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Smallholder Farmers' Perceptions and Adaptations to Climate Change and Variability in Kitui County, Kenya

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Abstract

The effects of climate change have highly challenged the productivity of the agricultural sector. The increasing temperatures and erratic rains, as well as diseases and pests have significantly reduced crop yields in the arid and semi-arid regions of Kenya. Though climate change has been the talk of the day, many farmers in the grassroots have hardly adopted any response options and have continued to suffer losses from the inherent effects of climate change. The present study sought to assess the perceptions of small scale farmers on climate change in selected villages in Kitui County and identify adaptation measures adopted by the farmers in response to climate change. Descriptive survey design was used. A total of 177 households were randomly selected to constitute the study sample. Data was coded and analyzed using SPSS version 20. The results showed that most farmers had perceived a changing climate with 74% and 100% of the respondents in Kaveta and Mikuyuni villages respectively, reporting an increase in temperature over the years. Regarding precipitation, 100% and 97% of the respondents in Mikuyuni and Kaveta villages respectively, had noticed a decrease in the average annual rainfall over the last two decades. Further, the results indicated that 76% and 88% of the respondents in Kaveta and Mikuyuni villages respectively had adopted various adaptation options in response to the decreasing rainfall and the unpredictable onset of rains. The study established that farmers in drier areas perceived climate change more and had adapted more to climate change and variability as compared to those in wetter areas. More resources in terms of credit facilities, access to climate change information and extension services should be availed to farmers in areas affected more by climate change and variability to increase their resilience.

Keywords: Arid and semi-arid lands; Crop yields; Climate change; Drought resistant crops; Perceptions

Introduction

The agricultural sector is one of the key contributors to Kenya's economic growth. The sector is estimated to contribute at least 25% of the country's GDP. The productivity of this sector has however been compromised by the now evident effects of climate change and variability [1]. The impact of climate change has been more pronounced in the Arid and Semi-Arid Lands (ASALs) in Kenya [2]. ASALs in Kenya cover approximately 80% of the country's land which supports 25% of the country's total human population that relies on nearly 75% livestock and crop production [3,4].

There has been reported that higher drought risks, extreme weather events such as floods, pests and diseases are some of the negative effects of climate change that farmers have faced in the recent years [5]. Most farmers have adopted various adaptation measures to reduce the adverse effects of climate change on their agricultural out puts.

Adaptation to climate change refers to the adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities [5]. The adaptation strategies in the agricultural sector include use of new crop varieties, crop diversification, adoption of mixed crop and livestock farming systems, changing planting dates and irrigation [6-9].

Maddison reported that farmers will first perceive a changing climate and then device practices in response to the perceived change [10]. Similarly, Doss and Morris opined that the perspectives of the local people, the way they think and behave in relation to climate, as well as their values and aspirations play a significant role in addressing climate change [11]. The perception of local farmers on climate change is therefore an important aspect towards successful climate change adaptation strategies.

Recent research efforts on climate change impacts and adaptations have focused on regional and national assessments of the potential effects of climate change on agriculture [12,13]. The present study focused on specific locations using a bottom- up approach which seeks to gain insight from the farmers themselves based on a farm housed hold survey. The broad objective of the study was to assess small scale famers' adaptations to climate change and variability in Kaveta and Mikuyuni villages, Kitui County. The specific objectives were; (i) to assess small scale farmers' awareness and perceptions of climate change and variability in Kaveta and Mikuyuni Villages, (ii) assess small scale farmers' adoption of adaptations to climate change and variability in Kaveta and Mikuyuni villages.

Materials and Methods

Profile of the study area; Topography and climate

The study was carried out in selected villages from Kwa Vonza-Yatta ward (Mikuyuni Village) and Kitui Township ward (Kaveta Village), Kitui County [14] (Figure 1). Generally, Kitui County lies between 400m to 1,830m above sea level and generally slopes from the west to east with the highest regions being Kitui Central, Mutitu Hills and the Yatta Plateau. Mikuyuni Village lies in the Yatta plateau while Kaveta

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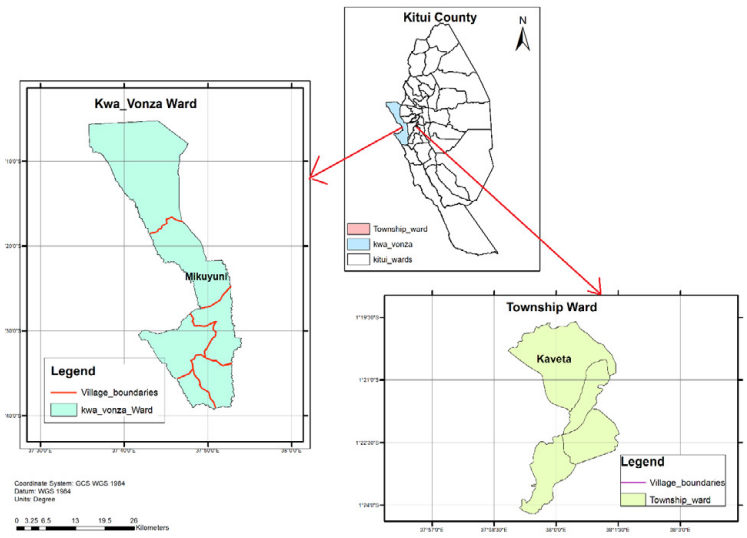

Figure 1: A map of the study area. (Source: Kitui County Ministry of Environment, Energy and Minerals Investments Development; GIS Office).

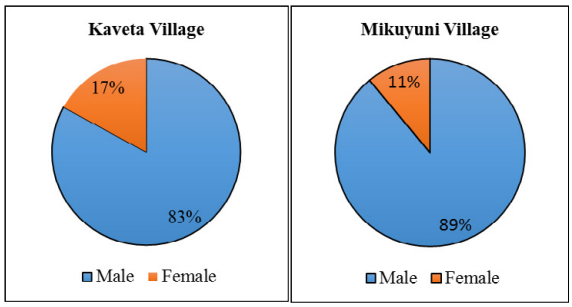

Figure 2: Gender distribution (%) of household heads in Kaveta and Mikuyuni Villages, Kitui County.

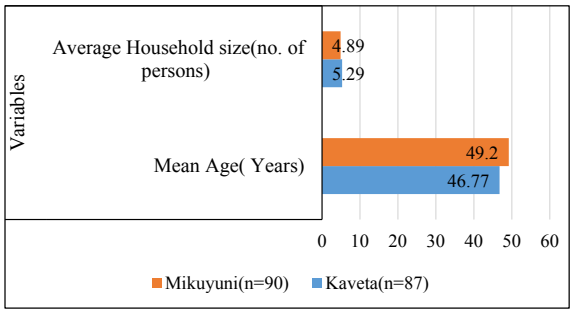

Figure 3: The mean age of household heads and average household size in Kaveta and Mikuyuni villages in Kitui County.

Village is in Kitui Central. The climate of the area is semi-arid with very erratic and unreliable rainfall. The area is hot and dry throughout the year with temperatures ranging from a minimum of 14-22° centigrade to a maximum of 26-34° centigrade. The months of February and September are the hottest months in the year. Rainfall is distributed within two seasons yearly and varies from 500-1050mm with about 40% reliability. The long rains are experienced between March and May and short rains between October and December. The short rains are considered more reliable than the long rains since it is during the short rains that farmers get their main food production opportunity. The soil types range from sedimentary rocks, red sandy soils, to clay black cotton soils which are generally low in fertility.

Population and Economy

Mikuyuni Village has a human population of 7,448 persons and 1,528 households while Kaveta Village has a human population of 4,584 persons and 936 households [15] with 90% of the population rural based. Livestock production and crop farming are the back bone of the people's economy in the area contributing to nearly three quarters of household earnings [15]. Cattle, sheep, and goats are the most important animals in the area. Various crops such as maize, beans, sorghum, pigeon peas, millet and cassava are cultivated mainly for subsistence while green grams, sweet potatoes, vegetables, and fruits (such as mangoes and bananas) are grown for sale.

Research design, data collection and data analysis

Descriptive survey design was used. Purposive sampling was used to select the villages while simple random sampling was used to select the households. For this study, Kaveta Village was selected to represent relatively wet areas while Mikuyuni Village was selected to represent the dry areas of Kitui County. The main objective of selecting the two villages was to gain insights into differences in perceptions and adaptations to climate change and variability between farmers living in wet and dry areas. The sample size for the study was 177 households (Kaveta= 87 and Mikuyuni=90). Primary data was collected through administration of questionnaires in Kaveta and Mikuyuni villages. Secondary data on rainfall patterns of the study areas for the last 30 years was also obtained from Kitui Meteorological Department to compare farmers' perceptions on climate change and variability and the actual rainfall trends. Both quantitative and qualitative data was used. The Statistical Package for Social Sciences (SPSS version 20) was used to run both descriptive and inferential statistics.

Results and discussion

Socio-economic characteristics of crop farmers in Kaveta and Mikuyuni Villages

Gender: The results indicated that 83% of the households are male headed while 17% of the households are female headed in Kaveta Village.

The results further showed that 89% of the households are headed by male and 11% of the households are female headed in Mikuyuni Village (Figure 2). This implies that most households in both villages are headed by men. Thus, most households were likely to perceive climate change as well as adopt climate change adaptation strategies since male headed households are more likely to perceive changes in the surrounding than female headed households. The results are in agreement with findings by Asfaw and Admassie and Tenge and Hella [16,17].

Age: The mean age of the household heads was 46.77 years and 49.20 years in Kaveta and Mikuyuni villages, respectively. This implies that majority of the crop farmers sampled were adults who had vast experience in farming and had observed the climate change over the years and could consequently adopt response strategies to improve crop production in the area. This is in line with observation by Akintonde Ndambiri and Maddison [7,10], who noted that older farmers were more likely to perceive and adapt to climate change as compared to younger farmers.

Household size: The average family size was 5.29 and 4.89 persons in Kaveta and Mikuyuni villages, respectively. Tizale noted that household size is a proxy to labor availability which could enable farmers to take up labor intensive adaptation measures (Figure 3) [18,19].

Education level: Data presented in Figure 4 evinced that 46% of the respondents in Kaveta village had attained primary level education, while 57% of the respondents in Mikuyuni village had attained secondary level education. Further, the results showed that an almost

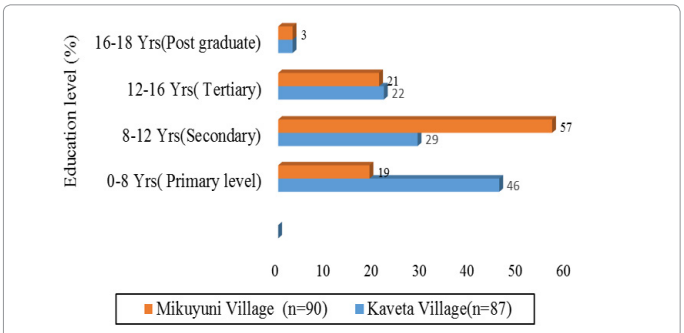

Figure 4: Distribution of education levels of household heads in Kaveta and Mikuyuni villages in Kitui County.

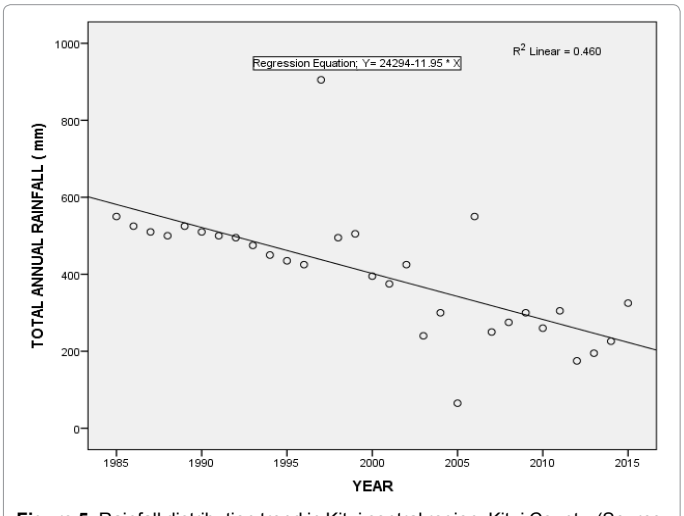

Figure 5: Rainfall distribution trend in Kitui central region, Kitui County. (Source: Kitui Meteorological Department).

Farming experience (in years)	Kaveta Village (n=87)	Mikuyuni Village (n=90)
	% of respondents	
Less than 10	32	36
Oct-30	55	57
Above 30	13	7
Total	100	100

Table 1: Farming experience of respondents in Kaveta and Mikuyuni Villages, Kitui County.

Village	Mean Annual on-farm income (Ksh.)	Mean Annual off-farm income (Ksh.)
Kaveta (n=87)	64, 137.93	98, 103.45
Mikuyuni (n=90)	32, 611.11	56, 444.44

Table 2: Mean annual on-farm and off-farm income of respondents in Kaveta and Mikuyuni Village, Kitui County.

equal proportion (22% and 21% in Kaveta and Mikuyuni villages, respectively) of the respondents in the two villages had attained tertiary level education. The results also pointed out that 3% of the respondents had attained postgraduate education in both villages.

The high level of education in the study area is likely to positively influence farmers' perception and adoption of adaptation strategies. This has been reported in similar studies by Ndungu and Bhardwaj, Deressa and Maddison [6,9,10].

Farming experience: Data presented in Table 1 revealed that 55% and 57% of the respondents in Kaveta and Mikuyuni villages respectively, had been in farming for 10 to 30 years while only 32% and 36% in Kaveta and Mikuyuni villages had been in farming for less than 10 years. Like education level, high farming experience in the study area is likely to positively influence farmers' perception and adoption of adaptation strategies since farmers with more farming experience are more likely to perceive and adapt to climate change and variability as compared to farmers with less farming experience. These has been reported in other studies [6,7,9,10].

Annual on-farm and off-farm income: The results presented in Table 2 showed that the mean annual on-farm and off-income was Ksh. 64, 137.93, 32, 611.11, 98, 103.45 and 56, 444.4 for Kaveta and Mikuyuni villages, respectively. Further analysis of the results indicated that the mean annual on-farm and off-farm incomes were statistically different ($t_{99.16}$ =3.350, p<0.001 and $t_{149.35}$ =1.324, p<0.005) between the two villages. It can thus be deduced that farmers in Kaveta Village had higher annual on-farm and off-farm incomes as compared to their counterparts in Mikuyuni Village. This implies that farmers in Kaveta Village had ventured more into off-farm activities as compared to those in Mikuyuni Village. In regard to on-farm income, the results imply that crop yields in Mikuyuni Village are relatively lower than those of farmers in Kaveta village. Thus, it can be established that, with lower on-farm and off-farm incomes, farmers in Mikuyuni Village are more vulnerable to the effects of climate change as compared to their counterparts in Kaveta Village. This is in agreement with findings from a similar study by Ndamani and Watanabe and Ndambiri [7,20,21] who reported that farmers with diversified incomes are more resilient to climate change and variability.

Institutional characteristics of respondents in Kaveta and Mikuyuni villages

Distance to market: Results presented in Table 3 indicated that most of the respondents (77%) in Kaveta Village were less than two kilometers from the market while most of the respondents (56%) in Mikuyuni Village were three to five kilometers away from the market.

Institutional characteristics	Distance	Kaveta Village (n=87)	Mikuyuni Village (n=90)
		% of respondents	
Distance from the market (in km)	Less than 2 Km	77	8
	3-5 Km	18	56
	6-10Km	5	33
	Above 10	0	3
Access to credit facilities		69	37
Access to extension services		3	0
Access to climate change information		26	69
Source of climate change information	None	74	31
	Media	23	52
	NGOs	2	13
	CGoK	1	3
Access to weather forecasts		38	64
Weather forecast reliability		0	2

Table 3: Institutional characteristics of the respondents in the study sites.

Weather Element	Farmers' perceptions	Kaveta Village (n=87)	Mikuyuni Village (n=90)
		% of respondents	
Temperature	Increased temperature	74	100
	Decreased temperature	13	0
	Constant temperature	13	0
Precipitation	Increased annual rainfall	3	0
	Decreased annual rainfall	97	100
	Constant annual rainfall	0	0
	Early onset of rains	2	9
	Delayed onset of rains	40	40
	Unpredictable onset of rains	55	47

Table 4: Farmers' perceptions of climate change and variability in Kaveta and Mikuyuni Villages, Kitui County.

This implies that most farmers in Kaveta Village are near the market as compared to those in Mikuyuni Village. According to Maddison, proximity to market is an important determinant of adaptation, presumably because the market serves as a means of information exchange for farmers [10].

Access to credit facilities: The results also indicated that 69% and 39% of the respondents in Kaveta and Mikuyuni villages, respectively, had access to credit facilities. This implies that financial constraints are not a major barrier to farmers' adaptation to climate change in Kaveta Village as it is the case in Mikuyuni village. Access to credit facilities offsets financial constraints enabling farmers to purchase improved crop varieties, acquire adequate labor for timely planting, purchase facilities for soil fertility management and water conservation as well as irrigation equipment. The role of credit facilities in enhancing smallholder famers' adaptation to climate change and variability has been reported in other studies Ndamani and Watanabe, Ndungu and Bhardwaj, Ndambiri, and Deressa [6,7,9,21].

Access to extension services and climate change information: Data presented in Table 3 showed that all the respondents (100%) in Mikuyuni Village did not have access to extension services and only 3% in Kaveta Village could access to extension services. This implies that most farmers from the two villages did not receive extension services and therefore are faced with challenges of making informed climate smart decisions in their efforts to adapt to climate change. According to Celia, climate-related concerns and information help farmers in making informed decisions on climate change adaptation [22].

The results also indicated that 36% and 69% of the respondents in Kaveta and Mikuyuni villages respectively, had received climate change information in the past one year. The results further showed that 23% and 52% of the respondents in Kaveta and Mikuyuni villages respectively received climate change information from the media. In Kaveta Village, 1% of the respondents reported to have received climate change information from Non-Governmental Organizations (NGOs) and 2% had received climate change information from the County Government of Kitui (CGoK). In Mikuyuni Village, 12% of the respondents received climate change information from the NGOs and 3% had received climate change information from the CGoK.

It can therefore be established that more farmers in Mikuyuni Village had received climate change information in the last one year as compared to those in Kaveta Village. This could imply that farmers in Mikuyuni Village have a higher probability to adopt climate change adaptation strategies as compared to those in Kaveta Village. Similar studies by Maddison, Nhemachena and Hassan indicated that access to climate change information by farmers positively influenced their adoption of climate change adaptation strategies [10,19]. From the results, it can also be noted that the Non- Governmental Organizations played a greater role in disseminating climate change information as compared to the county and central governments.

In regard to seasonal weather forecasts, 64% and 38% of the respondents in Mikuyuni and Kaveta Village, respectively, had received seasonal weather forecasts. This implies that a greater proportion in Mikuyuni Village had access to seasonal weather forecasts than in Kaveta Village. The results however showed that most of the respondents (98% and 100% in Kaveta and Mikuyuni respectively) in both villages observed that the weather forecasts were unreliable.

Seasonal weather forecasts are likely to influence farmers' adaptation to climate change in the study area and therefore farmers in Mikuyuni Village are more likely to make informed decisions in their efforts to adapt to climate change as compared to those in Kaveta Village. According to Jotoafrika, seasonal weather forecasts are crucial for the provision of early warning information to farmers since they give probabilities of different rainfall scenarios which strengthen the adaptive capacities of farmers [23]. In their study, Roudier also reported that farmers can use climate forecasts in order to maximize benefits from anticipated favourable conditions [24].

Farmers' perceptions of climate change in Kaveta and Mikuyuni Villages, Kitui County: Results from the study established that 74% of the respondents in Kaveta Village had observed an increasing temperature, 13% observed a decrease in temperature and 13% had perceived a constant temperature over the years (Table 4). In Mikuyuni Village, all the respondents (100%) had observed an increase in temperature over the years. No respondent had perceived a decrease in or constant temperature in Mikuyuni Village.

Results presented in Table 4 revealed that all the respondents (100%) in Mikuyuni Village had perceived a decrease in annual rainfall and no one (0%) had observed an increase in annual rainfall. In Kaveta Village, 97% of the respondents had observed a decrease in annual rainfall over the years and 3% had perceived an increase in annual rainfall.

No respondents in both Kaveta and Mikuyuni villages had observed a constant amount of annual rainfall over the years. The results further showed that 55% and 47% of the respondents in Kaveta and Mikuyuni

Weather Element	Adaptation options	Kaveta Village (n=87)	Mikuyuni Village (n=90)
		% of respondents	
Temperature	Planting drought resistant crops	0	14
	Planting just before the onset of rains	8	14
	Planting early maturing crops	9	7
	Irrigation	0	4
	Planting immediately after the onset of the rains	7	4
	Water harvesting	3	3
	Switching from crop farming to livestock keeping	3	0
Precipitation	Planting drought resistant crops	1	22
	Irrigation	0	6
	Planting just before the onset of rains	38	86
	Planting immediately after the onset of the rains	35	14
	Use of hybrid crop varieties	71	87
	Crop diversification	16	27
	Use of pesticides	52	84
	Use of fertilizer	24	6
	Use of manure	52	86
	Water harvesting	15	8
	Soil conservation	49	37
	Mixed crop and livestock farming	32	71
	Switching from crop farming to livestock keeping	6	0
Note: Values in the table represent individual responses and therefore not additive.			

Table 5: Adaptation measures adopted by farmers in response to increasing temperature and changing rainfall patterns in Kaveta and Mikuyuni Villages, Kitui County.

villages respectively, had perceived unpredictable onset of rains over the years.

From the results, it can be deduced that most farmers were generally aware of climate change since most farmers in both Kaveta and Mikuyuni villages reported that they had perceived changes in temperature and precipitation trends over the last two decades. Most farmers from the two villages reported an increase in temperature and a decrease in precipitation. The results were consistent with findings from a similar study in Kyuso District [7,25]. Findings by Kabubo-Mariara and Karanja also found that most Kenyans are aware of short-term changes in climate [26]. Okonya in their study also reported that nearly all households in agro-ecological zones of Uganda had observed climate change [27].

Linear regression results of rainfall data from Kitui Central weather station indicated a significant ($p<0.001$) decrease in the amount of precipitation with time ($R^2=0.46$) as shown in Figure 5. This implies that farmers' perceptions on changes in precipitation over the years were consistent with rainfall trends over the last three decades. The meteorological rainfall data indicated that precipitation was decreasing with time in Kitui region. The results are in agreement with findings in other studies [6,25].

An important finding from the study was that farmers from Kaveta Village had different perceptions on the changing climate as compared to their counterparts in Mikuyuni Village. While an equal percentage (13%) of the respondents in Kaveta Village perceived a decreasing and constant temperature over the years, all the respondents in Mikuyuni Village reported to have perceived an increase in temperature over the years. The same difference in perception between farmers from the two villages was also observed in changing precipitation patterns. While all the respondents in Mikuyuni Village had observed a decrease in precipitation, at least 3% in Kaveta Village reported to have observed an increase in precipitation over the years. This finding concurs with findings from a similar study by Kusakari [28], who found out that perceptions of farmers on changing temperature and rainfall patterns as well as frequency of extreme events such as drought and floods in Wa West District of the Upper West Region of Ghana were significantly different across different localities. The Ministry of Environment, Science, and Technology (MEST) of Ghana also stated that people's experience on climate shocks varies across different social groups, geographic locations and seasons of the year [29].

Luni and Macharia also emphasized that small scale farmers do have varying levels of perception and attitudes towards climate change and its impact which are intertwined with non-climatic forces as well as pervasive social, economic and political changes [30].

From the present study, it can be deduced that farmers in drier areas are more conscious of climate change and thus perceive climate change more, compared to those in wetter areas, thus, the difference in farmers' perceptions of climate change and variability in the two villages.

Farmers adaptation in response to the changing rainfall pattern and increasing temperatures: Data presented in Figure 6 showed that 76% and 88% of the respondents in Kaveta and Mikuyuni villages respectively, had adopted various adaptation options in response to the decreasing rainfall and the unpredictable onset of rains. This implies that an overwhelming majority of farmers in both Kaveta and Kaveta and Mikuyuni villages respectively, had adopted various adaptations strategies in response to the decreasing amount of precipitation and unpredictable rain patterns. The results concur with findings from a similar study by Ndamani [21], who found out that 85% of the respondents in Kyuso District had adopted several climate change adaptation strategies. Wamalwa also established that 74% of the respondents in Kisii County had employed several adaptation measures in response to the changing climate [31].

In regard to the increasing temperatures, the results showed that only 10% and 19% of the respondents in Kaveta and Mikuyuni villages, respectively had adopted some adaptation measures in response to the increasing temperatures (Figure 6). This implies that most farmers had employed adaptation strategies in response to the decreasing precipitation in both Kaveta and Mikuyuni villages as compared to the increasing temperatures. The present study findings were similar

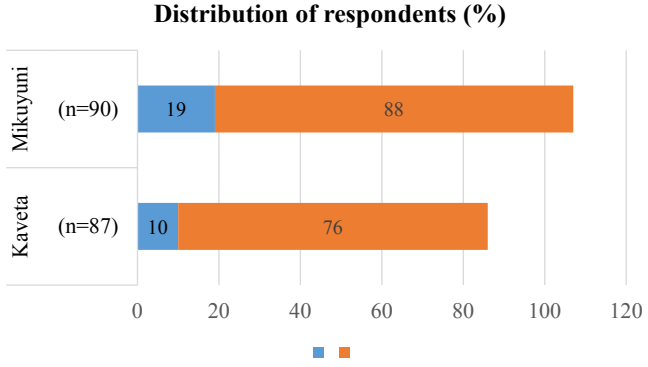

Figure 6: Farmers adaptation in response to increasing temperatures and rainfall patterns in Kaveta and Mikuyuni Villages, Kitui County.

to those by Kabibo-Mariara and Karanja [26], who found out that most households in Kenya had made efforts to counter long-term precipitation changes as compared to the case of changing temperatures.

The results further indicated that there was a significant difference between farmers' probability to adopt climate change and variability adaptation strategies in Kaveta and Mikuyuni villages (x^2= 4.24, df= 1, p=0.04). More farmers in Mikuyuni had adopted climate change and variability adaptation strategies than in Kaveta Village. The variability in adaptation between the Villages could be attributed to the fact that being, relatively drier, Mikuyuni Village received relatively lower amounts of rainfall as compared to Kaveta Village. This could be explained by the fact that on-farm income from Kaveta was significantly higher than that from Mikuyuni Village ($t_{99.16}$ =3.350, p<0.001). The lower on-farm income in Mikuyuni could imply that crop yields in Mikuyuni Village were relatively lower than those of farmers in Kaveta Village. Thus, farmers in Mikuyuni Village were more conscious of climate change and therefore more likely to adopt strategies to cope. The difference in adaptation in the two villages could also be attributed to other factors such as access climate change information and weather forecasts by farmers in the two villages. For example, most respondents in Mikuyuni reported to have had access to climate change information (69%) and weather forecasts (64%) as compared to only 36% and 34% of all the respondents who had access to climate change information and weather forecasts, respectively in Kaveta Village.

Adaptation measures adopted by farmers in response to the changing rainfall patterns and increasing temperature: From the results presented in Table 5, the main adaptation measures adopted by farmers in response to the decreasing precipitation in Kaveta Village included use of hybrid crop varieties (68%), use of pesticides (52%) and use of animal manure (52%). The results also indicated that soil conservation (49%), mixed crop and livestock farming (32%) and crop diversification (16%) were other adaptation practices employed by farmers in Kaveta Village. The results further showed that 38% of the respondents in Kaveta Village opted to plant before the onset of the rains and 35% of the respondents planted just after the onset of the rains in response to the unpredictable onset of the rains.

In Mikuyuni Village, use of hybrid crop varieties (87%), animal manure (86%), pesticides (84%) and mixed crop and livestock farming (71%) were the main climate change adaptation strategies adopted by the farmers in response to the decreasing precipitation (Table 4). Other adaptation options included soil conservation (37%) and crop diversification (27%). The results also showed that 86% of the respondents in Mikuyuni Village planted just before the onset of the rains and 14% of the respondents planted just after the onset of the rains in response to the unpredictable onset of rains.

The results further established that 22% of the respondents planted drought resistant crops and 6% of the respondents irrigated their crops in Mikuyuni Village. In Kaveta Village, only 1% of the respondents reported to have planted drought resistant crops. No irrigation practice was reported in response to the decreasing precipitation in Kaveta Village. Although no respondent had switched from crop farming to livestock keeping in Mikuyuni Village, at least 6% of the respondents in Kaveta Village had switched from crop farming to livestock keeping.

In response to the increasing temperatures, at least 8% of the respondents planted early maturing crops and 15% of the respondents changed planting dates where 8% of the farmers planted just before the onset of the rains and 7% planting just after the onset of the rains (Table 5). The results further indicated that 3% of the respondents reported to have switched from crop farming to livestock keeping. Interestingly, no farmer in Kaveta Village planted drought resistant crops in response to the increasing temperatures.

Planting of drought resistant crops (14%), planting of early maturing crops (7%) and changing of planting dates which included farmers planting just before the onset of rains (14%) and just after the onset of the rains (4%), were the only adaptation measures adopted by farmers in response to the increasing temperatures in Mikuyuni Village (Table 4).

The results were in consonance with findings by Oremo who indicated that farmers in Mutomo and Yatta districts responded to the decreasing precipitation and increasing temperatures through implementation of soil conservation schemes, changing crop varieties, reducing the number of livestock, diversification of crop types and varieties, different planting dates, diversification to non-farming activity, water harvesting schemes, and reducing the size of land under cultivation [25].

Studies by Ndambiri, Ndamani and Watanabe, Benedicta and Ndungu and Bhardwaj also indicted that farmers adopted growing of different crop varieties, , use of different planting dates, practicing crop diversification, switching from crops to livestock farming, changing land area under cultivation, adjusting the number and livestock management strategies, switching from farming to non-farming activities, increased use of irrigation, increased use of fertilizers and pesticides, increased use water of conservation technologies, practicing soil conservation, mulching and use of manure and switching from farming to non-farming as way of adapting to climate change and variability [6,7,21,32].

However, from the present study, it can be noted that despite the decreasing amounts of precipitation, while at least 22% of the respondents in Mikuyuni Village planted drought resistant crops such as sorghum, millet, cowpeas, green grams among others, most farmers in the Kaveta Village (99%) did not plant drought resistant crops. This could be attributed to inadequate information from extension officers on the type of crops to plant as well as unreliable weather forecasts.

From the results, it can also be noted that most farmers (86%) in Mikuyuni relied on use of the organic manure as compared to those in Kaveta Village where at least 24% of the respondents used inorganic fertilizers. This could be explained by the significantly higher income in Kaveta as compared to that in Mikuyuni Village. Thus, farmers in Mikuyuni Village invested in the affordable organic manure as opposed to the expensive inorganic fertilizers.

The results also pointed out that very few farmers in both villages had adopted irrigation of crops as an adaptation strategy. This could be attributed to lack of access to irrigation water and inadequate financial

and technological capacity among the farmers in both villages. The findings of the present study are in line with those by Oremo and Ndambiri [25,7,33-38], who found out that inadequate financial and technological capacity were some of the constraints of farmers' adaptation to climate change and variability.

Conclusion and Recommendations

The study established that farmers in drier areas are more conscious of climate change and thus perceive climate change more, compared to those in wetter areas. The study also found out that farmers in drier areas had adapted more to climate change and variability as compared to those in wetter areas. More resources in terms of credit facilities, access to climate change information and extension services should be availed to farmers in areas affected by climate change and variability to increase their resilience.

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References

1. Adamgbe E, Ujoh F (2013) Effect of variability in rainfall characteristics on maize yield in Gboko. Nigeria. J Environ Prot 4: 881-887.
2. Omoyo N, Wakhungu J, Oteng S (2015) Effects of climate variability on maize yield in the arid and semi-arid lands of lower eastern Kenya. Agricul Food Sec 4: 8.
3. Ottichilo W, De Leeuw J, Skidmore A, Prins H, Said M (2000) Population trends of large non-migratory wild herbivores and livestock in the Masai Mara ecosystem Kenya between 1977 and 1997. Afr J Ecol 38: 202-216.
4. Orindi V, Ochieng A, Otiende B, Bhadwal S, Anantram K, et al. (2006) Mapping climate vulnerability and poverty in Africa.
5. Intergovernmental Panel on Climate Change (IPCC) (2001) Climate change impacts, adaptation, and vulnerability. Contribution of Working Group II to the 3rd Assessment Report Cambridge University Press, Cambridge.
6. Ndungu C, Bhardwaj S (2015) Assessment of people's perceptions and adaptations to climate change and variability in mid-hills of Himachal Pradesh, India. Int J Curr Microbiol App Sci 4: 47-60.
7. Ndambiri H, Ritho C, Mbogoh S, Ng'anga S, Muirur E, et al. (2012) Assessment of farmers' adaptation to effects of climate change in Kenya. J Econ Sust Dev.
8. Kurukulasuriya P, Mendelsohn R (2006) Crop selection: Adapting to climate change in Africa.
9. Deressa T, Hassan R, Alemu T, Yesuf M, Ringler C (2008) Analyzing the determinants of farmers' choice of adaptation methods and perceptions of climate change in the Nile Basin of Ethiopia.
10. Maddison D (2006) The perception of and adaptation to climate change in Africa.
11. Doss C, Morris M (2001) How does gender affect the adoption of agricultural technologies? The case of improved maize technology in Ghana. Agricul Econ 25:27-39.
12. Fischer G, Mahendra S, Velthuizen H (2002) Climate change and agricultural vulnerability. A special report prepared by the International Institute for Applied Systems Analysis as a contribution to the World Summit on Sustainable Development.
13. Charles N, Rashid H (2007) Micro-level analysis of farmers' adaptation to climate change in Southern Africa. IFPRI.
14. CGoK (County Government of Kitui) (2014) Kitui County Villages Bill.
15. GoK (2009) Kenya National Bureau of statistics; The 2009 Kenya Population and Housing Census.
16. Asfaw A, Admassie A (2004) The role of education on the adoption of chemical fertilizer under different socioeconomic environments in Ethiopia. Agri Eco 30: 215-228.
17. Tenge J, Hella J (2004) Social and economic factors affecting the adoption of soil and water conservation in West Usambara highlands, Tanzania. Land Deg Dev 15: 99-114.
18. Tizale C (2007) The dynamics of soil degradation and incentives for optimal management in the Central Highlands of Ethiopia.
19. Nhemachena C, Hassan R (2007) Microlevel analysis of farmers' adaptations to climate change in Southern Africa.
20. Gbetibouo G (2009) Understanding Farmers' Perceptions and Adaptations to Climate Change and Variability: The Case of the Limpopo Basin, South Africa.
21. Ndamani F, Watanabe T (2015) Farmers' perceptions about adaptation practices to climate change and barriers to adaptation: A micro-level study in Ghana. Int J Agric Sci 5: 367-374.
22. Celia M, Sonny R, Christian N, Mina D, Gonzales K (2009) Climate variability, seasonal climate forecasts and corn farming in Isabela, Philippines.
23. Jotoafrika S (2013) Adapting to climate change in Africa.
24. Roudier P, Muller B, d'Aquino P, Roncoli C, Soumaré M, et al. (2014) The role of climate forecasts in smallholder agriculture: Lessons from participatory research in two communities in Senegal. Clim Risk Manag 2: 42-55.
25. Oremo F (2013) Small-Scale farmers' perceptions and adaptation measures to climate change in Kitui County, Kenya.
26. Kabubo-Mariara J, Karanja F (2006) The economic impact of climate change on Kenyan crop agriculture: A Ricardian approach.
27. Okonya S, Syndikus K, Kroschel J (2013) Farmers' perception of and coping strategies to climate change: Evidence from six agro-ecological zones of Uganda. J Agricul Scie 5: 252-263.
28. Kusakari Y, Asubonteng K, Jasaw G, Dayour F, Dzivenu T, et al. (2014) Farmer-perceived effects of climate change on livelihoods in Wa West District, Upper West region of Ghana. J Dis Res 9: 516-528.
29. Ministry of Environment, Science and Technology of Ghana (MEST) (2010) Ghana goes for green growth: Discussion document - Summary Accra: MEST, pp. 8-15.
30. Macharia P, Thuranira E, Ng'ang'a L, Lugadiru J, Wakori S (2012) Perceptions and adaptation to climate change and variability by immigrant farmers in semi-arid regions of Kenya. Afric Crop Sci J 20: 287-296.
31. Wamalwa I, Mburu B, Mang'uriu D (2016) Perception of climate change effects and its influence on uptake of climate smart practices among small scale farmers of kisii county, Kenya. Int J Info Res Rev 3: 2409-2417.
32. Benedicta F, Paul L, Vlek A, Manschadi M (2010) Farmers perceptions and adaptation to climate change: A case study in Sekyedumase district of Ashanti region, Ghana.
33. Shuaib L (2016) Assessment of level of use of climate change adaptation strategies among arable crop farmers in Oyo and Ekiti states, Nigeria. J Earth Sci Clim Change 7: 369.
34. Igoden C, Ohoji P, Ekpare J (1990) Factors associated with the adoption of recommended practices for maize production in the Lake Basin of Nigeria. Agri Admin Ext 29: 149-156.
35. Intergovernmental Panel on Climate Change (IPCC) (2014) Climate change: Impacts, adaptation, and vulnerability. Working Group II contribution to the IPCC 5th Assessment Report.
36. Norris E, Batie S (1987) Virginia farmers' soil conservation decisions: An application of Tobit analysis. Sout J Agricul 19: 89-97.
37. Wang J, Huang, J, Rozelle S (2010) Climate change and china's agricultural sector. An overview of impacts, adaptation, and mitigation.
38. Yirga CT (2007) The dynamics of soil degradation and incentives for optimal management in Central Highlands of Ethiopia.

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