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Implications of Climate Change in Northern Areas of Lake Victoria Basin

Isiko Mohamed
University of Eastern Africa,Baraton,
Kenya
isikomohammed@gmail.com

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Abstract: *This study assessed the implications of climate change in northern areas of Lake Victoria Basin around Jinja. It was conducted following unsteady temperature and rainfall patterns with unexplained effects and thus no appropriate responses. Issues of concern were; to identify factors behind the changes in temperature and patterns of rainfall, to establish implications of the changes in temperature and rainfall patterns on communities, to establish land use patterns that can help to harmonize observed changes in temperature and rainfall patterns and to suggest measures that can be adopted to respond to the effect of changes in temperature and rainfall patterns. A cross sectional survey design was adopted for this study with the aim of collecting data from a sample of 346 respondents using questionnaires in three months. Data was entered into Statistical Package for Social Sciences (SPSS) and results generated automatically. It was established that changes in temperature and patterns of rainfall was largely natural and man's activity mainly burning of fossil fuels in agricultural areas. Changes in temperature and rainfall patterns are associated with drought and floods which result in loss of life and influence growth of crops. The communities around Lake Victoria basin who are victims of changes in temperature and rainfall patterns are advised to plant more trees, desist from depositing industrial waste in water and to seek more information about climate change and the associated impacts. It was therefore recommended that communication be made on a wide scale to inform communities about the effect of climate change to minimize the effects, there is need for investing in new infrastructure, or radically upgrading existing highways and transmission lines, would help cut greenhouse gas emissions and drive economic growth in developing countries. Finally but not the least, community should be sensitized against cutting down trees and balancing the amount of wood taken out with the amount of new trees grown..*

Key Words: Climate Change, Lake Victoria Basin, Green house gas, Communities, Evapotranpiration

1. Introduction

Climate change is concerned with differences in the context of climate change and the complex and intersecting power relations arising from it. By altering the ecosystems of the planet, climate change, and more specifically global warming, directly affects the human race. These effects vary among segments of the population, specifically for people of different genders (Katz, Parlange, & Tebaldi, 2013).

Climate change affects the environment and natural resources immensely. Rainfall, temperature and evapotranspiration are major parameters of climate affecting changes in the environment (Ceballos, Martínez-Fernández, & Luengo-Ugidos, 2014). Evapotranspiration plays a key role in crop production and water balance of a region, one of the major parameters affected by climate change. The reference evapotranspiration or ET0 is a calculated parameter used in this research. The impacts of climate change have affected the water balance, resulting in an increasing disparity between the demand and supply of water that has resulted in greater attention to the planning of water resources (Ceballos et al., 2014).

Lake Victoria basin in East Africa has an abundance of natural resources and provides services like fishing, transport, agriculture, domestic and industrial water supply, as well as hydropower (Chen, Yu, & Tang, 2010). The lake basin is one of the most densely populated regions in Africa with more than 30 million people living around it and drawing their livelihoods directly or indirectly from its resources. The lake is also one of the main sources of the Nile River, which is a key lifeline for South Sudan and Egypt who depend almost entirely on the river for water supply (Sutcliffe and Lake Victoria is the largest lake in Africa and the second largest lake in the world (Palmer, 2014).

The available observational records and historical information show that variations in the level of Lake

Victoria and other East African lakes is closely related to previous trends in rainfall pattern over the region. The average rainfall experienced over the region in 1960s led to a record lake level rise of 2m, accompanied by heavy flooding over most parts of the lake basin (Ceballos, et al., 2014).

The severity and frequency of changes in climate have been observed to have increased over several parts of the world. These changes are the main cause of most climate related socio-economic implications. It is necessary to assess the possible implications of these changes into the future in order for disaster managers to come up with concrete contingency measures. In case steps are not undertaken, it is expected that future changes will generate new threats which some regions may not have experienced. Comprehensive information of past, present and future extremes is necessary for disaster risk which can provide climate change scenarios required for building a resilient society and economy in support of national disaster risk reduction, climate change adaptation and strengthening national sustainable development efforts.

2. Literature Review

Lake Victoria basin has an abundance of natural resources and provides services such as fishing, transport, agriculture, domestic and industrial water supply, as well as hydropower (Wilson, 2010). It is one of the most densely populated regions in Africa with more than 30 million people living around it and drawing their livelihoods directly or indirectly from its resources. The lake is also one of the main sources of the Nile River, which is a key lifeline for South Sudan and Egypt who depend almost entirely on the river for water supply and it's the largest lake in Africa and the second largest lake in the world (Coble & Dismukes, 2014).

In this study, it has been observed that changes in temperature and rainfall patterns are attributed to of factors categorized into human and natural made. Therefore, since the explanation about adverse effects of climate change based on solar radiation has no contextual explanations, information was used to establish how solar radiation was responsible for changes in rainfall and temperature (Alberge, 2013).

Causes of rise in Sea-Surface Temperatures (SSTs): an increase in solar irradiance leads to a raise in SSTs, regardless of whether the increase in solar irradiance resulted from variations in the solar cycle, or from changes in cloud cover, or from a reduction in stratospheric volcanic aerosols. The impact of shortwave radiation (visible light) on SST depends on factors such as the turbidity of the water and sea surface albedo, which in turn depend on other variables including wind speed and chlorophyll concentration (Tisdale, 2016).

Additionally, an increase in downward long wave (infrared) radiation would warm the top few centimetres of the oceans, and through mixing caused by waves and wind stress turbulence, would warm the mixed layer of the ocean. This in turn would affect the temperature gradient between the mixed layer and skin, dampening the outward flow of heat from the ocean to the atmosphere (Wordpress.com, 2010).

Global warming caused by human activities that emit heat-trapping carbon dioxide has raised the average global temperature by about 1°F (0.6°C) over the past century (Wilson, 2010). In oceans, this change is about 0.18°F (0.1°C). This warming has occurred from the surface to a depth of about 2,300 feet (700 meters), where most marine life thrives (Wilson, 2010).

Land use patterns: The effect of land use on the climate primarily depends on the type of land cover present within an area. For example, if rainforest is removed and replaced by crops, there will be less transpiration (evaporation of water from leaves) leading to warmer temperatures in that area (Warner & Heath, 2012). On the other hand, if irrigation is used on farmland, more water is transpired and evaporated from moist soils, which cools and moistens the atmosphere. The additional transpiration can also affect levels of precipitation and cloudiness in an area (Warner & Heath, 2012).

Urbanization is another change in land use that can affect the climate, sometimes significantly. Local climates tend to be warmer due to the increased amount of heat released within a densely populated area. Average temperatures in city centers can increase even more due to the high density of construction materials such as pavement and roofing materials since they tend to absorb, rather than reflect, sunlight. The phenomenon of higher urban temperatures, compared to lower temperatures is known as the urban heat island effect (Qvist, Staffan, & Brook, 2015).

Climate changes will affect everyone, but some populations will be at greater risk. Countries whose coastal regions have a large population, such as Egypt and China, may have to move whole populations inland to avoid flooding. The effect on people will depend on how well we can adapt to the changes and how much we can do to reduce climate change in the world.

In many communities, climate change will have a disproportionately greater effect on women, since women are often poorer and less educated than men and often excluded from political and household decision-making processes that affect their lives. Additionally, women usually have fewer assets and depend more on natural resources for their livelihoods. These and other factors indicate that women will be more vulnerable than men to the effects of climate change (Bradshaw, 2014).

When disasters occur, more women die than men, which reflects women's social exclusion: they are less able than men to run, often have not learned to swim, and have behavioural restrictions that limit their

mobility in the face of risk not least of which is the fact that their voices often do not carry as much weight as men's in their households. On the other hand, some post-disaster analysis has shown that men suffer higher mortality rates because they take more risks trying to save themselves and their families (Karina, 2012). Climate change has a greater impact on those sections of the population, in all countries, that are most reliant on natural resources for their livelihoods and/or who have the least capacity to respond to natural hazards, such as droughts, landslides, floods and hurricanes (Anderson, 2016).

Warming seas cause stronger hurricanes: rising temperatures are directly linked to the upswing in hurricane intensity seen in the past few decades. Researchers at the Georgia Institute of Technology in Atlanta examined data for a range of climate variables thought to contribute to the formation of hurricanes in categories 4 and 5, the upper end of the strength scale. Only sea surface temperature showed a strong correlation with the observed increase in the occurrence of these storms since 1970. And with sea temperatures set to rise still further, that means the next few decades could bring even more hurricanes like Katrina, which hammered New Orleans in August 2005. "The inference is that if you keep warming things up, you're going to get more intense storms," says Judith Curry, a member of the research team (Alonso & Bouma, 2010).

Temperature is often considered to be the primary driver of mosquito development. By developing a stage-structured model which explicitly captures its effects on each life stage we aim to understand how predicted seasonal temperature changes may affect mosquito seasonality (Knies & Kingsolver, 2010). Increasing temperatures caused by climate change will make the water of the oceans expand; ice melting in the Antarctic and Greenland also contribute to the sea level. Sea levels could rise by as much as 25 to 50cm, by 2100. Greater sea levels threaten the low-lying coastal areas such as the Netherlands and Bangladesh, millions of areas of land will be in danger from flooding; causing people to leave their homes. Low lying areas in cities will be hugely affected by the rising sea (Gregory, 2010).

All across the world, there is a big demand for water and in many regions, such as the central and eastern Africa there is not enough water for the people. Changes in the climate will change the weather patterns and will bring more rain in some countries, but others will have less rain, generally dry areas will become drier and wet areas could become wetter (FAO, 2010). As climate change takes place, our daily weather and normal temperatures change, the homes of plants and animals will be affected all over the world. Polar bears and seals are a good example of animals that will be affected by climate change, they will have to find new land for hunting and living, if the ice in the Arctic melts, but the fact is more real that these species could become extinct (Weather Resources, 2014).

In regions with heavy snowfall, reforestation or afforestation would cause the land to reflect less sunlight, resulting in the absorption of more heat on the land. This would, in turn, result in a net warming effect despite the removal of carbon dioxide from the atmosphere through the process of photosynthesis during the growing season. Additional reforestation could increase transpiration, leading to more water vapor in the air. In the troposphere, water vapor is considered to be the biggest greenhouse gas contributor to global warming (Baumert & Kevin, 2015). Changes in weather will affect many crops grown around world. Crops such as wheat and rice grow well in high temperatures, while plants such as maize and sugarcane prefer cooler climates. Changes in rainfall patterns will also affect how well plants and crops grow. The effect of a change in the weather on plant growth may lead to some countries not having enough food. Brazil, parts of Africa, south-east Asia and China will be affected the most and many people could be affected by hunger (Roemmich & Carmack, 2010).

Revenue impacts in an unmitigated climate change scenario appear to be significant. Climate change is projected to reduce economic output in the United States and across the globe. Reduced output in the United States means lost revenue for the Federal Government. The Intergovernmental Panel on Climate Change (IPCC)'s most recent midrange projection suggests that warming of four degrees Celsius over preindustrial levels will occur by 2100 if global emissions are allowed to continue unabated (Coble & Dismukes, 2014). Economists' estimates of the economic damages (in terms of reduced consumption) from this level of warming, projected using integrated assessment models (IAMs) of the climate-economy system, range from 1 to 5 percent of global Gross Domestic Product (GDP) each year by 2100 (Roehr, 2014). One of the most frequently cited economic models places the estimate of annual damages from warming of four degrees Celsius at about four percent of global GDP. Crop failure; Climate change and agriculture are interrelated processes, both of which take place on a global scale. Climate change affects agriculture in a number of ways, including through changes in average temperatures, rainfall, and climate extremes, changes in pests and diseases; changes in atmospheric carbon dioxide and ground-level ozone concentrations; changes in the nutritional quality of some foods; and changes in sea level (Hoffmann, 2013).

3. Methodology

3.1 Research Design

A cross sectional survey design was used in this study. Cross-sectional studies involve data collected at a defined time. A cross-sectional study is a type of study in which people of different ages (demographic characteristics) are examined at the same time(s). This is usually done with cohorts, so that researchers can examine how people of different ages perform, behave, or respond to a particular function (AlleyDog.com,

2017). The strengths of a cross sectional design is as follows:

i) Relatively quick and easy to conduct (no long periods of follow-up).
ii) Data on all variables is only collected once.
iii) Able to measure prevalence for all factors under investigation.
iv) Multiple outcomes and exposures can be studied.

The study population was categorized into agriculturalists, employees in surrounding industries, managers of about four industries, and those settlers who do their own businesses around Lake Victoria basin. The Table 1 shows the various categories from which sample size obtained.

Table 1: Target Population of the Study

Category	Number (N)
1. Employees in industries around	1005
2. Business owners around	1000
3. Agriculturalists	1200
4. Administrators of industries	15
Total	**3220**

Source: Approximated in Jinja District Community Development Office

3.2 Sample size calculation

According to Yamane (1978), the appropriate sample size is determined using the formula: $n = \frac{N}{1+N(e)^2}$ where n = sample size to be calculated, N the total population targeted and e = percentage of expected error made in selecting sample (5% or 0.05), and 1 is representative of any likely avoided element that would have been included.

$$\therefore n = \frac{3220}{1+3220(0.05)^2}$$

$$= \frac{3310}{1+3220\times 0.0025}$$

$$= \frac{3220}{1+8.3}$$

$$= \frac{3220}{9.3} = 346 \text{ respondents.}$$

Using results obtained by Yamane Formula, the obtained sample size (346) was further subjected to calculations to get the proportion of sample for each category of respondents. Below is a table indicating the proportional sample sizes to indicate the sample number for each of the employees in industries, business owners around Lake Victoria Basin, agriculturalists and administrators in industries.

Table 2: proportional sample size for respondents by category

No	Category	Proportion	General sample	Proportional sample
1.	Employees in industries around	$\frac{1005}{3220} = 0.312$	346	0.312 x 346 = 108
2.	Business owners around	$\frac{1000}{3220} = 0.312$	346	0.312 x 346 = 108
3.	Agriculturalists	$\frac{1200}{3220} = 0.372$	346	0.372 x 346 = 129
4.	Administrators of industries	$\frac{15}{3220} = 0.004$	346	0.004 x 346 = 1
	Total	**1.000**		= 346

Table 2 shows that the sample population of the study is categorized according to the respondents' designation. Out of the 346 respondents, an equal sample size of 108 respondents was obtained for employees in industries and business owners around the basin, 129 respondents were agriculturalists and the rest administrators.

3.2 Sampling techniques

First, **Multistage sampling** was used in this study. It refers to sampling plans where the sampling is carried

out in stages using smaller and smaller sampling units at each stage. Using a multi-stage sampling, the area surrounding Lake Victoria basin was considered in terms of random areas such as Bugembe, Kakira, Njeru, Mpumudde, Mbiko, Kimaka and some parts of industrial area. In these areas, the study categories of people were three-the agriculturalists, business owners who can also be categorised as private owners of businesses, employees in nearby industries and then the managers of these industries.

Another technique of sampling was **cluster sampling** used when mutually homogeneous yet internally heterogeneous groupings are evident in a statistical population. In this sampling plan, the total population is divided into these groups (known as clusters) and a simple random sample of the groups is selected. This technique of sampling was used to consider the study population by gender type and other unique characteristics which helped to explain the fact that the study was conducted without any form of discrimination.

Finally, a **purposive sampling** technique was used to include key respondents. This was used to include specifically the managers of industries to be targeted in this study. The advantages of purposive sampling are: purposive sampling is one of the most cost-effective and time-effective sampling methods available, and it is the only appropriate method available if there are only limited number of primary data sources who can contribute to the study.

3.3 Data collection instruments

Basically, a detailed questionnaire consisting of structured questions was designed to explore implications of climate change. This was designed with sections and respondents asked to respond to structured questions carefully formulated based on either tested models or formulated from the literature review.

Questionnaires have advantages over some other types of surveys in that they are cheap, do not require as much effort from the questioner as verbal or telephone surveys, and often have standardized answers that make it simple to compile data (Munn &Drever, 2004, p.2).

3.3.1 Validity and Reliability of instruments

In science and statistics, validity is the extent to which a concept, conclusion or measurement is well-founded and corresponds accurately to the real world.Validity of the study was determined by subjecting the research questions to expert analysts with in and outside the university, then finally, the supervisors vetted views of other experts and recommended questions used in this study as valid.

On the other hand, reliability is the degree to which an assessment tool produces stable and consistent results after carrying out research. Reliability checks on effectiveness of research methods/tools and their suitability. Secondly, it helped the researcher to estimate the costs and duration of the main study and test the effectiveness of its organization. Table 3 shows the results obtained from reliability tests to indicate that contents used to measure each of the variables summed up to coefficients on pre and post testing above .70.

Table 3: Reliability Results for the Study Variables

Variable	Number of Items	Coefficients	%age
Factors Behind Changes in Temperature and Rainfall (FCBT)	15	0.721	72.1
Items for effects of changes in temperature and rainfall	15	0.760	76.0
Land Use Patterns (LUSE)	10	0.774	77.4
General Measures to stabilize temperature and rainfall (Measure)	15	0.766	76.6

Source: Primary data from Lake Victoria Basin (Details in Appendix C)

Table 3 clearly shows reliability of items for different variables examined to establish the effects of changes in temperature and rainfall patterns on communities around Lake Victoria Basin. Results indicate that the 15 factors behind changes in temperature and rainfall patterns generated a Crombach reliability coefficient of 0.721, translating into 72.1%. In addition, responses in relation to the 15 items for effects of changes in temperature and rainfall generated a Crombach coefficient of 0.760, translating into 76% level of reliability. Further, the 10 items used to establish land use patterns resulted into a coefficient of 0.774, which is equivalent to 77.4%. Finally, 15 items were used to establish general measures to stabilize temperature and rainfall patterns. These led to a coefficient of 0.766, translating into 76.6%.

Therefore, based on Crombach's rule which requires that for responses to be significant, a set of items must measure a reliability scale of not less than 0.70 or 70%, results of this study were all highly reliable.

3.4 Data Analysis

The effect of climate change was graded on Mean Scores. Raw data was entered into Statistical Package for Social Sciences (SPSS) data entry sheet and checked thoroughly to reflect minds of respondents and to respect demands of specific objectives. The SPSS approach is relevant for this study because it is one of the kind, where quantitative data can easily be computed and statistics generated without bothering with the manual methods of calculations. The SPSS package is simple to use, it's automatically programmed

with mathematical calculations like Mode, Mean, Median, regression, correlations, reliability, and other expressions, which could not easily be calculated manually. This package is modified and the newer the version, the easier it is to manipulate data. In this context, SPSS (Version 22) was used. Frequencies and percentage for each item were run and mean scores generated along in the output.

4. Results and Discussion

4.1 Socio-demographic characteristics of respondents

Socio-demographic characteristics consisted of gender, nature of work, environmental aspect used most, period of operation in the area and whether there were any effects of changes in temperature and rainfall.

Table 4: Demographic characteristics of care-givers

	Item	Frequency	Percentage (%)
1.	**Gender**		
	Males	158	46.3
	Females	183	53.7
	Total	341	100.0
2.	**Nature of Work done**		
	Farmer	75	22.0
	Work in Industry	36	10.6
	Self Employed	158	46.3
	Public Servant	48	14.1
	Unemployed	24	7.0
	Total	341	100.0
3.	**Environmental aspect used most**		
	Trees	96	28.2
	Water from Lake Victoria	49	26.1
	None	156	45.7
	Total	341	100.0
4.	**Period of Operation in the Area**		
	1-5 years	150	44.0
	6-10 years	86	25.2
	Above 10 years	105	30.8
	Total	341	100.0
5.	**Whether changes in temperature and rainfall affect respondents**		
	Yes	189	55.4
	No	2	1.0
	Somehow	150	44.0
	Total	341	100.0

Source: Primary data from respondents around Lake Victoria Basin –Details in Appendix D

$\sum = 341$

4.2 Gender of Respondents

Findings consisted of views from both male and female respondents. Table 4 shows that the highest percentage 183(53.7%) of respondents who filled questionnaires were females while 158(46.6%) were male respondents. This structure of population was realized because during distribution of questionnaires, the number of females who were found willing to fill the questionnaires in areas of study was high compared to the males. In the areas of Mpumudde, there were many females running roadside businesses such as banana selling, tomatoes selling, hawking of ground nuts, managing kiosks with cold drinks and airtime, among others. In the same vein, women in Njeru were so actively involved in business activities. Coming to areas around the Nile Breweries, women were easily accessible, and so were the areas of Mbiko, Bugembe, and within most parts of Jinja town where the researcher randomly selected respondents. Majority of the male respondents were found in factories. However, not many of them were accessed owing to their busy schedules, and indeed, their level of business created a threat of possible loss of questionnaires.

4.3 Nature of Work done by the Respondent (s)

Respondents were asked to state the kind of work they were doing to earn a living. In this, the researcher intended to find out whether changes in temperature and rainfall could be in anyway attached to the nature of work. According to Table 4, out of the sample of 341(100%), 75(22%) practiced farming, 36(10.6%) worked in industries within and around Jinja Municipality, the highest percentage rating 158(46.3%) were self-employed, 48(14.1%) represented respondents who were public servants and the least

percentage 24(7.0%) were unemployed. Generally, Jinja town is mainly full of self-employed people. To be specific, majority of the women staying in Jinja are self employed thus, justifying the nature of responses obtained from this study.

4.4 The environmental aspect used most by respondents

This was investigated to check on the environmental component that was used most since the study was about effects of changes in temperature and rainfall, which are aspects of environmental practices. The environmental aspects included; trees, water from Lake Victoria or they did not use any of the two. Table 4 shows that the highest percentage 156(45.7%) did not use any of the two in their business activities, while 96(28.2%) used trees, and 49(26%) used water from Lake Victoria.

4.5 Period of operation

Respondents were asked to state the period, in terms of years, that they had spent in Jinja, by the time of this study. According to Table 4, 150(44%) of the respondents had stayed in Jinja for a period of 1-5 years, 105(30.8%) had been in Jinja for a period of 10 years and 86(25.2%) of the respondents had stayed in the study places for a period ranging from 6 to 10 years. The purpose of this information was to ensure that information given was reliable and out of experience. It is not wonderful, therefore that findings generated were obtained from respondents who were well-versed with the situation in Jinja town and other areas.

4.6 Implications of changes in temperature and rainfall patterns on communities around Lake Victoria

The first objective of the study was intended to establish factors which explained changes in temperature and rain fall patterns. The scale of measurement was "True-1" "Not Sure-2" or "False-3" and significant factors were established by **Mode = True**, justified by **Mean < 2.0000.**

Table 5: Implications of changes in temperature and rainfall on communities around Lake Victoria

C/No.	Statement of factor	df	Mean	Conf. Int.
1.	Increasing temperatures caused by climate change will make the water of lake Victoria expand (floods)	340	1.88563	95%
2.	Effect on crops grown such as wheat and rice which grow well in high temperatures, while plants such as maize and sugarcane prefer cooler climates.	340	1.98240	95%
3.	Changes in rainfall patterns will also affect how well plants and crops grow and thus cause famine	340	1.77713	95%
4.	Contamination of water that is safe for drinking	340	2.39003	95%
5.	It leads to loss of marine life in form of fish species	340	1.92962	95%
6.	Retards growth and development of businesses like fish farming	340	2.33431	95%
7.	Settlements near the lake are destabilized	340	1.76246	95%
8.	Reduction in regular incomes from business enterprises	340	1.54839	95%
9.	Loss of revenue to the central and lower local governments	340	1.71848	95%
10.	Health hazard of family members	340	2.44282	95%
11.	Loss of trees/gardens/house	340	2.02346	95%
12.	Increased frequency and magnitude of flood	340	2.01466	95%
13.	Increased frequency of cyclone	340	1.97067	95%
14.	Increase in the intensity of salinity in land	340	1.54252	95%
15.	Crop failure/ Severe impact on food and nutrient security	340	2.21701	95%

Source: Primary data from respondents around Lake Victoria Basin –Details in Appendix F

$\sum = 341$

Just like with the factors behind changes in temperature and rainfall, there are fifteen factors set for respondents to establish the effects of changes in changes in temperature and rainfall on communities around Lake Victoria Basin. The degrees of freedom (df) and confidence interval (CI) were constant. However, going by the means scores, nine factors were found to be significant and each of these is analyzed below.

4.7 Flooding of the lake

Table 4 indicates that change in temperature and rainfall patterns is dangerous because it leads to realization of floods as a result of expansion in water of Lake Victoria***(Mean =1.88563; df = 340; CI = 95%)*.**On the side of rain, each time there are more rains than the drainage system can take, there can be floods. Sometimes, there is heavy rain for a very short period that results in floods (Hernandez, et al., 2014). In other times, there may be light rain for many days and weeks and can also result in floods. In many cases also, rivers can overflow their banks to cause flooding (Georgole, 2010). This happens when there is more water upstream than usual and as it flows downstream to the adjacent low-lying areas (also called a floodplain), there is a burst and water gets into the land. In many cold regions, heavy snow over the winter usually stays un-melted for some time. There are also mountains that have ice on top of them. Sometimes the ice suddenly melts when the temperature rises, resulting in massive movement of water into places that are usually dry.

The surrounding area is affected in such a way that when floods rise, no activity can take place. Instead, there is serious displacement of people's settlements, destruction of crops, and claiming of people's lives in case this gets to the extreme. Most important to note is that the floods that were reported here do not necessarily come direct from Lake Victoria but the lake just fails to balance atmospheric gases leading to unusual precipitation that results in those negative experiences.

4.8 Growth of crops

Accordingly, certain crops such as wheat and rice grow well in high temperatures while others such as maize and sugar cane prefer cool climates. Therefore, the study was designed to find out whether changes in temperature had some effect on growth of some of these crops. In response, Table 4.2 shows that the statement was true *(Mean =1.98240; df = 340; CI = 95%)*.Temperature is a primary factor affecting the rate of plant development (Margareb, 2010). Warmer temperatures expected with climate change and the potential for more extreme temperature events will impact plant productivity (Arnette, 2013). Pollination is one of the most sensitive phonological stages to temperature extremes across all species and during this developmental stage temperature extremes would greatly affect production.

4.9 Plant Growth

Change in temperature and rainfall affects how well plants and crops can grow thus causing famine ***(Mean =1.77713; df = 340; CI = 95%).*** This is in two ways. First, crops such as maize and beans have a period in which they need too much rain especially when they are sprouting. However, if they are flowering, they require minimum amount of rain and sunshine. At harvest again, there is need for sunshine because after harvesting, if they are not dried, they rot (Sims, Rogner, & Gregory, 2003). In other words, throughout the entire process of agriculture, rain and temperature are needed interchangeably. The effect of these changes in this context varies. If there is too much rain at flowering, no better fruits are put on the maize plants. In the same way if rain is experienced at planting and period of sprouting, crops become stunted, which is a sign of famine in the community. In addition, most vegetables are categorized into two types: cool-weather and warm-weather. Cool-weather plants do well in the spring and fall, while warm-weather plants prefer plenty of sun and heat.

4.10 Marine Life

Table 4 shows that changes in temperature and rainfall patterns leads to loss of marine life such as fish species *(Mean =1.92962; df = 340; CI = 95%)*. In most cases, depletion of marine life happens because fish such as Tilapia (which no longer exists in Lake Victoria) survives by certain level of temperature (Nate, 2017). Too much heat may not favour survival of such species. Indeed it is not easy to find Tilapia in Lake Victoria at the moment. One of the negative implications is that such species are good for tourists. Besides, they are a source of balanced diet thus malnutrition easily sets in when they are no longer in the lake. The marine environment is already registering the impacts of climate change. The current increase in global temperature of 0.7°C since pre-industrial times is disrupting life in the oceans, from the tropics to the poles.

Other Marine species affected by climate change include plankton - which forms the basis of marine food chains - corals, fish, polar bears, walruses, seals, sea lions, penguins, and seabirds. The Intergovernmental Panel on Climate Change predicts a further rise of between 1.4°C and 5.8°C by the end of the century. Climate change could therefore well be the knock-out punch for many species which are already under stress from overfishing and habitat loss (McPhaden, 2002).

Human activities are releasing gigatonnes of carbon to the Earth's atmosphere annually. Direct consequences of cumulative post-industrial emissions include increasing global temperature, perturbed regional weather patterns, rising sea levels, acidifying oceans, changed nutrient loads and altered ocean circulation. These and other physical consequences are affecting marine biological processes from genes to ecosystems, over scales from rock pools to ocean basins, impacting ecosystem services and threatening human food security (Van, Linden, & Hanson, 2007). Most important to note also is that the rates of physical change are unprecedented in some cases. Biological change is likely to be commensurately quick, although the resistance and resilience of organisms and ecosystems is highly variable. Biological changes founded in physiological response manifest as species range-changes, invasions and extinctions, and ecosystem regime shifts. Given the essential roles that oceans play in planetary function and provision of human sustenance, the grand challenge is to intervene before more tipping points are passed and marine ecosystems follow less-buffered terrestrial systems further down a spiral of decline (WHO, 2008). Although ocean bioengineering may alleviate change, the principal brake to climate change remains reduced CO_2emissions that marine scientists and custodians of the marine environment can contribute to. This review describes present-day climate change, setting it in context with historical change, considers consequences of climate change for marine biological processes now and in to the future, and discusses contributions that marine systems could play in mitigating the impacts of global climate change.

Research by Crowley (2000) shows that when Earth formed about 4.2 billion years ago there were no oceans; thus, since then, as surface water has accumulated, the filling ocean basins have been the reaction chamber for the development of life on earth and have played a fundamental role in the ongoing evolution of the planet's climate. Crowley continues that no credible discussion of physical climatic processes on Earth can be conducted without consideration of the seas and oceans, and it is becoming increasingly apparent that rather than just being passive occupants that are impacted by physical change life forms in the ocean make active and climate-influencing contributions to planetary function.

4.11 Settlements near Lake Victoria

Another effect of changes in temperature and rainfall is in destabilizing of settlements near Lake Victoria *(Mean =1.76246; df = 340; CI = 95%)*. Human livelihoods and many economic activities depend on water, and human settlement is naturally drawn towards rivers, lakes and the coast. However, if augmented by heavy rainfall, snowmelt or storm surges, the water can rapidly turn from blessing to threat, and flooding may endanger lives, cause displacement and suffering, damage assets that have been assembled over long periods of time, and cause major economic losses. Managing flood risk is likely to become an even greater challenge in the future, with climate change impacts expected to increase the frequency and intensity of flooding events.

Lupaka (2012), in explaining about floods in East Africa and mostly countries like Uganda states that Climate change [changes in temperature and rainfall] manifests itself in, amongst other things, storm occurrence and flooding. This problem is further compounded by unguided rapid urbanisation and limited capacity of urban local authorities to address this issue. For example, most of the informal settlements lack storm-water drainage channels that are designed and built to engineering standards. The lack of storm-water drainage channels in settlements that are rapidly densifying is a major cause of flooding. This is due to the fact that as densification increases, water run-off from the roofs of buildings alters the urban land cover and land surface, including blocking existing natural storm-water drains. Poor solid waste management in the settlements further complicates the problem.

In countries such as Turkey, In Turkey, floods are reported to be the second most common cause of loss of life and property from disasters, to earthquakes and they are encountered primarily in urban areas that developed in varying locations. A total of 428 floods and flooding events, leading to 176 deaths, were reported between 2001 and June 2011. This continues to justify how floods are a very serious problem experienced in many countries of the world and requiring immediate attention to save lives of people.

4.12 Incomes of Business Enterprises

Changes in temperature and rainfall patterns translate in reduction in regular incomes of business enterprises ***(Mean =1.54839; df = 340; CI = 95%)***as indicated in Table 4.2. take an example, if floods become too much to the extent of destroying people's property, it is probable that such communities need to start life afresh. In most cases, gaining the economic level after going through a period of floods may require intervention of charity or donor agencies. The lifestyles of community are affected, incomes of households and limited choice is realized in the regular desires of one's heart.

4.13 Revenue to the Central Government

The central government collects revenue from various sources including mainly business people. As already identified in the social-demographic characteristics, Jinja and surrounding areas to the municipality. According to Table 4.2, the statement was significant such that *(Mean =1.71848; df = 340; CI = 95%).*

Other effects are not largely applicable in the context of Lake Victoria basin and these are two: Increased frequency of cyclone and Increase in the intensity of salinity in land *(Mean =1.71848; df = 1.54252; CI = 95%)* and Crop failure/ severe impact on food and nutrient security *(Mean =1.71848; df =* 2.21701*; CI = 95%)*.

Results in Table were computed and a one way AONVA analysis conducted to establish whether there were variations in responses based on the respondents' category. Findings were obtained as indicated in Table 6.

Table 6: Variations in responses on implications of changes in temperature and climate on community by respondents' category

	N	Mean	Std. Deviation	df	F-value	p-value
Employees in Industries	106	1.7629	.40201			
Business owners around	107	2.0312	.29494	2	22.640	.000
Agriculturalists	128	2.0885	.43617	338		
Total	**341**	**1.9693**	**.40979**			

Descriptive statistics reveal that there are variations in responses and that these variations were dependent on category of respondents. Table 6 indicate that the mean scores for business owners around Lake Victoria basin (2.0312), and the mean score for agriculturalists (2.0885) vary significantly with the mean score for employees in industries. Using a scale of "True-1" "Not Sure-2" or "False-3" in these ranking, high mean scores for the business owners and agriculturalists show that the opinions about implications of change in temperature and rainfall illustrated in Table 6 were to a large extent not applicable to business owners and agriculturalists. On the other hand, a low mean score among the employees in industries indicate that in the views of employees in industries, the implications of changes in temperature and rainfall stated in Table 4.5 above were applicable.

To find out whether the variations observed were significant, the popular p-value of 0.05 was used against the obtained p-value in Table 6 above. In this context, results of the study are significant if the p-value obtained is less than the popular p-value (0.05) as indicated in Table 6. Therefore, in this study, it is significant that employees in industries in the Lake Victoria Basin feel the implications of changes in temperature and rainfall

by far more than the business owners and agriculturalists.

5. Conclusion and Recommendations

5.1 Conclusions

Changes in temperature and rainfall in the Lake Victoria basin mostly has negative implications on communities in the areas. One of such implications is occurrence of floods due to natural expansion of water and this flood occurrence tend to create displacement of people, and significant effects on crop growth especially during high temperatures since most crops cannot grow well in high temperatures, loss of marine life such as fish species is experienced due to acid rain and disposal of wastes in the lake, and there is also reduction in regular incomes of business enterprises owing to the fact that due to floods, some areas cannot sustain businesses.

Climate change was found to have significant effects mostly on the female gender given the fact that they do most of the work such as cultivation, firewood collection, fetching water, among others which necessitate environment. Negative climate changes cause floods, droughts, storms which destroy harvests and loss of trees in compound and garden, which affect more female gender than the males. The male gender is only bothered if climate change causes destruction of shelter.

5.2 Recommendations

Stakeholders should use social media to communicate to youths, middle-aged and elderly about the dangers of interfering with climate in Jinja such that each person becomes participant in these global climate change adaptation endeavours.

Gas-smart cars, such as hybrids and fully electric vehicles, save fuel and money. And once all cars and light trucks meet 2025's clean car standards, which mean averaging 54.5 miles per gallon, they'll be a mainstay.

Forego Fossil Fuels, considered to be the most daunting challenge as denizens of nations literally eat, wear, work, play and even sleep on the products made from such fossilized sunshine.

Infrastructure Upgrade; Investing in new infrastructure, or radically upgrading existing highways and transmission lines, would help cut greenhouse gas emissions and drive economic growth in developing countries.

House to house sensitization with focus on gender participation should be one to equip both gender with knowledge on the dangers of destroying tree cover and the importance of keeping green environment at home and outside.

In response to traditional treatment of men towards their wives, men need to let their wives freely participate in various programs because most of the climate change effects largely affect their wives.

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