



Relationship Between Households' Characteristics and Perception of Effect of Rainfall Variability on Farming Practices in Kisii Central Sub County, Kenya

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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. 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 mainly used community level data. Information on actual dynamics of rainfall variability at household in high potential areas like Kisii is scanty. This study therefore aimed at determining the relationship between households' characteristics and perception of effect of rainfall variability on farming practices among the households in Kisii Central Sub County. Structured questionnaires were administered to a proportionate random sample of 120 households from the four administrative divisions of the Sub County. Data from questionnaires were also complemented by oral interviews with key informants from Water Resources Management Authority (WRMA), Kenya Agricultural Research Institute (KARI) (currently Kenya Agricultural and Livestock Research Organization (KALRO), Ministry of Agriculture, FGDs and secondary data. Descriptive statistics as well as inferential statistics technique have been used to analyze data with the help of Statistical Packages for Social Sciences (SPSS version 20). Inferential statistics technique employed the use of Chi-square (χ^2) test to analyze data. To make reliable inferences from the data, all statistical tests were subjected to a test of significance at coefficient alpha (α -level) equal to 0.05. There existed a statistically significant relationship between the mixed farming, mulching/shade and technology adoption (e.g. greenhouses) adaptation strategies with gender. Most of the households practicing crop diversification (growing of more than one type of food/cash crop), mulching/shading of crops and modern technology such as green houses were middle aged (between 31-40 years). Irrigation practice was most associated with household heads with secondary and tertiary level of education while use of chemicals/ herbicides was mainly associated with household heads with tertiary level of education. This study recommends that the government (County and national) as well as development partners who have a stake in climate change and adaptations should endeavour to strengthen the adaptive capacity of vulnerable populations and of the agriculture sector as a whole in the study area. There is also need to support households through policies that help them get better access to hybrid seeds that are bred to match with the prevailing rainfall variability.

Key Words—Households' Characteristics, Perception, Rainfall Variability, Farming Practices in Kisii Central Sub County, Kenya.

1. INTRODUCTION

The effect of climate variability and change on natural systems has emerged as one of the most critical issues faced by humankind (Makenzi et al., 2013; UNDP, 2007). Climate change is a global threat and has no geographical boundaries and is a topical issue worldwide because of its attendant problems that are threatening the sustenance of man and his environment. Climate change is projected to disproportionately affect the poor living in both rural and urban environments. Rural Subsistence farmers or households are threatened by the changes in climate change.

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Climate change and variability in Sub-Saharan Africa is already impacting negatively on rain-fed agriculture and livestock systems (Ngeno & Bebe, 2013). Countries in Sub-Saharan Africa are particularly vulnerable to climate change impacts because of their limited capacity to adapt (Bryan et al., 2011). Kenya experiences a number of natural hazards, the most common being related to adverse weather change (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 (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; 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 (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 (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 (Olden *et al.*, 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 *et al.*, 2010). 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 (UNESCO, 2012). Communities have long been adapting to climate variability and change (Kristajansen *et al.*, 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.

Despite countrywide studies on the impact of climate variability on farming practices and the response strategies, there is variation in response depending on location, socio-economic systems and environmental conditions of the area. In addition many studies 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. It is in this view that this study sought fill the gap by determining the relationship between households' characteristics and perception of effect of rainfall variability on farming practices among the households in Kisii Central Sub County.

2. METHODOLOGY

The study was conducted in Kisii Central Sub County of Kisii County, South Western Kenya (Figure 1).

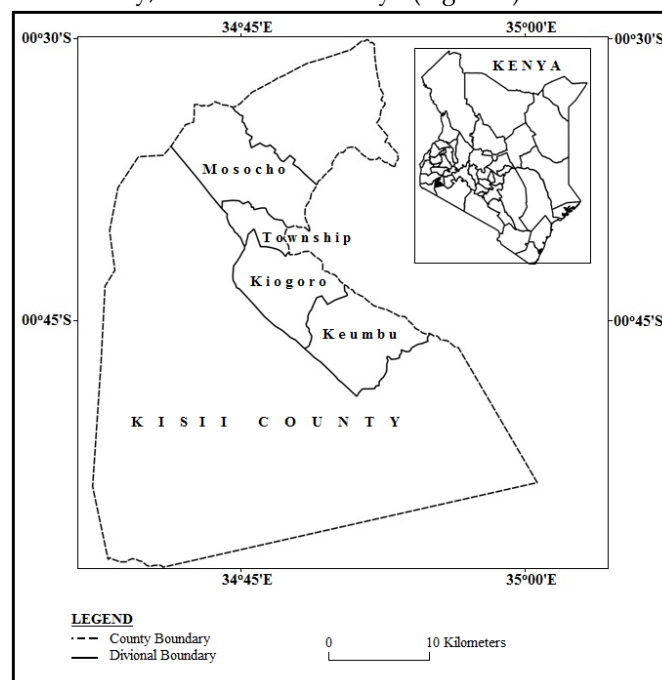


Figure 1: Map of Kisii County showing the wards of Kisii Central Sub County

Source: Kisii County Government (2013)

This study used a descriptive survey and qualitative research design. 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. The target population for the study consisted of 58617 households in Kisii Central Sub County (GoK, 2009). The following formula was used to come up

with appropriate sample for the study as proposed by Nassiuma (2000).

$$n = \frac{NC^2}{C^2 + (N - 1)e^2}$$

Where: n = Sample size,
N = Population,
C = Coefficient of variation,
e = Standard error.

The sample size was calculated at 25% coefficient of variation, 2% margin of error and a population of 58616 households.

Twenty five percent (25%) coefficient of variation was used to ensure that the sample size is wide enough to justify the result being generalized for Kisii Central Sub-County. Two percent (2%) margin of error was used because the study was a cross sectional survey, whereby the independent variables were not to be manipulated. Using the above formula, a sample of 120 respondents was selected.

Proportionate stratified random sampling was used to obtain the sample from different wards (strata) in the Sub-County. The method was used to ensure each ward and thus agro ecological zones were represented. Table 1 shows the target population and the percentage proportion for each division (strata) in Kisii Central Sub-County. It also shows the calculated sample size for each ward and the total sample size for the study.

Table 1: Number of Households in Each Ward and Sample Size

Ward	Population	Sample size
Kiogoro	16923	35
Mosocho	15077	31
Township(Getembe)	14853	30
Keumbu	11764	24
Total	58617	120

The instruments used in this study were structured questionnaires and interview schedules. Correct sampling was done to allow generalization to other people, times and contexts and hence give it external validity. Reliability of the questionnaire used in this study was assessed by pre-testing 20 questionnaires in one ward within Manga Sub County, which had households with similar characteristics as those in the target study area. 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.

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. Inferential statistics included Pearson's Chi-square.

3. RESULTS AND DISCUSSION

3.1 Characteristics of the Survey Respondents

The subjects for the study comprised of heads in 118 randomly selected households in Kisii Central Sub County. This implies a response rate of 98.3% which the study considered as satisfactory. 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.

3.1.1 Gender of the Respondents

Table 2 shows that majority (56.8%) of the respondents were male. The proportion of female respondents was only 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)

Table 2: Gender of the Respondents

Gender	Frequency	Percent
Male	67	56.8
Female	51	43.2
Total	118	100.0

3.1.2 Highest Level of Education of the Respondents

The findings of the study indicate that majority of the respondents (63.6%) had attained secondary education. The results further indicate 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 in the study area. The distribution of the respondents' highest level of education was as shown on Table 3.

Table 3: Highest Level of education of the household head

Level of education	Frequency	Percent
No formal education	3	2.5
Primary level	19	16.1
Secondary level	75	63.6
College education	21	17.8
Total	118	100.0

Farmers with more education are more likely to have enhanced access to technological information than less educated farmers. Igoden *et al*, (1990) observed a positive relationship between the education level of the household head and the adoption level of improved technologies and climate change adaptation.

3.1.3 Age of the Respondents

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. Table 4 shows the summary of the results.

Table 4: Age of the Respondents in Years

Age in years	Freq	Percent
18 – 30	18	15.3
31 – 40	58	49.2
41 – 50	21	17.8
51 – 60	17	14.4
Above 60 years	4	3.4
Total	118	100.0

Mean Age = 37.83, Std. Deviation = 11.28, n = 118

It was found that majority (49.2%) of the household heads were aged between 31 - 40 years (mean age of 37.83). However, 17.8% of the respondents were aged between 41 - 50 years which was closely followed by 15.3% and 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 et al. (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. Gbetibouo (2009) 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.

3.1.4 Years of stay in the area

This study was 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. The results are summarized in Table 5.

Table 5: Duration of Stay in the Area

Duration in Years	Frequency	Percent
Less than 10 years	18	15.3
10 - 19 years	41	34.7
20 - 29 years	24	20.3
30 - 39 years	20	16.9
40 years and above	15	12.7
Total	118	100.0

Note. Mean Duration (years) = 15.94, Std. Deviation = 7.65, n = 118

The findings in Table 5 indicate that 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 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 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.

3.1.5 Primary Activities Undertaken by the Respondents

Table 6 shows the distribution of household heads primary activities undertaken. These included farming, business, salaried employment and students.

Table 6: Primary Activity Undertaken by the Respondents

Primary Activity	Frequency	Percent
Farming	58	49.2
Business	17	14.4
Formal Employment	41	34.7
Students	2	1.7
Total	118	100.0

Table 6 depicts that 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.

3.1.6 Size of Land and its Allocation to Food Crops and Cash Crops

The findings of the study showed that households had generally small parcels of land that was mainly used for both food crops and cash crops. The distribution of mean acreage under food and cash crop production is shown in Table 7.

Table 7: Households Mean Land Size

Farm Enterprise	Min.	Max.	Mean	Std. Dev.
Cash crop acreage	.00	2.50	1.168	.57286
Food crop acreage	.20	4.00	1.204	.68006

The results in Table 7 show that the mean size of land that was under cash crop and food crop production was 1.168 and 1.204 acres respectively. These findings agree with Onura, (2012) that land is highly fragmented with a single household owning averagely less than 2 acres.

Small land holdings invariably lead to more intensive land use systems. As a result, several types of crops are grown in the study area as food and/or cash crops.

There are different types of crops (both cash and food crops) grown in the study area. The popularity of the cash crops grown in the study area is indicated in Figure 2:

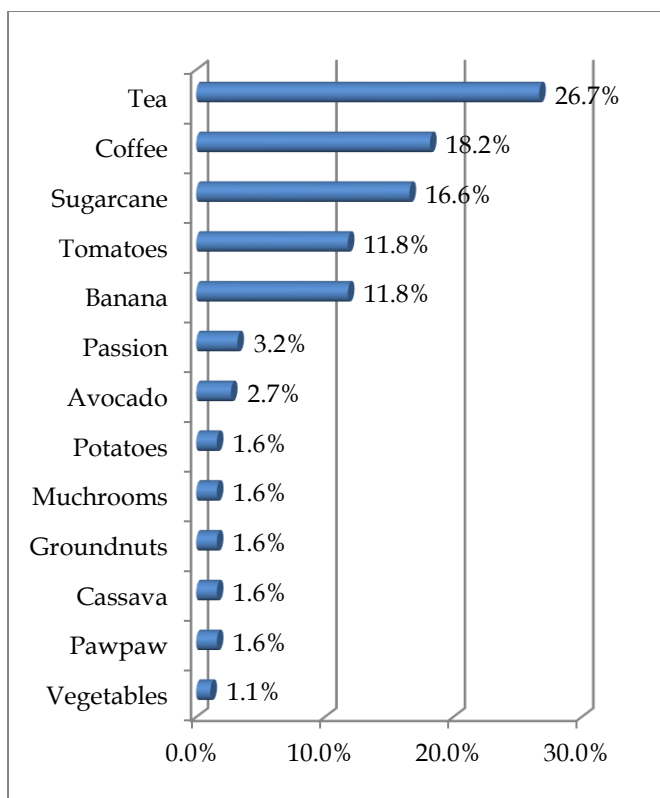


Figure 2: Types of Cash Crops Grown In the Study Area

Figure 2 shows that the most common cash crops grown are tea (26.7%), coffee (18.2%), sugarcane (16.6%), tomatoes (11.8%) and banana (11.8%). Other cash crops grown included: passion (3.2%), avocado (2.7%), potatoes (1.6%), mushrooms (1.6%), groundnuts (1.6%), cassava (1.6%), pawpaw (1.6%) and vegetables (1.1%).

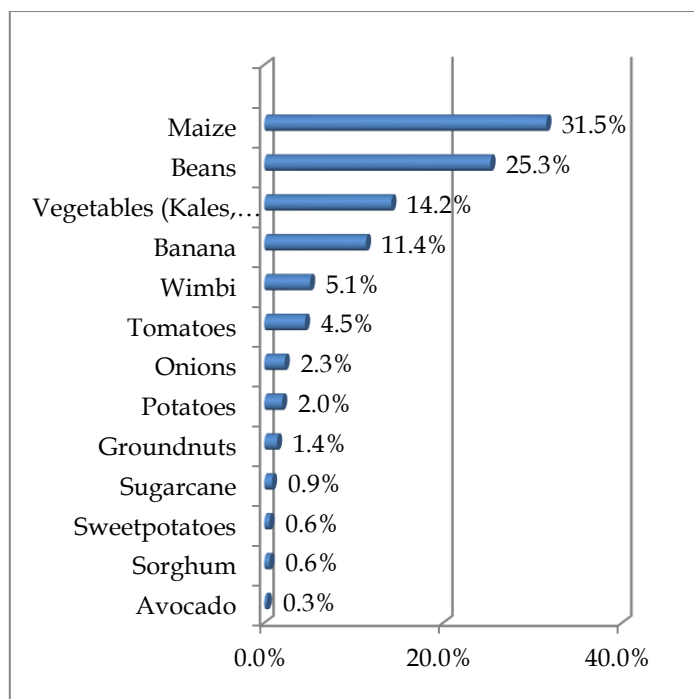


Figure 3: Types of Food Crops Grown in the Study Area

Results in Figure 3 show the different food crops grown in the study area. The most popular food crop in the area is maize, as grown by the majority of respondents (31.5%) and was closely followed by beans as grown by 25.3% of the total respondents.

The popularity of vegetable (Kales (*sukumawiki*), black night shade (*Managu*), spider flower (*Saga*), etc) production in the study area cannot be overemphasized with approximately 14.2% of the total respondents indicating to be growing the food crops. About 11.4% of the farmers were growing bananas as food crops in the study area. Other food crops grown in the area includes: *wimbi* (5.1%), tomatoes (4.5%), onions (2.3%), potatoes (2.0%), groundnuts (1.4%), sugarcane (0.9%), sweet potatoes (0.6%), sorghum (0.6%) and avocado (0.3%).

3.2 Relationship between households' characteristics and perception of effects of rainfall variability on farming practices in Kisii Central Sub County

Table 8 shows the household head's perception on effects of rainfall variability.

Table 8: Effects of Rainfall Variability

Effects of Rainfall Variability	Yes		No		Totals	
	n	%	n	%	n	%
Increased crop yields	6	5.1%	112	94.9%	118	100.0%
Reduced crop yields	79	66.9%	39	33.1%	118	100.0%
Reduced water availability	50	42.4%	68	57.6%	118	100.0%
Increased weed attacks (infestations)	18	15.3%	100	84.7%	118	100.0%
Delays in planting and harvesting	93	78.8%	25	21.2%	118	100.0%
Increased crop disease and pests	21	17.8%	97	82.2%	118	100.0%
Emergence of livestock diseases	34	28.8%	84	71.2%	118	100.0%
Emergence and re-emergence of human diseases	24	20.3%	94	79.7%	118	100.0%

Delays in planting and harvesting and ultimately reduced crop yields seem to be the greatest fear to the households as represented by 78.8% and 66.9% of the households, respectively. This is in line with Moyo *et al.*, (2012) whose study also revealed that the perceived climate changes led to changes in agricultural productivity, mostly a decline in crop production. These results too, 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 were asked to rate the severity of the effects of rainfall variability in the study area as they had experienced the issue in the past ten years. About 42.4%, 28.8% and 20.3% of the households reported to have been affected by reduced water availability, emergency of livestock diseases and emergency/re-emergence of human diseases, respectively. Some of the effects that are less serious in the study area as reflected by the households' heads perception include increased crop diseases/pests, increased weed attacks (such as black jack, Mexican marigold, oxalis/sorrel, double thorn, thorn apple, couch grass, nut grass, wandering Jew, sow thistle, devil's horsewhip, MacDonald's eye/gallant soldier and Sodom apple) and increased crop yields.

The effects of this changes in rainfall amounts and patterns identified by the FGDs include; reduced crop yields,

reduced milk production, low quality produce, increased pest infestation, increased disease attacks on livestock and crops, reduced incomes, shortage of livestock pasture and water, increased weeds, increased cost of production (due chemicals and weeding expenses) and soil erosion. The FGDs associated the decline in food production to climate variability especially delayed rains and occasional dry spells. The dry spells of January and February were of major concern as their duration has increased and this coincides with the planting season of maize and beans and *wimbi* (millet). Maize happens to be the staple food in the study area, besides other foods such as bananas and *wimbi*. However they also noted that the decrease in yields would also be due to other non-climatic related factors such as declining soil fertility (due to continuous cropping), pests and diseases such as the maize necrosis disease currently affecting maize plants in the study area, over fragmentation of land, inadequate extension services and poverty which restrains many households' ability to purchase farm inputs.

This study was also concerned about the variations on households' perceptions on effects of rainfall variability along their background characteristics (gender, age and educational level). The cross-tabulation in table 9, 10 and 11 shows these results.

Table 9 shows the relationship between household heads' perception on the effects of rainfall variability and gender.

Table 9: Relationship between perception on the effects of rainfall variability and household heads' gender

Perceived Effects of Rainfall Variability	Male	Female	Total	χ^2	Df	P-value
Increased crop yields	39	79	118	1.416	1	.234
Reduced crop yields	67	51	118	.003	1	.955
Reduced water availability	50	68	118	7.723	1	.005
Increased weed attack	66	52	118	.013	1	.909
Delays in planting and harvesting	71	47	118	2.111	1	.146
Increased crop disease and pests	28	90	118	11.316	1	.001
Emergence of livestock diseases	66	52	118	.016	1	.900
Emergence and re-emergence of human diseases	30	89	118	12.399	1	.000

The results shows a statistically significant difference between male and female household heads' perception on reduced water availability, increased crop disease/pests and emergence/re-emergence of human diseases as represented by chi-square values of 7.723, 11.316 and 12.399, respectively at 5% level and 1 degree of freedom. The results shows more females perceived rainfall variability as having effect on reduced water availability, increased crop disease/pests and emergence/re-emergence of human diseases as compared to their male counterparts. Specifically, about 58.0%, 76.2% and 75.0% of females considered rainfall variability as being responsible for reduced water availability, increased crop disease/pests and emergence/re-emergence of human diseases as compared to 42.0%, 23.8% and 25.0% male heads that were of the same opinion, respectively. This is particularly the case because women and girls are often the primary

collectors, users and managers of water than males. The results shows no significant gender difference in the perception of effects of rainfall variability on increased/reduced crop yields, increased weed attack, delays in planting and harvesting and emergence of livestock diseases. This implies that there may be a significant difference in the types of crops that different gender mainly concentrates with. Women are more likely to be involved in the production of food crops while men are more likely to be involved in the production of cash crops (FAO, 2010). Involvement by particular gender on certain farming activities is likely to affect their perception of effects of rainfall variability.

Table 10 shows the relationship between perception on the effects of rainfall variability and household head age.

Table 10: Relationship between perception of the effects of rainfall variability and household head age

Perceived Effects	Age of the household head in years					χ^2	df	P-value
	18 - 30	31 - 40	41 - 50	51 - 60	>60			
Increased crop yields	20	59	0	39	0	20	4	.571
Reduced crop yields	18	54	28	12	6	18	4	.028
Reduced water availability	21	59	9	24	5	21	4	.131
Increased weed attack	13	39	13	26	26	13	4	.000
Delays in planting and harvesting	15	56	23	19	5	15	4	.346
Increased crop disease and pests	6	67	28	17	0	6	4	.469
Emergence of livestock diseases	0	62	17	24	14	0	4	.001
Emergence and re-emergence of human diseases	0	93	25	0	0	0	4	.004

The results indicated in Table 10 shows a significant relationship ($P < 0.05$) between the perception on the effect of reduced crop yield and households' heads age with most households in the age of 31-40 years citing to have reduced yields as represented by 45.6%. There were fewer households in the age above 50 years who cited the effect of reduced crop yields. In the same way, there was a significant relationship between household perception on increased weed attack and households' heads age at 5% level. Majority of the farmers with the perception that rainfall variability contribute to increased weed attack were aged between 31-40 years as represented by 33.3% of the total respondents. This was closely followed by households aged between 51-

60 years and 60 years and above each with 22.2% of households who held a perception that rainfall variability could be blamed for the increased cases of weed attacks. This study noted that majority of households with perception that the emergence of livestock diseases as well as emergence and re-emergence of human diseases has been contributed by rainfall variability were aged between 31-40 years as represented by 52.9% and 79.2% of the respondents, respectively. Table 11 shows the relationship between perception on the effects of rainfall variability and household head level of education.

Table 11: Relationship between perception on the effects of rainfall variability and household head level of education

Perceived Effects	Level of education of the household head				χ^2	df	P-value
	No formal Education	Primary	Secondary	College			
Reduced crop yields	0	0	98	20	18.622	3	.000
Increased crop yields crop yields	4	9	15	90	21.543	3	.000
Reduced water availability	0	12	35	71	11.646	3	.009
Increased weed attack	0	33	59	26	20.426	3	.000
Delays in planting and harvesting	4	11	23	80	13.865	3	.003
Increased crop disease and pests	17	17	17	67	14.252	3	.003
Emergence of livestock diseases	10	0	24	83	15.683	3	.001
Emergence and re-emergence of human diseases	0	25	10	84	2.952	3	.399

Majority of the households who had a perception that rainfall variability has decreased crop yields and increased weed attack had secondary level of education as represented by 83.3% and 50.0% of the respondents, respectively. Most of the households who perceived that rainfall variability had resulted to reduced crop yields (75.9%), reduced water availability (60.0%), delays in planting and harvesting (67.7%), increased crop disease and pests (57.1%) and

emergence of livestock diseases (70.6%) had college level of education (70.8%).

Table 12 summarizes the severity of drought, flooding, disease epidemic, water resource decrease, feed shortage, soil erosion and pest attack as perceived by respondents in the study area.

Table 12: Severity of the effect of rainfall variability in the area

Effects	Not affected	Low	Moderate	High	Very high	Total
Drought	12 (10.2%)	29 (24.6%)	59 (50.0%)	13 (11.0%)	5 (4.2%)	118 (100.0%)
Flooding	70 (59.3%)	23 (19.5%)	22 (18.6%)	3 (2.5%)	0 (0.0%)	118 (100.0%)
Disease epidemic	9 (7.6%)	48 (40.7%)	48 (40.7%)	10 (8.5%)	3 (2.5%)	118 (100.0%)
Water resource decrease	0 (0.0%)	29 (24.6%)	56 (47.5%)	22 (18.6%)	11 (9.3%)	118 (100.0%)
Feed shortage	9 (7.6%)	10 (8.5%)	45 (38.1%)	37 (31.4%)	17 (14.4%)	118 (100.0%)
Soil erosion	4 (3.4%)	52 (44.1%)	44 (37.3%)	18 (15.3%)	0 (0.0%)	118 (100.0%)
Pest attack	2 (1.7%)	29 (24.6%)	71 (60.2%)	14 (11.9%)	2 (1.7%)	118 (100.0%)

Source (Field Data, 2014)

Table 13: Ranking of the perceived effects

Effect of rainfall variability	Mean	Std. Dev.	Rank
Feed shortage	3.364	1.075	1 st
Water resource decrease	3.127	0.892	2 nd
Pest attack	2.873	0.699	3 rd
Drought	2.746	0.935	4 th
Soil erosion	2.672	0.755	5 th
Disease epidemic	2.603	0.833	6 th
Flooding	1.661	0.877	7 th

Feed shortage was noted to be the most severe effect on the farming practices in the study area as a result of rainfall variability (mean = 3.364 with a standard deviation of 1.075). This was closely followed by water resource decrease (mean = 3.127 with a standard deviation of 0.892). Some of the other severe effects of rainfall variability in the area were cited as pest attack (2.873), drought (2.746), soil erosion (2.672), disease epidemic (2.603) and flooding (1.661). These findings are consistent with Ng'eno & Bebe (2013) who in their study of perception of climate variability and change impact on dairy production in Nandi and Rongai Sub counties noted that drought, feed shortage, water resource and disease epidemic ranked highly. From households' point of view, drought is the cause of feed shortage. According to Thornton *et al.* (2006), climate change and variability is associated with changes in herbage growth, quality and dry matter yield which is in agreement with the findings of this study. Changes in rainfall and temperature regimes are also key parameters which modulate the emergence of various animal diseases and vectors often leading to reduced animal productivity (Baker & Viglizzo, 1998).

The FGDs too confirmed that dry spells cause shortage of pasture for livestock leading to reduced milk production, emaciated livestock thus fetching low market values. Increased pests and disease attack especially during heavy than normal rains and dry spells were also reported. The informants acknowledged the link between climate variability and the increased incidences of crop and livestock pests and diseases. However in the discussions, it was importantly noted that other than rainfall variability, crop and livestock production in the study area was greatly hampered by over fragmentation of land, decline in soil fertility caused by continuous cropping, soil erosion, and traditional livestock production systems.

These results are consistent with Bryan *et al.* (2011) who noted that households from 13 divisions within 7 districts (Garissa, Mbeere South, Gem, Njoro, Mukurwe-ini, Othaya and Siaya) in Kenya also identified feed shortage, drought, flood, erratic rainfall and hailstorms as the main climate-related shocks that affected farming practices of the respondents. The understanding of how farmers perceive climate risk is valuable to other stakeholders such as extension service, providers and climate information providers as it can assist in tailor-making their services to suit the farmers' needs and support them to better cope and adapt with climate variability (Moyo *et al.*, 2012). Seeking to understand the household perception of climate variability

is important as it determines the process of how to provide relevant meteorological services.

4. CONCLUSION AND RECOMMENDATION

There existed a statistically significant relationship between the mixed farming, mulching/shade and technology adoption (e.g. greenhouses) adaptation strategies with gender. More male than female headed households practice mixed farming and adopt modern technology that is geared towards provision of resilience against rainfall variability e.g. greenhouses. On the contrary, the mulching/shading response strategy is more popular with females than male headed households. Most of the households practicing crop diversification (growing of more than one type of food/cash crop), mulching/shading of crops and modern technology such as green houses were middle aged (between 31-40 years). As far as households' heads education was concerned, this study noted that irrigation practice was most associated with household heads with secondary and tertiary level of education while use of chemicals/herbicides was mainly associated with household heads with tertiary level of education.

This study recommends that the government (County and national) as well as development partners who have a stake in climate change and adaptations should endeavour to strengthen the adaptive capacity of vulnerable populations and of the agriculture sector as a whole in the study area. This requires a comprehensive assessment of the impacts of climate change and variability and the potential policy options that can facilitate adaptation. This can be done through an integrated approach that reinforces actions at both the County and national levels by helping households use their local knowledge in combination with introduced innovations to enhance local adaptations.

There is also need to support households through policies that help them get better access to hybrid seeds that are bred to match with the prevailing rainfall variability. This may be implemented through provision of subsidized planting seeds through the NCPB as well as strengthening the research organizations (KARLO (then KARI), KEFRI, ILRI, etc.) capacity to come up with appropriate planting seeds.

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