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Farmers' Perceptions of Impacts of Climate Variability on Market Gardening and Adaptation Strategies on the Slopes of Mount Cameroon.

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Abstract: *Climate variability is expected to intensify existing problems in Cameroon due to poverty, over dependence on rain fed agriculture, and limited access to capital and technology. This research was conducted to assess the knowledge and perception of farmers to climate change indicators, farmers' perceptions of the negative impacts of climate variability on market gardening and the adaptation strategies put in place and to propose a set of recommendations for agricultural development within the slope of Mt Cameroon. Data were collected using structured interviews to farmers selected using the random sampling technique. Climatic records for a 30-year period were used to establish the annual trends of rainfall and temperature in Buena. Results showed that that the key problem of climate variability to market gardening was a reduction in crop yields. Adaptation strategies put in place such as the use of agrochemicals, irrigation and use of improved crop varieties are not really effective because 61% of the farmers lack knowledge on climate change adaptation mechanisms. Therefore, the study recommends that climatic information should be made available to farmers to enable them plan their activities and adjust their agricultural calendar to avoid crop failures and ensure adaptation effectiveness and resilience to climate variability.*

Keywords: *Adaptation, climate variability, market gardening, perception,*

1. INTRODUCTION

There is a growing evidence that climate change, specifically higher temperatures, altered patterns of precipitation and increased frequency of extreme events such as drought and floods, is likely going to affect crop yields and increase production risks in many regions of the world (IPCC, 2001). Climate variability has become a global concern since it can adversely affect elements of various systems and sectors thereby posing a threat to human wellbeing. The fifth assessment report of the Intergovernmental Panel on Climate Change (IPCC, 2013) provides clear evidence of changes in climate due to human activities. Irrespective of the fact that the extent and nature of the effects of climate change on agriculture has not yet been accurately documented; its impact so far on many farming regions of the world is high (McClean, et al., 2005; FAO 2007; Revkin, 2008). There is scarcity of water and at times excess, little or no rainfall and flooding and inundation in coastal areas is a common occurrence (Brown, 2006; Dore, 2005; Hopkin, 2005).

Most African countries will be the most affected by climate change because of limited capacities and equipment for disaster management, limited financial resources, weak institutional capacity, and heavy dependence on rain-fed agriculture (Rockstrom, 2000). Moreover, the majority of the population survives on agriculture making them more vulnerable (IFPRI, 2004). The problem of climate change is aggravated due to poor soils in most parts of Sub-Saharan Africa (SSA) as a result of by poor production techniques and lack of appropriate policies with regard to use of agrochemicals (fertiliser) and no access to credit (Reardon et al., 1999). Climate change threatens to intensify development challenges already confronting the Sub Saharan African (SSA) region, including food insecurity (Scholes and Biggs, 2004), widening and deepening poverty, pandemics (e.g. HIV/ AIDS), increasing crop and animals' pests and diseases, and ineffective governance (IPCC, 2001). In some regions in Africa, the increase in the gap between population growth and agricultural capacity is exacerbating the already declining food security, and increasing vulnerability and rural poverty, which amplify the impacts of droughts that

appear to have become more severe in recent years (Funk et al., 2008).

Agriculture is the backbone of Cameroon's economy employing more than 70% of its population. The slopes of Mount Cameroon are noted for market gardening which is the commercial production of vegetables, fruits, flowers and other plants on a scale larger than a home garden. The rich volcanic soils around Mt Cameroon has favored this activity. Market gardening is carried out all round the year. The principal crops cultivated include; green beans, cucumber, cabbages spices and vegetable. These crops are not only consumed within the Mt Cameroon Region but are also taken to Douala for sale. Climate change have badly affected the production of market gardening crops leading to decrease in yields, reduction in quality and increasing pest and diseases, water shortage as well as little or no water for irrigation Though market gardening is considered as an ever-reliable income-generating activity to farmers within the Mt Cameroon Region, it is however highly exposed to the adverse effects of climate variability and change. Molua and Lambi (2006) highlighted that changes in climate especially seasonal and yearly changes in temperature and precipitation (climate variability) could seriously damage the economy of Cameroon. There are increasing concerns about possible climate variability and its impacts on the slope of Mt Cameroon. Major concerns relate to temperature increases, irregular rainfall patterns, abnormal tropical storms, and severe flooding which directly affect the phonological cycle, agricultural productivity, and pest and disease incidences (Epule, and Bryant, 2016). Most agricultural production in the area relies on rainfed conditions. Crop production is highly sensitive to climatic variability, and crop yields are predicted to decrease due to the negative impacts of climate change (Tendongmo,2021). Craufurd and Wheeler (2009) highlighted that a major factor affecting the rate of plant development is temperature and crop development stages are shorten under warmer climate conditions resulting to a reduction in mean crop yields.

To cope with this, proactive preparation with due understanding and adaptation capacity are considered vital to minim is the impacts of possible climate extremes and their impacts. However, most adaptation options are not geared to meet farmers' needs and do not in any way consider farmers' views and knowledge about climate variability and a consideration of the problems that hinder them from adopting particular adaptation options thereby affecting the effectiveness. There exists a dearth in the literature in the area in particular on the resilience of market gardening to climate change. Most especially, no work has been done on farmers' perceptions of impacts of climate variability on market gardening in the area. These issues if not considered will likely impact on farmers' performance and affect food security and livelihoods in the area. Efforts geared towards ensuring sustainable agricultural production and to combat food insecurity have often failed because information on perceived climate variability impact on market gardening in the area is not available. There is therefore a dire need to investigate the perception of climate variability related impacts and adaptation measures put in place by farmers so as to guide putting in place appropriate policies in an era of climate change. Understanding farmers' perceptions of impacts of climate variability and adaptation capacity are considered vital to cope with possible climate extremes and their impacts and is the focus of this study.

2. Material and Method

2.1 Study Area

Mt Cameroon is located in Buea, Fako Division, South West Region between latitudes 4.055° and 4.378° N and longitudes 9.031°- 9.294° E (Figure 1) (MINFOF, 2014). It is a community located within a blend of urban, semi urban, rural and traditional settings. Buea has a subtropical highland climate. Due to its location at the foot of Mount Cameroon, the climate in Buea is humid, with neighborhoods at higher elevations enjoying cooler temperatures while the lower neighborhoods experience a hotter climate. There are two main seasons; the rainy season which runs from Mid-March to Mid-October and dry season from Mid-October to Mid-March. March is the warmest month of the year. The temperature in March averages 19.7°C. In July, the average temperature is 17.3°C and is lowest average temperature of the whole year. The average temperatures vary during the year by 2.4°C. The area is made up of undulating high and low lands with many rocks and gravels due to volcanic eruptions. The area has volcanic soils which are black and well drained due to the general hilly nature of the terrain. The soil and climate are very supportive for agriculture and greatly favor the cultivation of market gardening crops such as tomatoes, pepper and vegetables in the area. Agriculture is the major economic activity and source of livelihood for majority of individuals, families and households within the Buea Sub

division. The potentials of this activity are that it provides a source of employment and revenue to residents. The common problem associated with it is a drop in agricultural production and low productivity.

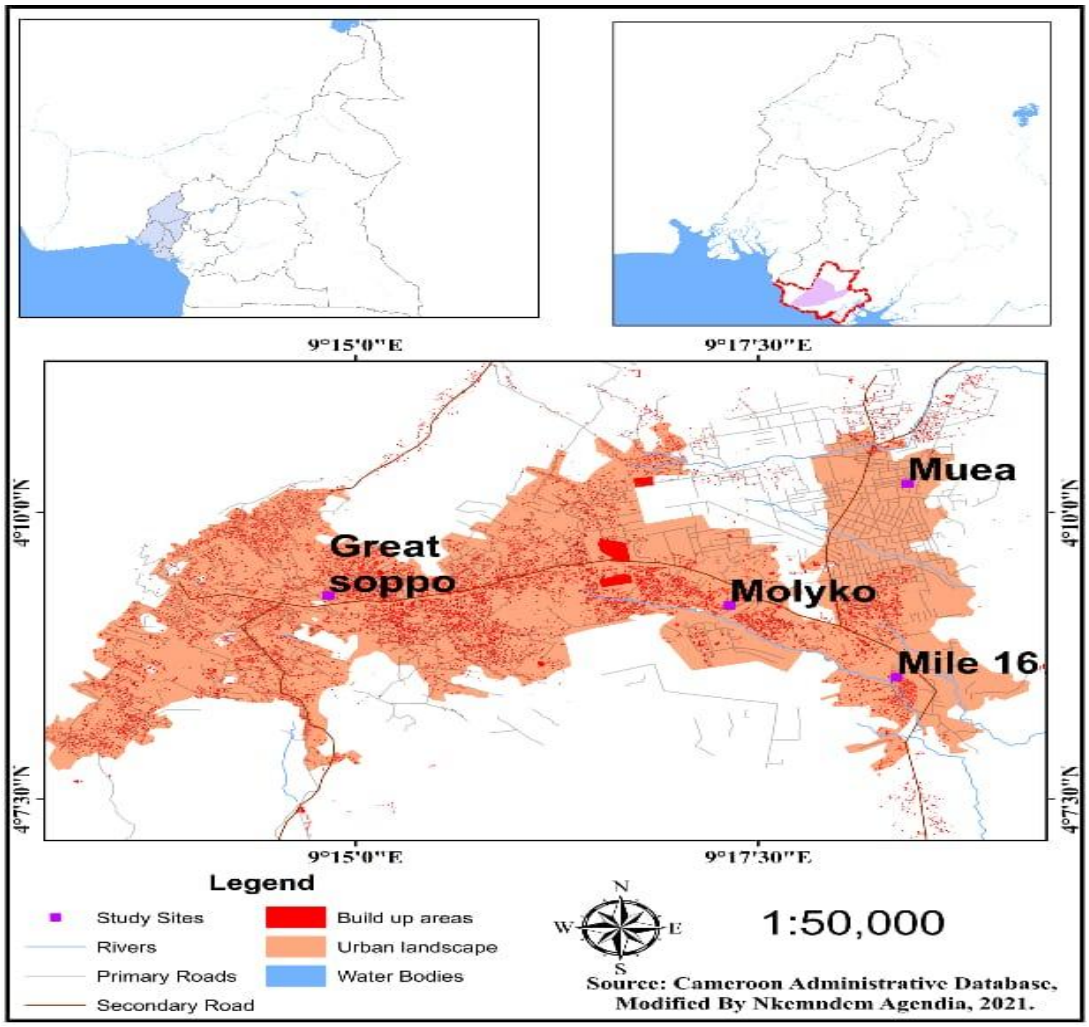

Figure1. *Location of Buea in Fako division, South west Region, Cameroon*

2.2. Data Collection and Analysis

The study made use of data collected from primary and secondary sources. A two-stage random sampling design was adopted for the study. The first stage was the selection of the study sites. A simple random sampling design was used in the selection of the sites: Muea, Molyko, Great Soppo and Mile 16 for the study. The second stage was the selection of the sampled population where random sampling was used in the selection of 160 farmers for the administration of questionnaires and interviews. A random sample was chosen because of the high degree of homogeneity in terms of the farmers' characteristics in the area. A 30 years (1985-2015) record of climatic data on rainfall and temperature of Buea were obtained from the Cameroon Development Corporation (CDC) head office in Bota Limbe, data on market gardening crop production was gotten from the Sub Divisional Delegation of Agriculture and Rural Development Buea. Secondary information on related works on climate change and variability, adaptation to climate change, impact of climate change on agriculture, and adaptation strategies put in place to combat climate change, was gotten from published journals and articles, textbooks, the Google search engine, past research projects and the University of Buea Library. Data collected was analyzed using both descriptive and inferential statistics. Descriptive statistics of mean, maximum and minimum were calculated to show the climate situation of Buea. Linear regression analysis was also applied to identify the extent of variability in the climatic elements of rainfall and temperature while the chi-square statistics was used to show the relationship between the adaptation methods to climate change at 0.05% level of significance. The data was put on excel sheets and analyzed using the Statistical Package for the Social Sciences, (SPSS) version 21.

3. RESULTS AND DISCUSSION

3.1. Annual Trends of Rainfall and Temperature in Buea (1985-2015)

The manifestation of climatic elements of rainfall and temperature in Buea were assessed to see whether farmers' views of these climatic elements are in line with them or not. As shown on Figure 2, analysis of rainfall data revealed rainfall variability within Buea over the years was characterized with some anomalies. The maximum annual rainfall for the period under consideration occurred in 2010 (4000mm). Minimum annual rainfall of 3621.6mm occurred in 1985. This variability is confirmed by the standard deviation value of 1196.76mm and a CV value of 23.80%. This indicates a fairly high variability in annual rainfall in Buea during the period considered. Trend analysis further reveals an annual rainfall of approximately 53.87mm per year. Figure 3 shows the annual temperature trend of Buea. The temperature demonstrates a fluctuating pattern. The minimum temperature of 24.75°C was recorded in 1994 and the maximum temperature of 27.25°C was recorded in 2016.

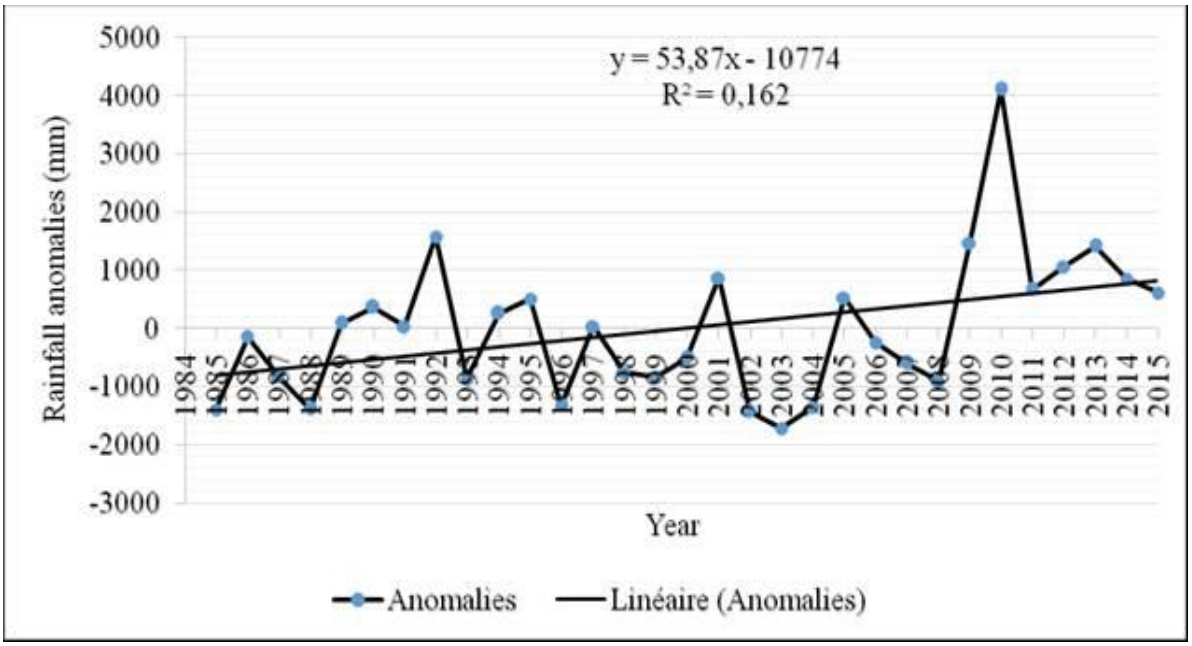

Figure2. *Annual rainfall trend over Buea (1985-2015)*

Source: Analysis based on CDC Meteorological data from Bota- Station, 2018

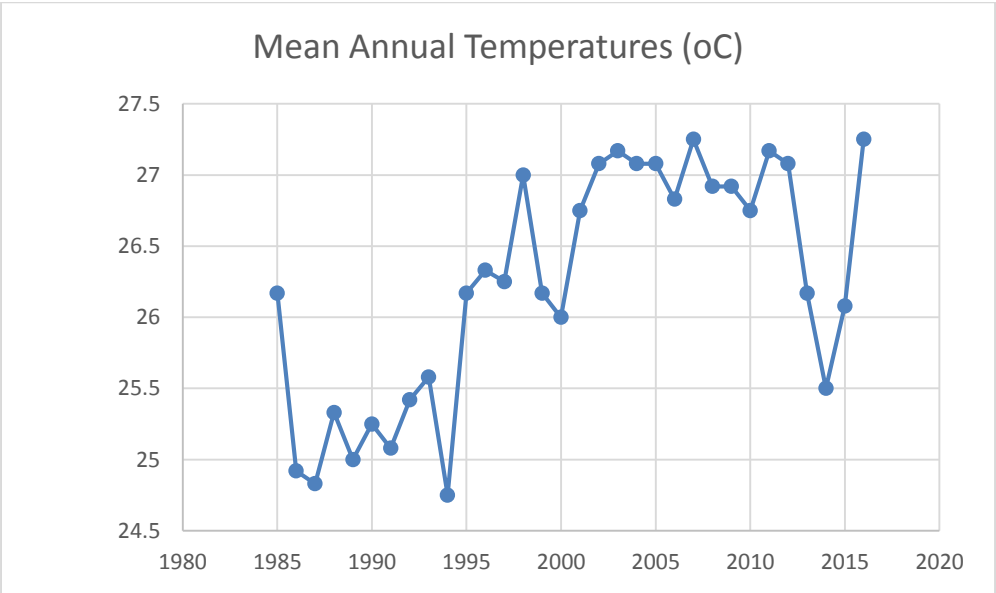

Figure3. *Annual temperature trend over Buea (1985-2016)*

Source: CDC Meteorological Service at Bota- Station, 2018

3.2 Knowledge and Perception of Climate Change Indicators

Farmer's perception of the manifestation of climate change was sought and their representations of climate change was more centered around climate parameters that affect their agricultural activities such as changes in temperature and rainfall. A total of 86% of the farmers indicated to have been aware of climate change and climate variability phenomenon as opposed to 14% who are not aware of the phenomenon of climate change and variability. From the histogram (Figure 1), 82.5% acknowledge that temperature has been increasing, 11.3% said it has been decreasing, 5.0% said there has been no change and 1.3% were not aware of anything.

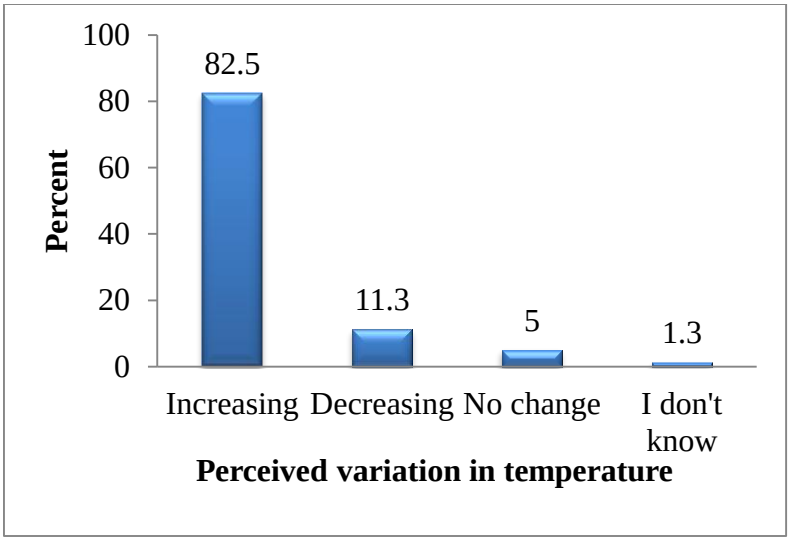

Figure4. *Perceived variation in temperature*

Based on variation in rainfall, 28.8% farmers said rainfall is increasing, 63.8% experienced a decrease in rainfall, 3.8% observed no change and 3.8% declared they don't know (Figure 5).

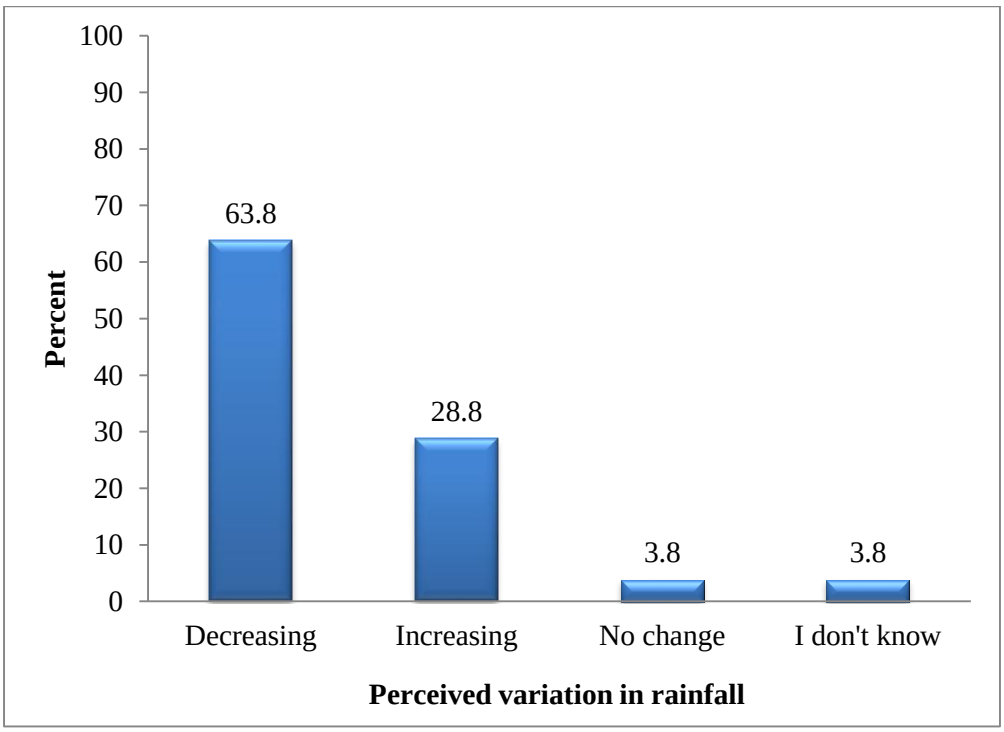

Figure5. *Perceived variation in rainfall*

A study by Julie et al (2017) reveal that farmers of the South west region of Cameroon perceived climate changes as late start and early cessation of rains, decrease intensity of rainfall, increase temperature and intensity of sunshine. Tunde (2011) found out rather that farmers in Ondo State perceived climate change as increase in temperature and inadequate/ excessive rainfall.

3.3. Impact and Manifestation of Climate Variability on Market Gardening

Climate is considered as the major determinant of agriculture despite the existence of other factors. The variability in rainfall and temperature as perceived by farmers has an impact on their activities. A total of 68.8% acknowledged the impact of climate on farming, 16.3% said there was none while 15.0% were not aware of anything. There were further asked about the manifestation of climate variability and their responses are seen on Table 1. A total of 90% attested to a decline in yields of crops due to climate variability as opposed to 10% who disagree to this, 85% identified the problem of pests and diseases, 59% said Soil erosion is a bigger problem now and 37.5% complained about floods being more frequent.

Table1. *Impact of climate variability on market gardening*

Statement	Strongly Agreed	Agreed	Disagree	Strongly Disagree
There is decline in yields of crops	57.5%	32.5%	8.8%	1.3%
Pest and crop diseases have increase	32.5%	52.5%	8.8%	6.3%
Soil erosion is a bigger problem now	31.3%	27.5%	33.8%	7.5%
Floods are more frequent	16.3%	21.3%	35.0%	27.5%

A Correlation analysis was carried out to identify the factors that significantly cause a decrease in crop yields and the results are presented on Table 2.

Table2. *Impact of climate change on crop production*

Spearman's rho	Stats	There is decline in yields of crops
Have observed a long-term change of the climate	Correlation Coefficient	.125
	Sig. (2-tailed)	.268
	N	80
Perceived variation in temperature	Correlation Coefficient	.203
	Sig. (2-tailed)	.071
	N	80
Perceived variation in rainfall	Correlation Coefficient	-.082
	Sig. (2-tailed)	.467
	N	80
Average temperature seems to be higher	Correlation Coefficient	.176
	Sig. (2-tailed)	.119
	N	80
Rains come late than before	Correlation Coefficient	.232*
	Sig. (2-tailed)	.038
	N	80
Rainfall is lesser over the year	Correlation Coefficient	.229*
	Sig. (2-tailed)	.041
	N	80
Rainfall is more variable now	Correlation Coefficient	-.103
	Sig. (2-tailed)	.365
	N	80
The weather is unpredictable	Correlation Coefficient	.197
	Sig. (2-tailed)	.080
	N	80
There is the drying up of streams around your farm	Correlation Coefficient	.235*
	Sig. (2-tailed)	.036
	N	80
Pest and crop diseases have increased	Correlation Coefficient	.296**
	Sig. (2-tailed)	.008
	N	80
Soil erosion is a bigger problem now	Correlation Coefficient	.156
	Sig. (2-tailed)	.166

	N	80
Flood are more frequent	Correlation Coefficient	.073
	Sig. (2-tailed)	.519
	N	80

***. Correlation is significant at the 0.01 level (2-tailed).*

**. Correlation is significant at the 0.05 level (2-tailed).*

The table above indicates that the following factors significantly cause a decline in yield (P<0.05): rains come late than before (P=0.038), rainfall is lesser over the year (P=0.041), there is the drying up of streams around your farm (P=0.036) and pest and crop diseases have increased (P=0.008).

Results revealed that farmers have strongly observed increasing dry conditions, changes in agricultural calendar, late start of rains, decline in soil productivity, decline in agricultural yields, early drying up of water sources, stunted growth of crops, and increase in crop pests and diseases which they all attributed to climate variability and change in the region. These projections announce a reduction yields of crops with increase proliferation of pests and an increased likelihood of short-run crop failures and long-run production declines (Nelson et al., 2009). Researchers are of the opinion that if the problem of climate change is not properly contended, a decline in crop yields of up to 50% should be expected (Phiiri, 2016).

3.4 Adaptation strategies to Climate Change

Farmers attested that decrease in rainfall and the late coming of rains is a problem to market gardening with a high dependence on the availability of water for watering and spraying of the crops all year round. To combat these issues, they have put in place some adjustment measures as seen on Figure 6.

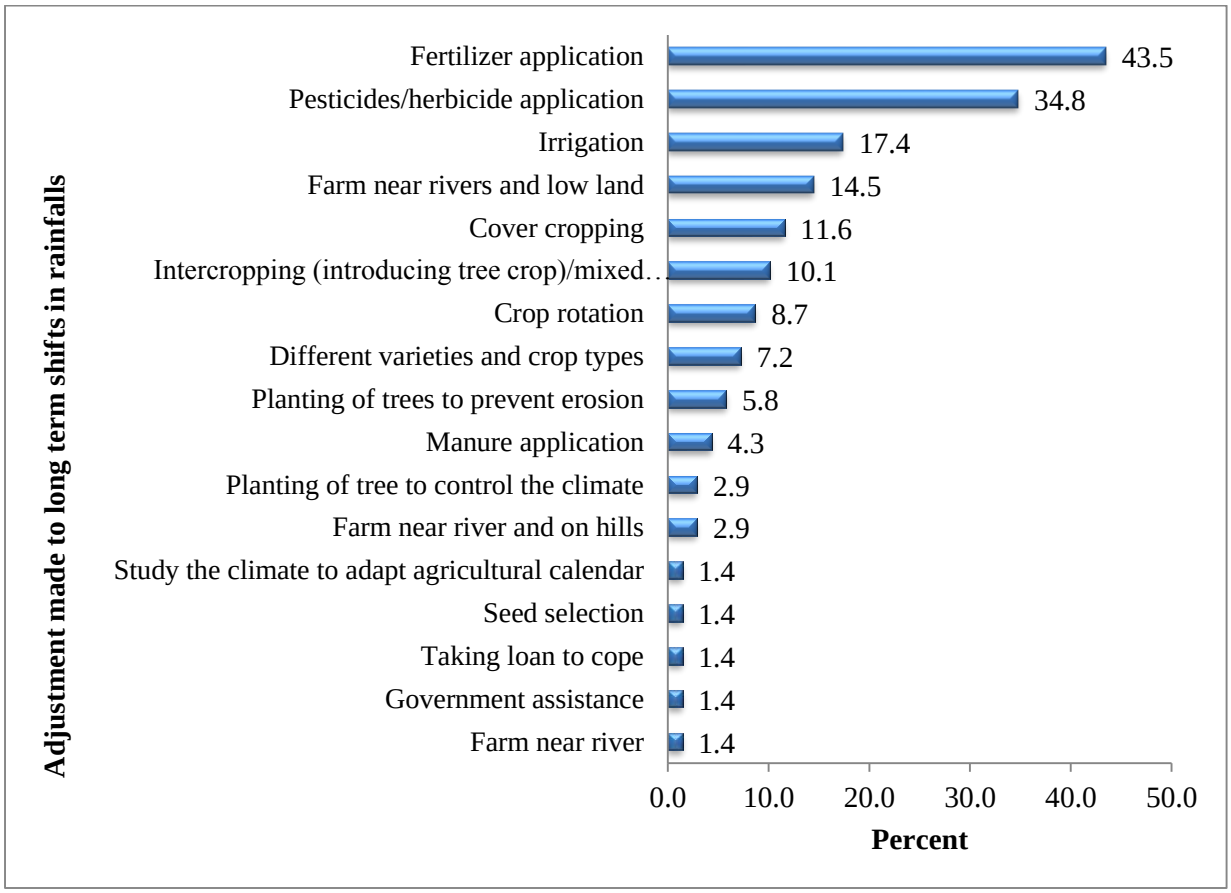

Figure6. *Adjustment made to cope with long term shifts in rainfalls*

Results show that most of the adaptation measure are geared to combat rainfall fluctuations and changes than temperature variability and changes. Farmers adaptation options include; fertilizer application to augment yields, irrigation and farming near rivers and streams to guarantee water availability. This

holds true to other studies carried out within Cameroon by Epule and Bryant, 2007 who highlighted that the adaptation strategies of small-scale indigenous farmers within Fako and Meme Divisions in the face of declining or stagnant crop yields due to climate change were; fertilizer application and irrigation practices.

3.5. Challenges faced in adapting to Climate Change

Farmers within the slope of Mt Cameroon face a number of problems in adapting to climate change. A total of 61.4% complained of lack of education on climate change adaptation, 17.1% identified insufficiency and untimely delivery of agricultural inputs, 17.1% highlighted lack of credit/income and 4.3% mentioned lack of agricultural extension workers as seen on Figure 7.

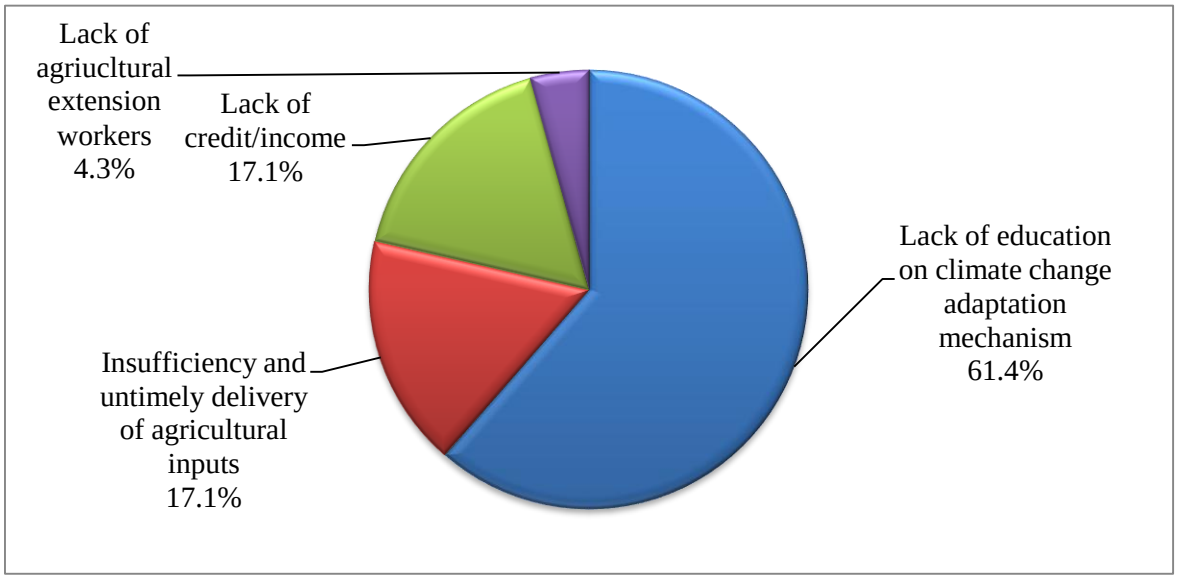

Figure7. *Challenges faced in adapting to climate change*

The inability of farmers to put in place some adaptation strategies was largely due to a lack of knowledge on possible adaptation strategies to be employed as a result of no agricultural extension workers to educate and sensitize farmers. This is an acute problem in Africa as also documented by Antwi-Agye et al., 2013 who identified lack of education as the greatest barrier to climate change adaptation by farmers in Ghana. In addition, the sustainable Livelihood framework on climate change adaptation by Kollmair and Gamper (2002) emphasize the importance of financial capital to farmers in order to enable them to adopt different livelihood and adaptation strategies in the midst of climate variability so as to build resilience to climate change impacts on their crops.

4. Conclusion and Recommendations

Climate variability is a reality and is affecting market gardening negatively within the slope of Mt Cameroon. Farmers show much knowledge of awareness on climate change such as increase in temperature and decrease in current rainfall over the region which is evidence with empirical data. Empirical climatic data of Buea clearly reveals that, there has been much variability in temperature and rainfall. Farmers are actually suffering from the negative impacts of climate variability, namely decreased yield of crops, increase in pest and diseases, soil erosion and floods. These negative impacts will however become more serious during the next decades. Therefore, the results of the research support the need for awareness and adaptation programs towards climate variability, leading to adaptation strategies through which farmers and relevant agencies should focus on agricultural development to help shape adaptation effectiveness and increase resilience.

We recommend that policies geared towards the implementation of adaptation strategies should emphasize the crucial role of providing information on better production techniques and on climate change and create financial means through which farmers can afford credit schemes to enable them to adapt. In doing this government can however link with financial institutions and offer financial assistance to farmers at very low interest rates.

Climatic information should be made available to farmers to enable them plan their activities and adjust their agricultural calendar to avoid crop failures.

Farmers' education programs on climate change, its manifestation, causes and impacts on agriculture and the environment should be developed in order to raise farmers' awareness level on climate change and to its causes within the subdivision.

REFERENCES

[1] Antwi-Agyei, P., Dougill, J.A and Stringer, L C (2013): Barriers to Climate Change Adaptation

[2] In Sub-Saharan Africa: Evidence from Northeast Ghana & Systematic Literature Review, Centre for Climate Change Economics and Policy Working Paper No. 154, Sustainability Research Institute Paper No. 52

[3] Brown, P. (2006) Global warming: The last chance for change. Published by Dakini books.

[4] Craufurd, P. Q., & Wheeler, T. R. (2009). Climate change and the flowering time of annual crops. Journal of Experimental Botany, 60(9), 2529 e 2539.

[5] Dore, H.I. M. (2005). "Climate Change and Changes in Global Precipitation Patterns: What Do We Know?" Environment International., 31(8): 1167-1181

[6] Epule, T.E. and Bryant, C.R. (2016). "Small scale farmers' indigenous agricultural adaptation options in the face of declining or stagnant crop yields in the Fako and Meme Divisions of Cameroon". Agriculture 2016, 6, 22.

[7] FAO. (2007). "Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities". Interdepartmental working group on climate change, Food and Agriculture Organization of the United Nations Rome ftp://ftp.fao.org/docrep/fao/009/j9271e/j9271e.pdf

[8] Kollmair, M., and Gamper, S. (2002): The Sustainable Livelihood Approach, University of Zurich, Pp. 1-11

[9] Tendongmo A. F. (2021). Knowledge and perception of farmer's adaptation to climate change. case study of market gardening on the slope of Mount Cameroon (Unpublished M.SC. Thesis), Department of Geography, University of Buea, Buea, Cameroon.

[10] Hopkin, M. (2005). "Amazon Hit by Worst Drought for 40 Years: Warming Atlantic Linked to Both US Hurricanes and Rainforest Drought." Nature News. http://www.bioedonline.org/news/news.cfm?art=2094

[11] IFPRI. 2004. Ending Hunger in Africa: Prospects for the small farmer. Washington, D.C., USA.

[12] IPCC. 2001. Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J. and White, K.S. (Eds.). Cambridge University Press, Cambridge, UK. 1032 pp.

[13] Intergovernmental Panel on Climate Change (IPCC). (2013). Climate change 2013: The physical science basis. New York, NY: Cambridge University Press.

[14] Julie, D.T., Amungwa, F.A., Manu, I (2017): Farmers' Perception of Climate Change and Adaptation Options in Southwest Cameroon, International Journal of Rural Development, Environment and Health Research, Vol. 1, No, 3, Pp.102-115

[15] McClean, C.J., Lovett, J.C., Küper, W., Hannah, L., Sommer, J.H, Barthlott, W., Termansen, M., Smith, G.F., Tokumine, S., and Taplin, R.D.J. (2005). African plant diversity and climate change. Annals of the Missouri Botanical Garden, 92(2), 139–152

[16] Molua, E., and Lambi, C. (2006): The Economic Impact of Climate Change on Agriculture in Cameroon. CEEPA Discussion Paper No. 17 Special Series on Climate Change and Agriculture in Africa, ISBN 1-920160-01-9 http://www.ceepa.co.za/docs/CDPNo17.

[17] Phiiri, G.K., Egeru, A., and Ekwamu, A (2016): Climate Change and Agriculture Nexus in Sub-Saharan Africa: The Agonizing Reality for Smallholder Farmers, Int J Cur Res Rev, Vol 8, Issue 2, January 2016, pp. 57-64

[18] Reardon, T., Barrett, C., Kelly, V. and Savadogo, K. 1999. Policy reforms and sustainable agricultural intensification in Africa. Development Policy Review 17: 375-395.

[19] Revkin, C. A. (2008). "New climate report foresees big changes". The New York Times. http://www.nytimes.com/2008/05/28/science/earth/28climate.html

[20] Rockstrom, J. 2000. Water resources management in smallholder farms in eastern and southern Africa, an overview. Physics and Chemistry of the Earth Part B-hydrology Oceans and Atmosphere 25: 275 - 283.

[21] Scholes, R.J. and Biggs, R. 2004. Ecosystem services in southern Africa: The regional-scale component of the South African millennium ecosystem assessment. CSIR, Pretoria, South Africa.

[22] Tunde, A. M (2011): Perception of Climate Variability on Agriculture and Food Security by Men and Women Farmers in Idanre L.G.A, Ondo State Nigeria, Ethiopian Journal of Environmental Studies and Management, Vol. 4., No.2, Pp. 19-32 http://dx.doi.org/10.4314/ejesm.v4i2.3

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