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Socioeconomic Determinants of Banana Farmers' Perception to Climate Change in Nyeri County, kenya

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ABSTRACT

Climate change is one of the key constraints to banana production globally. The extent of the climate change impacts depends largely on farmers' awareness, perceptions and responses to climate change. This study examined the perception of farmers in Mt Kenya region, Nyeri County-Kenya of climate change impacts on banana value chain and analysed the socio-economic factors that influenced these perceptions. The study sites were purposively selected to include areas where banana production had been practiced since the 1980s. Data was collected from a hundred and thirty farming households between February and April 2018. Results indicated that 78.2% of the respondents perceived increase in rainfall and temperature as what constituted climate change. The major perceived effects of climate change to be high transport cost of banana to the market, low prices during rainy season and high demand of the produce during dry season. Results of logit model analysis indicated that gender of household head, farming system, type of farming and access to weather information influenced farmers' perception towards climate change. Even though majority (78.5%) of the farmers perceived climate change to have changed over the years, 47.7% recommended accessibility of weather information on onset of the rainfall period, while 49.2% preferred information on rainfall distribution within the seasons in order to respond to climate change occurrences. These findings show that there is need to integrate policies that safeguard the smallholder farmers from adverse effects of climate change.

Keywords: Banana, Climate change, Perception, Socio-economic.

1. Introduction

Climate change is expected to have a significant impact on agricultural production due to increased average temperature and unpredictable and unreliable rainfall patterns (Nhemachena et al.,

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2010). Farmers place greater emphasis on rainfall pattern when making farming decision concerning planting and harvesting. Misconception about impacts of climate change and its associated menace may result to no adaptation or maladaptation thus increasing the negative impact of climate change (Grothmann and Patt, 2005).

Farmers perceive climate change in terms of reduced and unpredictable rainfall patterns as well as increased temperatures and variations. Perception of climate change, is a tremendously difficult idea for the farmers; has limited boundaries as the individual's perception differs with the past and present situation (Saarinen, 1976). According to Ogutu et al., (2008), perception may be influenced by the recent climate trends more so the prolonged extreme events such as drought or floods. Perceptions of climate change thus appear to be mainly based on farmers' experience on agricultural production depending on the number of years involved in farming practices (Bryan et al., 2013). Thus, perception is likely to affect how farmers respond to climate induced risks and opportunities. The precise nature of their behavioural responses to the impacts will shape adaptation options, the process involved, and adaptation outcomes (Adger et al., 2009; Pauw, 2013).

Information on the impacts and responses to climate change effects is crucial to small holders' farmers in order to get the best adaptation options. Therefore, adaptive processes to the effects of climate change are the priority and crucial to build resilience into the lives of the banana farmers. Previous studies on banana production, transport and trade in the area have been conducted with a focus mainly on socio-economic components, but the contribution of climate change had only limited attention. Hence the socio-economic factors that determine farmers' perception are paramount when they are opting for the best adaptation strategies due to climate change. Thus, this study assessed the farmers' perception to climate change on banana value chain and socio-economic factors that influenced these perceptions.

2. Literature review

Agriculture is the main occupant of rural households many developing countries and a source of income (UNEP, 2011). Agricultural production is inherently sensitive to climate change due to the close natural connections and dependencies that exist between climatic conditions and plant growth (GoK, 2013). Climatic variability and change directly affect agricultural production and food security given that most of the population in the rural areas relies on agriculture for its livelihoods (Ochieng and Mathenge 2016).

Funk et al., (2010) argues that Mt. Kenya region in Kenya which has traditionally been central to crop production will experience climate change related impacts. These impacts will be through decline in crop yields mainly due to climate induced conditions such as a lack of sufficient rainfall, high temperatures and high incidences of pest and diseases. This will have a direct relationship with the market food prices. The main concerns will be by how much will the rainfall decrease and what will be the net effect on production. Unusual climate variability incidences arising from climate change were experienced during the 1997 Elnino rains and the 2001 drought, leading to flooding, landslides, and high levels of erosion and resulted to damage of infrastructure (Nyeri District Environment Action Plan, 2007). The roads to market and farms were cut and therefore produce would not reach to the market.

An analysis of the trends in temperature, rainfall, sea levels and extreme events point clear evidence of climate change in Kenya. Studies indicate that temperatures have generally increased throughout the country (King'uyu et al., 2000; GoK, 2009). Mutimba and Wanyoike, (2013) further notes that temperature has increased by 0.7–2.0°C during the last 40 years, coupled with unpredictable rainfall, leading to poor timing of agricultural activities while other projections predicts gradual increase in mean annual temperature of 1 to 3.50 C by the 2050s. The annual rainfall shows either neutral or slightly decreasing trends to a general decline in the long rains season that extends from March to May (GOK, 2013).

Climate change impacts such as increase in rainfall will make transportation and trading challenging due to poor and inaccessible road networks (Swinnen, 2007). Extreme climatic event such as flooding cuts off road links and destroys the limited infrastructure (GOK, 2013). This affects the overall value chain of the production. Two mechanisms that appear to be critical to break this bottleneck are physical infrastructures (such as technological advancements, road and storage facilities) and market information that will link smallholders to market (Swinnen, 2007). This will reduce market risks and operation cost that are incurred as a result of climate change and variability.

This calls for clear response strategies in order to deal with the threats posed to the small-scale farmers by climate change. Therefore, this study tends to investigate the existing gap while choosing the climate change adaptation strategies. This gap consists of the socioeconomic factors that determine farmer's perception to climate change.

3. Methods and materials

3.1 Description of the study area

The study was carried within Mt Kenya region in Nyeri County. According to UTM projection Nyeri County is located between Longitudes 360 and 380 East and between the equator and Latitude 00 38´ South. The study area and sites were purposively selected to include Agro- Ecological Zones (AEZ) where banana production has historically been grown for the entire period of 1980-2017. Data collection was carried out in Mukurweini sub-County and specifically in the following sites; Ruigi, Mukurweini Central, Gikondi and Gakindu.

In the selected sites, land is unequally distributed with a minority of large-scale farmers owning most of the land while the majority of households own small parcels of land usually less than 2 ha. The average land holding size is 1.8 ha for small holder farmers and 18.25 ha for large scale farmers (GoK, 2013). According to Jaetzold, et al., (2006), Nyeri County experiences equatorial rainfall due to its location within the highland zone of Kenya. The long rains occur from March to May while the short rains occur in October to December, but occasionally this pattern is disrupted by abrupt and adverse changes in climatic conditions. The annual rainfall ranges between 1,200mm and 1600mm during the long rains. The lowest and highest temperature range from 12.8°C to 23.25°C while the monthly mean temperature ranging from 200C to 20.80C.

The study adopted mixed research design to determine climate change perceptions among banana farmers in Nyeri (Mukurweini Sub County) within the Mt. Kenya region. The study area was purposively selected to include diverse locations where banana production has been grown for the target period from 1980-2017. Simple random sampling was used to obtain the participating respondents for the study. The sampling method was chosen because of its merit in ensuring a high degree of representativeness by providing the respondents with equal chances of being selected as part of the sample. In this study, the target population consisted of small-scale banana farmers.

According to GOK (2009), the population statistics of Mukurweini Sub-County is 83,932 represented in 24,083 households. The sample size of 130 respondents was calculated using the using Krejcie and Morgan (1970). The study involved a triangulation of methods whereby both qualitative and quantitative techniques were adopted to collect data using structured questionnaire administered to small holder banana farmers. Qualitative methods of data such as interviews to key informants, Focus Group Discussions (FGDs) and observations were used to enrich the primary data. Close ended questionnaires were used to capture key factors determining farmers' perception on impact of climate change on banana value chains. Focus Group Discussions sessions were undertaken in study area to validate data collected from individual households.

3.2 Statistical analysis

Farmers' perceptions on climate change were analyzed using binary models. A binary choice model was used to estimate the socio-economic factors influencing farmers' perceptions of the long-term changes in climate. Binary logit models were employed when the number of choices available was two (whether perceiver or non-perceivers). Perception is measured by a dummy variable in the model which was assigned a value of 1 for farmers who perceived climate change and a value of 0 for farmers who did not perceive climate change events. The dependent variable in this study is perception while independent variable are socio-economic characteristics of the farmers as described in Table 1.

Thus,

For Farmers perception on climate change:

$R^*i=Xi\alpha+\varepsilon i$

Where

R* is the latent variable,
ε is the error term, and
X denotes the set of explanatory variables or factors that influence farmers' perceptions.

Therefore, a logit model was used to identify the factors affecting the banana farmers' perception to climate change.

Table 1.
Description of variables used in the logistic regression models

Variable	Definition
<u>Dependent Variable</u>	
Perception to climate change	1 = Perceived
	0 = Not perceived
<u>Independent variable</u>	
Gender of household head	1 = Male
	0 = Female
Age of household head	1 = <20yrs
	2 = 21-30years
	3 = 31-40years
	4 = 41-50years
	5 = 51-60 years
	6 = >60years
Education level of the household head (HHH)	1 = No formal education
	2 = Primary
	3 = Secondary
	4 = Tertiary
Type of farming	1 = Subsistence
	2 = Cash-crop farming
	3 = Mixed farming
Member of social group	1 = yes,
	0 = no
Land ownership	1 = own land,
	2 = rented land
Access to credit	1 = access to credit,
	2 = no credit
Access to extension services and training	1 = access to extension services,
	2 = no extension services
Access to market information	1= Yes
	0 = no
Information on weather	1 = Yes
	0 = No
Land size	Acreage
Perceptions of households towards climate change	1= yes,
	0 = No

4. Results and discussions

The study sought to establish farmers' perception and socio-economic factors that influenced farmers' perception to climate change. The climatic change aspects observed in this study included reduced rainfall amounts, changes in rainfall patterns, changes in temperatures, increase in drought frequency and changes in water availability. To establish the extent of observed changes in rainfall or temperature in the study period, the respondents were required to specify if they had observed any climatic changes (i.e. precipitation level, temperature level) (Figure 1).

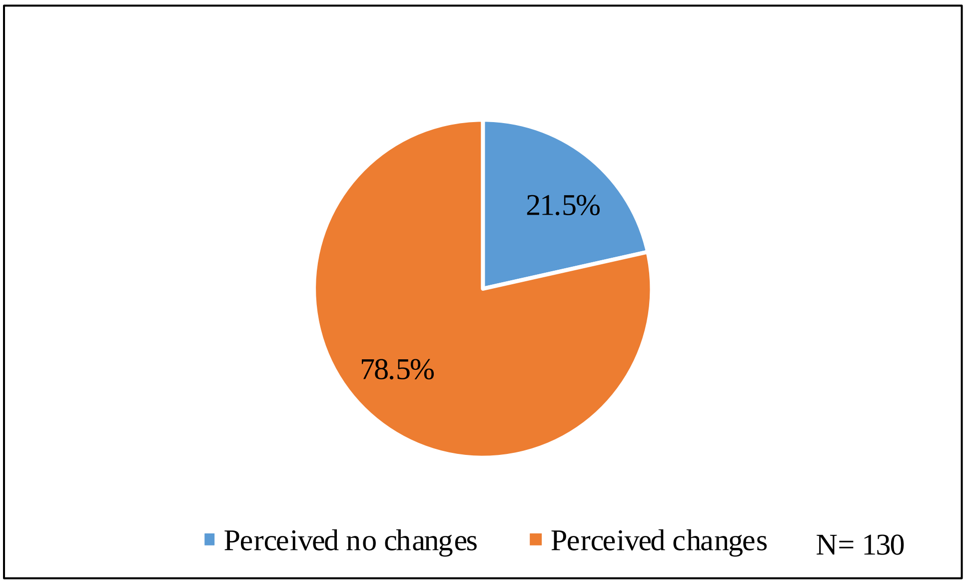

Figure 1. Percentage of respondents' perception of observed climatic changes in the study area

It was observed that majority of the respondents (78.5 %) admitted that they had observed changes in rainfall and temperature while 21.5% stated they had not observed any changes in climate in the last 20 to 30 years. Similar findings were reported in Bangladesh by Uddin, et al., (2017) who found that 88% of the respondents indicated that within a period of 20 years, they had experienced climatic change events. In rural Sahel, Mertz et al., (2009) realized that many households were aware of climate variability and identified reduced crop yields and excess rainfall as the factors of most significance. In Ethiopia, Deressa et al., (2011) and Recha et al., (2016) while reporting for Kenya had earlier observed that for climate change to be addressed, farmers had to first perceive that climate variabilities existed.

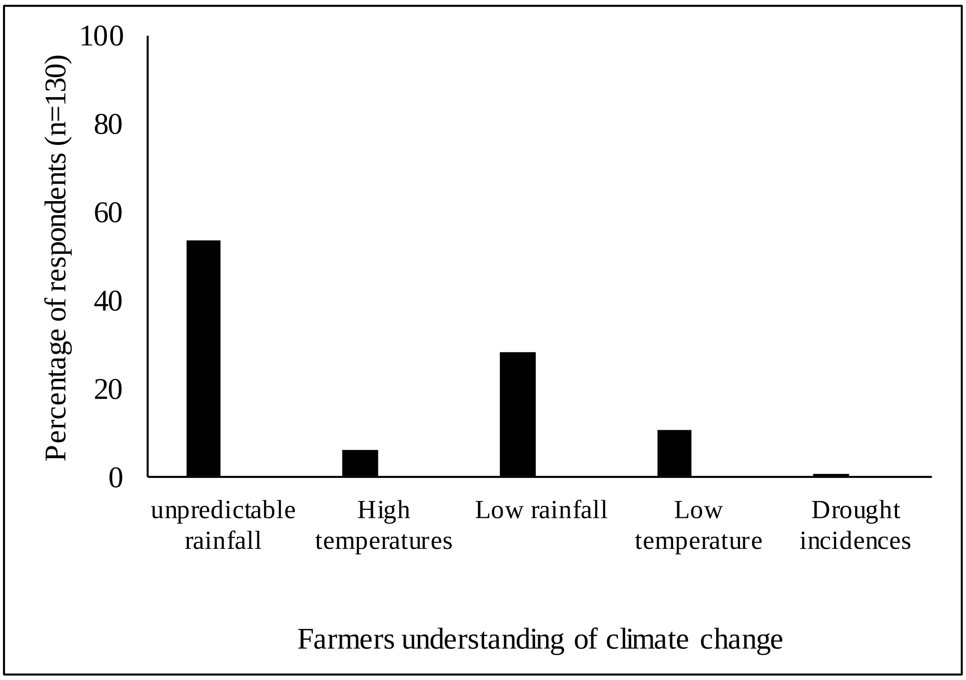

Figure 2. Farmers understanding of climate change and variability

Understanding the meaning of climatic change from the respondents was crucial in this study. Majority of the respondents in the study area revealed that their understanding of climate change was occurrence of unpredictable rainfall (53.5%) and low rainfall (28.46%) respectively (Figure 2). From these findings, the respondents interpreted climate change based on the rainfall amount and its predictability. The study further revealed that significant number of farmers (22%) believed that precipitation has declined or is unpredictable. This shows that there are likely to be drought occurrences in Nyeri county in the future if the trend in rainfall continues as it is. The unpredictable and low rainfall will affect both banana production negatively since most farmers in the study locations depend on rainfed agriculture. These findings are consistent with Ezenwa et al., (2018), who observed that there was decrease in rainfall in Baringo, Kenya and Jigawa State in Nigeria and where farmers adapted by changing their livelihood. Farmers in many parts of the world have always faced climate variability in regard to rainfall and temperature fluctuations. Adaptation to these variabilities have been achieved through adoption of new farming practices such as choice of crops to adapt to low rainfall, crop diversification, early planting and irrigation (Recha et al., 2016).

4.1 Socio- economic factors determining farmers' perception of climate change

The respondent's perception to climate change is a function of household characteristics (i.e. gender of house hold head (HHH), age group of HHH, level of education, land size, type of farming, land size under banana crop, farming system, access to market information, group membership, access to financial assistance, access to extension services, perception to climate change, future information on weather and land ownership) (Table 1). The study findings for economic and social characteristics of the respondents are shown in Table 2. The results showed that type of farming system was significant in explaining farmers' perception of climate change on banana production. Whereas other factors such as level of education and age of the house hold head did not significantly affect the perception though they have been reported in other studies for example by Deressa et al., (2011). It is poorly understood what determines farmers' perception and adaptation to climate change. Several studies such as Below et al., (2012), Maddison, (2007) and Mertz et al., (2009) have indicated that the level of education, gender, age, and wealth of the head of household; access to extension information on climate, social capital, agro ecological settings, all influence farmers' perceptions and decisions regarding climate changes.

Table 2.
Socio-economic factors influencing farmers' perception of climate change

Social economic characteristic		Not Perceived Climate change	Perceived Climate change	Total	x^2 P Value
Gender of the HHH¶	Male	12(21.1%)	45(78.9%)	57(100%)	Ns
	Female	16(21.9%)	57(78.1%)	73(100%)	
Level of education	No formal education	4(40%)	6(60%)	10(100%)	Ns
	Primary	12(22.6%)	41(77.4%)	53(100%)	
	Secondary	9(15.8%)	48(84.2%)	57(100%)	
	Tertiary	4(40%%)	6(60%)	10(100%)	
Age group	Less than 20 years	0 (0%)	1 (100.0%)	1(100%)	Ns
	21 – 30 years	4 (23.5%)	13 (76.5%)	17(100%)	
	31 – 40 years	2 (13.3%)	13 (86.7%)	15(100%)	
	41-50 years	9 (29.0%)	22 (71.0%)	31(100%)	
	51-60 years	6 (18.2%)	27 (81.8%)	33(100%)	
	Over 60 years	13 (21.2%)	46 (78.8%)	60(100%)	
Types of farming system	Subsistence	0 (0%)	3 (100%)	3(100%)	0.028*
	Cash-crop farming	1 (100 %)	0 (0 %)	1(100%)	
	Mixed farming	27 (11.4%)	99(78.6%)	126(100%)	
Membership to farming group	No	25 (21.7%)	90 (78.3%)	115(100%)	Ns
	Yes	3 (20 %)	12 (80%)	15(100%)	
Access to market information	Yes	6(12.5%)	42 (87.5%)	48(100%)	Ns
	No	22 (26.8%)	60 (73.2%)	82(100%)	

System of farming	Rainfed	25 (20.2%)	99 (79.8%)	124(100%)	Ns
	Irrigation	1(33.3%)	2 (66.7%)	3(100%)	
	Rainfed and irrigation	2 (66.7%)	1 (33.3%)	3(100%)	
AEZ ⁑	LM	0 (0%)	30 (0%)	0(0%)	Ns
	UM	28 (21.5%)	102(78.5%)	130(100%)	
	LH	0 (0%)	0 (0%)	0 (0%)	
Access to weather information	Yes	16 (18.4%)	71 (81.6%)	87(100%)	Ns
	No	12(27.9%)	31 (72.1%)	43(100%)	
		Mean	Mean		t-test
Land area under banana (ha)		0.60	0.63		Ns
Size of land (ha)		2.20	2.18		Ns
Perception on production		3.54	3.43		Ns

¶ HHH = House Hold Head; ⁑ =AEZ based on Jaetzold et al., (2006); N=130, * Significant at 5% probability level; Ns not significant. Numbers in parenthesis indicate the perception in (%)

4.2 Determinants of specific farmers' climate change perceptions

The results of the Logit model analysis of farmers' perception of climate change are presented in Table 3. The model was significant at $p<0.001$ and correctly predicted 83.5% of both those who perceived and those who never perceived changes in rainfall and temperature in the last 20 to 30 years. Four variables: gender of house hold head, farming system, type of farming and access to weather information were significant in explaining the farmers' perception of climate change in the study region. This however, did not mean that other variables were not influenced by climate change (zero ratio), but their effect was very minimal.

Table 3.
Logit regression model analysis of factors influencing farmers' perception of climate change in Mukurweini sub-county

Independent variables	B	S.E.	Wald	Sig.	Exp(B)
Gender of HHH	-0.321*	0.354	0.725	0.092	1.352
Age of HHH	0.034	0.171	0.341	0.860	1.027
Level of education of HHH	0.246	0.247	0.994	0.319	1.279
Farm Land size	0.254	0.139	3.354	0.287	1.289
Access to market information	-0.456	0.722	0.398	0.528	0.634
Farming system	-0.731**	0.290	4.72	0.030	0.532
Group membership	0.494	0.397	1.551	0.213	0.610
Agro-Ecological Zone	-.0720	0.284	0.065	0.799	0.930
Farming practice	-0.255*	0.528	0.233	0.099	1.290
Access to weather information	0.184**	0.245	0.477	0.044	1.185
Land under banana	-0.490	0.289	2.887	0.289	0.612

N=130, * Significant at 5% probability level, **Significant at 10% probability level, HHH = House Hold Head

Gender of the household head negatively ($\beta=-0.321$, $p=0.092$) influenced farmers' perception towards climate change. The gender coefficient was negative indicating that female headed households who practised banana production identified more with changes in rainfall and temperature than male dominated households. These findings are in line with the arguments that male-headed households are more likely to get information about new technologies and usually take risky decisions on businesses than female-headed households (Asfaw and Admassie, 2004). According to Ali and Erenstein, (2017) male-headed households have more adaptation methods to climate risks compared to the female-headed household. Men also make decision on farming activities and attend baraza and workshops since they hold land rights. This is because farm activities are mainly undertaken by women but income is attributed to men. Studies conducted in Meru by MOA (2016) also observed that females are more actively involved in banana production as compared to male headed households.

Type of farming system negatively (β=-0.731, p=0.03) influenced farmer's perception (Table 2 and 3). The farmers who depended on rainfed banana production perceived climate change as a factor affecting production since the unpredictability of rainfall seasons led to untimely planting and hence led to crop failure or reduced yields.

Various land indicators are associated with the climate change perceptions and adaptation practices used. Households with more land implement more farming practices, possibly because they have a higher ability to adopt and mitigate loss of overall yields (Ochieng and Mathenge,2016; Recha et al., (2016). These findings further concur with studies conducted in Mt Kenya region (MOA, 2016) which observed that farmers' who rely on rain-fed agriculture for banana production face serious challenges due climate variability attributed to unpredictable and low rainfall.

Farming practices had a negative (β=-0.255, p=0.099) influence on farmers' perception of climate change. The farmers who depended on subsistence farming perceived the effects of climate change more as compared to those who practiced mixed farming. This can be attributed to over dependence on food crops which were more vulnerable to climate change (Recha et al., 2016).

Access to weather information positively (β=0.169, p=0.049), influenced farmers' perception to climate change. This implies that those who did access information on weather identified themselves more with changes in rainfall and temperatures as compared to those who had access to weather information. Information on seasonal and daily weather forecasting (i.e., temperature and rainfall) had positive and significant effect on the probability of changing crop types and changing planting dates. Thus, farmers who had access to weather information perceived climate change effects. Similar findings were reported by Maddison (2007), who found that farmers' awareness of changes in climate attributes (temperature and precipitation) is important for perceiving or interpreting climate change. Access to climate information increased farmer perception of climate change and its associated risks (Maddison, 2007). Ali and Erenstein, (2017) while working in Pakistan noted the role of access to weather information and other resources which empower the farm household head to adopt to climate-risk coping strategies and thus changing the perception of climate change effects.

Level of education of the household was positive though not significant indicating that the higher the education level, the more likely the farmer was to perceive the effects of climate change. Experienced and well-educated farmers are more likely to perceive climate change and respond by making at least one adaptation strategy (Maddison, 2007). More educated farmers are likely more aware of climate change, adaptation practices and the benefits of the adaptation practices. These finding are in agreement in those obtained by Ali and Erenstein, (2017), Chung et al., (2018), Cooper and Coe (2011), and Ochieng and Mathenge, (2016).

4.3 Perceived effects of climate change and variability on Banana value chain

4.3.1 Perception on Production

The highest percentage of the respondents in the study locations perceived effects of climate change on banana production as low yields (79.2%) (Figure 3). Water shortages was perceived by 11.5% of the respondents as a contributing effect to banana production. Variations of labor cost had the lowest (1.1%) perception of climate change effect on banana production. Previous studies have reported decline in yields due to climate changes. In Europe and Africa, vulnerability of crops and cropping systems as a result of climate change have been reported to result to decline in grain yields. To adapt to the changing climate, farmers have been altered planting times and selecting other crop species and cultivar which could best suit the changing climate (Olesen et al., 2007; Schmidhuber and Tubiello, 2007).

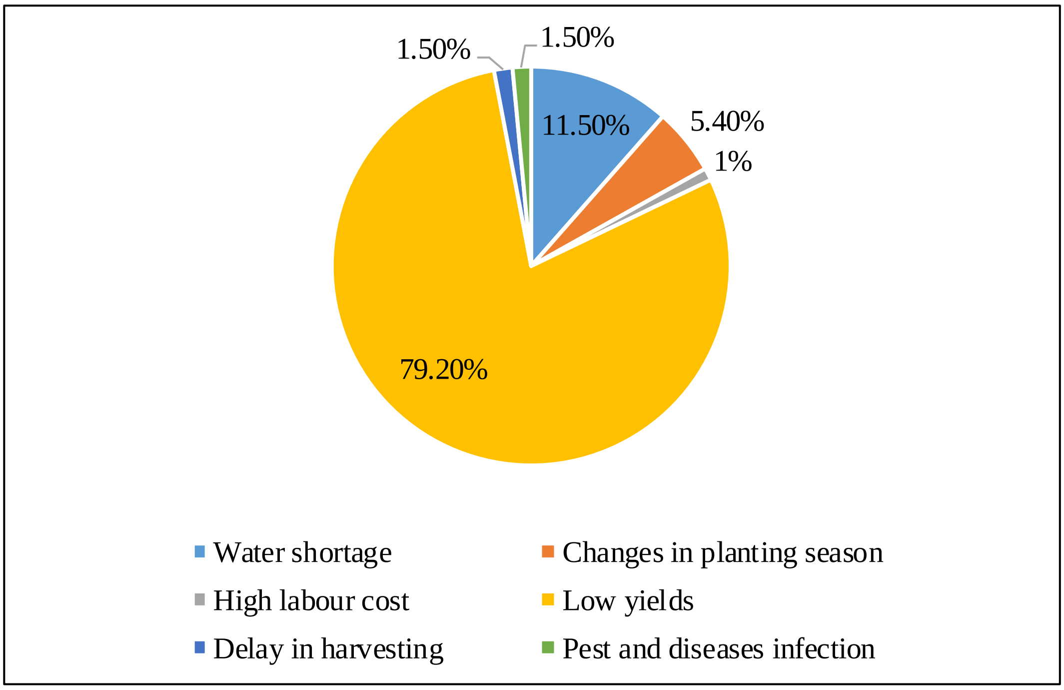

Figure 3. Respondents' perception of climate change effects on banana production

Perceived effect of high rainfall on banana marketing and trading was reported as low market prices (48.5%), while the least of the respondents indicated low quantity of produce (34.6%) (Figure 4). During rainy seasons the respondents reported challenges in transport of produce to the market due to inaccessibility of roads. Farmers who lived close to all-weather roads were able to supply the produce to the market hence resulting to oversupply. This resulted to reduced market prices and increased risk of produce waste and losses. In addition, traders offer low prices in times of oversupply, when farmers have few alternatives to immediate sale of their produce.

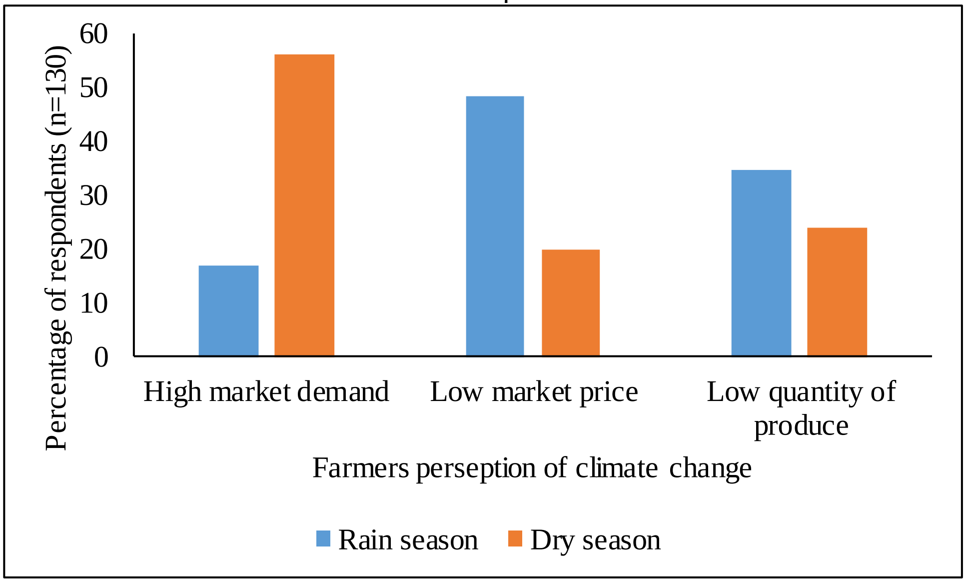

Figure 4. Perceived effects of climate change on banana marketing and trading during the rainy and dry season

According to Figure 4, the perceived effect of climate change by majority of the respondents during low rains (dry seasons) on banana trade was high market demands with (56.2%), while least of the respondents indicated low market prices (23.8%). During dry season banana supply in the markets is low in the study area due to overdependence on rainfed production. Prices soar during periods of low production, particularly in the dry spell, when only few farmers have bananas to sell.

The likely impacts of climate change on banana production and in extension the dimensions of food security in the study areas may include availability, utilization, and access. Due to market uncertainty with climate change there are likelihoods of vulnerability of households to access food. Adopting irrigated farming could be seen as a coping strategy when faced with climate variability such as unappreciable and low rainfall as reported by Morton, (2007). Morton, (2007) further proposes allocating farm labour across the seasons in ways that follow unpredictable intra-season rainfall variations and therefore negotiating the rain and its negative effect on labour availability.

4.3.2 Transport to the market

Majority of respondents (52.3%) perceived the effect of climate change on transport of banana production to be the increased transport cost and lack of accessibility to the farms (34.6%) (Table 4). This was due to the nature of the seasonal roads to the farms. Climate change related shifts in weather patterns cause infrastructure disruptions in both rural and urban centres which have resulted to unavailability of agricultural produce, increased prices of commodities and in some instances food unavailability and inaccessibility.

Table 4.

Perceived effects of climate change on transport and climate information

	Frequency (N = 130)	Percentage
Transport to market during rainy season		
High transport cost	68	52.3
Lack of accessibility to farms	45	34.6
Poor handling affecting quality	17	13.1
Total	*130*	*100*
Type of information and access		
Onset of rain	62	47.7
End of rainy season	1	0.80
Distribution of rainfall within seasons	64	49.2
Occurrence of floods	3	2.30
Total	*130*	*100*

4.4 Access to climate information

Majority of the respondents in the study area cited that weather information they wish to receive in future in order to improve banana production would be rainfall distribution within the seasons (49.2%) and onset of the rains (47.7%) data (Table 4). The preferred mode of disseminating the weather information was cited as such as radio. Our findings align with other studies for instance those that show the positive effects of extension services in enhancing the availability of information of the climate risk and adaptation options (Maddison, 2007; Nhemachena and Hassan, 2007). Thus, the role of access to information will empower the farm household to cope or adapt to climate changes (Abid et al., 2015). Further it is suggested that information about future climate change condition is necessary to enhance timely planning and shifting of planting dates in order to correspond to high market demand and low instances of crop failure.

5. Conclusion

Farmers' perception of climate change is important in securing agricultural activities and enhancing coping strategies. In this study, farmers perceived climate change in the region in the last 20 to 30 years as unpredictable or low rainfall while the effect of climate change on banana production was perceived as low or declining yields. The perceived effects of climate on banana transport during the rainy season was high transport cost from the farm to the collection points or market centers while the perceived effect of climate change on banana trade was low market prices during rainy season and high market demands for the produce during dry season. This is in line with the law of demand and supply.

The logit model explained four socio- economic factors which influenced farmers' perception to climate change in the study area which included gender of household head, type of farming system, farming practice and access to weather information. The preferred future weather information on banana production would be the onset of the rainfall season and distribution of rainfall within the seasons.

To safeguard the smallholders from climate change impacts, there should be formulation of policies on development of climate information, sharing and knowledge management systems. In addition, strengthening collaboration between Ministry of Agriculture and others stakeholders will enhance capacity for agro-meteorological information provision and ensure effective service delivery mechanisms including climate smart extension.

The study proposes the following policy implications. Firstly, the County government should motivate and support farmers to embrace banana value addition in the region through setting up processing factories for wines, crisps and flour, certification and market of produce so as to enhance the welfare of residents. Enhancing the capacity of smallholder farmers to fully exploit opportunities in product value-chains is critical through training on value addition.

Secondly, access to credit facilities is critical to enhance level of participation in the banana farmers' marketing association. The small-scale farmers have an inherent working capital constraint and require affordable credit facilities. The County governments should formulate policies on affordable credit to small-scale farmers within the region such Uwezo funds. Lastly, access to comprehensive market information is essential for development of agricultural marketing; the public sector should support provision of market information to improve on market transparency. There is also need for the public agricultural extension service providers to integrate market information in their routine extension messages. Equally important are policies aimed at improving the livelihood status of the household as this might increase innovativeness and contribute to improved overall adaptation. Providing social safety nets might, therefore, be useful at lower levels of adaptation. At higher levels of adaptation, efforts to ease liquidity constraints by increasing access to credit are required.

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