

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

Samwel P. Lunyelele¹ Kenneth M. K. Bengesi² Josiah Z. Katani³

1.The Mwalimu Nyerere Memorial Academy, P. O. Box 9193, Dar es Salaam, Tanzania

2.Development Studies Institute, Sokoine University of Agriculture, P.O. Box 3024, Chuo Kikuu, Morogoro, Tanzania

3.Department of Forest Mensuration and Management, Sokoine University of Agriculture, P.O. Box 3013, Chuo Kikuu, Morogoro

The research is financed by the Mwalimu Nyerere Memorial Academy, Dar es Salaam- Tanzania.

Abstract

This study assessed peri-urban farmers' awareness on the concept of climate change in Temeke District, Dar es Salaam Region. A total of 240 questionnaires were administered to the heads of households in four wards of the study area. Descriptive statistics mainly frequency distribution, percentages and average were used to analyse socio-economic characteristics of the respondents. Perceived indicators and the effects of climate change were measured through a five point Likert Scale. Off the interviewed respondents 97.9% were generally aware of climate change. Farmers' awareness is manifested through the 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 for the Government intervention based on farmers' specific needs. In the other vein, more researches on climate change awareness is recommended in order to enhance local community's adaptive capacity.

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

1.0 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; Kashagili *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 (Komiremko and Hoermann, 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. It 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 literatures: For example, it was reported that peri-urban farming was contributing an average of 17% of the total food requirements of Dar es Salaam (URT, 2010).

Peri-urban farming was also reported as the main producer of large quantities of perishable foods consumed in cities like Dar es Salaam (Sumberg, 1996; 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 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 of Dar es Salaam Region between two censuses period (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 2002 Census (URT, 2013). An increase of 1,877,253 people among others implies an increase in the demand for perishable foods (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 for 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 past five decades (START, 2011). This portrays a substantial impact in farming activities in the region including peri-urban farming which is undertaken in Temeke District.

Rigorous literature search has shown that in Tanzania most of studies on peri-urban farming 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 the 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 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 the efforts of addressing climate change so far made through the national and global programmes and strategies such as United Nation's Framework Convention on Climate Change and the Tanzanian Vision 2025. Second, 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 emphasise on enhancing public awareness and information management on climate change. Further, the findings from this study are useful among the policy, decision makers and development practitioners in their bid to device policies, programmes and strategies. Furthermore, the study enhances scientific understanding on climate change among different stakeholders including policy makers, academicians and researchers.

2.0 Study Area and Methodology

2.1 The Study Area

The study was conducted in Temeke District, Dar es Salaam which is located between latitudes 6.36 ° and 7.0 ° to the south of Equator and longitudes 39.0 ° and 33.33 ° to the east of Greenwich (URT, 2004) (Appendix 1). Administratively, the District has a total of 30 wards: 21 urban and 9 peri-urban with a total land area of 652 km² (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 29°C and humidity of around 96% in the mornings and 67% in the afternoons (URT, 2004).

The area receives the average rainfall of 1000mm 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 the entire region was reported to decline (START, 2011; Mdemu *et al.*, 2012). 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 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, this study found 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 yielded a total of 240 respondents.

Primary data were collected through household surveys, interviews 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, perceived 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 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 informants' interviews were done in each ward. Ward Executive Officers, Extension and Livestock Officers were interviewed as key informants.

Secondary data collection was based on the desk work by reviewing different literatures relevant for this study. The main sources were journal articles, Government reports and online resources. The information from such sources strengthened and justifies 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 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. 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 informants interviews were analyzed qualitatively through content analysis.

3.0 Results and Discussions

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.

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 (Table 1). In this study majority of the respondents were adults. This implies that they 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 the other studies (Ishaya and Abaje, 2008; Badi, 2011; 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 to commit more of their energy in farming practices. This study emphasizes the importance of age in assessing awareness on climate change issues.

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 the 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.

3.1.4 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 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.

3.1.5 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 are in good agreement with an earlier study done in Dar es Salaam by Stevenson *et al.* (1996). They reported farming as the reliable economic activity for the interviewed peri-urban farmers.

Respondents which 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 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

3.2 The Level of Awareness on Climate Change

This study tested for awareness in order to ascertain the extent to which farmers in the study area understand the concept of climate change. In addition, awareness is an important tool which may assist farmers to plan appropriately for their farming activities. The study has revealed that 97.9% of the respondents claimed to be aware of climate change with only 2.1% who were not aware. Further, the findings show that the highest level of awareness was 25.97 while the lowest level was 0.5. This implies that in the study area farmers are more aware of climate change regardless of education or age categories. The results are somehow in agreement with the 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.

3.3. 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. Results show that the most commonly known indicators of climate change was 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. Respondents reported that some years have been receiving above normal rainfall which last for a short period while many years have observed rainfall below normal.

The overall trend as perceived by the households was a general decline in the amount of rainfall over the period of time. Farmers reported of 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 climatological data which showed the decline in the amount of rainfall coupled with the rise in temperature in the whole of Dar es Salaam region over the past 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 the other study done in Dar es Salaam and the Coastal Region (Kashaigili *et al.*, 2014). They revealed the 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 was also revealed in the other studies done in the other parts of Tanzania (Kihupi *et al.*, 2007; Mary and Majule, 2009; Lyimo and Kangalawe, 2010; Mongi *et al.*, 2010; Kihupi *et al.*, 2015).

The findings also corroborate with the findings from the 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. Perceptions of the farmers on the aforementioned indicators imply that climate change has affected farming practices in the study area.

Table 2: Perception 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

3.4 Sources of Information of Climate Change

The source of information is an important tool in disseminating knowledge on climate change in the local area and other places. In the study area this depends on farmers' exposure and experience on the subject matter. The findings from this study reveal that about 86.5% of the respondents reported that they get 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 reveal 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 reveal 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, only 14.2% of the 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.

3.5 Perceived 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 3. The findings show that 74.6% of the respondents reported that unregulated cutting of trees for fuel wood and charcoal 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 natural processes in causing 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 the other studies (Nyanga *et al.*, 2011; Abaje *et al.*, 2013). In their assessment 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, 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 chlorofluorocarbons (IPCC, 1990). These have increased since pre-industrial era (IPCC, 2014). The concentration of GHGs destruccts 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 anthropogenic 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 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 3: Perception of the Respondents 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

3.6 Peri-urban Farmers' Perceived Effects of Climate Change

The perceived effects of climate change on peri-urban farming are presented in Table 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 4: Respondents' Perceived Effects of Climate Change

Effects of climate change	Mean Score	Rank
Climate change has dropped 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

4 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 the 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 device interventions on climate change based on the local communities' specific needs. For example, climate change issues should be addressed alongside vigorous tree planting programmes in order to enable the local communities obtain their daily energy needs. In the other vein, 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.

Acknowledgements

The authors gratefully acknowledge the Mwalimu Nyerere Memorial Academy and Higher Education Students' Loans Board for financing the study. Further, we are thankful to the Vice Chancellor of Sokoine University of Agriculture for introducing the Team to Temeke Municipality. We also extend our gratitude to Temeke Municipal Director for introducing the Team to the sampled wards. Finally, the team would like to thank the households of the four wards of Temeke District for dedicating their time during primary data collection exercise.

References

- Abaje, I. B., Sawa, B. A. and Ati, O. F. (2014). Climate variability and change, impacts and adaptation strategies in Dutsin-Ma Local Government Area of Katsina State, Nigeria. *Journal of Geography and Geology* 6 (2):103 – 110.
- Adger, W.N. and Vincent, K. (2005). *Uncertainty in Adaptive Capacity* (IPCC Special Issue on 'Describing Uncertainties in Climate Change to Support Analysis of Risk and Options') *Comptes Rendus Geoscience* 337: 4, 399-410.
- Adebayo, A.A., Onu, J.I., Adebayo, E. F. and Anyanwu, S. O. (2012). Farmers' awareness, vulnerability and adaptation to climate change in Adamawa State, Nigeria. *British Journal of Arts and Social Sciences* 9 (II): 104 – 114.
- Ajaero, C. K., Akukwe, T. I., & Asuoha, G. C. (2010). Climate change concepts and issues. In R. N. C. Anyadike,I. A. Madu & C. K. Ajaero (Eds.), *Climate Change and the Nigerian Environment*. Enugu: JamoePublishers ,Nigeria. 1-17pp.
- Babbie, E. (1990). *Survey Research Methods*, Second Edition. Wadsworth, Cengage Lerning, Belmont, USA. 395pp.
- Badi, S. H. (2010). Adaptation strategy to prevailing climate change: The use traditional methods by farming communities I Plateau State. Proceedings of the 24th Annual National Conference of Farm Management Association of Nigeria. 11th-14th October, 2010.
- Bello, M., Salau, E. S., Galadimal, O. E. and Ali, I. (2013). Knowledge, perception and adaptation strategies to climate change among farmers of Central State Nigeria. *Sustainable Agriculture Research* 2(3): 107-117.
- Binns, J. W. and Lynch, K. (1998). "Feeding Africa's growing cities into 21st Century: potential of urban agriculture." *The Journal of International Development* 10: 777 – 793.
- Doss C, Morris M (2001). How does gender affect the adoption of agricultural innovations? The case of improved maize technology in Ghana. *Agric. Econ.* 25: 27–39.
- Dubbeling, M. (2011). *Cities, Climate Change and Urban Agriculture: The potential contributions of urban and peri urban agriculture and forestry (UPA/F) to climate change adaptation and mitigation*. Proceedings of RUAF-CAH Conference, Almere 19-20 May, 2011.
- Enger,E.D. and Smith,B.F. (2008). *Environmental Science, A Study of Interrelationships* (11th edn).Mc Graw Hill,New York. 380-387 pp.
- Idrisa, Y. L., Ogunbameru, B. O., Ibrahim, A. A and Bawa, D. B. (2012). Analysis of awareness and adaptation to climate change among farmers in the Sahel Savannah Agro-ecological Zone of Borno State,Nigeria. *British Journal of Environment & Climate Change* 2(2): 216-226.
- Intergovernmental Panel for Climate Change (2007). *Climate change: synthesis report summary for policymakers*, Workgroup contribution to the fourth Assessment Report at IPCC Plenary, XXVII, November, 12-17 pp.
- Intergovernmental Panel for Climate Change (2007a). Summary for Policy Makers. In: *Climate Change 2007: the physical science basis*. Contribution of working group I to the fourth assessment report International Panel on Climate Change. (edited by Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K. B., Tignor, M. and Miller, H.L.). Cambridge University Press, Cambridge, UK and New York, USA. 1 – 18.
- Intergovernmental Panel for Climate Change (2014). Synthesis Report. Contribution of Working Groups I,II and III to the Fifth Assessment Report of the Intergovernmental Panel for Climate Change.(edited by Pachauri, R.K. and Meyer, L. A. Geneva, Switzerland. 151pp.

- Ishaya, S. and Abaje, I.B. (2008) Indigenous people's perception on climate change and adaptation strategies in Jemma LGA of Kaduna state. *Journal of Geography and Regional Planning* 1 (18) 138-143.
- Jacobi, P. (1997). *Importance of Vegetable Production Systems in Dar es Salaam, Tanzania*. Dar es Salaam: Urban Vegetable Promotion Project (unpublished).
- Kandlinkar, M. and Risbey, J. (2000). Agricultural impacts of climate change: if adaptation is the answer, what is the question? *Climatic Change* 45:529-539.
- Kashaigili , J.J., Levira, P., Liwenga, E. and Mdemu, M. V. (2014). Analysis of climate variability, perceptions and coping strategies of Tanzanian coastal forest dependent communities. *American Journal of Climate Change* 3: 212-222.
- Katz, R.W., Brown, B.G. (1992). Extreme events in changing climate: variability is more important than averages. *Climate Change*. 21: 289–302.
- Kevin, M. (2005). Charcoal and forest management could reduce greenhouse gas levels and save lives in Africa. Harvard School of Public Health, Public release, 31 March, 2005.
- Kihupi, N. I., Tarimo, A. K. P. R. and Dihenga, H. O. (2007). Spatial and temporal variations of growing season characteristics in Tanzania. *Journal of the Geographical Association of Tanzania* 32: 33-49.
- Kihupi, M., Chingonikaya, E.E., Mahonge, C. (2015). Smallholder farmers' perception of climate change versus meteorological data in Semi-arid Areas of Iringa District, Tanzania. *Journal of Environment and Earth Science* 5 (2): 137 – 147.
- Komirenko, Z. and Hoermann, D.M. (2008). *Urban and Peri-urban Agriculture in Kyiv (Ukraine)*: "Crisis Induced Strategy"versus Recreational Resource, A paper presented in 12th Congress of the European Association of Agricultural Economists.
- Lyimo, J.G. and Kangalawe, R.Y.M. (2010). Vulnerability and adaptive strategies to climate change and variability. A case of rural households in semi Arid-Tanzania. *Journal of Environmental Economics* 1(2): 89 – 97.
- Maharjan S.K; Sidgel E.R; Sthapit B.R. & Regmi B.R (2011) Tharu community's perception on climate change and their adaptive initiations to withstand its impacts in Western Terai of Nepal. *International NGO Journal* 6 (2):35-42.
- Manyatsi, A. M., Mhazo, N., & Masarirambi, M. T. (2010). Climate variability and change as perceived by rural communities in Swaziland. *Research Journal of Environmental and Earth Sciences*, 2(3): 164-169.
- Mascarenhas, O. (1995). Gender aspects of urbanisation and natural resource management in Tanzania. University of Dar es Salaam (report initiated by Mazingira Institute, Nairobi).
- Matari, E. R., Chang'a L. B., Chikojo G. E., Hyera T. (2008). Climate change scenario development for Second National Communication –Tanzania. *TMA Research Journal* 1: 40 – 54.
- Mc Gregor, D. (2002). Climate, Environment and Development. In: *The Companion to Development Studies*. (Edited by Desai V.and Potter, R.B.), Oxford University Press and 198 Madison Avenue, New York. 278-283 pp.
- Mdemu, M., Kashaigili, J.J.,Lupala, J., Levira, P., Liwenga, E., Nduganda, A. and Mwakapuja, F. (2012). Dynamics of land use and land cover changes in the Pugu and Kazimzumbwi Forest Reserves. Proceedings of the 1st Climate Change Impacts, Mitigation and Adaptation Programme Scientific Conference held at Blue Pearl Hotel, Dar es Salaam on 2nd and 3rd January, 2012.
- Mlozi, M. R. S, Lupala, A., Chenyambuga, S. W., Liwenga, E. and Msogoya, T. (2013). Knowledge assessment on the effects of climate change due to keeping livestock in urban and peri-urban areas of Dar es Salaam, Tanzania. *International NGO Journal*. 8(1): 1-12.
- Mongi, H., Majule, A. E. and Lyimo, J.G. (2010). Vulnerability and adaptation of rain fed agriculture to climate change and variability in semi-arid Tanzania. *African Journal of Environmental Science and Technology* 4(6): 371-381.
- Padgham, J. (2012). Urban/peri-urban agriculture and climate change: Overview of a 9-city assessment. A paper presented in the ICLEI Resilient Cities Conference 13 May 2012 Bonn, Germany, START
- Schneider, S.H., Semenov, S., Patwardhan, A., Burton, I, Magadza, C.H.D., Oppenheimer, M., Pittock, A.B., Rahman, A., Smith, J.B. and Yamin, F. (2007) Assessing key vulnerabilities and the risk from climate change. *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. (Edited by Parry, M.L. et al.), Cambridge University Press, Cambridge, UK. [<https://www.ipcc-wg2.gov/AR4/website/19.pdf>] site visited on 29/4/2015.
- Shemsanga, C., Omambia, A.N. and Gu, Y. (2010). The cost of climate change in Tanzania: Impacts and Adaptations. *Journal of American Science* 6(3): 182-196.
- Stevenson, C., Xavery, P. & Wendeline, A. (1996). Market production of fruits and vegetables in the peri-urban area of Dar es Salaam. Dar es Salaam: Urban Vegetable Promotion Project (unpublished).
- Sumberg J. (1997). Policy, milk and the Dar es Salaam peri-urban zone: a new future for an old development

- theme? *Land Use Policy* 14 (4): 277-293.
- System for Analysis, Research and Training (START) (2011). *Urban poverty and climate change in Dar es Salaam, Tanzania: A case study*. Study Report. International START Secretariat, Washington D.C., USA. 131.
- Tadross, M. and Johnston, P. (2012). Sub-Saharan African Cities: A five-City Network to Pioneer Climate Adaptation through Participatory Research and Local Action. Climate Change Projections for Port Louis: Adding value through downscaling. ICLEI-Local Governments for Sustainability-Africa, Cape Town, South Africa.
- Tesha, J. O. (1996) . An assessment of the extension needs of urban agriculture: The case of Dar es Salaam region. MSc Thesis, Sokoine University of Agriculture, Morogoro.
- United Republic of Tanzania (2003). *Initial National Communication under the United Nations Framework Convention on Climate Change*. Government Printer, Dar es Salaam, Tanzania.
- United Republic of Tanzania (2004). *Dar es Salaam City Profile*. Dar es Salaam City Council, Dar es Salaam, Tanzania. 4 – 7pp.
- United Republic of Tanzania (2007). *National Adaptation Programme Of Action (NAPA)*. Vice President's Office, Division of the Environment, Government Printer, Dar es Salaam, Tanzania. 20 – 22 pp.
- United Republic of Tanzania (2012). *National Climate Change Strategy: Vice President's Office*, Division of Environment, Government Printer, Dar es Salaam, Tanzania. 53 – 62pp.
- United Republic of Tanzania (2013). *2012 Population and Housing Census Counts*. Government Printer, Dar es Salaam. [<http://www.nbs.go.tz>] site visited on 1/5/2013.
- United Republic of Tanzania (2013). *Tanzania in Figures 2012*. Government Printer, Dar es Salaam. 21pp.
- van Veenhuizen, R. (2007). Profitability and sustainability of urban and peri-urban agriculture, Agricultural Management, Marketing occasion paper, FAO.
- van Veenhuizen, R. (2012). Urban and peri-urban agriculture and forestry (UPAF): An important strategy to building resilient cities? Webinar ICLEI, 18 October 2012, RUAF Foundation.
- Varadan, R. J. and Kumar, P. (2014). Indegenous knowledge about climate change: Validating the perceptions of dryland farmers in Tamil Nadu. "Indian Journal of Traditional Knowledge". Vol. 13 (2) pp. 390 – 397.
- Weber, E. U. (2010). What shapes perceptions of climate change? *Journal of WIRES Climate Change* 1: 332 - 342.
- Yanda, P.Z., Kangalawe, R.Y.M. and Sigalla, R.J. (2006). Climatic and socio-economic influences on malaria and cholera risks in the Lake Victoria Region of Tanzania. *ICIFAI Journal of Environmental Economics* 4(3): 44-70.

Appendix 1.

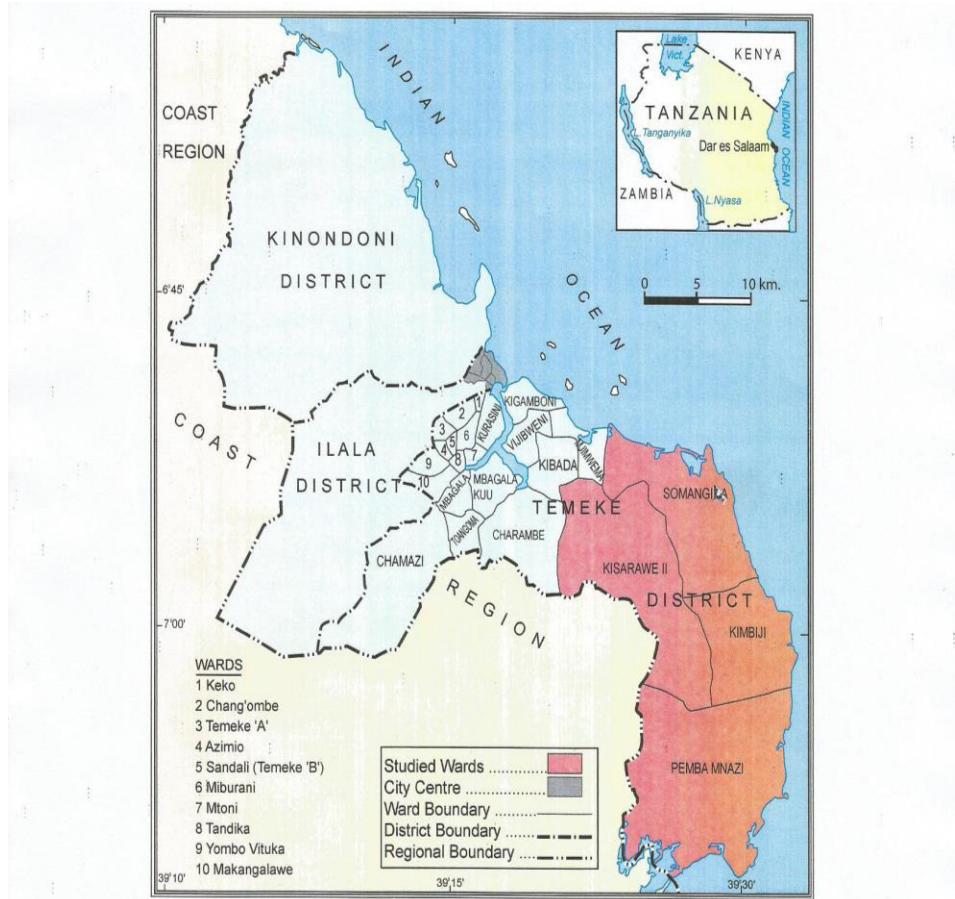


Figure: A map of Temeke District showing the study area.