IMPACT OF CLIMATE VARIABILITY ON SOCIO-ECONOMIC ACTIVITIES OF MIXED FARMERS IN EMBU EAST SUB-COUNTY, KENYA

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ABSTRACT
Kenya like many countries in the world is highly susceptible to climate variability and change. The economy of the people in Embu East Sub-county is highly dependent on rain fed agriculture and so a change in climate affects food production. The objective of the study was to determine the impact of climate variability on socio-economic activities of the farmers in Embu East Sub-county. The hypothesis tested was; there was no significant influence of climate variability on socio-economic activities of the farmers. The total sample comprised of 376 subjects was composed of 374 heads of farming families and 2 Agricultural Field Officers. Data was obtained through administration of household questionnaires and interview schedule. Methods of data analysis and presentation included: frequency tables, percentages and pie charts. Student's t-test was used to obtain the significant difference between various responses. Chi-square was used to test the hypothesis. The study established that farmer's socio-economic activities were affected negatively which was evidenced by losses in crops, livestock yields and poor access to social services like the hospitals and schools.Recommendations of the study includes: upgrading the rural road network to improve accessibility, capacity building on alternative source of livelihood to the farmers, more focus on rainfall harvesting, initiating small scale irrigation schemes, and organizing field days to empower the farmers on the control measures of pest and diseases.
Keywords: Impact, Climate variability, Socio-economic, Mixed farming

INTRODUCTION

Climate variability refers to short term fluctuation of weather patterns that occurfrom year to year as well the variations in the mean state and other statistics (such as standard deviations, occurrence of extreme event among others) of climate on all temporal and spatial scale beyond that of the individual weather event Integovernmental panel on Climate Change (IPCC, 2014). Climate change is shocks considered the greatest threat to agriculture and food security in the 21st century in many of the developing agricultural based countries of Sub-Saharan Africa with low capacity to effectively cope (FAO 2015). Shah M. (2008) Africa is already vulnerable to rainfall variability and extremes, as evidenced by the impact of the current weather extremes such as floods and droughts (FAO, 2007).

Alderman and Haque (2007) noted that weather related risks often determine rural livelihoods and explain why households remain poor. GoK (2015) report indicate that agricultural sector accounts for 62% of the total national employment, 45% of annual revenue and 60% of the export and about 80% of the population in Kenya live in rural areas and derive their livelihood largely from subsistence agriculture. The World Bank estimates that, by 2010, 78 percent of the extreme poor were living in rural areas (World Bank, 2015). The rural poor are more likely to rely on agriculture than other rural households (FAO, 2015). GoK (2013) reported that, ongoing change in rainfall, seasonal patterns, increased frequency and severity of drought are already complicating people's ability to grow food, rear livestock and live healthy lives and the longer term trends are set to increase the challenge. Jones and Thornton (2003) found out that extreme weather event have always occurred periodically in rural area and may considerably disrupt rural life. Beegle (2008) found out that, climatic shocks can have long-lasting impacts on the poor. For example, households affected by drought in Ethiopia and the United Republic of Tanzania had lower incomes than unaffected households even ten years later. Embu East Sub-county is a rural area where most people depend on rain fed agriculture for their survival. Therefore, the climate variability is likely to have a negative impact on socio-economic aspect of the farmers like crop production, livestock rearing, access to the market, education and other health facilities.

Climate variability is not a distant future threat but a present challenge for the livelihood of people depending on land, water and weather. Embu East Sub-county has a diverse agro-ecological zones and its proximity to Mt. Kenya forest, this is in addition to the two permanent rivers that traverse the Sub-county and fertile soil. Despite these endowments, the locals are unable to meet their food demands usually attributed to unpredictable weather patterns. Therefore, the impact of climate variability on cultivation of crops, livestock rearing and access to social services like market is likely to be highly felt by farmers. It is against this

background that the present study sought to find out the impact of climate variability on socio-economic aspect of the mixed farmers in Embu East Sub-county.

The objective of the present study was to determine the impact of climate variability on socio-economic aspect of the mixed farmers in Embu East Sub-county

Hypothesis of the study was that there is no significant influence of climate variability on socio-economic activities of the farmers'.

METHODOLOGY

The study was conducted in Embu East Sub-county. The sub county is divided into two divisions namely; Runyenyes and Kyeni. The divisions are further subdivided into six and five locations respectively, totaling to eleven (11). The altitude of the area ranges between 1500m to 4500m above the sea level. The most conspicuous physical features are the Kirimiri hills, mt Kenya forests in the north east and River Thuci and Ena which act as administrative boundaries of Embu east Sub- county. The study employed a descriptive survey design to determine the impact of climate variability on socio-economic aspect of mixed farmers between the year (2017-2018). The target population constituted of 30,000 farming families in Embu East Sub-county (KNBS, 2009). Accessible population for the study was 3742 respondents. Multi stage random sampling techniques was used to come up with a total sample of 376 subjects which was composed of 374 heads of farming household and 2 Agricultural Field Officers (AFO). Structured questionnaires for the farmers and interview schedule for AFO were used to collect the data. Data was analyzed using percentages, frequency tables and charts while chi-square statistics was used to test hypothesis and student t-test was used to test the signicant difference between variables.

RESULTS

The following results were realized after analyzing the collected data. The results presented in Table 1 indicated that 93.0% of community members were aware of climate variability while 7% of the farmers were not aware of climate variability.

Table 1. Level of awareness on climate variability

Indicators	Frequency	Percentage	t-test
Yes	332	93 .0	
No	25	7.0	0.22672*

*Confidence level is 0.1

The level of awareness influences the adaptation strategies by the farmers. Student t-test showed that there was no significant difference between respondents who were aware of climate variability and those who were not aware.

The study revealed that 91% respondents had experienced drought, delayed onset, variation in cessation and intensity of rainfall (Table 2).

Table 2. Indication that climate is varying

Indicators	Frequency	Percentage	t-statistics
Drought	40	11.2	
Delayed onset	97	27.2	0.1254
Cessation	53	14.8	0.0906
Intensity	135	37.8	0.1305
None	32	9.0	

The student t-test showed that there was no significant difference in responses on indicators of rainfall characteristics which is critical element in rainfall variability. The results showed 11.2% of the respondents had regularly experienced drought, 27.2 delayed onset, 14.2% late or early cessation and 37.8% high or low rainfall intensity while 9.0% had not observed any change in rainfall characteristics.

The findings presented in Figure 1 revealed that 70% of the respondent noted the human activities had led to climate variation, while 26% said it was an act of God and 4% didn't know the cause of climate variability.

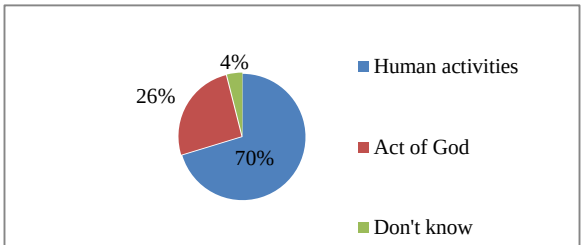


Figure 1. Cause of Varying Climate

From the findings most farmers 70% were aware climate variability is caused by human factors a scenario that can be attributed to provision of information by various governments and non-governmental organizations. Likewise, the 30% of the responses point to inadequate information on causes of varying climate which could hamper the adaptation efforts to climate variability.

The results in Table 3 reveal that 77% of the respondents indicated that rains did not in any way destroy their houses while 23% said their houses were destroyed by rains. Majority of the respondent had the

opinion that, varying climate did not destroy their houses. The argument was supported by student t-test which revealed that there was significant difference among the respondents whose houses were destroyed and or not destroyed.

Table 3: Effects of varying climate on loss of houses

Indicators	Frequency	Percentage	t-statistics
Yes	82	23.0	
No	275	77.0	0.1652**

The difference could be attributed to the fact that the larger part of Embu East Sub- county is located in higher altitude area, which is well drained, hence least affected by flush floods. Further, the nature of the materials people might have used could determine the resistant against extreme climatic event.

The researcher sought information on the effect of varying climate on the loss of crops. The findings presented in Figure 2 show that, 79% of the respondents indicated varying climate had led to the loss of crop yields and 21% had the opinion that varying climate had no effect on their crops yields.

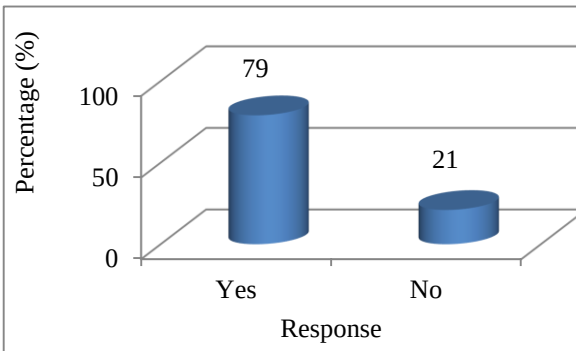


Figure 2. Effect of Varying Climate on Loss of Cr

This fact is alluded to by the key informant that varying climate had led to loss of crops through flooding the farm washing away of nutrients, causes leaching, sometimes destruction of crops which affect the final yields. This finding corroborates with a study by Mongi, Majuja and Lyimo (2010) findings that farmers experienced decreasing food production as a result of impact of extreme events.

The researcher sought information on the effects of varying climate on the gain in crops production. The results in Table 4 revealed that, 74.8% said that there was no increase in crop production while 25.8% of the respondents indicated the varying climate had led to the increase in crop production.

Table 4. Effects of varying climate on gain in crop production

Indicators	Frequency	Percentage	t- statistics
Yes	92	25.8	
No	265	74.8	0.1433**

Student t-test showed that, there is a significant difference between the respondents who pointed out that they had realized a gain in crop production and those farmers who did not realize any gain in crop yields due to varying climate. This could be attributed to greater loses due to prolonged rainfall.

The study sought information on the effects of varying climate on livestock. The data in Table 5 revealed that 66% of the respondents indicate, climate variability had led to the loss of their livestock and 34% were not affected.

Table 5. Effects of varying climate on loss of livestock

Indicators	Frequency	Percentage	t-statistics
Yes	235	65.8	
No	122	34.2	0.0976**

Student t-test showed that there was significant difference between the respondents who indicated that their livestock were affected and the ones that were not affected by climate variability. This is corroborated by (IPCC 2007) finding that climate shocks and change in land uses has been associated with high morbidity because of the increase parasitic diseases and parasitic diseases which negatively threaten livestock production and survival rate. These effects could have contributed to loss in livestocks and livestock products and reduced resilience and adaptation to climate variability.

Ease of access to credit, hospitals, markets and other services could reduce vulnerable significantly. The results in Figure 3 indicate that 73% of the respondents were unable to access social services due to climate variability and 27% did not have any challenge in accessing socio-economic services.

Access to facilities such as television could increase access to information required to make the decision to adapt to climate variability. There is a strong positive relationship between access to social services and adaptation behavior of farmers (Yirga, 2007). If the road network is not paved for use in all seasons, then farmers' socio-economic activities will be affected because of the reduced mobility.

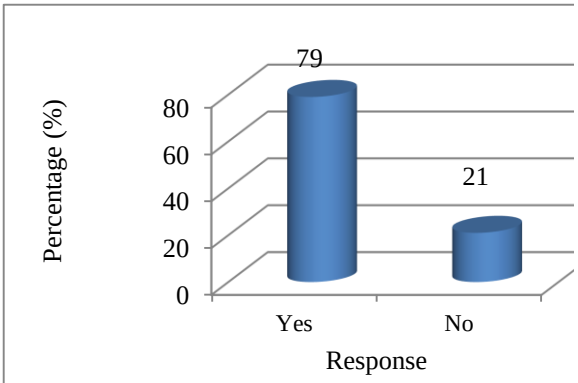


Figure 3. Loss of Crops Crops

The results presented in Figure 4 shows that, 72% of the respondents indicated that climate variability had led to reduced fresh water supply and 28% noted there was no effect on fresh water supply.

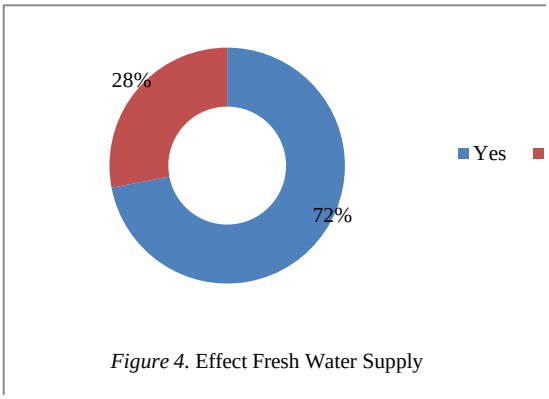


Figure 4. Effect Fresh Water Supply

Figure 5 present the results on the effect of climate variability on increased fresh water. The study revealed that, 82% of the respondents indicated that climate variability had not led to the increased fresh water supply and 18% indicated fresh water supply had increased over time. Majority of the respondents indicated that climate variability had not led to increase in fresh water supply. This could point to decrease in rainfall, consequently reduced river volume and drying of streams and springs.

The study sought information on the effects of varying climate on soil. The results in Table 6 revealed that, a majority, 75.4% of the respondents indicated the flash flood had led to loss of productive land through soil erosion on their farms and 24.6% had not witnessed soil erosion on their productive land. The study revealed that majority of the respondents indicated soil erosion through flash floods had affected productivity of their land by lowering the crop yields.

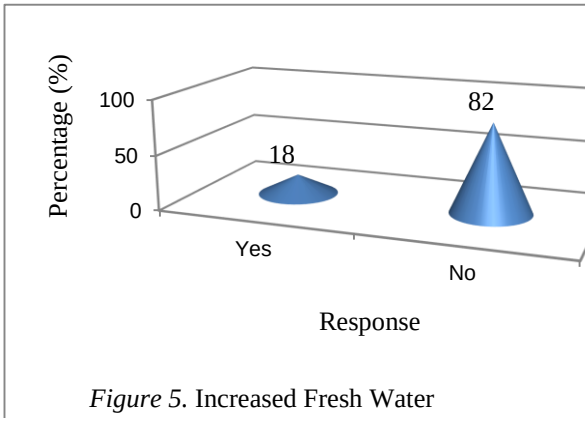


Figure 5. Increased Fresh Water

Table 6. Soil erosion through flash flood

Indicators	Frequency	Percentage	t-statistics
Yes	269	75.4	
No	88	24.6	0.14926**

T-test showed that there was significant difference between those who indicated there was soil erosion and those whose land was not affected by soil erosion. Having taken place on their farms. This was attributed to low vegetation cover due to poor farming practices that expose the land to extreme weather events. The soil nutrients are washed away by surface runoff and crop yields per acre are reduced in a given season.

The findings presented in Figure 6 revealed that, majority 67% of the respondents indicated that the recurrent drought had rendered their land unproductive and 33% said that drought had no effect on their productive land. This implies that the farmers had experienced drought which had led to loss of crops due to lack of sufficient moisture in the soil which affect the maturing of crops.

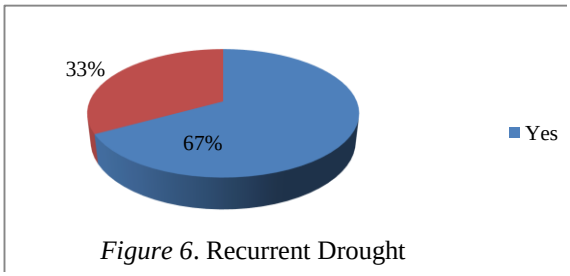


Figure 6. Recurrent Drought

Majority of the farmers indicated that recurrent drought causing insufficient moisture in the soil for maximum yield. This corroborates with a study by Mongi et al. (2010) finding that, majority of farmers in Tanzania had observed decreasing food production as a result of impact of extreme events such as drought.

The findings presented in the Table 7 indicate that 16.2% of the respondents experienced water logging on their land and 83.8% did not experience water logging on their land.

Table 7. Loss of productive land due to waterlogging

Indicators	Frequency	Percentage	t- statistics
Yes	58	16.2	
No	299	83.8	0.1889**

The student t-test showed that there was significant difference between the respondent who had experienced water logging and those who did not experience water logging on their land. This could be attributed to the nature of steep slope and well drained soil especially in the upper agro-ecological zone unlike the lower zone which is gentle and with clay soil.

The results presented in the Table 8 showed that 78.7% of the respondents indicated that varying climate had destroyed road infrastructure while 21.3% did not have their road network affected. The findings revealed majority of the farmers were affected by impassable roads especially during wet seasons. This could affect movement of the inputs to the farms and produce to the market like Runyenjes, Karurumo and Ena.

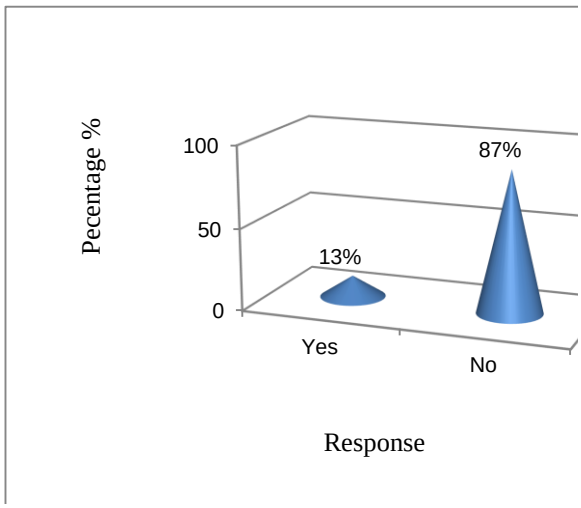
Table 8. Destruction of road infrastructure

Indicators	Frequency	Percentage	t- statistics
Yes	281	78.7	
No	76	21.3	0.1661**

The t-test revealed that there was significant difference between the respondent who indicated that the road infrastructure was destroyed and those who did not observe any effect. This is attributed to poor accessibility road infrustructure during wet seasons because most of the roads are dry weather roads.

This affects farmers' access to market and make it difficult for the farmers to transport inputs to the farms. This is consistent with GoK (2013) that found, poor infrastructure in the country as increased the risks and vulnerability to climate change and a higher percentage of roads are earth roads which are impassable during the wet season.

The findings presented in the Figure 7 indicated that, 13% of the respondents did not have any challenge with marketing channels for their farm produce and 87% indicated that marketing channels was not a big challenge when coping with varying climate.



The findings revealed majority of the famers had no challenge of marketing channel. This could be attributed to the fact that most farmers grow cereals/grain crops like maize and beans and the rest of the land is occupied by cash crops such as tea, coffee and sunflower in addition dairy farming, which have an established marketing channel through cooperative.

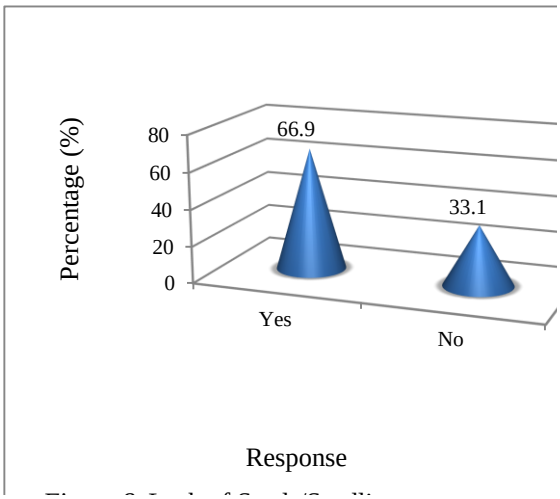
The results presented in Table 9 indicated that, majority of households 71.7% had access to information on weather pattern and approximately 28.3% of the households did not have access to information on weather patterns.

Table 9. Lack of information on weather pattern

Indicators	Frequency	Percentage	t-statistics
Yes	256	71.7	
No	101	28.3	0.01304**

The t-test revealed that there is significant difference between those who had access to information on weather patterns and those who did not have access to information. This could be attributed to failure to totally incorporate weather forecasts education to agricultural activities in the area.

Results in Figure 8 revealed that, 66.9% of the respondent indicated they lacked certified seeds and 33.1% indicated they could access the right seeds and seedling. The study showed that majority of the respondent indicated they lacked appropriate crop varieties in form of certified seeds and seedlings to plant on their farms. This could be attributed to some unscrupulous businessmen and extension workers who provide famers with uncertified seeds.



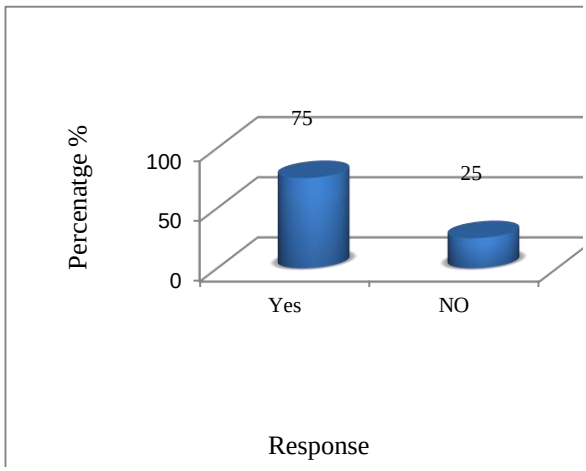


Table 10 present the findings on the emergence of pest and diseases due to varying climate. The data revealed that 80.7% of the respondents indicated that the climate variability had led to the emergence of pest and diseases and 19.6% indicated they had not observed the emergence of pest and diseases.

Majority of the farmers indicated there was emergence of pest and diseases in the region. This could be attributed to varying climate. This fact lowers crop yield because most of the crop is destroyed before the maturing stages. Likewise, the high cost of input could be a deterrent to the farmers thus leaving them vulnerable to climate variability threat.

Table 10. Emergence of pest and diseases

Indicators	Frequency	Percentage	t-statistics
Yes	287	80.7	
No	70	19.6	0.1737**

The t-test indicated that there was significant difference between the farmers who indicated that there was an emergence of pest and those who did not. This could be explained by change in weather patterns for example extended dry and wet seasons make it suitable for the survival of disease causing micro-organisms and pests. This could destroy the crops in the field and reduce crop yields for example Army Worm invasion that destroyed the maize crops.

Figure 11 present the information on the loss of crop and livestock. The findings revealed that, 75% of the respondents had experienced losses on their crop and livestock while 25% did not experience losses. Majority of the farmers had counted losses in crop and livestock production in the locality.

The chi-square statistics was used to test the impact of unexpected weather occurrence on socio-economic activities of the farmers. The results are presented in Table 11. The test was done based on impact of various unexpected weather based factors; loss of crops, chi-square value = 122.356>, P-value 0.000<0.05, loss of livestock, chi-square value= 35.768>, p-value 0.000<0.05 and inability to access social services, chi-square = 72.608>, p-value 0.000<0.05.

Table11. Influence of climate variabiltiy on socio-economic activities

Items	Chi-square	df	Asymp
Loss of crops	122.356	1	.000
Loss of livestock	350.768	1	.000
Inability to access socio-services	72.608	1	.000

Note: level of significance was 0.05.

The test revealed that the actual probability of the computed chi-square value that is p-value on all the items considered was less than the level of significance, which was at 0.05. As such the researcher rejected the hypothesis which stated that there are no significant influence of climate variability on socio-economic activities of the farmers and accepted the alternative hypothesis which stated that there is significant influence of climate variability that influence socio-economic activities in the study area.

CONCLUSIONS

The study established that the climate variability in the study area was indicated by observable rainfall characteristics like drought, delayed or early onset/cessation, and fluctuation in rainfall intensity. Famers had significantly experienced loss of crop and livestock production, poor access to socio-economic services for instance markets and hospital and decline

in availability of fresh water. Further, farmers witnessed emergence of pest and diseases on their farms. The study concluded that there is statistically significant influence of climate variability on socio-economic activities of the farmers.

RECOMMENDATIONS

The study recommends the following strategies, upgrading the rural road network to improve accessibility, capacity building on alternative source of livelihood to the farmers to guard against uncertain climate, more focus on rainfall harvesting, initiating small scale irrigation schemes, and organizing for farmers' field days to empower them on pest and diseasease control measures

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