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Identification of the Weather Shocks Associated With Rainfall in Kisii Central Sub County, Kisii County, Kenya

Otiso, Clifson Masese[1], Ondimu, Kennedy Nyabuti[1], Mironga, John Momanyi[1]
[1]*Egerton University Department of Geography*

Abstract: *Agricultural productivity in Kenya, as in many developing countries, is significantly affected by rainfall variability. The reliability of the rain for agricultural purposes has reduced in the recent years due to climate variability and change. In the study area, there is a continued trend of more frequent and intense climate related disasters which is expected to have significant impacts on the livelihood activities. Most studies on the impact of climate variability on farming practices and the response strategies have mainly focused on arid and semi-arid regions of Kenya and have used community level data. Information on actual dynamics of lowest possible level such as a household in high potential areas like Kisii is scanty. This study was aimed at identifying the weather shocks associated with rainfall in Kisii Central Sub County, Kisii County, Kenya. Structured questionnaires were administered to a proportionate random sample of 120 households from the four administrative divisions of the sub county. Information from questionnaires were also complemented by oral interviews with key informants from Water Resources Management Authority (WRMA), KARI (currently KALRO), Ministry of Agriculture and FGDs in the study area. Descriptive statistics were used to analyze data with the help of Statistical Packages for Social Sciences (SPSS version 20). The study revealed that gross changes in rainfall patterns have been noticed in the past ten years in the study area. Changes in rainfall patterns in the study area were mainly in form of raining later than normal, unpredictable/erratic rains and longer droughts. These incidences of climate change and variability present a number of socioeconomic and environmental challenges. This study concludes that government (county and national) should realize the urgent need for measures that are geared towards reversing the negative impact of climate change and especially rainfall variability in the study area. The noted gross changes in rainfall patterns noticed in the past ten years have been proved to affect agricultural (crop and livestock) activities in the area and pose a big risk to future food security.*

Keywords: *Weather shocks, Rainfall, Rainfall variability*

I. Introduction

The effect of climate variability and change on natural systems has emerged as one of the most critical issues faced by humankind (UNDP, 2008; Vaga, Jaramillo, Olanye, Kamonjo & Jaramillo,2009; Ojwang, Agatsiva & Situma, 2010; Owolabi, Gyimah & Amponsah, 2012; Makenzi, Ketiem, Omondi, Maranga & Wekesa, 2013). Climate change and variability in Sub-Saharan Africa is already impacting negatively on rain-fed agriculture and livestock systems (ATPS, 2013). Countries in Sub-Saharan Africa are particularly vulnerable to climate change impacts because of their limited capacity to adapt (Bryan, Ringler, Okoba, Koo, Roncoli, Herrero & Silvestri, 2011; IFPRI, 2011). Kenya experiences a number of natural hazards, the most common being related to adverse weather change (UNDP, WMO, GOK, IGAD & DMCN, 2002; IPCC, 2007). Climate change is increasing inter-annual rainfall variability and the frequency of extreme events (Ojwang *et al.*, 2010). Recurrent extreme weather events have high economic implications on the affected households and can trigger food insecurity, thus impacting negatively on the economic wellbeing of the affected communities and can restrict or hamper long term growth (ISDR, 2002; IFPRI, 2011). Climatic variability may affect crop farming and animal production differently, such that it may be favorable to one but unfavorable to the other (IPCC, 2007). Kenyan agriculture is sensitive to climate variability, particularly variations in rainfall. It is therefore important to establish the exact effects of rainfall variability on crop and livestock production in Kisii, a high potential region whose people heavily rely on rain fed agriculture thus making the households vulnerable to the negative effects.

Kenyans rely heavily on rain-fed agriculture for food security, economic growth and employment creation, stimulation of growth in off-farm employment and foreign exchange earnings (NEMA, 2005). Food production is particularly sensitive to climate change, because crop yields depend directly on climatic conditions (Owolabi *et al*, 2012). In the study area, agriculture is highly dependent on rain as irrigation is seldom practiced (NEMA, 2005). Crop productivity depends on agro-ecological factors such as temperature, rainfall amount and distribution, soil characteristics and use of inputs such as chemicals and fertilizers. However, most significant of these factors is the erratic and unpredictable rainfall and elevated temperatures (NEMA, 2005; Barrios, Outerra & Stroble, 2008; Ojwang *et al.*, 2010) that will lead to reduced productivity and an increase in production costs.

The effects of climate change will vary based on locality with some regions becoming unsuitable for cultivation of certain crops and some becoming suitable (Kurukulasuriya & Mendelsohn, 2007; Gbetibouo and Hassan, 2005; IPCC, 2007; UNDP, 2010). Therefore climate change does not only come with detrimental effects but also with some opportunities. However, the probability of disruption of agricultural sector is very high. The future effects of climate change and variability will include increases in short term weather extremes. It is therefore imperative to examine the effects of rainfall variability at household level in Kisii Central sub county.

Research by Thornton (2011) has noted the negative effects of climate change in Kenya. This is due to low adaptive capacity, predominance of rain-fed agriculture and scarcity of capital to adapt (Fischer, Shah, Francesco & Van Velhuizen, 2005; Nnamchi & Ozor, 2009; Speranza, 2010). Over the past years, multiple interrelated factors such as small

fragmented landholdings and minimal access to agricultural inputs, reduced employment opportunities, market inefficiencies have contributed food insecurity and gradually weakening households' livelihoods in Kisii region. The agricultural system in the study area is dominated by intensive small-scale mixed farming. Maize and beans are the main food crops while tea, coffee and are the major cash crops (Omosa, 1998; Olden, Thompson, Bolton, Kim, Hickley & Spencer, 2012), which are highly vulnerable to rainfall variability. Kenya is likely to continue experiencing countrywide losses in the production of key staples such as maize due to rainfall variability (Herrero, Ringler, van de Steag, Thornton, Zhu, Bryan, Omolo, Koo & Notenbaert, 2010). Herrero *et al*, (2010) observes that rainfall variability reduces the production of not only staple food crops such as maize but also other major crops such as tea, sugarcane and wheat. It is primarily for this reason that this region must be put on a high research agenda.

Rainfall variability effects include among others; reduced crop yields, emergence of crop and livestock diseases and pests, delayed planting and harvesting, reduced livestock feeds (fodder) and loss of incomes. To cope with these effects of climate change, rural people draw on indigenous knowledge and innovate through local experimentation and adaptation (Nzeadibe, Egbule, Chukwuone & Agu, 2011; UNESCO, 2012). Communities have long been adapting to climate variability and change (Kristajansen, Neufeldt, Gassner, Mango, Kyazze, Desta, Sayula, Thiede, Forch, Thornton & Coe, 2012). A number of households in Kenya already practice a range of adaptation measures and therefore households in Kisii Central Sub County could be adapting to the changing climatic conditions using traditional knowledge, innovations and practices. Olden *et al,* (2012), notes that there is need for households in Kisii to diversify their farming practices as response to climate variability as the effects have already been felt in the region. It is for this reason that this study sought to examine the effect of rainfall variability as perceived by the households and how it has been affecting their farming practices.

II. Methodology

The study was conducted in Kisii Central sub county of Kisii County, South Western Kenya. The sub county has a population of 365745 persons covering an area of 362.5km^2 making it one of the most densely populated sub counties in Kenya with 1009 persons per km^2 (RoK, 2009). Kisii Central sub county is characterized by a hilly topography with several ridges and valleys. The sub county can be divided into three main topographical zones. Zone one covers area below 1500m above sea level mainly in Mosocho division. The second zone is one with an altitude of between 1500m to 1800m above sea level and is mainly found in Keumbu division, while the third zone is one with an altitude of above 1800m also mainly found in Keumbu and Kiogoro divisions. Soils in the district are generally fertile. Existence of natural vegetation is very limited as over 90% of the total land is under cultivation and homesteads (GoK, 2010a).

This study used a descriptive survey and qualitative research design. Descriptive survey is a method of collecting information by administering a questionnaire to a sample of individuals (Orodho, 2003). It describes the state of affairs as they exist. Descriptive research design is suitable in covering issues relating to climate change (Nachmias and Nachmias, 1997) and may often result in the formulation of important principles of knowledge and solutions to significant problems (Kerlinger, 1973) such as climate change. This design enabled generalizing the findings to a larger population of households in Kisii County due to its high degree of representation. The study also used qualitative research design by employing FGDs (Focused Group Discussions).

The target population for the study consisted of 58617 households in Kisii Central sub county (RoK, 2009). In deciding the unit of analysis, the household always seemed the logical choice: in most studies of coping strategies the household is taken as the unit of analysis because it is assumed that decisions about production, investment and consumption are primarily taken at the household level. The study targeted household heads since they were the ones who make decisions in their farms and deemed suitable to provide the relevant information about practices in their farm.

A sampling design is a definite plan for obtaining a sample from a given population. Kisii Central sub county is divided into four main administrative divisions. Being a descriptive survey all the four divisions were included in the study.

The sampling distribution formula as proposed in Nassiuma (2000) was used to come up with a sample size of 120 for the study. A proportionate stratified random sampling was used to obtain the sample from different divisions (strata) in the sub-county. The method was used to ensure each division and thus agro ecological zones were represented.

According to Mugenda and Mugenda, (2003), reliability is the measure to which an instrument yields consistent results over repeated trials. Reliability of the questionnaire used in this study was assessed by pre-testing 20 questionnaires in one division within Manga sub county, which had households with similar characteristics as those in the target study area. The purpose of piloting was to detect possible flaws in the measurement procedure and to identify ambiguously formulated items. The instrument used in this study was considered reliable because it achieved a reliability coefficient of 0.84 using Cronbach Alpha's (1951) scale obtained on a sample of 20. Cronbach's Alpha is a general form of the Kunder- Richardson (K-R) 20 formula. A reliability coefficient of 0.7 or above implied that the instrument was reliable and acceptable for a study in Social Sciences.

The study utilized both primary and secondary data sets. Primary data was collected through questionnaires, interview schedules and observation. Information on socio-economic characteristics of households, perceived effects of rainfall variability on farming practices and coping strategies to rainfall variability and was collected using questionnaires. The households to be involved in the study were visited in their homes and given the questionnaire to respond to. Once the respondent completed the questionnaire, it was collected on the spot to ensure high response rate. Primary data was also collected by conducting face to face interview with purposefully selected two key informants from KARLO (then KARI), WRMA and Ministry of Agriculture. The interviews were used to collect detailed information on farming practices, effects of rainfall variability and coping strategies in the study area. Secondary data was also sought to supplement the primary data. This included documented information on climatic patterns of the study area and the agricultural activities in the study area. The sources of this information included the Ministry of Agriculture, Ministry of Environment and Mineral Resources (MEMR), Kisii Meteorological station, books, newspapers, journals and internet. The researcher made attempts to reconcile

information on questionnaire with on-ground observations in the study area. This was important in comparing the information reported in questionnaire with the actual occurrences in the study area

Once the measuring instruments were obtained from the respondents, the raw data was systematically organized through coding to facilitate analysis. The data collected was analyzed and presented to facilitate answering of the research objectives and questions. Analysis of the data was by use of both descriptive and inferential statistics. Descriptive statistics included the use of means, percentages, and frequencies and the results presented graphically using charts and tables.

III. Results And Discussion

Characteristics of the Survey Respondents

The subjects for the study comprised of heads in 118 randomly selected households in Kisii Central sub county. The study gathered information on a variety of respondents' attributes. These attribute encompassed gender, age, level of education, years of stay in the area and primary activity.

As far as the gender distribution of respondents was concerned, the results indicated that majority (56.8%) of the respondents were male. The proportion of female respondents was on 43.2%. This implies that majority of the households in the area are headed by males and consequently are the ones who make majority of the farming decisions. In most African societies men make decisions as women's voices are often muted in family or community decision making (Quisumbing, 2003)

Majority of the respondents (63.6%) had secondary education. The results further indicated that 17.8% of the respondents had college level of education. This was closely followed by 16.1% of the respondents who had primary level of education. It was only 2.5% of the farmers who had no formal education. These results generally imply that most farmers had adequate education that could enable them to carry out agricultural activities with better knowledge on how to cope with the effect of rainfall variability on household farming practices in the study area. Norris and Batie (1987) argue that farmers with more education are more likely to have enhanced access to technological information than less educated farmers. Igoden *et al.* (1990) and Lin (1991) too observe a positive relationship between the education level of the household head and the adoption level of improved technologies and climate change adaptation.

The study was interested in the average age of the household heads represented in this study. The ages of the household heads were categorized into 18-30 years, 31-40 years, 41-50 years, 51-60 years and above 60 years. It was found that majority; forty nine point two percent (49.2%) of the household heads were aged between 31 - 40 years. However, seventeen point eight percent (17.8%) of the respondents were aged between 41 - 50 years which was closely followed by fifteen point three (15.3%) and fourteen point four (14.4%) of the respondents who were aged between 18 – 30 and 51 – 60 years respectively. It was just 3.4% of the respondents who were aged above 60 years. According to Mintewab, Abe, Zenebe, and Livousew (2013), the age of a farmer is correlated with experience necessary to understand various aspects of climate variability that has implication on the farming practices. Older farmers are more likely to have had an opportunity to witness majority of the climatic variability issues as well as the variability of its variables. Adesina and Forson (1995) and Gbetibouo (2009), in their respective studies, too observed a positive relationship between age of the household head and the adoption of improved agricultural technologies. They have noted that older farmers have more experience in farming and are better able to assess the attributes of modern technology than younger farmers. Hence, older farmers have a higher probability of perceiving and adapting to rainfall variability.

This study was also interested in the length of stay in the study area of the household since it had an implication on the respondent's knowledge on matters related to rainfall variability. Majority of the households had lived in the study area for between 10 – 19 years as represented by 34.7% of the respondents. About 20.3% of the households had been in the study area for between 20 – 29 years which was closely followed by 16.9% and 15.3% of the households who had lived in the study area for 30 – 39 and less than 10 years respectively. These results imply that majority of the respondents were in a perfect position to understand the climatic issues in the area and could easily bear witness of the state of rainfall variability in the area within a period of past ten years which was the recall period adopted in this study. According to Jokastah *et al*., (2013) farmers with more than 10 years duration of stay in an area (or farming experience) can be suitable for a study that examine the effect of rainfall variability on household farming practices since the data to be collected from such group could give a clear representation of the required perception and full information about the climatic changes and variability in the study area.

Majority of the households were engaged in farming as the primary activity as represented by 49.2% of the respondents. Some household heads were however on salaried employment (34.7%) or were engaged in business (14.4%). A few of the household heads were full-time students (1.7%). The variety of primary activities undertaken by respondents could partly be as a result of adoption of coping strategies that enhance resilience under rainfall variability.

Short term weather shocks/events associated with rainfall in Kisii Central Sub County

This study sought to understand the short term weather events associated with rainfall in Kisii Central Sub County and determining how frequent the events occur. To achieve this objective, respondents were first requested to indicate whether they have noticed any changes in rainfall patterns in the past ten years in the area. The results showed that overwhelming majority of the respondents (94.1%) were in agreement that gross changes in rainfall patterns have been noticed in the past ten years in the area as compared to 5.9% of the respondents who were of the contrary opinion. Studies on assessing farmer perceptions on climate change in Kenya have reported similar findings (Bryan *et al.*, 2011; Rao *et al.*, 2011; Thorlakson, 2011; Jokastah *et al*., 2013). These findings also concur with Moyo, Mvumi, Kunzekweguta, Mazmimavi, Craufurd and Dorward (2012) who in a study in Zimbabwe found out that most farmers belief that the climate is changing and that the changes are mainly associated with rainfall amount, distribution and temperature. Rainfall variability thus tends to be the dominant source of livelihood and production risk affecting smallholder agriculture or households. Farmers' climate

perceptions are likely based on an observed decline in water availability perhaps due to temperature increases as well as other environmental and social drivers such as an increase in population density as is the case in the study area.

These results are consistent with Jokastah *et al*., (2013) who in their study of smallholder farmers' perception of the impacts of climate change and variability on rain-fed agricultural practices noted that agriculture to a large extent is affected by different production factors, both natural and man-made; one such factor being climatic variability which is characterized by extremes of temperatures and rainfall variability.

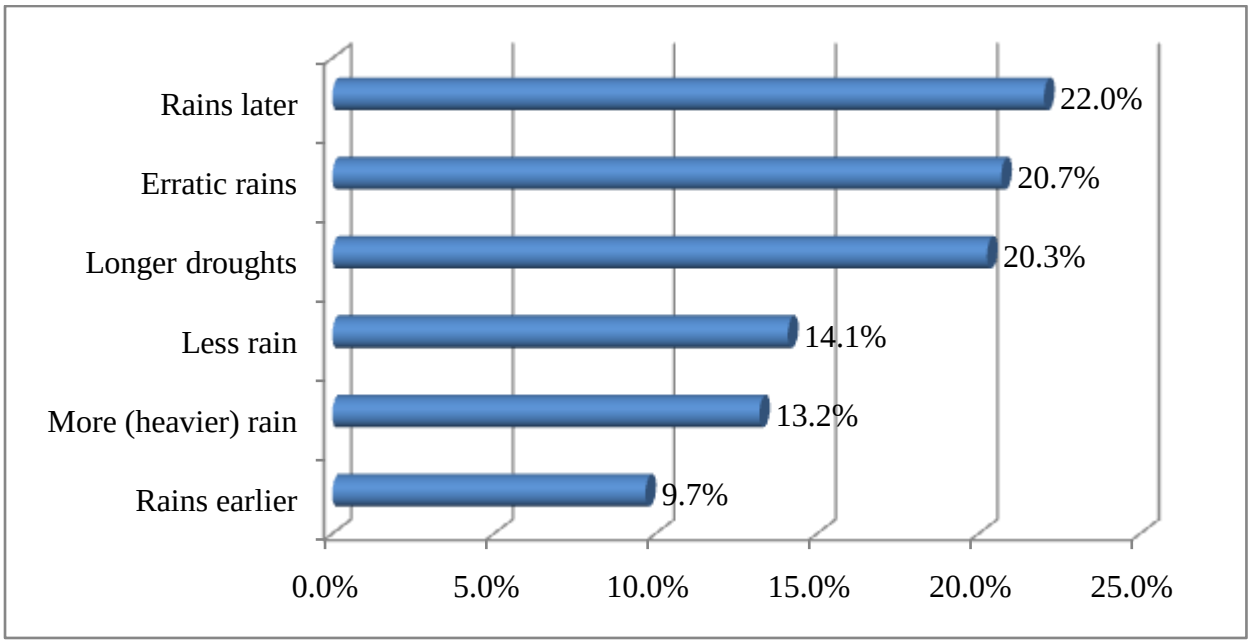

Figure 1: Changes in rainfall patterns in the past ten years

The results presented in Figure 1 shows that changes in rainfall patterns in the past ten years was mainly noticed in form of raining later than normal (22.0%), unpredictable/erratic rains (20.7%) and longer droughts (20.3%). Other significant changes in rainfall patterns that were cited to have occurred in the past ten years include less rains (14.1%) and raining earlier (9.7%). This implies that the agricultural activities in the study area may be at a great risk and therefore farmers may be realizing very little and erratic returns from their undertakings.

These results are consistent with GoK (2010a) that documented that Kenya, like the rest of the world, is experiencing climate change and variability and the associated adverse impacts. An analysis of trends in rainfall patterns, extreme events and slow onset events points to clear evidence of climate change in the country. A study carried out in Zimbabwe (Moyo *et al.*, 2012), showed that farmers perceived climatic and weather patterns to have changed over the past decade or two, as indicated by erratic rainfall patterns, decreased rainfall and temperature increases, leading to crop productivity decline and increased livestock morbidity and mortality. The annual variation, including the onset, intensity, duration and cessation of rainfall greatly impact on agricultural productivity (Unganai, 2000).

These incidences of climate change and variability present a number of socioeconomic and environmental challenges and opportunities for Kenya. According to Farm Management Handbook of Kenya (2009), some of the challenges include intensified natural resource degradation, increased flooding, storms, excessive and erratic rainfall, droughts, invasive weeds, pest-and-disease epidemics, infrastructure damage, and increased risk of resource use conflicts, reduced agricultural production and increased food insecurity. While vulnerability to these impacts is differentiated and context-specific, it has the potential to result in significant economic costs that can derail attainment of development goals.

The study also sought secondary data from Kisii Meteorological Department to ascertain if climate change with respect to temperature, rainfall and humidity variability existed in Kisii Central Sub County and if so, how big the problem was. The results are as given in Table 1, Table 2 and Table 3.

Table 1: Mean Monthly Temperature in 0C for the years 2007-2011

Month Year	2007	2008	2009	2010	2011	Mean
Jan	20.9	21.5	23.4	21.6	21.5	21.8
Feb	21.4	21.9	22.0	22.0	22.3	21.9
Mar	21.8	21.3	22.4	21.1	21.6	21.6
Apr	21.3	20.3	20.7	21.6	21.3	21.0
May	20.9	20.7	20.3	20.9	20.9	20.7
Jun	19.8	19.7	20.6	20.7	20.1	20.2
Jul	19.5	18.9	20.4	20.1	19.7	19.7
Aug	19.9	20.0	20.9	20.7	19.9	20.3

Sept	20.5	20.9	21.1	20.4	20.3	20.6
Oct	20.7	20.4	21.1	20.8	19.8	20.6
Nov	20.5	20.6	21.1	21.0	19.9	20.6
Dec	20.8	21.5	20.8	20.7	21.1	21.0

Source: Kisii Meteorological Department (2014)

From the data represented in Table 1 above, the mean temperature for the five years in January was 21.8^0C while for December was 21^0C, July was 19.7^0C while in August 20.3^0C. Generally July recorded the lowest temperatures while January was among the second highest after February. The mean annual temperatures are higher for the four months. Warm temperatures cause increased rain variability by increasing atmospheric moisture and altering cycling of water in the atmosphere (Held and Snoden 2006, Patricola and Cook 2010).

Rainfall in Kisii Central Sub County is varying in the past twenty years as records can show (Figure 2 and 3). Since 1995 rainfall has become varied such that during the study period, some years recorded high rains whilst others recorded low rains as can be seen in Figure 2. However this data does not show significant trends in terms of average yearly precipitation.

The study also sought secondary data from Kisii Meteorological station to ascertain if rainfall variability existed in Kisii Central Sub County and if so, how big the problem was. Rainfall in Kisii Central Sub County is varying in the past eighteen years as records can show (Figure 2 and 3). Since 1995 rainfall was found to be varied such that during this period, some years recorded high rains whilst others recorded low rains as can be seen in Figure 2. Figure 2 shows that coefficient of determination (R^2) is 0.7 and this is a reflection that rain in the Kisii Central Sub County is highly variable with time. The variation in rainfall can perhaps be explained by many factors such the reduction in area covered by forests, wetlands as a result of agricultural activities, urbanization and upcoming settlements in Kisii Central Sub County. Clearing of trees will increase temperatures of the area and consequential increase in evapotranspiration. Warm temperatures cause increased rain variability by increasing atmospheric moisture and altering cycling of water in the atmosphere (Held & Snoden, 2006, Patricola & Cook, 2010).

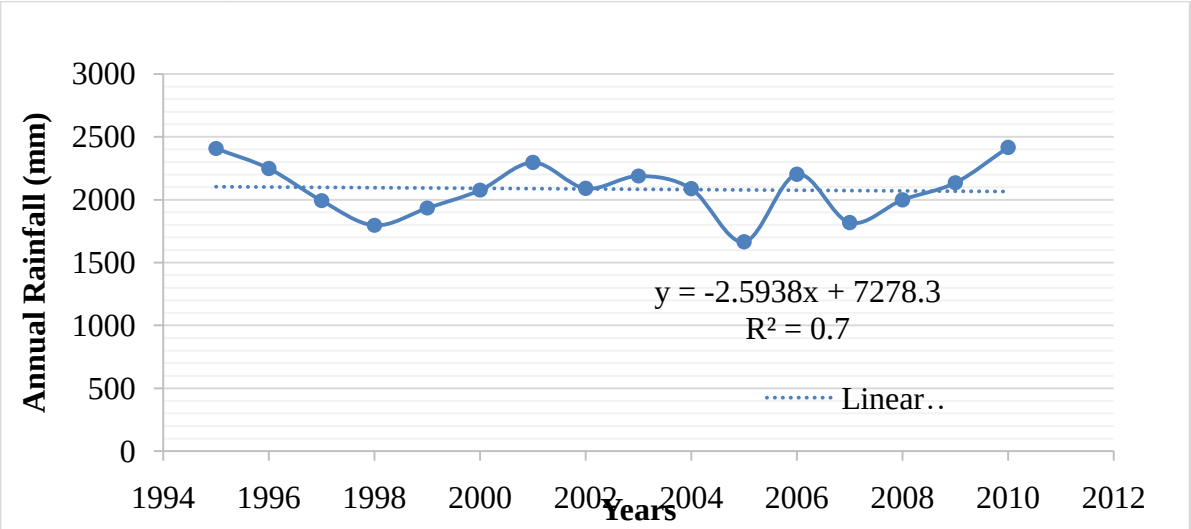

Figure 2: Rainfall variability in the Kisii Central Sub County

Figure 2 too, shows that rainfall in Kisii Central Sub County is varying with time with coefficient of determination as R^2=0.0705 for maximum monthly rainfall and R^2=0.1101 for minimum monthly rainfall and R2=0.87 for mean monthly rainfall. Thus minimum rains are the most variable with time.

From figure 3, it is concluded that maximum rainfall of 663.7 mm was skewed and of excess kurtosis of 8.2 and as such was treated as an outlier. 90th percentile had 447.07 mm, 75th percentile had 368.23 mm, 50th percentile had 324.8 mm and 10th percentile had 245.35 mm of rainfall. The mean rainfall was 341.33 mm and was very close to the median which was 324.8 mm. The rainfall range was very large (430.5 mm) because of the high value of maximum rainfall and low value of minimum rainfall.

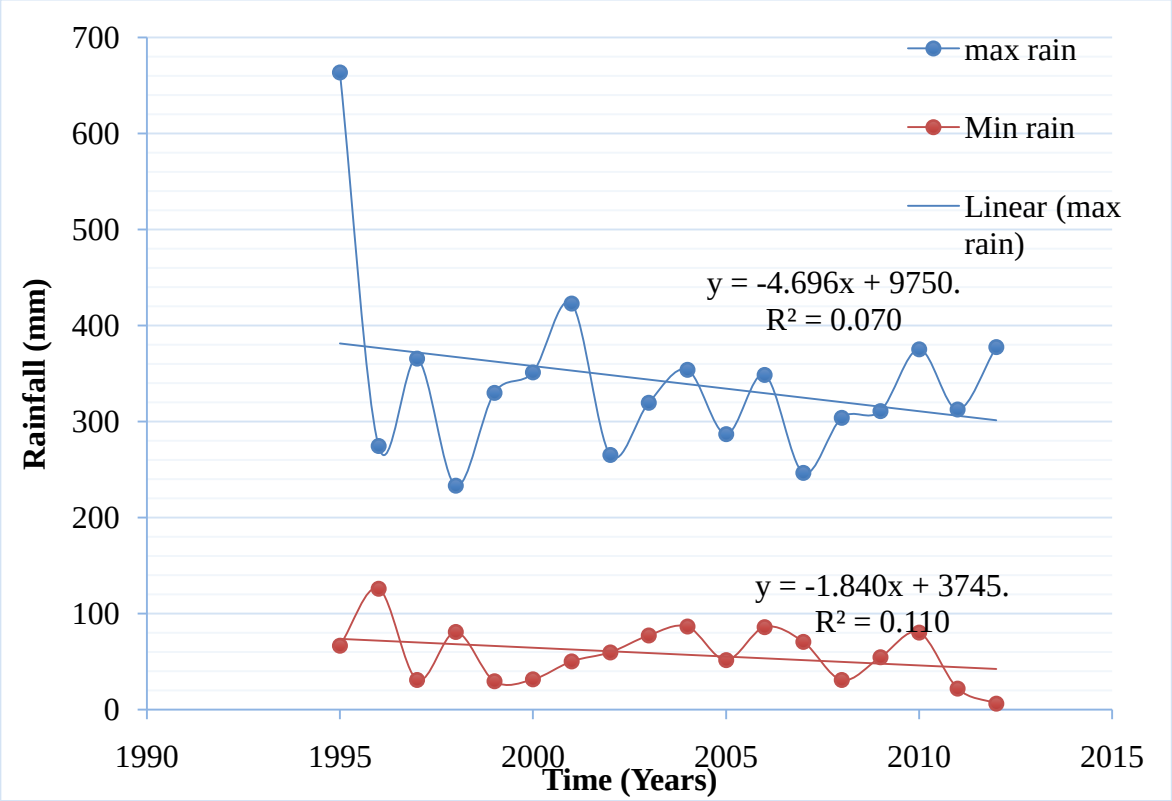

Figure 3: Monthly Maximum rainfall and minimum rainfall in the Kisii Central Sub County in the period 1995 to 2014.

Generally both maximum rainfall and minimum rainfall show a decreasing trend over the years. This can perhaps be explained by weather changes brought about climate change and variability.

This study investigated the incidences of extreme or unusual weather events(s) associated with rainfall that were witnessed in the past ten years in the study area. The results showed that overwhelming majority of the respondents (96.6%) had indeed experienced extreme weather events with rainfall in the past ten years. However, about 3.4% of the respondents indicated to have not experienced any extreme weather event. Moyo *et al*., (2012) says that households use personal experiences of the past which could sometimes be unreliable. Households' memory of past events can be faulty due to failure to differentiate between climate (statistical expectation) and weather (what they get) patterns. Rationally households prefer to learn from experience instead of statistical descriptions which may lead to flawed interpretation.

According to Gordon, Jaspat and Situma (2010), it is important to consider the experience of extreme weather events with rainfall because an increase in the total quantity of rainfall does not always capture the impact of rainfall variability (including when, where and how much of the rain falls each time), which has serious implications for the capacity of the population to adapt. In farming, the amount of rainfall is important and is an indicator of long term changes in the climate system. However, of more importance to farmers is the pattern of the rainfall (Falaki, Akangpe & Ayinde, 2013).A study carried out in Laikipia East district (Huho *et al*., 2012) found out annual rainfall amounts increased between the years 1976-2005, but this did not lead to good agricultural production. This was due to the changing rainfall patterns. If the rain falls in the right amount and then it ceases for a long period before the next rain, the long dry spell can be devastating to farmers. If however the rain falls in small amount but at the expected time and spread over the period of planting, it is a good season for farmers.

Respondents were asked to state the most recent extreme event(s) that have taken place in the area in the past ten years (2003 – 2013) and the results are as shown in Figure 4.

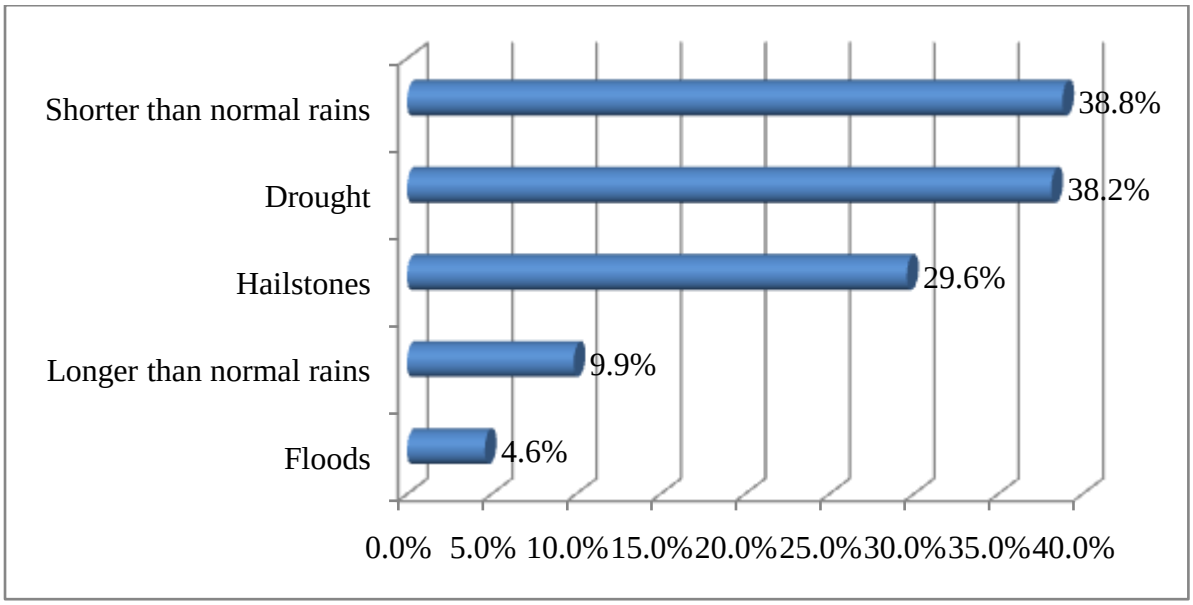

Figure 4: Most recent extreme event that have taken place in the past ten years (2003 – 2013)

With regard to rainfall variability, farmers specified which changes they had noticed (Figure 4). The most recent extreme event associated with rainfall variability in the last ten years was shorter than normal rains as cited by 38.8% of the total respondents. This was closely followed by drought and hailstones as cited by 38.2% and 29.6% of the respondents respectively. Some respondents however cited the occurrence of longer than normal rains (9.9%) as well as floods (4.6%). Kisii Central Sub County's topography is mainly highland, and this possibly the reason why floods rank lowly.

A study by Thorlakson (2011) also found that most farmers interviewed had noticed changes in the normal rainfall patterns beginning early 1990's. The farmers said they had noticed that rainfall variability had increased substantially, as rainfall fail to come more frequently or come suddenly at abnormal times of the year. This study is also consistent with findings on household perception of climate change in sub Saharan Africa (Gbetibouo, 2009). These results agrees with Jokastah*et al*., (2013) who noted that most smallholder farmers in semi-arid and the sub-humid regions of Kenya had witnessed a reduction of crop production attributed to either low rainfall or erratic rainfall patterns coupled with other factors such as hailstones, floods and longer than normal rainfall. Households perception that drought has been increasing in frequency over the last ten years are also consistent with other research (Sheffield & Wood, 2008; Gamble, Campbell, Allen, Barker, Curtis, McGregor & Popke, 2010). The drought defined by households during FGDs includes a wide range of events than those defined meteorological data alone. These findings are therefore consistent Sledgers and Stroosnijder (2008) that drought should not be defined only as a physical event. Generally there are mixed findings among studies comparing farmer or household perception to meteorological trends. However, most studies agree that farmers overemphasize the recent changes in the last ten or so years when discussing observations in the long term climatic trends (Thorlakson, 2011).

IV. Conclusion And Recommendations

Gross changes in rainfall patterns have been noticed in the past ten years in the study area. Changes in rainfall patterns in the study area were mainly in form of raining later than normal, unpredictable/erratic rains and longer droughts. These incidences of climate change and variability present a number of socioeconomic and environmental challenges. This study concludes that government (county and national) should realize the urgent need for measures that are geared towards reversing the negative impact of climate change and especially rainfall variability in the study area. The noted gross changes in rainfall patterns noticed in the past ten years have been proved to affect agricultural (crop and livestock) activities in the area and pose a big risk to future food security.

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