SMALL SCALE FARMERS AND RESILIENCE ADAPTIVE STRATEGIES TO CLIMATE CHANGE IN KAKAMEGA COUNTY

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ABSTRACT

Kakamega County is a rich agricultural area where various food and cash crops are grown. However, changes in climate coupled with declining soil fertility over the area have an impact on crop production, and hence affect food security especially among small scale farmers. On the basis of this scenario, this study sought to explore the existence and determine the characteristics of climate variability/change, assess its impact on small scale farmers and explain their resilience and adaptive strategies. The study adopted a descriptive survey design. Data from both primary and secondary sources were used. The latter included data collected from meteorological stations and was mainly rainfall and temperature data for a period of 46 years (1968-2014) to establish any existence and characteristics of climate variability/change in the study area. Primary data included Focal Group Discussions (FGDs), questionnaires and interview schedules administered to farmers to gain information on trends on crop production and adaptation strategies to climate change if any. Regression analysis was used in the study to establish the rainfall and temperature trends. Spearman rank correlation test was used to establish any existence of relationships between various variables under study. It was established that there were changes in rainfall amounts and temperature in the region. The rainfall amounts were having a negative trend of 3mm per annum, a sign of reduction over time, whereas temperatures had a negative trend of 0.04 ^{0} C on yearly basis. Despite these changes in climate crop farmers had put in practice some adaptation strategies to cope with the changing trends, though they were faced with many challenges in trying to implement these strategies.

Key Words: *Climatic Change, Adaptation Strategies, Small scale farmers.*

1.0 Introduction

Agriculture, especially in developing countries, is extremely vulnerable to climate change particularly to adversities of weather, not only because farmers are dependent on rain but because farming is subsistence oriented and is practiced with relatively basic knowledge and or technologies on small pieces of land. These small holder farmers already practice under pressure from food insecurity, increased poverty and water scarcity (Oxfam 2010, CEEPA 2006, Regassa *et al.*, 2010).Higher air and soil temperatures eventually reduce yields of desirable crops while encouraging weed and pest proliferation. Changes in precipitation patterns increase the likelihood of short-run crop failures and long-run production declines. Although there will be gains in some crops in some regions of the world, the overall impacts of climate change on agriculture are expected to be negative, threatening global food security.(IPCC,2007)

In Kenya agriculture remains central to the economy and the growth of the sector is positively correlated to the growth of the overall economy according to the Agricultural Sector Development Strategy (2009-2010). The sector contributes 24% of the national Gross Domestic Product (GDP) and employs about 70% of the population in both basic production and industry in Kenya (GOK 2009). The majority of the Kenyan population is involved in subsistence agriculture which is vulnerable to weather shocks especially the lack of adequate moisture. (Irungu *et al.,* 2009). This is especially so since agriculture in Kenya is mainly rain fed and is practiced by smallholders, hence the need for various coping mechanisms (Macharia *et al.*, 2010).

The issue of climate change as witnessed in the 21st century is a major threat facing humanity. The fourth assessment report of Intergovernmental Panel on Climate Change (IPCC) of 2007 indicates that climate warming is unequivocal and observations show an increase in global average air and ocean temperature, widespread melting of snow and rising global mean sea level. At continental and regional levels, numerous long term changes in climate have been observed and include widespread changes in precipitation amounts and distribution, ocean salinity, wind patterns and aspects of extreme weather resulting to droughts, heat waves, and intensity of tropical cyclones. These changes threaten community livelihoods, food security, economic sectors, ecosystems and social groups (Watson *et al,*. 1998; O Brien and Leichiko, 2000). The socio-economic sectors that are adversely affected include water resources, agriculture, forestry, fisheries and human settlements, ecological and human health.

African countries are particularly vulnerable to climate change because of their dependence on rain fed agriculture, high levels of poverty, low levels of human and physical capital, and poor infrastructure. The negative effects of climate change on crop production are especially pronounced in Sub-Saharan Africa, as the agriculture sector accounts for a large share of Gross Domestic Product (GDP) export earnings, and employment (IFPRI, 2009). Consequently, without appropriate responses, climate change is likely to constrain economic development and poverty reduction efforts and exacerbate already pressing difficulties.

Agriculture is at the forefront of shaping the concept of sustainable development for many developing countries, particularly Kenya. The renewed attention for the role of agriculture in development processes will have to take account of the vulnerabilities and risks posed by climate change. In Kenya the general observation is that impacts of climate change exist and may have affected some of the keysectors of the economy which are highly depended upon by the local communities. Agricultural production, environment, energy, forest, tourism, infrastructure and public health are bearing much of the impact. At the moment the country is facing severe drought that has resulted in extreme hunger among some parts of the population and the death of significant numbers of livestock, power rationing and increased conflicts over dwindling water resources.(Kuria,2009)

Climate variability and changes in Kenya have been well studied (Obando *et al*., 2007. However very little is known related to the effects of climate change on crop production and yet climate change is the most significant environmental threat of the 21st century (Thornton et al 2006). Population increase has led to the mushrooming of unplanned settlements, increased agricultural activities and deforestation which has led to changes in land uses in various areas.

Crop production is highly sensitive to climate variability and weather extremes, such as droughts, floods and severe storms. The forces that shape our climate are critical to farm productivity. Human activities have already changed atmospheric conditions such as temperature, rainfall, levels of carbon dioxide and ground level ozone (Thornton *et. al.,* 2006).While food production may benefit from a warmer climate in temperate regions (IPCC 2007) the increased potential for droughts, floods and heat waves will pose challenges for farmers. Additionally, the enduring changes in climate, water supply and soil moisture could make it less feasible to continue crop production in certain regions. Recent studies in Kenya indicate that increased frequency of heat stress, droughts and floods affect crop yields and livestock beyond the impacts of mean climate change, creating the possibility for surprises, with impacts that are larger and occurring earlier, than predicted using mean variables alone.(Kuria, 2009). This is especially the case for subsistence sectors of farming at low latitudes.

On the basis of the aforesaid, the main objective of this study was to investigate climatic changes and their impact on small holder farmers and response adaptation strategies in Kakamega County. Specifically, the study sought to analyse patterns and trends of climate change in Kakamega County between 1968 and 2014 and assess coping strategies to such climate changes and how these impact on small holder farmers in Kakamega County in Western Kenya.

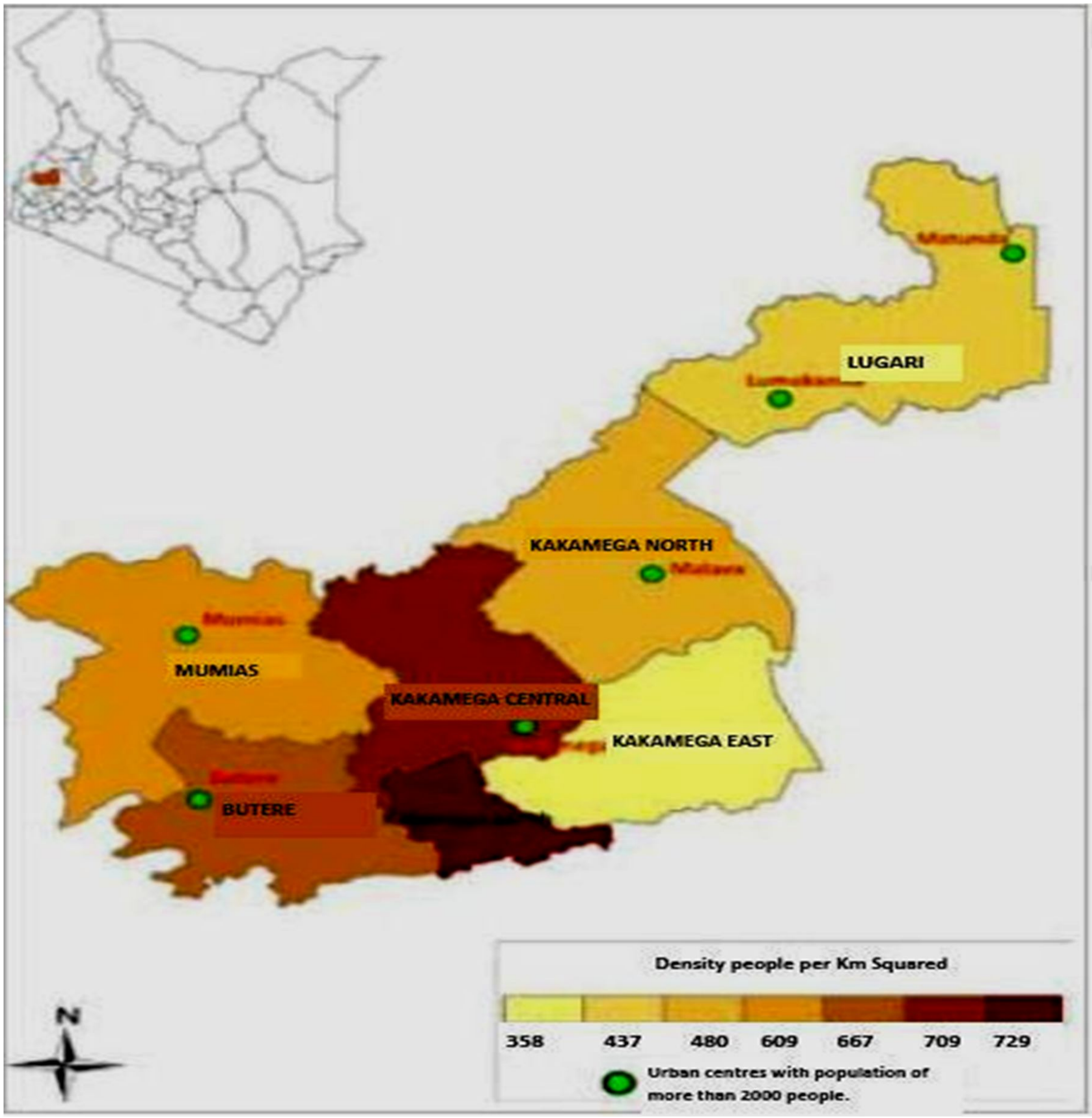
2.0 Methodology

The study adopted a descriptive survey design because of the large amount of data from the population regarding resilience to climate change impacts by small scale farmers in Kakamega county of Kenya.

2.1 Study Area

Kakamega County is located in the former Western Province of Kenya. Its capital is Kakamega and its largest town is Mumias. It has a population of 1,660,651 and an area of 3,224.8 km². It is located on coordinates: 0.283333°N 34.75°E and covers an area of 3224.9 KM^2. It is located at an altitude of 1520 – 1680 metres above sea level and has 12 sub counties namely Lugari, Ikolomani, Mumias, Likuyani, Malava, Shinyalu, Butere, Lurambi and Khwisero, as shown in Fig. 1 below.

Figure 1 Map showing Kakamega County administrative units



The climate of the area is described in terms of precipitation and temperature. The rainfall amounts range from about 1200 mm to 2000mm per annum, and is bimodal as it occurs in two rainy seasons. The long rains occur in the months of April to June while the short rains occur in October to November, with a short dry season between December and March. The daytime temperatures are about 30.8°C whereas at night they drop to up to 9°C with yearly mean of about 20.5°C. Evaporation ranges from 1600mm to 2000 mm.The climate is mainly tropical, with variations due to altitude.

The soils are deeply weathered, poor to moderate in their nutrient content and partly acidic with pH of less than 5.5 and have low organic carbon of less than 2%, high bulk density, more sandy in texture and have low basic cations.

The soils are deficient in nitrogen and phosphorous though efforts are being made to address the declining soil fertility including the use of organic manure, fertilizers and terracing. However poor utilization of inorganic fertilizers in both amounts and types is evident (Nandwa *et al*,. 2001).
Kakamega County has various drainage features such as River Yala, and River Nzoia. The rivers are permanent due to heavy rains that occur in the area. Geomorphologic features determine the vegetation of the catchment area. There is an evergreen forest; Kakamega Forest, a preserve which is a remnant of a rainforest that initially stretched west through Uganda.
Agriculture is the main economic activity with 62% of the population involved mainly in crop farming of maize and beans for subsistence use, tea, in some parts of the county, on small scale, and sugarcane as a major agricultural activity, largely on large scale in areas around Mumias. Animal keeping of local breeds and dairy farming is also practised on small scale.
The study area has a population of about 1,660,551 people according to the 2009 population and housing census with ratios of 48% men and 52% women but the population has been increasing rapidly over the years. The population density is 515 per square kilometer and has the following age distribution (0-14 years at 46.6%) 15-64 years (49.7% while 65+ years is at 3.6%. There are approximately 358,709 households (CBS 2009). Most of the population tends to settle around towns and trading centres and Kakamega municipality has about 1485 persons per square kilometer. Annual population growth is estimated at 2.12%. Rapid population growth has implications on land resources such as the depletion of water resources, cultivation of marginal lands, over cultivation leading to land degradation . This unsuitable land management practices have impacts on the long-term climatic trends of this area.

2.2 Sampling procedure and sample size

Kakamega County consists of 9 sub counties which have various agro- ecological zones with variations in soils, rainfall amounts and even the type of crops grown. All the agro–ecological zones constituted the study sites targeted for sampling the study households. The study made use of the Morgan table and out of a population of 353,700 households a sample size of 387 households was derived. This was later randomly sampled in each of the nine sub-counties.
In the next stage, stratified sampling was used to apportion the 387 households to the various agro-ecological zones and according to the number of households and thereafter a simple random sampling was used to choose the households and accordingly, a sample size tabulation was obtained as shown in table 1

Table 1: Sample size Tabulations

Sub county	No. of households	No. of Households randomly picked
Ikolomani	23,144	24
Shinyalu	34,177	36
Butere	23,220	24
Lurambi	65,121	69
Likuyani	30,476	32
Malava	40,635	43
Khwisero	30,121	32
Mumias	78,685	84
Lugari	29,121	43
Total	353,700	387

Source: Central Bureau of Statistics 2009 for household per sub-county

2.3 Methods of Data collection and Analysis

Both primary and secondary data was collected. Primary data included climate change adaptation strategies, crops grown, family sizes, education levels, gender, land tenure, farming experiences and farmers perceptions on climate change issues. This was collected using questionnaires administered to household heads who constituted the respondents. Interview schedules from key informants were used to gain information from agricultural officers and meteorological officers in various capacities in the county. Focal group discussions were used to collect extra data and validate the data that was collected from the other sources.

Secondary data collected included climatic data that was retrieved from the meteorological stations within the area of study. This was mainly from Kenya Meteorological Department but more specifically data from Kakamega Meteorological Station and Butere Meteorological Station.

Household interviews were carried out in the project area using open- and close-ended questionnaires. A sample of households was selected through a double-stage (multi-stage) sampling procedure then random sampling was done to find out the farmers' views and perceptions on issues of climate variability and change and crop production and mitigation measures that are put in place. Focus group discussions (FGDs) were conducted in between the household surveys. The focus group sessions were carried out in at least three out of the twelve sub counties. Between 20 and 30 people participated in each of the FGDs. The FGDs was used to probe socioeconomic issues from the survey questionnaire that needed further clarification. The discussions focused on socioeconomic topics especially crop production, climate change and climate mitigation measures in the area. A checklist of questions was used to guide the discussions. The focus group sessions were conducted to gain insight into the dynamic relationships of attitudes, opinions, motivations, concerns and problems related to current and projected human activity with respect to the area. The sessions also served as a means of understanding the behavior and perceptions of the people, who are affected by climate change towards and to identify ways and means to influence this behavior.

In order to ensure validity and reliability, the questionnaire was composed of carefully constructed statements/items to avoid ambiguity and in order to facilitate answers to the research questions. The questionnaire was pre-tested to evaluate it for clarity, style, meaningfulness and ease or difficult of completion. The questionnaire was found to be lengthy, but all agreed that the items and information sought were necessary and relevant to the study. Revision of the questionnaire was made based on the feedback to ensure consistence and quality prior to final distribution. This assured that the questionnaire was clear and well-understood by potential respondents (Huang and Lee, 2013)

The collected data was subjected to both quantitative and qualitative analyses using standard statistical packages to extract various information including household characteristics, climate change strategies and climate change trends of the area, status of livelihoods in the study area, constraints to livelihood improvements, and opportunities for poverty reduction as an incentive for forest conservation.

2.3.1 Rainfall and Temperature Analysis

To get the trends of rainfall over this period of study, monthly, seasonal, annual and decadal analysis were done. To get the actual representation and the structure of the monthly rainfall distribution for each month for the period (1968-2014), Regression analysis was used, to understand the changes over this period.

The monthly rainfall and temperature values were plotted against the time (years) for the period of 1968-2014). This was done for all the months starting from January to December for the years from 1968 to 2014. This resulted in linear graphs, which showed the general distribution of the monthly rainfall amount. The linear regression equation was obtained for each of the month (January to December) showing how rainfall had been changing over time.

2.3.2 Analysis of Climate Change Adaptation Strategies

This research established the climate change strategies that are being used by farmers in the study area. The strategies were ranked accordingly to establish the most commonly used strategies for adaptation to climate change. The analysis was done thematically using the various themes that emerged from the data collected from the data collected and have several sub topics to evaluate on the various adaptation strategies. The findings were subjected to Spearman's rank correlation to establish if there were any correlations between certain variables and adaptation strategies.

3. Demographic characteristics

The study sought to establish the age of the respondents and according to the findings, 17.1% of the respondents were between 20 – 24 years while 10.5% of them were aged between 25 – 29 years. A further 18.4% of the respondents were aged between 30 – 34 years while 9.2% of them were aged between 35 -39 years. At the same time, 7.9% of the respondents were aged between 40 – 44 years while 13.2% of them were aged between 45 – 49 years. The respondents aged between 50 – 54 years were 13.2% while another 6.6% of them were aged between 55 – 59 years. Finally, the oldest respondents of over 60 years were 3.9%.

It is notable that most farmers within this region are those within the ages of 30-34 years and therefore the assumption is that these are people who understand well the issues involved in farming and are armed with necessary information regarding climate change adaptation strategies that can be well achieved and adhered to.

This study also established the respondents' gender. Majority of the respondents were male constituting 67.5% while females were 32.5%. In many households in the study area most agricultural activities are planned by men and this meant that most women, apart from those single headed households, were left out on issues of agricultural production, climate change and even adaptation strategies that could be suitable in the area. It is worth noting that 80% of women in Kenya are involved in agricultural activities such as weeding and harvesting but when it comes to agricultural planning/calendar they are left out.

3.1 Levels of education

It was necessary to establish the level of education of the respondents, and the findings indicate that (10.0%) of the respondents were of Primary level while a further (36.3%) were at secondary school level. At the same time, (26.3%) of the respondents had reached tertiary level while (27.5%) had reached university level. There was need to establish if there was any significant relationship between level of education of farmers and their adaptation to climate change. Notably from the findings, there seemed to no significant difference since most farmers have attained secondary level of education yet, as will be shown later, they have adopted minimal adaptation strategies.

3.2 Household Sizes

There was need to establish household sizes for the families. The findings indicate that (46.8%) of the respondents had a household size of below 4 individuals while (43.0%) of them had a household size of between 5 – 9 individuals. At the same time, (6.3%) of the respondents had household sizes of between 10 – 14 individuals while (3.8%) of them had households of above 15 people. Household sizes are necessary for one to understand how the members are involved in various aspects of farming. Secondly it was necessary so that we could deduce implications of family sizes on family resources and even income from farming and how it affects climate change adaptation.

3.3 Farming experiences of the respondents

The study further established the respondents' farming experience and the findings indicate that (16.5%) of the respondents had a farming experience of between 0 – 4 years while (30.4%) of them were had a farming experience of between 5 –9 years. A further (8.9%) of the respondents had farmed for between 10 – 14 years while (10.1%) of them had farmed for between 15 - 19 years. At the same time, (15.2%) of the respondents had been involved in farming for a period of between 20 – 24 years while (16.5%) of them had farmed for a period of between 25 – 29 years. Finally, (2.5%) of the respondents had been farmers for a period of over 30 years.

Farming experience is an important aspect in agriculture. Notwithstanding the number of years one has been involved in agricultural activities, one can be able to even predict their production, understand certain scenarios involved in farming and gain more information and knowledge with regard to whatever farming activity they are involved in.

3.4 Main crops grown in the region

This study sought to establish the main crops that are grown by these small scale farmers and the findings were as shown in Table 2 below.

Table 2: Main Crops Grown in Kakamega County

Crop	***Percentage***
Millet	4.4%
Maize	31.1%
Cassava	1.3%
Sugar cane	12.3%
Potatoes	4.4%
Beans	18.4%
Sorghum	1.8%
Vegetables	8.3%
sun flower	2.6%
Banana	5.7%
Peas	0.9%
Napier grass	0.4%
Ground nuts	1.8%
Marandas	0.4%
Coffee	0.4%
Pepper	0.4%
Egg plant	0.4%
Beet root	0.9%
Tomato	0.4%
Onion	0.4%
Fruits	0.9%
Cucumber	0.4%
Tea	1.3%
Arrow roots	0.4%
Total	*100.0%*

Results in the table above indicate that maize is the most common crop grown by farmers in the county with (31.1 %.) followed by beans with 18.4% and sugarcane with 12.3 %. Together, these crops account for over 60% of the crops grown in the study area.

3.5 Monthly Incomes from farming activities

In addition, this study sought to establish the respondents' monthly income from farming activities. Results indicate that (1.3%) of the respondents had a monthly income of below Ksh. 5000 while (20.5%) of them had a monthly income of between Ksh.5,000 –10,000. A further (48.7%) of the respondents had a monthly income of between Ksh.10,000 – 20,000 while (29.5%) of them had a monthly income of over Ksh.20,000.

3.6 Farm sizes of farmers

The study further established the respondents' farm size. See Table 3 below for the findings.

Table 3: Farm Sizes of Farmers in Kakamega County

Farm Size	Percentage (%)
0-1 ha	35.4
2-3 ha	40.5
4-5 ha	15.2
6-7 ha	3.8
8-9 ha	1.3
Above 10 ha	3.8
Total	**100.0**

The findings in the table reveal that over 90% of the farmers in the study area had less than 5 hectares of land under farming, an indication that the majority of the farmers are small scale. It was necessary to establish if farm sizes had an influence on the way farmers adapted to climate change as it is well known that if farming is taken as business the chances of farmers being keen on production and yields will be given a priority as compared to those that take farming merely as a tradition. In addition, it was established that (97.4%) of the respondents owned land while only (2.6%) had leased the land.

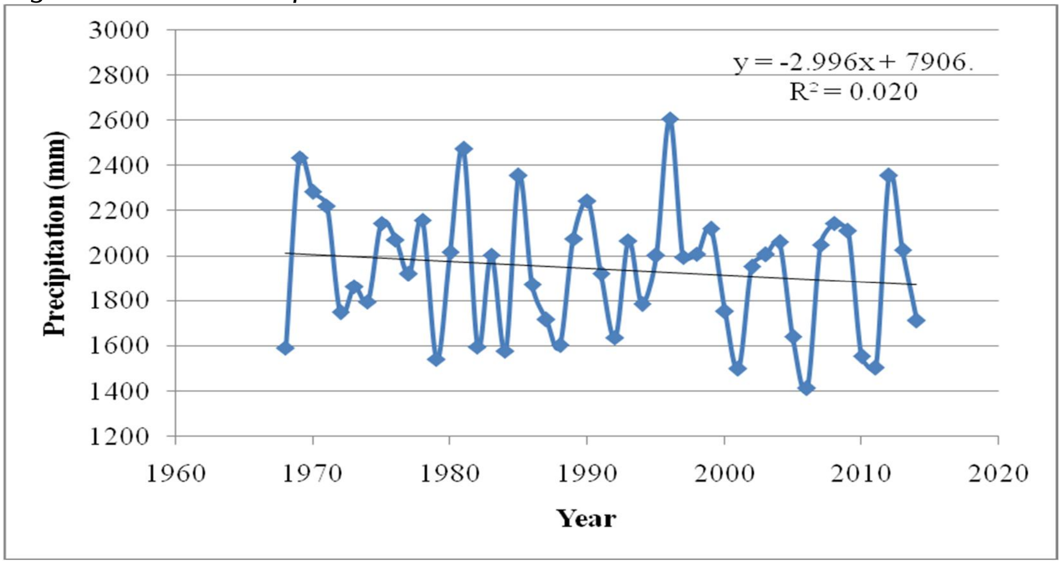
4. Trends in Rainfall and Temperature Amounts for the Period 1968-2014

Rainfall and temperature are important weather element s that impact on crop production, hence any minimal variation or change in rainfall and temperature amounts and even regimes would affect crops. It is worth noting that these elements are important for most of the physiological processes that take place in a plant cycle, starting right from seed germination to harvesting.

4.1 Rainfall Trends

Results in the figure below indicate that there was a regression coefficient of 0.46. This shows that there was a positive linear trend in January precipitation as from 1968 to 2014. This implies that as the years went by, the January precipitation increased and for every additional year, the precipitation increased by 0.46mm. Consequently there is likely to be an increase in the precipitation in the month of January in future years. Though this will not have an implication to the growing season of farmers within the study area as the rainfall amounts are not enough for the season. It is also notable that January is the month when most farmers cultivate their land in anticipation of the long rains which start around March.

Figure 2: Annual Rainfall Amounts

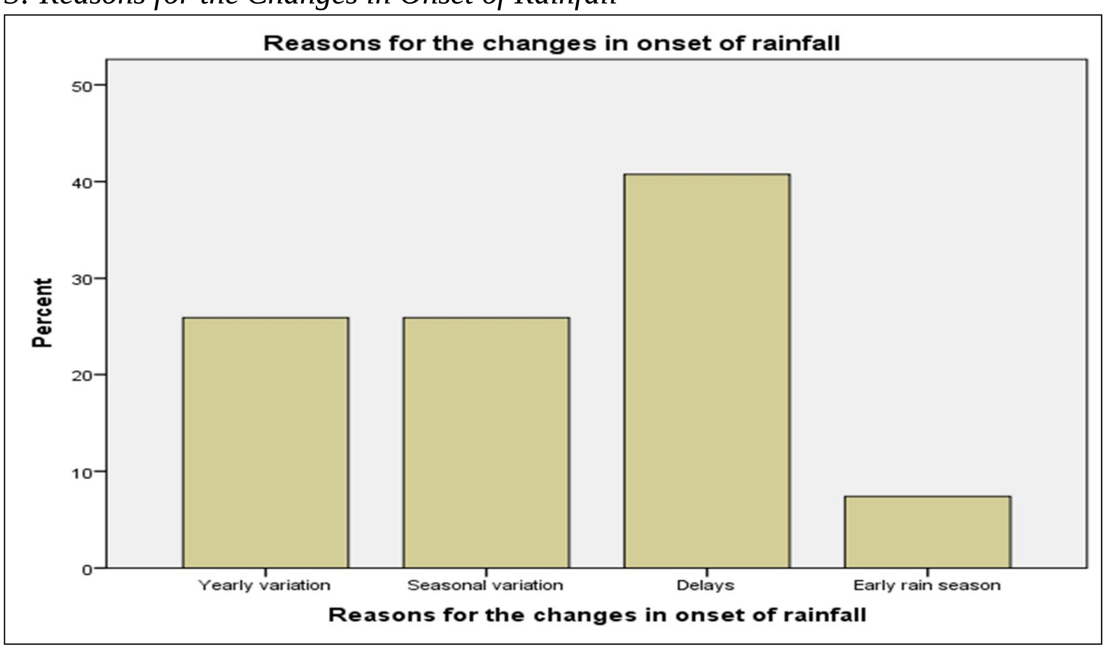


4.1.1 Long Term Mean Rainfall over the last 20 years

In addition to the annual rainfall amounts, this study established whether there was long term mean rainfall over the last 20 years. Findings indicate that (89.2%) of the respondents reported that there was long term mean rainfall over the last 20 years while a further (10.8%) of them indicate that there was no long term mean rainfall over the last 20 years.

At the same time, this study established reasons for the changes in the onset of rainfall and the findings are as shown in Figure 3 below with the majority of the respondents (40%) indicating that the changes are mainly as a result of delays in onset.

Figure 3: Reasons for the Changes in Onset of Rainfall



4.2 Temperature trends

As shown in figure 4 below, general temperature trends have been increasing over the years under study. This trend is also likely to continue in the future, hence the need for intervening measures to cushion farmers from the effects of such trends.

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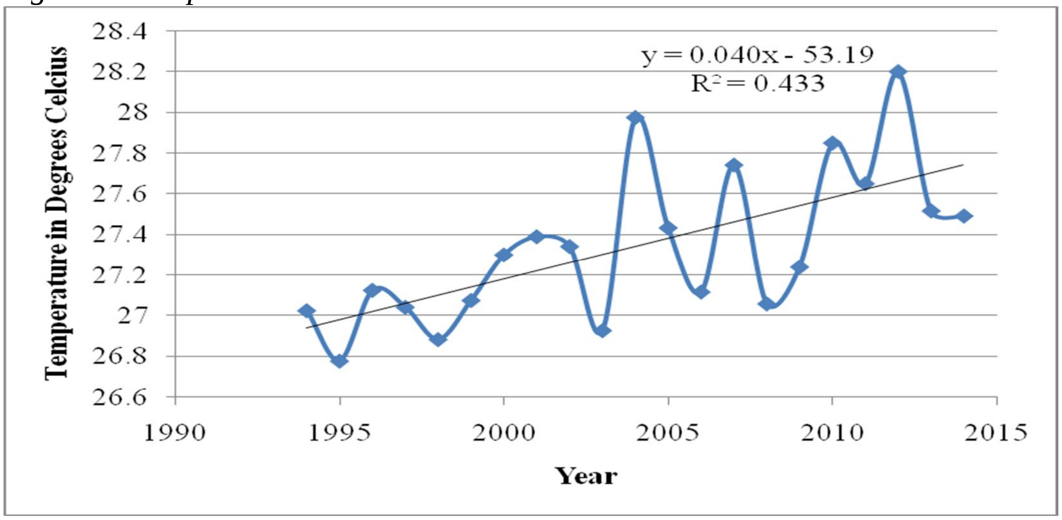
Figure 4: Temperature Amounts



4.2.1 Perceptions of farmers to temperature trends over the last 20 years

There was need to establish farmers perceptions on temperature changes over the last 20 years and the following was revealed. (76.8%) of the respondents reported that the number of hot days had increased while another (13.0%) of them indicated that the number of hot days had declined. On the other hand, (10.1%) of the respondents indicated that the number of hot days remained the same.

4.2.2 Reasons for Long Term Changes in Mean Temperature

The study further sought to establish farmers' perceptions on the causes of long term changes in mean temperature over the last 20 years. Results indicated that (14.3%) of the respondents thought that mean temperature changed due to deforestation while (33.9%) of them indicated that the change in temperature was due to increase in temperatures in certain months. At the same time, (5.4%) of the respondents revealed that change in temperarture was due to global warming while another (7.1%) of them felt that the change in temperature was due to decrease in certaing months. Furthermore, (28.6%) of the respondents felt that the change in temperature was due to inconsistency with another (10.7%) of them indicating that the change in temperature was due to other reasons.

4.2.3 Adjustments made to Farming

There was need to establish the adjustments made by the farmers on how they were coping with the increase in number of hot days and the findings indicate that farmers are engaged in a number of activities with agroforestry, irrigation, and planting of drought resistant crops alone accounting for over 40% of the activities. The findings are shown in Table 4 below.

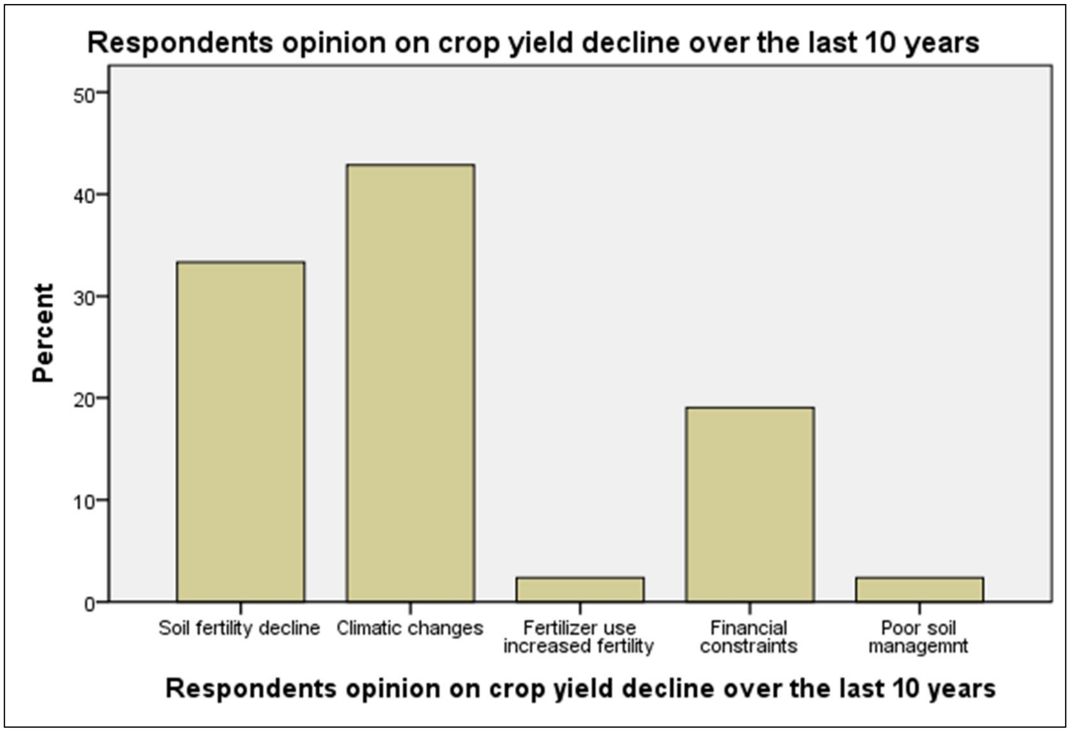
Table 4: Intervention Strategies to Cope with Temperature Trends

Adjustments made	Frequency (F)	Percentage
Mulching		9.3%
Agroforestry		15.0%
Irrigation		12.1%
Timely planting		9.3%
Plant drought resistance crops		17.1%
Planting early maturing crops		10.0%
Rain water harvesting and storage		2.9%
Good farming practices		10.0%
Other		14.3%
Total		**100.0%**

5. Crop Yields over the last 10 Years

After establishing the effects of rainfall and temperature trends, and the intervention strategies, there was need to determine what the farmers felt about the trend in their crop yields over the last 10 years. The findings indicated that most farmers (61.5%) felt that their crop yields had been declining over the last 10 years while the rest of the respondents (38.5%) reported that their crop yield was increasing. The study also sought to establish the respondents' opinion on the reasons for the decline of crop yields over the last 10 years. As shown in figure 5 below, most of them (42.9%) attributed this to changes in climate while, (33.3%) of them indicated that there was decline in crop yield due to soil fertility decline. It is significant to note that the majority of the respondents attribute the decline in yields to climatic changes. This prompted the need to determine sources of climatic information. The findings indicate that (49.4%), 28. 2%, 1.2% 1.2% of the respondents indicated that they got climatic information through radio television, barazas and extension officers respectively. At the same time, (11.8%) of the respondents reported that they got the information through print media while another (3.5%) got it through weather stations. Furthermore, (3.5%) of the respondents indicated that they got climatic information through seminars while (1.2%) of them relied on the internet.

Figure 5: Respondents' Opinion on Crop yields Decline over the last 10 year



In the face of the decline in crop yield over the years, the study sought to establish whether the people engaged in any other activity to cushion them from the effects of climatic changes. Consequently, it was rstablished that (11.6%) of the people engaged in land preparation, whereas (13.6%) reported that they were involved in planting with another (6.8%) of them indicating that they engaged in sand harvesting. (23.1%) of the respondents indicated that they engaged in local businesses while (3.4%) of them engaged in transport business. At the same time, (0.7%) of the respondents reported that they engaged in storage while (2.0%) of them revealed that they engaged in bee keeping. Another (9.5%) indicated that they engaged in dairy farming while (0.7%) reported that they engaged in real estates. At the same time, (14.3%) of the respondents indicated that (14.3%) of the respondents engaged in social activities while (2.0%) of them resported that they engaged in poultry farming.

6. Conclusion

From the study, it is noted that Kakamega County is generally experiencing changes in its rainfall amounts. The rainfall amounts are declining. This implies that as the years went by, the annual precipitation reduced and for every additional year, the precipitation reduced by 3.00mm. This prediction shows that there is likely to be a reduction in the precipitation in the future years. In addition, it was established that, just like most parts of the world are experiencing increase in temperature, Kakamega County is no exception. It has an upward trend of about 0.04 ^{0} c yearly.

In order to overcome the effects of the aforesaid climatic changes, most small scale farmers in the county have embraced various coping mechanisms. Most common strategies employed include: Involvement in off farm activities, changing form purely crop farming to keeping of livestock and poultry, Taking insurance covers to cushion them from the severe crop losses, soil conservation practices such as mulching; use of animal manure/compost, crop diversification and even growing

of drought tolerant and fast maturing crops, accessing credit facilities, and leasing of land among others.
Despite all the effort and measures put in place by these small scale farmers there are several barriers that are slowing them from appropriately adapting to the changing climate. These include mainly lack of finances, lack of climate information, lack of expertise in implementation of some of the methods, lack of extension services, and even culture.

This study recommends the following:

1. Capacity building must be an integral component of any climate change adaptation strategy due to existing uncertainty within the climate models, particularly at local and national levels. The capacity of smallholder farmers to adapt to climate change is perhaps the most vital area for development. Exception of capacity building, projects should not be undertaken solely for the purpose of adapting to climate change. Building capacity and creating awareness among farmers, extension service providers, Insurance providers, climate service providers and other relevant on issues of climate change. This can be achieved through continuous interaction of stakeholders through meetings, symposiums, exchange visits and workshops.
2. The need to increase the access to accurate and precise climate information to farmers. This could be achieved through dissemination of the information in barazas, use of local fm radios in broadcasting.
3. Provision of financial services that are farmer friendly so that farmers can be able to get credit facilities that could enable them plan more effectively on their various needs.
4. Document best local practices in climate change adaptation and demonstrate them to farmers.

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