peri-urban farmers in the study area? ii) How successful is the National Climate Change Strategy in addressing mitigation and adaptation measures among the farming communities? iii) What are challenges encountering the implementation the strategy's priotised mitigation and adaptation measures??

This paper contributes to empirical data on policy implementation success and challenges in terms of the extent of implementation of strategy's priotised measures and the reasons behind the level of implementation among peri-urban farmers. In addition, the study is important among the policy makers and implementers as it attempts to offer some challenges on the implementation of mitigation and adaptation measures priotised in the strategy as a national policy framework. Furthermore, the study contributes to the academic debate on challenges on policy implementation on mitigation and adaptation measures.

5. 2 METHODOLOGY

5.2.1 The study area

The study covered four peri-urban wards of Temeke District, Dar es Salaam Region. Temeke District is the Southern most of the Municipalities of Dar es Salaam Region, which lies between latitudes 6º 55’ to 6º 90’ South and longitudes 39º25’ to 39º33’ East (UNAIDS, 2010). The choice of Temeke district was based on two grounds: The district has the large land under cultivation (33 000ha) compared to Kinondoni (13 600ha) and Ilala (11 678ha). Also, agriculture in the district provides the region with more food compared to other districts of Kinondoni and Ilala (URT, 2012). This indicates that, the district has a notable contribution to the overall city’s food basket. According to 2012 Population and Housing Census, the total population in the district stood at 1 368 881 with 669 056 males and 699 825 females (URT, 2013). In view of the average annual intercensal population growth rate of 5.6% per annum (URT, 2013; URT, 2016), the projected total population for the year 2017 is 1 797 567. Climatic condition of the area is a modified type of equatorial climate, which is generally hot and humid throughout the year with an average annual temperature of 29ºC (URT, 2004).

Rainfall is devided into long rains “*masika*” and short rains “*vuli*”. While the long rains start from March to May and short rains start from mid-October to late December. However, the whole of coastal regions including Dar es Salaam Region have experienced rainfall deficiencies (START, 2011).

Natural vegetation found in the area includes coastal shrubs, miombo woodland, coastal swamps and mangrove trees (URT, 2004). The natural vegetation has been significantly destroyed by human activities including felling of trees for energy purposes (Mlozi *et al.*, 2013). Sources of income in the study area include farming, formal employment and petty

business which embraces sale of food crops, sales of forest products, sales of livestock and associated products and fishing. However, in recent years farming has been inadequate to ensure good food security due to heavy dependency on unreliable rainfall (URT, 2012).

5.2.2 Research design

This study used a cross sectional research design to examine the current challenges related to climate change policy implementation among peri-urban farmers of Temeke District. This research design was appropriate for this study as it was compatible to the time and available resource allocated for a study. The design allowed data to be collected and examined once. The choice of the design is supported by Babbie (1990) who argued that a cross sectional design allows data to be collected at a single point in time.

5.2.3 Sampling design and sample size

Four wards namely: Kisarawe II, Somangila, Pemba Mnazi and Kimbiji were selected for this study. The selection of these wards involved consultation of the District Agricultural Officer who listed the wards in which farming is more dominant as compared the other wards as indicated in the Regional profile (URT, 2014). A study population consisted of peri-urban farmers residing in peri-urban areas of Temeke District. A simple random sampling was employed to choose four streets in each ward. With the help of street leaders, a sampling frame was prepared for each street by listing the names of the farming households. From each sampling frame 15 heads of the households were randomly chosen to ensure equal representation across all selected streets. Finally, a total of 240 respondents were randomly chosen: 60 from each ward.

5.2.4 Data collection methods

Primary data were collected through semi structured household questionnaire surveys of which information on household's level mitigation and adaptation measures were elicited. This was complemented by one focus group discussion in each ward which consisted of 10 to 12 participants. The focus group discussions were performed through a discussion guide that was composed of checklist of strategic issues pertaining to mitigation and adaptation measures. FGDs consisted of farmers who were more experienced as recommended by the ward and/or street leaders. Also, documentary review was done using documents from various places including SUA National Agricultural Library, Tanganyika Library, District offices as well as online where different websites were visited. Documents involved in a review included climate change reports and scientific journal papers, strategies, action plans, economic profile and agricultural records and scientific papers.

5.2.5 Data analysis

Quantitative data from the household surveys mainly respondents' background and mitigation and adaptation measures were analysed through descriptive statistics where frequencies and percentage were produced. Mitigation and adaptation measures pursued by peri-urban farmers were subjected to Kendall's W Test, which produced ranking scores for each specific measure. The mean scores informed the level of priority of each measure implemented in the study area. Mean scores were also useful to enable comparison between measures applied in the study area with those identified in the strategy. On the other hand, qualitative data from focus group discussions was analysed through content analysis. FGDs participants' views and opinion were important to enrich quantitative data.

5. 3 RESULTS AND DISCUSSIONS

5.3.1 Socio-economic background of the farmers

Socio-economic background of the respondents as summarized in Table 5.1 provides key attributes of the farmers in relation to awareness and implementation of mitigation and adaptation measures mentioned in policy frameworks. The findings revealed that majority (69%) of the respondents had primary education. This indicates that peri-urban farming in Temeke District is dominated by people with lower level of education. This agrees with a study by Mlozi *et al*. (2014), which showed that about half of the farmers involved in their survey in Dar es Salaam Region had primary education with few who had secondary education. The possible explanation is that educated people are more likely to be employed in non-farm economic sectors and spend most of their time over there. This has a negative implication on the ability of the farmers to access and understand policies related to mitigation and adaptation measures. Access to and understanding of policy directives is easier among educated than low and uneducated people.

Table 5.1. Socio-economic background of peri-urban farmers

Attribute	Frequency	Percent
Education Level		
No formal education	31	12.9
Adult education	30	12.5
Primary	165	68.8
Secondary	13	5.4
College certificates	1	. 4
Total	**240**	**100**
Occupation		
Farmers	118	49.2
Farming with commercial activities	117	48.8
Formal employment with farming	5	2.4
Total	**240**	**100**
Attendance to the workshop/seminars		
Attended	4	1.7
Never attended	236	98.3
Total	**240**	**100**

In terms of occupation, the findings indicated that almost half (49.2%) of the respondents were solely dependent on farming as opposed to 48.8% who were doing farming

alongside commercial related activities and 2.4% who were on formal employment. This shows that majority of farmers derive their livelihood exclusively from farming. Mlozi *et al*. (2014) also revealed that apart from few vegetable growers who were teachers, and tailors and petty traders, most of the farmers in Dar es Salaam were not formally employed. Minimal number of formal employees engaged in farming has a strong negative implication on the ability to access strategic information pertaining to farming and addressing climate change. The reason behind is that, lack of formal employment undermines the possibility of farmers to engage in some formal social networks which are crucial for information sharing and overall farm undertakings.

In terms of participation in any climate change awareness seminars/workshops/meetings, about 98% had never attended while less than 2% attended. This again has a direct bearing on the degree of exposure to policies and strategic issues pertaining to farming and in mediating climate change. In particular, minimal participation in seminars or workshops or meetings denies farmers information on policies and programmes including those which address climate change. This is because awareness seminars, workshops and meetings are part of empowerment to address various issues related to farming including those related to climate change challenges. Awareness on relevant policy/strategies can add value on the adoption of mitigation and adaptation measures and consequently enhance sustainability of farming practices. Workshops, seminars and meetings can empower peri-urban farmers in such a way that when combined with local expertise, farmers can improve their capacity to address climate change.

5.3.2 Farmers' mitigation measures versus strategy's proposed measures

Peri-urban farmers in Temeke District have devised several mitigation measures to address climate change effects (Table 5.2). The ranking of mitigation measures was

performed by Kendall's W test. This test established priorities of mitigation measures by producing a mean score for each measure of which the highest score was 5. The findings revealed that the most important mitigation measure used by peri-urban farmers was cover cropping which had a mean score of 2.73. This was followed by the use of alternative energy sources with a mean 2.63 and agroforestry appeared to be the least important measure with a mean score of 2.04.

Table 5.2: Kendall's W ranking of the respondents' mitigation measures

Mitigation measures	Ranking Scores
Use of cover crops	2.73
Use of alternative energy sources	2.63
Mixed farming	2.61
Agroforestry	2.04

Despite the indigenous mitigation measures, the Strategy has priotised different measures. These include: promoting agroforestry systems, enhancing management of agricultural wastes, promoting efficient fertilizer utilization and promoting best agronomic practices (URT, 2012). As the findings revealed, mitigation measures mentioned in the Strategy are not similar to the ones practised by peri-urban farmers of Temeke District. Of all mitigation measures priotised by the Strategy, it is only agroforestry which appeared to be applied by peri-urban farmers in the District and it was not highly prioritised by farmers as compared to other measures. The possible reason is that, farmers are not well informed on those mitigation measures directed by the Strategy. For this reason, they depended on their own knowledge and expertise to pursue mitigation measures so as to sustain farming.

5.3.3 Farmers' adaptation measures versus strategy's proposed measures

The study assessed adaptation measures applied in the study area versus those priotised by the Strategy in order to establish comparability between locally developed measures with those priotised in the strategy. The order of importance of peri-urban farmers implemented

adaptation measures was performed by Kendall's W test which produced the ranking scores for each individual adaptation measure. The study results revealed that, the use of drought resistant crop varieties was the most important adaptation measure and had a mean score of 4.95 out of 5, followed by economic diversification (mean score =4.71) and irrigation farming (mean score=4.08). The least important adaptation measure practised by the respondents in the study area was intercropping which had a mean score of 3.41 (Table 5.3).

Table 5.3: Kendall's W ranking of adaptation measures pursued by the respondents in the study area

Adaptation measures	Ranking
Drought resistant crops	4.95
Economic diversification	4.71
Irrigation farming	4.08
Mixed farming	3.87
Sequential cropping	3.51
Use of cover crops	3.47
Intercropping	3.41

Apart from adaptation measures used in the study area, the strategy has priotised a number of adaptation measures. According to this strategy, adaptation measures related to agriculture include: promotion of nonuse of wood construction materials, promoting energy efficient technologies, enhancing decentralization of forest management and assessment of crop vulnerability and suitability (cropping pattern) for different agro ecological zones. Other measures are assessment of trade comparative advantage on traditional export crops with changing climate and promotion of appropriate irrigation system (URT, 2012).

Based on the findings, few of adaptation measures pursued by peri-urban farmers were also mentioned in the strategy such as irrigation. Although farmers practice irrigation

which is emphasized in the strategy is not the best way to make their initiatives more promising. This is because, it was locally initiated and sustained without any sort of strategic and technical assistance to improve it. In view of these results, it might be difficult for farmers to address appropriately climate change impacts. This means that, traditional knowledge is not enough in adapting to climate change and sustaining farming activities especially in this era of science and technology. Sustainable PUF depends on a combination of traditional and scientific knowledge to address climate change.

5.3.3. The success of the National Climate Change Strategy

Tanzania has been part of the global efforts to address climate change. To achieve this, the Government has adopted a number of policy frameworks to address climate change specific issues. These frameworks include the National Adaptation Plan of Action, for adaptation measures, the Strategy for Reducing Emissions from Deforestation and forest Degradation (REDD+) and Clean Development Mechanism. Despite these, the Government has particularly adopted the National Climate Change Strategy as a national policy framework for climate change interventions. This framework recognizes climate change as one among the great socio-economic challenges in the country.

In order to address successfully this challenge, the strategy acknowledges the role each sector such as agriculture, health and water sector, in addressing climate change. In the course of mainstreaming the implementation of mitigation and adaptation measures among the farming communities, the strategy has set a number of objectives for this matter. These include: capacity building among Tanzanians to adapt to climate change impacts, and enhancing participation in mitigating climate change. Another objective focuses on resource mobilization to address climate change. Apart from the objectives, the strategy has developed a list of agricultural mitigation and adaptation measures related to

agriculture (URT, 2012). These have been set to guide local communities' efforts to address successfully climate change in their locations. This is a success story because; it is an important stage towards the actual implementation of activities leading to mitigation and adaptation measures.

5.3.4 Challenges on the implementation of sstrategy's priotised mitigation and adaptation measures among peri-urban farmers

The implementation of the Strategy's mitigation and adaptation measures encounters the challenges. As revealed from the findings, the major challenge is low implementation of agricultural adaptation and mitigation measures in the study area as priotised by the strategy. This is critical because local communities such as peri-urban farmers in Temeke District are also stakeholders in policy implementation like other farmers in rural areas. Scholars (Mansanet-Bataller, 2010; Carvalho *et al*., 2013) uphold that mitigation and adaptation measures are largely pursued at the local levels. Minimal implementation of the priotised measures is not merely because of the location factors, but, lack of strategic assistance, especially shortages of extension services. This makes peri-urban farmers unable either to update their traditional skills or adopt new skills as emphasized in the strategy, and hence make them to rely on their own knowledge to address climate change. This was emphasized during FGDs that there was inadequate extension services to help farmers improve capacity to address climate change.

The findings also revealed that, mitigation and adaptation measures compatible to those earmarked in the strategy were locally initiated and enhanced. This is perhaps linked to lack of seminars/workshops/meetings geared towards improving farmers' capacity to improve their skills or to adopt the improved techniques. The other possible reason is linked to what was raised earlier in this thesis that; radio was the main source of

information on climate change among peri-urban farmers. This means that, little efforts have been dedicated to assist peri-urban farmers to apply mitigation measures priotised by the strategy. Farmers' expertise is not enough to address climate change effects. A combination of local skills and strategic or scientific expertise is more paramount to address climate change consequences.

In case of mitigation measures, agroforestry was indicated in the Strategy as it was practiced by peri-urban farmers in the study area. Nonetheless, while the Strategy emphasizes on promoting agroforestry system (URT, 2012), what was evident on the ground is that agroforestry is locally implemented because there is no strategic support to promote it as stipulated in the strategy. Moreover, challenges such as felling of trees in search for fuel wood and charcoal have been more alarming in the study area (Mlozi *et al*., 2013) alongside frequent land use changes. These challenges undermine farmers' efforts to implement and sustain agroforesty.

With regard to adaptation measures, irrigation was the only measure indicated in the strategy that was applied by peri-urban farmers. However, it is locally practiced through the shallow water wells without any strategic assistance to promote and modernize it. This was revealed during a focus group discussion (FGD) that irrigation has been part and parcel of farming practices in the study area. For example, during FGD one participant had this to say;

> *"We have been doing irrigation through using locally drilled wells during the dry season for seasonal crops mainly vegetables such as ladies' finger, pumpkin leaves, sweat potatoes leaves, water melon, etc."*

However, FGDs participants added that, decreasing rainy cycles in both seasons have decreased the amount of and duration of water stored in the shallow wells, hence; plagues irrigation farming pursued by peri-urban farmers in Temeke District. It was further revealed that, despite the challenges associated with irrigation, there was no technical strategic assistance in terms of extension services or any other assistance directed to the farmers to promote and improve irrigation. This is contrary to the objective of the Strategy which stresses on the promotion of appropriate irrigation system (URT, 2012). It is also critical among peri-urban farmers in the study area since irrigation is highly influenced by the duration and intensity of rainy cycles. Change rain cycles has negative implication since it decreases the duration of irrigation farming, and therefore, affects the entire production cycle. As a result of shortage of extension services, respondents urged for capacity building programmes so as to equip them with the necessary skills for implementing different mitigation and adaptation measures.

Similar to this finding is a study by Kiduanga and Shomari (2016). These scholars found few urban farmers in Dar es Salaam Region were water pumps and other improved agricultural equipments. They observed that "*Kilimo Kwanza*" (government strategy to promote agriculture), had received little strategic support to add value on their own initiatives to address climate change, thus poor policy implementation by farmers.

Also, lack of policy support is implied in other literature (URT, 2007; URT, 2012). These literatures indicate that climate change intervention policies in Tanzania started between 1990s and 2000s, farming activities were being done and irrigation was one of them. Further, Mlozi *et al*. (2013) argue that lack of strategic assistance undermines sustainability of peri-urban farming because apart from climate change stressors, peri-urban farming also faces land use challenges. It is maintained that land use changes favour

settlement expansion at the expense of farming (Mlozi *et al*., 2014). Despite the recognition of PUF in policies such as Human Settlement Policy of 2000 and Livestock Policy of 2006 (URT, 2000; URT, 2006), its implementation is confusing. What is observed in practice is lack of PUF recognition as land use changes seem to discourage farming. This is exhibited by land insecurity which despite affecting peri-urban farming in the study area, it shifts farming activities to other places in the City (Kiduanga and Shomari, 2016). This factor can cause challenges in the implementation of Climate Change Strategy in the settings of peri-urban in favour of rural areas.

Results from this study are in agreement with other studies done. For example, Kihupi *et al*. (2015) in a study done in semi-arid areas in Iringa District reveal that farmers tend to be reluctant to implement adaptation measures introduced by the Government. Elsewhere, it was shown that policy implementation challenges among the farmers is linked to the challenges of low involvement of farmers in policy formulation (Ejembi and Alpha, 2012; Carvalho *et al*., 2013; Ampaire *et al.*, 2017).

Study results from the present and other studies indicate that policy implementation is a challenge in different places despite a number of interventional frameworks. These challenges can constrain farmers' initiatives to address climate change consequences because of lacking political directives and assistance as emphasized by the strategy. However, this does not necessarily ignore local conditions and convenience matters for adapting to climate change. Study results reinforce the fact that the question of having a strategy as a guiding tool is one thing and implementation is another thing. Low implementation of the strategy's priotised measures among peri-urban farmers undermines capacity of the farmers to address adequately climate change. Despite local conditions in

addressing climate change, a combination of local and scientific or strategic expertise is essential in addressing climate change.

5. 4 CONCLUSIONS AND RECOMMENDATIONS

The study has revealed that the adaptation measures implemented by peri-urban farmers are not similar to the measures proposed by the Strategy as a national framework. This suggests that the implementation of the Strategy in terms of agriculture mitigation and adaptation measures among peri-urban farmers is a challenge. There were few measures, locally initiated and enhanced, implemented by peri-urban farmers that were also indicated in the strategy. This leads to the conclusion that, strategic assistance on priorities earmarked by the guiding framework is a major problem confronting the farming communities to sustain their farming practices. Overall, results suggest a mismatch between policy formulation and implementation among the real actors including peri-urban farmers of Temeke District which negatively affect farmers' efforts to address climate change.

This study recommends the government to ensure farming communities benefit from strategic assistance as priotised in the policy framework including Climate Change Strategy. This is crucial to ensure that farmers address climate change and consequently sustain their farming practices.

The study further recommends for more studies on policy and strategy's implementation challenges in other agricultural settings so as to reveal whether the existing policy framework is adequately implemented and whether value addition related to interventions is realized among the farming communities.

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CHAPTER SIX

6.0 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 Summary of Major Results and Conclusions

6.1.1 Awareness of peri-urban farmers on the concept of climate change

Awareness and effects of climate change on peri-urban farming is discussed in chapter two to address the first objective of this study. The chapter examined awareness of peri-urban farmers on the concept, indicators, causes and effects of climate change. Assessment on awareness was organised into high, medium and low levels. The study showed that the level of awareness on the concept was generally higher (97%) for both male and female headed households across different education categories.

Also, farmers' awareness in the study area is exhibited on the way peri-urban farmers described important parameters linked to climate change including indicators, causes and effects. Farmers mentioned the observable indicators with the most important being increasing in the incidences of droughts. These, according to peri-urban farmers, appear to be more evident recently than approximately a decade ago. On the other hand, peri-urban farmers are aware that rainfall in both seasons: long rains (*masika*) and short rains (*vuli*) have decreased below the normally experienced cycles. This is complemented by secondary meteorological data which also indicated a decrease in the amount of rainfall over the past five decades. Apart from that, incidences associated with rainfall unpredictability were revealed by peri-urban farmers. It appears that, rainfall unpredictability is more commonly characterised by the late in the onset of rainfall with an early cessation in some years and decrease is particularly more pronounced during the short rains. Nonetheless, the overall trend as revealed by the farmers is the general

decrease in the amount of rainfall and the normal cycles. Other indicators worth noting included recurrent floods in some years.

Peri-urban farmers linked climate change with their common livelihood practices such as unregulated cutting of trees for fuel wood and charcoal (74.6%), industrial activity (16.6%) and expansion of settlements (0.4%). The major driver of climate change as reported by the farmers is directly related to their normal life of which trees clearance for charcoal and fuel wood appears to be the common activities in their life. Thus, based on this finding, peri-urban farmers associate climate change with general conducts of their livelihood. Despite the fact that they were not able to mention directly the scientific causes of increasing in the atmospheric emission of greenhouse gases. What farmers described were the causes that contribute to the emissions of greenhouse gases which directly cause climate change.

It was also revealed from the findings that climate change consequences are evident among peri-urban farmers of Temeke District. The evident effects include decreasing in crop yields, loss of vegetation cover, shortening in the growing seasons and land use changes. The effects worth noted are directly associated with decreasing in the amount of rainfall which culminated into an increase in the incidences of droughts. These effects have a strong implication on an increase in farming expenses among the farming households leaving aside an implication on undermining Governments' efforts to attain sustainable development.

Based these evidence, it is apparent that the level of awareness of climate change among farmers in the study areas is generally high. Nonetheless, awareness enhancement remains a core concern in the bid to build a more adaptive farming community.

6.1.2 Mitigation and adaptation measures of peri-urban farmers as a response to climate change

Mitigation and adaptation measures used by peri-urban farmers of Temeke District are discussed in chapter three to address the second specific objective. The chapter addressed the following questions: i) which mitigation measures are pursued by peri-urban farmers of Temeke District? ii) which adaptation measures are pursued by peri-urban farmers of Temeke District? iii) what is the level of mitigation and adaptation measures?

Disaster Crunch Model was applied to examine mitigation and adaptation measures implemented by peri-urban farmers to address climate change stressors. According to the model, the observed indicators and effects of climate change on farming systems undertaken by peri-urban farmers affect their farming practices and consequently the entire farm productivity. This situation triggers mitigation and adaptation measures to sustain farming in the changing climate.

With regards to mitigation measures, peri-urban farmers in Temeke District use combination of mitigation measures against climate change. Based on the findings, 81.6% of the respondents indicated that they use cover crops as a mitigation measure, 72.1% use alternative energy sources and 82.4% applied a mixed farming technique. Moreover, 60.9% practised agroforestry although it is affected by land use changes taking place in the setting of peri-urban which are in favour of settlement expansion. Peri-urban farmers implement a number of adaptation measures against climate change. The most popular adaptation measures were the use of drought resistant crop varieties (94.5%), followed by economic diversification (90.8%), irrigation farming (85%) and mixed farming (79.5%). Other adaptation measures identified in the study area include intercropping (74.5%), sequential cropping (73.7%) and the use of cover crops (72%). It appears that, some of mitigation measures were also reported as adaptation measures. These include mixed

farming and cover crops. These observations indicate existence of a synergy between mitigation and adaptation measures. This reinforces that, improving farmers' adaptive capacity has a positive implication in mitigating climate change.

The chapter demonstrates that peri-urban farmers firmly addressed climate change stressors. This is exhibited by the findings which revealed that the level of mitigating climate change is high due to the fact that 60.8% of the respondents had the highest level of mitigation measures, 32.5% had the medium level with 6.7% who had the lowest level. Results from a Kruskal Wallis Test revealed statistically significantly differences in the level of mitigating climate change across three age groups involved in farming (20 – 34, 35 – 39 and 60+) at $p< 0.05$. Based on the mean ranks for each group, the oldest group (60 years and above) exhibited the highest level of mitigation than the other age groups. The level of adaptation was also high because 72.5% had the highest level of adaptation, 27% had medium level while 0.41% had the lowest level. This implies that most of the farmers were using a multiple of adaptation measures to address climate change. The findings from Kruskal Wallis Test showed that there were no statistically significantly differences in adapting to climate change across three age groups (20 – 34 years, 35 – 59 and 60+) at $p> 0.05$. This suggests that, similar initiatives were undertaken by the respondents across different age groups to implement adaptation measures. The possible argument is that, adaptation measures are key interventions to sustain peri-urban farming in the face of climate change.

The chapter concludes that in the bid to sustain peri-urban farming, mitigation and adaptation measures are not optional interventions. Similarity between some mitigation and adaptation measures indicates complementarities between climate change

interventions. Thus, enhancing farmers' adaptive capacity has a potential and long-term implication on mitigating climate change.

6.1.3 Comparison of gendered determinants of mitigation and adaptation measures among peri-urban farmers of Temeke District, Dar es Salaam Region

Gendered determinants of mitigation and adaptation measures are discussed in chapter four to address the third specific objective. Specifically, the chapter addressed the following questions: i) what are the differences in mitigation and adaptation measures pursued by male and female headed households? ii) what are the differences in the determinants of mitigation and adaptation measures undertaken by male and female headed households? To address the aforementioned research questions, the study applied Mann Whitney U Test to establish whether there are statistically significant differences in gendered determinants of adaptation measures between men and women. Alongside this test, content analysis analysed opinion of participants on issues linked to determinants of mitigation and adaptation measures. This analysis was of particular relevance to enrich quantitative data.

The study findings showed that there were no statistically significant difference in mitigation measures pursued by men and women in the study area. The most possible reason is that mitigation measures are prerequisite interventions against climate change because farming forms an important livelihood strategy in the study areas. The results showed that mixed farming was not statistically significant different between men and women at p= 0.886, agroforestry was not statistically significantly different at p= 0.525, cover crops p= 0. 745 and alternative energy sources was not statistically significantly different at p=0.390. Similarly, in terms of adaptation measures the findings revealed that

there were no statistically significantly differences in adaptation measures. This is exhibited by the following results which revealed that: the use of drought resistant crops was not significantly different between men and women at p=0.276, economic diversification (p = 0.949), irrigation farming (p= 0.077), mixed farming (p=0.835), intercropping (p= 0.220) and cover crops (p = 0.338), sequential cropping (p= 0.306). These results indicate that both men and women take firm decisions to mitigate and adapt to climate change. The possible argument behind the findings is that adaptation measures are more paramount interventions since farming is part and parcel of life of peri-urban farmers in the study areas. Devising adaptation measures therefore, indicates farmers' initiatives to sustain farming activities regardless of gender.

Furthermore, there were no statistical significant differences in the determinants of mitigation measures where household's income was not significant at p = 0.051. Likewise, geographical location was not statistically significantly different between men and women at p = 0.341 while, tradition and customs were not statistically significantly differently at p=0.719. In case of adaptation measures, geographical location was statistically significantly different between men and women at p=0.031 while tradition and customs were statistically significantly different at p=0.043. Contrary to these findings, households' income and literacy level were not statistically significantly different across gender. Based on the findings, the chapter concludes that there are differences in the determinants of mitigation and adaptation measures across gender. These differences reinforce more initiatives to uphold gender concerns in addressing climate change among the local communities including peri-urban farmers.

6.1.4 Policy implementation success and challenges on climate change mitigation and adaptation measures pursued by peri-urban farmers of Temeke District, Dar es Salaam Region

Policy implementation challenges on climate change mitigation and adaptation measures are discussed in chapter five to address the fourth specific objective of the study. The study intended to address three research questions i) what is the extent of implementation of the Strategy's priotised mitigation and adaptation measures among peri-urban farmers in the study area? ii) How successful is the National Climate Change Strategy in addressing mitigation and adaptation measures of the farming communities including peri-urban farmers? iii) What are the challenges behind the implementation of the Strategy's priotised mitigation and adaptation measures? To address the aforementioned research questions, the study compared mitigation and adaptation measures indicated in the National Climate Change Strategy for Tanzania versus peri-urban farmers' locally developed measures. Peri-urban farmers in Temeke District have devised several mitigation measures.

The study findings from Kendall's W test revealed that, cover cropping was the most important mitigation measure used by peri-urban farmers in the study area. This had a mean score of 2.73, followed by use of alternative energy sources 2.63 while agroforestry appeared to be the least important measure with a mean score of 2.04. The Strategy on the other hand, has priotised different agricultural mitigation measures which include: promoting agroforestry systems, enhancing management of agricultural wastes, promoting efficient fertilizer utilization and promoting best agronomic practices.

However, most of mitigation measures priotised in the Strategy were not compatible to those applied by peri-urban farmers in Temeke District. It was only one mitigation

measures priotised by the Strategy which also appeared to be implemented by peri-urban farmers of Temeke District. According to the findings, this measure was locally developed without strategic initiatives to improve so as to make it sustainable. Contrary to that, the same measure was negatively affected by the incidences of cutting of trees for charcoal and fuel wood which were more alarming alongside frequent land use changes. Therefore, the extent of implementation of the Strategy's priotised mitigation measures among peri-urban farmers was low.

Results from Kendall's W Test revealed that drought resistant crops was the most important adaptation measure with a mean score of 4.95 followed by economic diversification (mean score =4.71). Other adaptation measures included irrigation (mean score=4.08), mixed farming (mean score=3.87), sequential cropping (mean score=3.51) and intercropping (mean score=3.41). On the other hand, agricultural adaptation measures priotised in the National Climate Change Strategy include: promotion of nonuse of wood construction materials, promoting energy efficient technologies, enhancing decentralization of forest management and assessment of crop vulnerability and suitability (cropping pattern) for different agro ecological zones. Other measures are assessment of trade comparative advantage on traditional export crops with changing climate and promotion of appropriate irrigation system. It was identified that out of the adaptation measures priotised by the strategy, irrigation farming and assessment of crop vulnerability and suitability (cropping pattern) for different agro ecological zones appeared to be implemented by peri-urban farmers in Temeke District.

However, it was concluded that the extent of strategy implementation was low because even irrigation was initiated by the farmers and was implemented locally through the seasonal locally drilled wells. These results indicate a mismatch between development of

policy framework and implementation among the real actors on mitigation and adaptation measures including peri-urban farmers of Temeke District. The other challenge is lack of strategic assistance to help farmers in their efforts to address climate change. This undermines peri-urban farmers' ability to well address climate change and subsequently reduce the challenges and sustain peri-urban farming as a key life strategy among these farming communities.

6.2 Recommendations

6.2.1 Upholding local communities' mitigation and adaptation initiatives

i) The existing mitigation and adaptation measures, if well practiced are crucial among the farmers to sustain farming practices which is backbone to most households in the country. In this view, it is recommended that farmers should enhance the application of existing mitigation and adaptation measures. This can be achieved by creating enabling environment through district authorities. These environments include strengthening of agricultural extension services at ward and street levels in order to reach more farmers.

ii) The study has demonstrated that the local communities such as peri-urban farmers of Temeke District have skills which are crucial for climate change interventions. Thus, it is recommended that, the district councils should include the local communities when developing climate change interventions and policy frameworks. This will increase effectiveness of strategic interventions because by including the local communities will offer ground level expertise. This expertise in combination with scientific knowledge will add value on the locally developed measures and increase efficiency of their locally developed initiatives to address climate change.

6.2.2 Addressing policy implementation challenges

The thesis has demonstrated policy implementation challenges along with differences in the determinants of adaptation measures across gender in the study area. Thus, it is pertinent for the Government to revise policies and programmes such that they address practically local communities initiatives along with gender issues in mitigation and adaptation measures. This will make policies and programmes on mitigation and adaptation to climate change fairer and more practical.

It is imperative for the Government to upscale efforts to assist the local communities including the farming communities to address well climate change. This can be done by creating enabling environment among the farmers to improve and enhance their practices leading to mitigation and adaptation on climate change. This may include for example, creating environment that will enable farmers to shift from traditional irrigation to modern irrigation farming. This technological shift will increase efficiency and sustainable farm productivity, leading to the improvement in the well being.

6.3 Areas for Further Research

The study recommends the following areas for further research:

i) This thesis has exhibited that peri-urban farmers use several mitigation and adaptation measures as a response to climate change. Due to this observation, it is imperative to do more studies on mitigation and adaptation measures in the other settings. Studies across different settings will provide useful data for intervention purposes. This will enable the Government and other stakeholders to come up with more appropriate interventions which improve local communities' mitigation and adaptation practices, leading to sustainable farming.

ii) The study has revealed that there were gendered differences in the determinants of adaptation measures in the setting of peri-urban. Thus, there is a need for further studies on determining factors for mitigation and adaptation measures to identify barriers confronting local communities to address climate change in the other locations. A study of this nature is crucial as it will come up with the possible recommendations on how to help the local communities to improve their capacity to intervene climate change.

iii) This thesis has demonstrated some challenges in the implementation of mitigation and adaptation measures mentioned in the National Climate Change Strategy. Therefore, more studies should be carried out to address the challenges on policy implementation in other agricultural settings so as to establish possible areas for policy implementation intervention.

iv) The present study was more focused on perception of peri-urban farmers on mitigation and adaptation measures against climate change in peri-urban areas. Further research should quantify agricultural production changes due to mitigation and adaptation measures.

6.4 Contribution of the Study

6.4.1 Contribution to the body of knowledge

The study makes a significant contribution on academic debate on climate change interventions on PUF. Particularly, the thesis contributes to the knowledge on climate change in different aspects, including awareness on concept, indicators, causes and effects. These are key stages towards climate change mitigation and adaptation measures, meaning that, intervention depends on understanding of these attributes. Also, the study contributes to understand the real farm and non-farm practices implemented by peri-urban farmers to mediate climate change effects. Initiatives of peri-urban farmers to address climate

change have received little attention by researchers and academic community. Therefore, peri-urban farmers' practice to mediate climate change is not sufficiently known, despite PUF being an important source of livelihood in and outside Tanzania. Based on increasing needs of farm products from periphery, it is obvious that PUF will continue being practiced as a survival strategy in the face of climate change.

Moreover, the study contributes to understand gender concerns in mitigation and adaptation to climate change in the peri-urban setting. Farming is a gender issue; the same applies to climate change effects which are also gendered. This obviously implies that, mitigation and adaptation to sustain farming pursue gender dimension since these dimensions are not static across contexts. Finally, the study contributes to the understanding of policy implementation success and challenges. Climate change mitigation and adaptation measures are policy issues, and have raised concern right away from the global level, national level and at local levels where real implementation takes place. For this case, the study provides empirical information on the extent of implementation of the national policy framework for climate change and areas yet to be implemented. Thus, it identifies areas which need further emphasis so as to assist farmers in their efforts to address climate change episodes. Generally, empirical information from this study contributes to the ongoing debate on the phenomenon of climate change and also provides data essential for intervention practices.

6.4.2 Theoretical reflection

In this study, Disaster Crunch Model was applied to describe how communities respond to a disaster through socio-economic activities contributing to their livelihood. Theoretically, the study has contributed to the explanation of a Disaster Crunch Model. The model offers a systematic approach for understanding occurrence of a disaster and individuals'

responses on it. Such responses are geared towards reducing the likely impacts and sustaining the livelihood under climate change situation. The present study links climate change effects and peri-urban farmers' intervention to the situation. This study regards climate change as a disaster because it has affected farming practices taking place in the peri-urban areas. In response to this disaster (climate change), peri-urban farmers implement mitigation and adaptation measures for sake of reducing the impacts and also sustaining their practices. From this study, the model is described based on the impacts of climate change on PUF and consequently peri-urban farmers' responses to sustain farming through addressing climate change.

6.2.4 Practical contribution

Practically, the study contributes to address climate change which forms the main agenda of United Nations Framework Conversion on Climate Change (UNFCCC) and one among the objectives of Sustainable Development Goals (SDGs). UNFCCC was adopted to facilitate adaptation measures while the thirteen's objective of SDGs stresses on taking firm actions to combat climate change. Likewise, at the national level, the study contributes to address the National Adaptation Plan of Action (NAPA), strategy for Reducing Emissions from Deforestation and forest Degradation (REDD+) and the National Climate Change Strategy. NAPA and REDD+ Strategy address mitigation and adaptation initiatives. Other national programmes addressed in this thesis include National Strategy for the Growth and Reduction of Poverty and Tanzania National Development Vision 2025. These programmes address issues such as eradication of extreme poverty and hunger which are linked to climate change. This means, addressing mitigation and adaptation measures contributes to address issues to hunger and poverty eradication so far addressed in these national programmes. Therefore, examining peri-urban farmers'

mitigation and adaptation measures implies acknowledging farmers' contribution to address global and national strategies intended for the same.

APPENDICES

Appendix 1: Copy of a Questionnaire used for the Household Surveys

Household Questionnaire

Title: Peri Urban Farmers' Mitigation and Adaptation Measures Against Climate Change in Tanzania: *A case of Temeke District, Dar es Salaam Region*

Questionnaire Identification

Date of interview……Questionnaire number……..

Name of interviewer……Name of respondent (optional)……

Ward……..Street/Village ……..

A. Households' Demographic and Socio Economic Characteristics

Please provide response (s) for each question. For questions with multiple answers put cycle the response number of your choice (s) from the list of choices given and for other questions fill your response in the space provided.

1. What is your age? (in complete years) ……

2. Sex l. Male 2. Female

3. What is your marital status?

1. Married
2. Single
3. Divorced
4. Separated
5. Widowed/Widower
6. Other (mention)……..

4. What is the size of your household?... ……

5. What is the number of dependants below 15 years old? ……

6. What is your highest level of education?

1. Adult Education

2. No formal education
3. Primary education
4. Secondary education
5. Certificate
6. Diploma
7. Degree
8. Others (specify) ……

7. What is your occupation?

1. Official
3. Retired
4. Farmer
5. Self employed
6. Business
7. Others (specify) ……

8.How many meals do you eat per day? 1. One meal; 2. Two meals; 3. Three meals; 4. Other (mention)...

9. How much (in Tshs) do you earn per year?.....

10. What type and number of asserts do you own?

Assets	**Quantity**	**Unit value (Tshs)**	**Total value (Tshs)**
Farm			
Radio			
Television set			
Solar panel			
Tractor			
Motorbike			
Bicycle			
Hand hoes			
Machetes			
Sickles			
Others (specify)			

B: Peri urban farmers' awareness on climate change

11. Have you ever heard the word climate change? 1. Yes; 2. No

12. What is the important indicator of climate change?

1. Changes in the onset of rain seasons
2. Decline in rainfall
3. Rise in temperature
4. Increase in rainfall
5. Other (mention)……..

13. What are the evident indicators of climate change in this area?

……

……

……

14. What is the most important cause of climate change?

1. Deforestation
2. Emission from the industries
3. Agricultural malpractices
4. Other (mention)……

15. What are the effects of climate change?

1. Recurrent droughts
2. Food shortages
3. Diseases
4. Other (mention)……

16. What is the source of information which is making you aware of climate change?

1. Radio; 2. Newspapers; 3. Television; 4. Workshops/seminars 5. Other (specify)

17. How often do you get news on climate change per month from?

Radio	
Newspapers	
Television	
Workshop/seminars	
Other sources (mention)	

Key: 0= Never; 1= Once a month; 2 = once a week; 3 = every day; 4 = I don't know

C. The Effects of climate change on peri urban farming

18. In the following table, please give an assessment of the possible effects of climate change on peri urban farming. Put "X" on appropriate answer.

Effects of climate change	**Strongly disagree 1**	**Disagree 2**	**Undecided 3**	**Agree 4**	**Strongly agree 5**
Climate change decreases precipitation					
Climate change increases droughts					
Climate change increases precipitation					
Climate change reduces crop harvests					
Climate change increases flooding					
Climate change causes land use changes					
Climate change prolong the growing seasons					
Climate change shorten the growing seasons					
Climate change leads to encroachment into the marginal lands					
Climate change causes decline in pastures for livestock					
Others (mention)					

D. Mitigation measures

19**.** The following table indicates the possible mitigation measures applied by peri urban farmers against climate change effects. Put "X" on appropriate answer.

Mitigation measures	Strongly disagree 1	Disagree 2	Undecided 3	Agree 4	Strongly agree 5
Mixed cropping reduces climate change effects					
Mixed farming reduces climate change effects					
Agro forestry reduces climate change effects					
Use of cover crops reduces climate change effects					
Use of alternative energy sources reduces climate change effects					
Other (mention)					

E. Adaptation measures

20. The following table indicates the possible adaptation measures applied by peri urban farmers against climate change effects. Put "X" on appropriate answer.

Adaptation measures per household	Strongly disagree1	Disagree 2	Undecided 3	Agree 4	Strongly agree 5
The use of drought resistant crops is a good adaptation to unreliable rainfall					
Shifts in farming dates ensures good harvest					
Irrigation farming helps to overcome rainfall shortages					
Encroachment into wetlands					
Use of cover crops is commonly used as adaptation measure against climate change effects					
Mixed farming reduces severity of rainfall shortages					
Change from farming into other economic activities such as business activities is a commonly applied as adaptation measure					
Sequential cropping ensures enough yields					
Intercropping is a reliable adaptation measure					
Other (mention)					

21. Please rate the following mitigation measures

Systems	1. Very Effective	2. Effective	3. Not effective	4. Not sure
Mixed cropping				
Agro forestry				
Use of cover crops				
Mixed farming				
Alternative energy sources				
Other (mention)				

22. Please rate the following adaptation measures

Techniques/practices	1. Very effective	2.Effective	3.Not effective	4.Not sure
Mulching				
Cover crops				
Sequential/double cropping				
Mixed farming				
Changes in farming dates				
Use of drought resistant				
Irrigation farming				
Irrigation farming				
Change from farming into other economic activities such as business activities is a commonly applied as adaptation measure				
Other (mention)				

F. Factors affecting mitigation measures

23. The following table indicates the factors affecting mitigation measures. Put "X" on appropriate answer

Factors affecting mitigation measures	Strongly disagree 1	Disagree 2	Undecided 3	Agree 4	Strongly agree 5
Household's income determine mitigation measures per household					
Costs of farming determines the farming option against climate change effects					
Influence of political leaders affect mitigation measures					
Lack of capital affects mitigation measures					
Other (mention)					

24. How do factors mentioned in qn. 23 affect mitigation measures?

……

……

……

……..

G. Factors affecting adaptation measures

25. The following table indicates the factors affecting adaptation measures. Put "X" on appropriate answer

Factors affecting adaptation measures	Strongly disagree 1	Disagree 2	Undecided 3	Agree 4	Strongly agree 5
Capital determines adaptation measures					
Geographical location determines adaptation measures					
Farmer's literacy level determines adaptation measures					
Tradition influences the choice of adaptation measures					
Political interference determines adaptation measures					
Government policies determine adaptation measures					
Other (mention)					

26. How do factors mentioned in qn. 25 affect adaptation measures?

……

……

……

……..

Thank you for your co operation

Appendix 2: Interview Checklist for Key Informant's Interviews

1. Name of Ward…….
2. Name of Village……..
3. Name of street…….
4. Position of interviewee……
5. You might have heard of climate change; how does this apply in your context?
6. How does the climate change apply in peri urban farming?
7. Is there any connection between climate change and peri urban farming? If yes how does this relate?
8. How climate change is affecting peri urban farming?
9. How peri urban farmers mitigate climate change effects?
10. How peri urban farmers adapt to climate change?
11. Which factors affect peri urban farmers 'mitigation against climate change effects?
12. Which factors affect peri urban farmers' adaptation to climate change?

Appendix 3: Discussion Guide for Focus Group Discussions

1. Name of Ward…….
2. Name of Village/street……..
3. Definition of climate change by local people
4. Indicators of climate change
5. Evidence of climate change in the study area
6. Effects of climate change (positive and negative)
7. Mitigation to climate change in the study area.
8. Adaptation to climate change in the study area.
9. Factors affecting mitigation in the study area.
10. Factors affecting adaptation in the study area.