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EFFECTS OF CLIMATIC VARIABILITY ON LIVELIHOOD CHOICES AMONG RURAL POPULACE IN BARINGO COUNTY, KENYA AND JIGAWA STATE, NIGERIA

***[1]Ezenwa, L.I; [2]Omondi, P; [1]Ubuoh, E. and [3]Nnamerenwa, G.C.**

[1]Dept. of Environmental Management and Toxicology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
[2]Dept. of Geography, Faculty of Arts and Social Science, Moi University, Eldoret, Kenya
[3]Dept. of Agricultural Economics, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria
***Corresponding Author Email:** *nwankwo.lilian@mouau.edu.ng;* lilianchild@yahoo.co.uk
+2348039377915

ABSTRACT

This paper analysed the implication of climatic variability on livelihood assets among the rural populance in Baringo County, Kenya and Jigawa State, Nigeria. Purposive sampling and questionnaires were administered to 338 households in Baringo County, 153 households in Jigawa State were sampled and Focused Group Discussion were organised. Data were analysed using frequency distribution statistics, trend and Multiple Regression analysis. The result shows that age, gender, education level and house hold size are the major determinant of livelihood choices in both locations. In Jigawa State, decreasing rainfall showed positive impacts on livestock keeping, maize and beans cultivation, bee-keeping, aquaculture while the increasing temperature was observed to have positive impacts on millet, beans and sorghum farming while it showed negative impact on horticulture, bee keeping-and aquaculture, livestock keeping, poultry farming and fruit production both in Baringo County and Jigawa. In Baringo County, drought ($\bar{X}$=3.78), crop pest and diseases ($\bar{X}$=3.65), livestock pest and diseases ($\bar{X}$=3.70), cases of human diseases ($\bar{X}$=4.01) and drying of water bodies ($\bar{X}$=3.53) and in Jigawa, drought ($\bar{X}$=3.95), livestock pest and diseases ($\bar{X}$=3.4670), cases of human diseases ($\bar{X}$=3.46) and drying of water bodies ($\bar{X}$=4.14) were identified as implications of climatic variability respectively. The paper empahasised the need for pro-active measures to avert the negative implications of climatic variability in order to maximize the positive influences. Also relevant governement agencies should act promptly to update the rural populance on the adaption measures especially water management and conservation methods.

Key words: Climatic variability, Livelihood, Rainfall, Temperature, Perception

INTRODUCTION

Climatic variability occurs when climate fluctuates yearly above or below a long-term average value (Source). It poses a significant threat to so many sectors of sub-Saharan Africa's economy and especially to the agricultural sector, which is heavily dependent on rain-fed cultivation (Adesina, 2008; Speranza, 2011; Antwi-Agyei *et al*., 2014; IPCC, 2014). Presence of year-to-year variability, seasonality, uncertainty and patchiness of rainfall and extreme events such as droughts and flooding exemplified climate stress (McCarthy *et al*., 2001). Climatic variability is expected to increase in most places on earth with significant consequences on food production beyond the impacts of changes in climatic means (Akinseye *et al*., 2012). For instance, its variability will alter plant composition; aggravate soil erosion, cause drought and change the growing season and salt-water intrusion along the coastal belt. Other impacts include reduction of agricultural productivity, production stability and income within the study area.

Seventy percent (70%) of the livelihood activities in Africa are dependent on rain-fed agriculture, characterized by small-scale, subsistence farms that are vulnerable to a variety of climate extremes. Owning to the adverse effects on livelihoods, climate variability is expected to have a negative impact on food security (Stige, *et al.*, 2006; Thornton *et al*. 2007; Speranza, 2010; Niang *et al*. 2014; Amin *et al.*, 2015).

Areas within the sub-Saharan Africa experiences extreme droughts thereby impeding the farmers willingness to grow crops and rear livestock, which directly has a negative impact on their income. The pastoralists and agro-pastoralists will have to seek the appropriate adaptation methods to reduce the effects arising from the changes in water regimes in order to maintain their food security and well-being (Kebede *et al.* 2011; FAO.2011).

Future projections for Africa indicate increasing temperature and decreasing rainfall that implies decline in dependence on nature for agriculture (Speranza, 2010; Akinseye *et al*., 2012; IPCC, 2014; Ladan, 2014; Chukwuone, 2015 and Guan 2016). This has ensured a threat to food security, which is an established issue in a developing continent like Africa. Baringo County, Kenya, is in a semi-arid environment receiving an annual rainfall a little above 500mm and has experienced negative impacts of climate variability in the recent past. It had its fair share of mild to severe drought during the period of 1991 -2000, 2004, 2008 – 2009 and the intense El-Niño rain that led to flood in the 1997 – 1998 periods (Orindi and Ochieng, 2005; Anyangu *et al.*, 2010; Nguku *et al.*, 2010; Ochieng and Mathenege, 2016). These factors make Baringo County and Jigawa State highly vulnerable to climate variability (Nguku *et al.*, 2010; Olayide, 2016).

Jigawa state, Nigeria on the other hand has been established to have experienced declining or rather fluctuating rainfall and a rise in temperature (short wet season, a long dry season, high annual temperature range of about 28˚C – 32˚C) (Odjugo, 2010; Bidoli, *et al.* 2012; Mora 2013; Olayide, *et al.*, 2016). This variability, increasingly affects crop production (cereal and perennial) and livestock production. Consequently, the state has low crop yield due to the short wet season, which lasts from June – September (except for the introduction of an extensive irrigation scheme which support crop production) (Kurukulasuriya and Mendelsohn, 2007; Sowunmi, 2010). Majority of the residents live in rural areas and take agriculture as their major source of livelihood (especially pastoralism and agro–pastoralism) which is largely rain-fed and undeveloped. The economy of Baringo county and Jigawa State is majorly agro-based; as agriculture provides a source of livelihood for over 80% of the population (Orindi and Ochieng, 2005; Ladan, 2014).

Most of the farmers are financially incapable to access equipment, infrastructure and methods which could help them to adequately adapt to the impacts of climate variability (IPCC, 2014; Brian *et al.*, 2016; Ochieng, and Mathenge 2016; Olayide, *et al.*, 2016).

This paper attempts to do a cross comparison and provide information on the trend of climate variability from 1984 – 2016 in Baringo county, Kenya and Jigawa state, Nigeria, the perception of farmers to climatic variability and the implications of climate variability on their livelihood asset.

MATERIALS AND METHODS

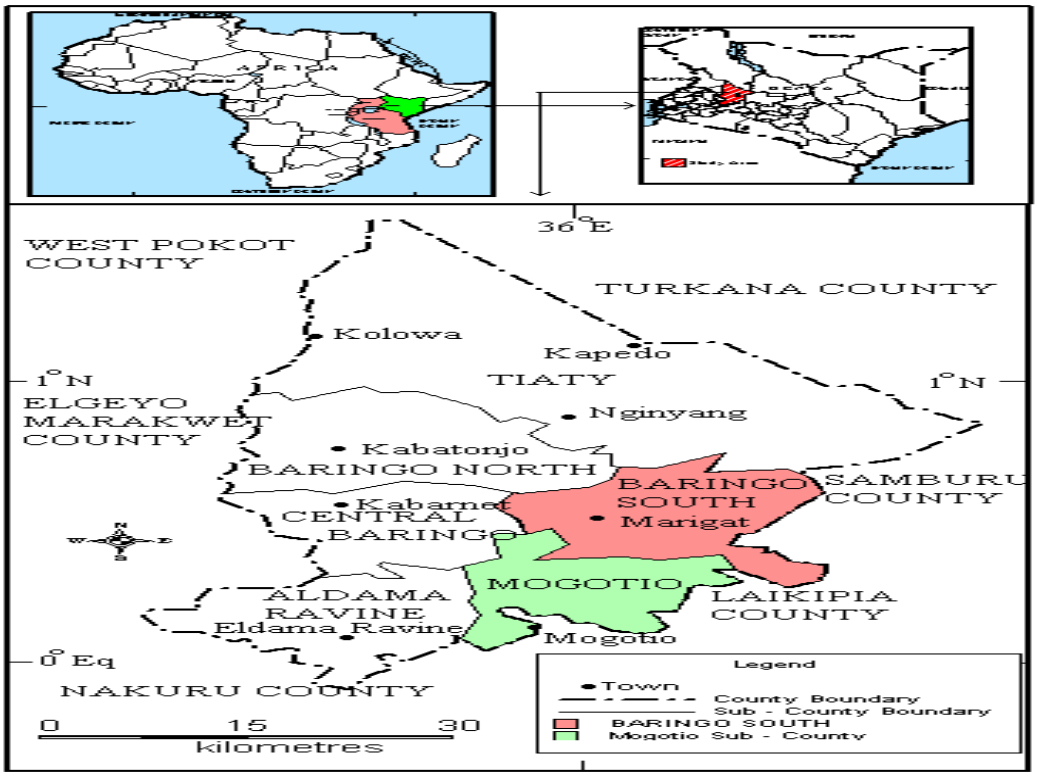
Study Area

Baringo County, Kenya is a semi-arid area situated at an average altitude of 900m above the sea level and lies between latitude 00º26' - 00º32'N and longitude 36º 00'- 36º09' E and it is located within agro-climatic zone IV and V (Wasonga, *et al*., 2011). The area has a mean temperature of about 32.8°C ± 1.6°C with annual average rainfall of 512 mm occurring in two seasons: March to August and November to December.

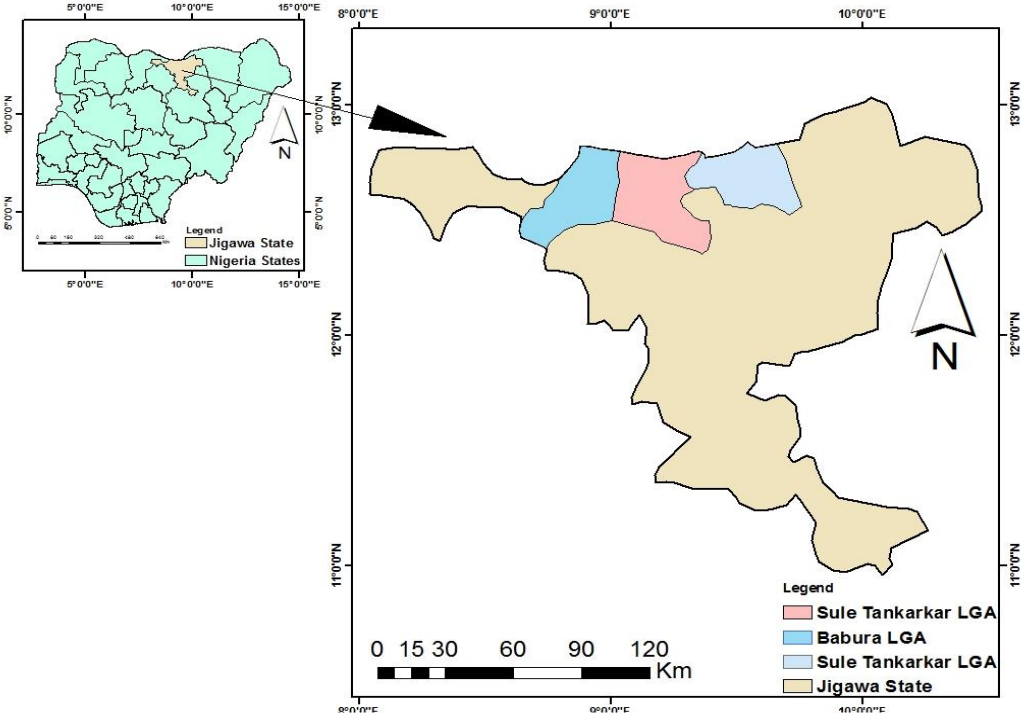
The study was carried out between March and July 2017 in Marigat and Mogotio sub-county (Baringo County) which is located in North-West Kenya (Figure 1). Baringo is one of the 47 counties in Kenya, situated in the Rift Valley region. It borders Turkana and Samburu counties to the North, Laikipia to the East, Nakuru and Baringo to the South, Uasin Gishu to the Southwest, and Elgeyo - Marakwet and West Pokot to the West. With an area of 11,075.3 km^2, Baringo County has an estimated population of 555,561 (KNBS, 2010).

The study in Nigeria was carried out in three local government areas in Jigawa state namely Maigatari, Babura and Sule-Tankarkar (Figure 2). Jigawa state, Nigeria is located in the northwestern part of Nigeria. It is situated between latitude 11˚N, 13˚N and Longitude 8˚E, 10.15˚E. A larger part of the state lies in the Sudan savannah while the southern part is majorly guinea savannah. The total annual rainfall ranges from 600mm (northern part) to about 1000mm (southern parts of the state. It experiences an Annual rainfall average of 650mm (Bidoli *et al.*, 2012). The maximum temperature

reaches 40˚C around March to September while the minimum temperature could drop to 19˚C in October to February. Jigawa State borders Kano and Katsina States to the west, Bauchi State to the east and Yobe state to the northeast. To the north, it shares an international border with the Zinder Region of the Republic of Niger. The estimated population of Jigawa state is about 4,348,649 (NPC, 2006), with an approximate land area of 23,154 km².



Map 1: Map of Baringo County showing the study locations



Map 2: Map of Jigawa State showing the study locations-Research Design and Data Collection

In this study, a multi-stage sampling technique was applied, using both quantitative and qualitative approaches. Primary data were collected using a well-structured questionnaire while time series data for 31-years climatic variables were obtained from Kenyan Meteorological Department, Nairobi and Nigeria Meteorological Agency, Oshodi, Lagos**.** The validity of the semi-structured questionnaire was pre-tested before it was used in collecting data from the sampled communities and villages. The target population comprised of household heads, father or mother or any adult person in charge (aged 18 years and above) of the household. The qualitative data was obtained using focus group discussions (FGDs). Focus group discussions were held in different villages to elicit information concerning climate variability impact of drought, livelihood activities as it relates to men and women in the study area. These served as a guide in counterchecking the information that was supplied by each male headed and female headed households in the study area.

Statistical Technique

Data obtained were analysed using descriptive statistics such as frequency distribution, trend analysis, percentage and means; and inferential statistics such as multiple regression analysis. These data obtained were compiled, processed and analysed using SPSS version 23 and E view 9 computer statistical software. The ordinary least square multiple regression analysis was equally used in the study model as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + e_i \text{ ----------1}$$

Where,

Y_i = Livelihood assets of the respondents (dependent variable)

i = Different livelihood assets of the respondents [land for agriculture (hectares); livestock keeping (counts); maize farming (Kg); Horticulture ($); Bee keeping ($); Poultry farming (Number of birds); fruit production ($); Charcoal production ($), fish farming (number of fishes); Sesame farming (Kg); Millet farming (Kg); Beans Farming (Kg) and Sorghum farming (Kg)

X_1 = Average annual rainfall (millimetres);

X_2 = Average annual maximum Temperature (degree centigrade);

e_i = Error term.

The same regression in equation (1) above was used for both data obtained from Baringo County, Kenya and Jigawa State, Nigeria. Stata 14.1C version of computer statistical package was used for the regression data analysis.

RESULTS

Socio-economic Characteristics of the Respondents in Choice Location

The distribution of the rural population in Baringo County, Kenya and Jigawa State, Nigeria by their socio-economic characteristics is presented in Table 1 below.

Table 1: Socio-economic characteristics of the Respondents in choice locations

Socio-economic characteristics	Baringo County, Kenya		Jigawa State, Nigeria	
	Frequency	Percentage	Frequency	Percentage
Gender				
Male	206	60.95	98	64.1
Female	132	39.05	55	35.9
Total	338	100.00	153	100.0
Age of respondents				
18 – 30	38	11.24	15	9.8
31 – 40	119	35.21	42	27.5
41 – 50	130	38.46	59	38.6
51 – 60	41	12.13	29	19.0
>60	10	2.96	8	5.2
Total	**338**	**100.00**	**153**	**100.0**
Level of Education				
No School	64	18.93	8	5.2
Primary	103	30.47	97	63.4
Secondary	128	37.87	13	8.5
Tertiary/College	33	9.76	12	7.8
University	10	2.96	23	15.0
Total	**338**	**100.00**	**153**	**100.0**

Table 1 continues

Socio-economic characteristics	Baringo County, Kenya		Jigawa State, Nigeria	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Marital Status				
Single	60	17.75	44	24.18
Married	185	54.73	37	28.76
Divorced	25	7.40	40	26.14
Separated	25	7.40	7	4.58
Widowed	43	12.72	25	16.34
Total	**338**	**100.00**	**153**	**100.00**
No. of Family Members				
1 – 5	169	50.00	115	75.16
6 – 10	149	44.08	1	0.65
11 – 15	15	4.44	19	12.42
16 – 20	2	0.59	10	6.54
>20	3	0.89	8	5.23
Total	**338**	**100.00**	**153**	**100.00**
Occupation of HHead				
Pastoralist	153	45.27	127	83.01
Agro-Pastoralist	120	35.50	9	5.88
Business	35	10.36	11	7.19
Employed	30	8.88	6	3.92
Total	338	100.00	153	100.00
Occupation of Spouse				
Pastoralist	16	4.73	14	9.15
Agro-Pastoralist	280	82.84	138	90.20
Business	30	8.88	1	0.65
Employed	12	3.55	-	-
Total	**338**	**100.00**	**153**	**100.00**
Do you have Land				
Yes	315	93.20	104	67.97
No	23	6.80	49	32.03
Total	**338**	**100.00**	**153**	**100.00**
If Yes, was it				
Bought	60	17.75	48	31.37
Rented	59	17.46	56	36.60
Issued by Govt. Ranch	9	2.66	35	22.88
Issued by National Irrigation Board	3	0.89	-	-
Issued by Government	207	61.24	14	9.15
Total	**338**	**100.00**	**153**	**100.00**
Size of the Land (ha)				
1 – 3	145	42.90	-	-
3.1 – 6.0	88	26.04	-	-
6.1 – 9.0	24	7.10	116	75.82
9.1 – 12.0	25	7.40	37	24.18
>12.0	56	16.57	-	-
Total	338	100.00	153	100.00

Source: Field Survey, 2017

The result showed that most (38.46% and 38.6%) of the respondents in Baringo County, Kenya and Jigawa State, Nigeria respectively were within the age bracket of 41 -50 years. This implies that the

rural population in the choice locations were in their active stage of life. They are physically fit to work for a long time, bear risk, be innovative, and have mental capacity to cope with daily challenges, this was corroborated by Hansen, *et al*., (2012). Majority (54.73% and 28.76%) of the respondents are married. This implies that married individuals dominated the study area.

Most of the household head in Baringo county are pastoralist (45.27%), agro-pastoralist (35.5%) with other involved in business (10.36%) and those employed (8.88%), while in Jigawa State most of the household head are majorly pastoralist (83.01%), while others are agro-pastoralist (5.88%), business (7.19%) and employed (3.92%). This implies that the climate of the locations determines largely the livelihood of the rural populace, but with the variability, it positively or negatively influenced. It will be noted that the spouses' occupation of the most of the household heads are involved in agro-pastorialism, with Baringo County and Jigawa State recording 82.84% and 90.20% respectively. In Jigawa state 0.65% of the spouses are involved in business (0.65%), this validates the definition of the area as an agrarian region but some of the spouses of the household head in the Baringo County still do business (8.88%) and few are employed (3.55%). This help them to support their spouse when the yield of crop declines due to climatic dynamics. Most of the land put to use in the Baringo County were either bought or rented constituting 17.75% and 17.46% respectively, implying that there are enough lands to grow crops and rear livestock. However, in Jigawa state, most of the rural populace rent the land where they use (36.60%) and some have to buy the land (31.37%). A contrast can be seen in size of land used between the two locations, in Jigawa state most of the farmers (75.8%) have large farm size (6.1 – 9.0 ha) while 24.18% have farmland that is quite larger (9.1 – 12.0%). In the Baringo County, most (42.9%) of the farmers operate on small size of land (1-3 ha), while 26.04% uses 3.1 -6 ha, discouraging large-scale food production with climatic fluctuation biting harder, large area is needed to grow more crops and raise more livestock to ensure food security especially as most of the populace are involved in livestock keeping and crop production (Gonzalez, 2007 and Alemu *et al*., 2007).

Trend of Rainfall and Temperature in Baringo County, Kenya and Jigawa State, Nigeria

The distribution of the rural population by their perception on rainfall in Baringo County, Kenya and Jigawa State, Nigeria is presented in figure 1.

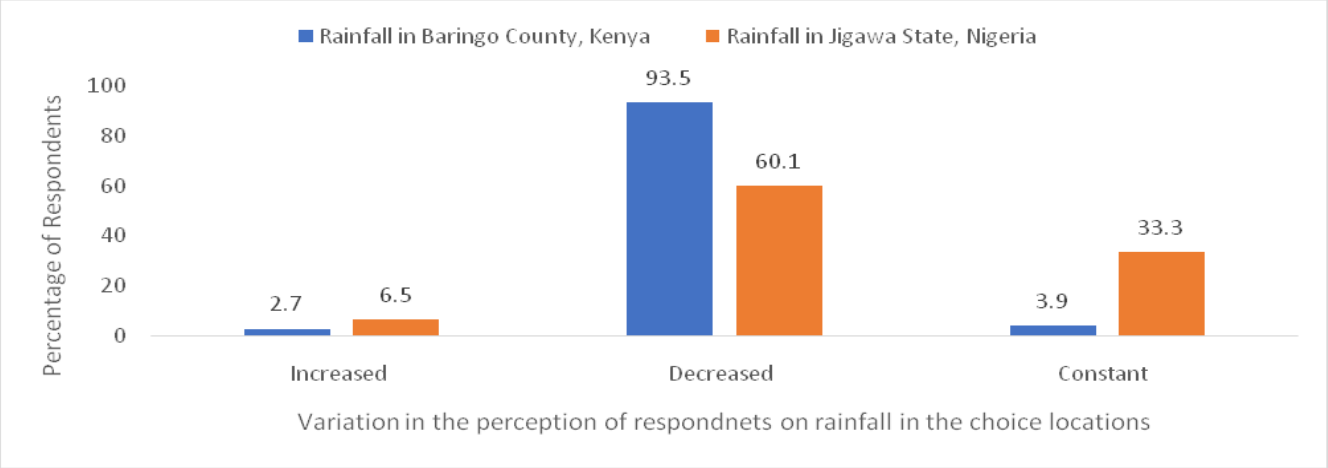


Figure 1: Variation in the perception on Rainfall in Baringo County, Kenya and Jigawa State, Nigeria

Figure 1 showed that most (93.5% and 60.1%) of the rural population in Baringo County, Kenya and Jigawa State, Nigeria respectively reputed that there is a decrease in rainfall. This depicts that there is possibility of drought occurring in Baringo County and Jigawa State in years to come, if the trend of rainfall in these choice locations is not reverted upward in the succeeding years. This decrease in rainfall will affect both crop production and livestock keeping negatively since agriculture in Kenya and Nigeria are rainfed. This finding is consistent with Cooper and Coe (2011), Ayugi *et al*., (2016), Recha *et al*., (2016); Odjugo (2010), Oguntade *et al*., (2012) and Chung *et al*., (2018) whose works also observed that there is decrease in rainfall amount in Kenya and Nigeria in the recent years caused by climatic variability.

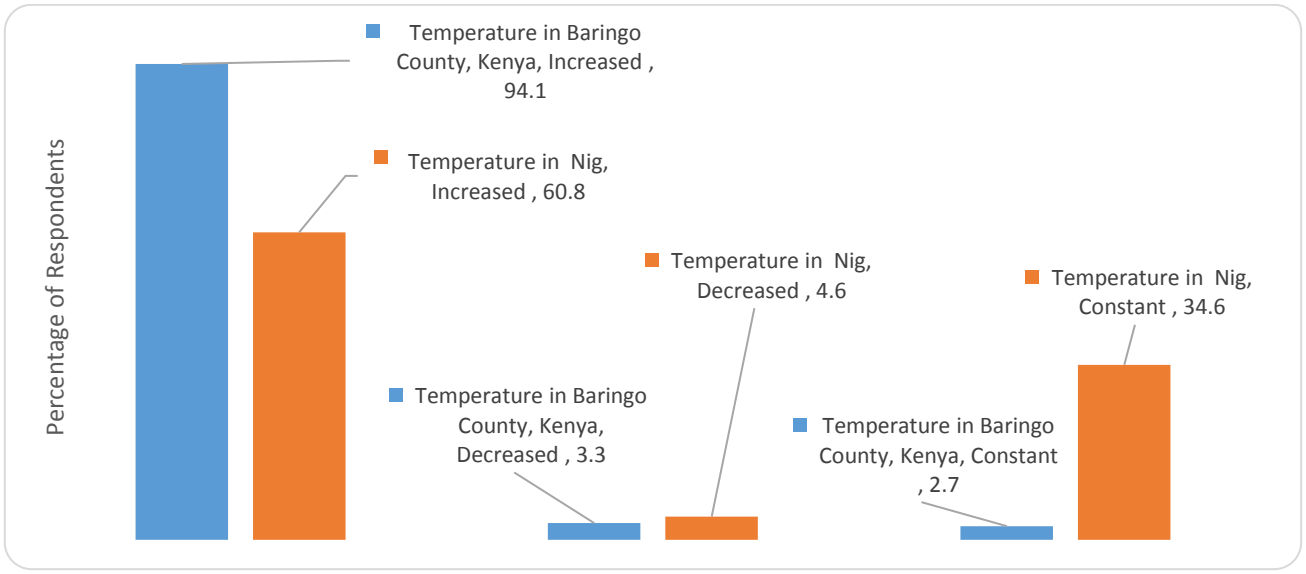


Figure 2: Perception on temperature in Baringo County, Kenya and Jigawa State, Nigeria

Figure 2 showed that (94.1% and 60.8%) of the respondents in Baringo County, and Jigawa State, respectively reputed that there has been an increase in temperature in the last few seasons. , leading to prevalence of diseases such as heat rashes, measles etc. Wilting of trees, flowers and leaves were observed in both Baringo county, and Jigawa state, which was attributed to high temperature (Epstein, 2002; McMichael *et al*., (2006); Sawa and Buhari, (2012); Rodo *et al*., 2013; Ostfeld and Brunner, 2015; Wilcox *et al.*, 2015). As at the month of June, 2017, the soil was observed to be dry with no visible signs of rain, this could be attributed to high temperature and low rainfall in both study areas. Verification of the certitude in the observations of the respondents on climate variability in the studied area was made by collecting a thirty-two years' data on rainfall and temperature from the meteorological station located at Nairobi, Kenya and Meteorological stations in Lagos State, Nigeria for Jigawa State climatic data, which covers the meteorological conditions of the studied area. Figures 3 and 4 represent the thirty-two (32) years mean monthly data on rainfall and temperature in Baringo County, Kenya and Jigawa state, Nigeria.

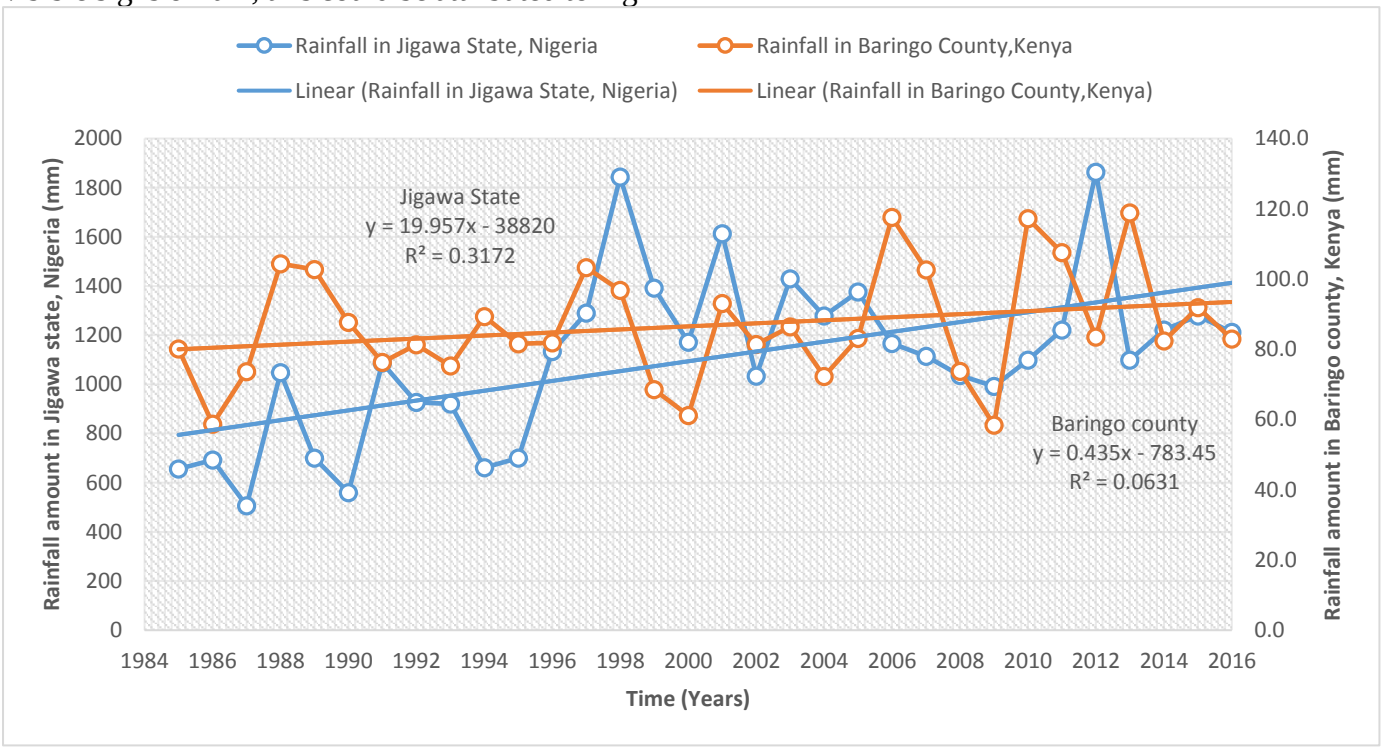


Figure 3: Mean variation in the annual rainfall in Baringo County, Kenya and Jigawa State, Nigeria

The trend analysis of the annual rainfall in Baringo County, Kenya from 1984 - 2016 shows fluctuations with increased annual rainfall (Figure 3). This volume of rainfall declined from 80.1millimetres in 1985 to 58.7millimetres of rainfall in 1986, and increased to 104.3millimetres in 1988, before decreasing again to 76.3millimetres in 1991. The volume of rainfall in Baringo county fluctuated more between 2001 and 2003 and thereafter increased steadily from 72.3mm in 2004 to 117.6mm in 2006 but later declined to 58.4mm in 2009 before skyrocketing to as high as 117.2mm in 2010 and to its highest volume of 118.9mm in 2013. However, there is a decrease in the volume of rainfall in Baringo County since 2016. A 6.31% variation in volume of rainfall in Baringo County was explained by changes in time. A unit change in time causes the volume of rainfall to fluctuate by 0.435mm. This depicts a scenario of drought occurring in Kenya. This result is consistent with the finding of Rowell (2015), Souverijns *et al*., (2016) OXFAM (2017), Andualem *et al*., 2018), observed frequency of drought due to reduced amount of rainfall and other extreme climate events in Kenya is increasing.

Similarly, the amount of rainfall in Jigawa state, Nigeria fluctuated between 1985 and 2016. Increases in rainfall were recorded in 1988, 1991, 1995 – 1998, 2001, 2004, and 2012 while decreases in the amount of rainfall in Jigawa state was obviously observed in 1985 - 1987, 1989 - 1990, 1993 -1995, 2002, 2006 -2011, and 2013 - 2016. These years had rainfall amount below the linear trend line. A 31.72% variation in the amount of rainfall in Jigawa state was explained by changes in time. A unit change in time causes the amount of rainfall in Jigawa state to fluctuate by 19.957mm.

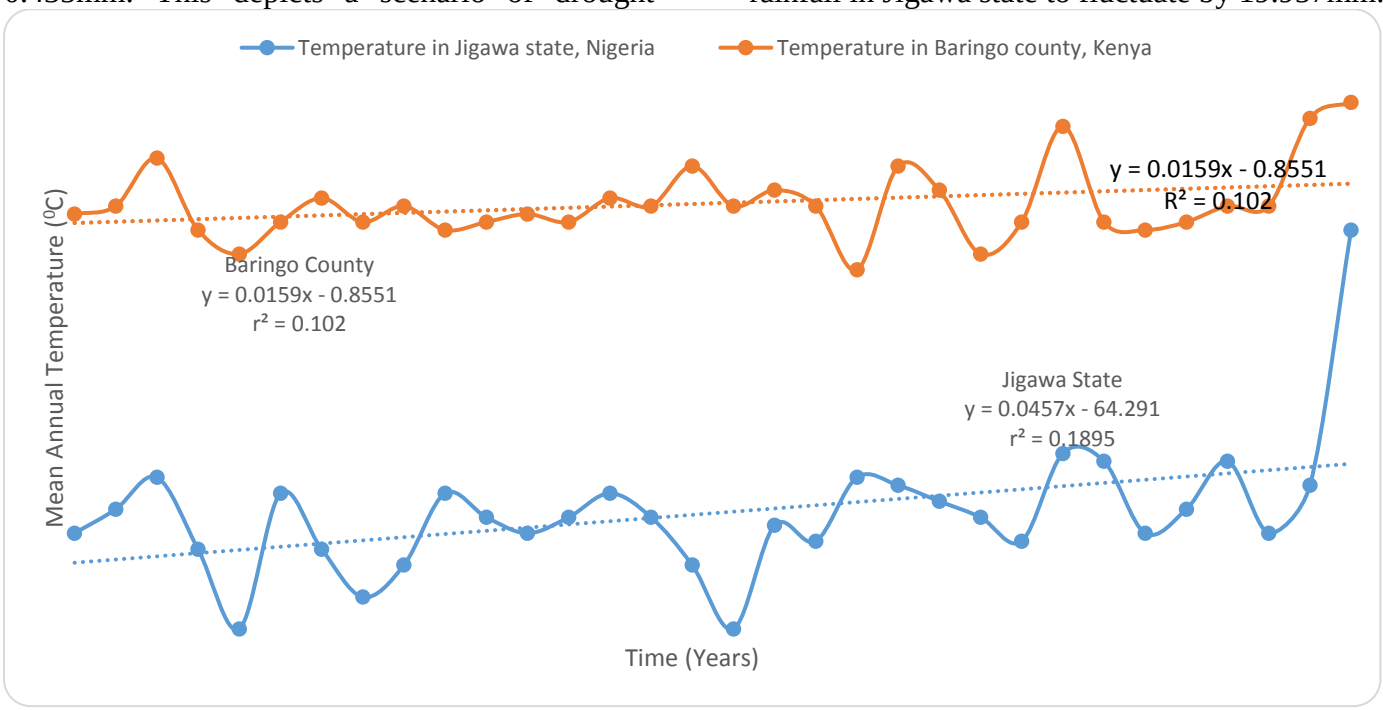


Figure 4: Mean Variations in the annual temperature in Baringo County, and Jigawa State

The trend of temperature from 1985 to 2016 in Baringo county, Kenya and Jigawa state, Nigeria fluctuated with slight increase in temperature overtime (Figure 4). The average annual maximum temperature in Baringo County increased from 30.8^{0}C in 1985 to 31.5^{0}C in 1987, but dropped to 30.3^{0}C in 1989 before it vaults up to 31^{0}C in 1991. The maximum temperature of the area vaults up to 32^{0}C in 2015 and 32.2^{0}C in 2016. A 10.2% variation in the maximum temperature in the area was explained by changes in time. A unit change in time causes the maximum temperature to slightly change by 0.016^{0}C. The average annual maximum temperature in Jigawa state increased from 26.8^{0}C in 1985 to 27.5^{0}C in 1987, but dropped to 25.6^{0}C in 1989 before it slightly increased to 27.3^{0}C in 1990.

The average annual maximum temperature in the area fluctuated steadily between 1991 (26.6^{0}C) and 2010 (27.7^{0}C) and decreased to 26.8^{0}C in 2011. An 18.95% variation in maximum temperature in the

area was explained by changes in time. A unit change in time causes the maximum temperature to slightly change by 0.046^0C. The people's perceptions on temperature variations in the studied area was in line with the climate data records obtained from their meteorological centres.

Effects of Climate Variability on Livelihood Assets of Rural Populace in Kenya and Nigeria

The multiple regression result of the effect of climate change variability on livelihood assets of rural populace in Baringo County, Kenya is presented in Table 2.

Table 2: Ordinary least square multiple regression implcations of climatic variability on livelihood assets of rural populace in Marigat and Mogotio, Baringo County, Kenya

Models		Constant	Rainfall	Temperature	R^2	Adj.R^2	F-statistic
1	Land for agriculture	5.265	1.430	-0.121	0.612	0.593	18.533***
		(2.417)**	(2.621)**	(-3.587)***			
2	Livestock keeping	6.309	1.184	-2.028	0.613	0.598	12.282***
		(2.841)***	(2.112)**	(-3.419)***			
3	Maize farming	8.419	1.048	-0.993	0.609	0.583	13.536***
		(2.441)**	(2.545)**	(-3.379)***			
4	Horticulture	8.433	0.792	0.048	0.554	0.438	7.690***
		(2.673)**	(2.101)**	(0.760)			
5	Bee keeping	9.030	4.058	-0.037	0.564	0.541	21.840***
		(3.215)***	(0.809)***	(-0.676)***			
6	Poultry farmig	9.635	-0.439	-1.133	0.481	0.465	9.902***
		(3.576)***	(-2.485)**	(-1.941)*			
7	Fruit production	5.222	-1.067	-1.024	0.592	0.571	11.837***
		(3.983)***	(-3.158)***	(-2.551)**			
8	Charcoal production	6.125	-1.042	1.304	0.638	0.611	12.645***
		(2.712)***	(-3.105)***	(2.128)**			
9	Fish farming	7.012	1.080	0.039	0.428	0.405	9.185***
		(3.148)***	(3.016)***	(1.255)			

Source: Author's computation from field survey data, 2017

Note: ***, ** and * represents 1%, 5% and 10% levels of significance

For the land model, the value of the coefficient of multiple determinations (R^2) was 0.612, implying that about 61.2% of the variations in the value of land for agriculture among rural populace in Baringo County, Kenya was explained by the regressors (independent variables) included in the model. The F-statistic of (18.533) was significant at $P < 0.05$, implying that the entire model was significance. The result showed that rainfall and temperature significantly influenced the value of land for agriculture in Baringo County, Kenya. The coefficient of rainfall was positive and significant at 5% indicating that increase in rainfall leads to an increase in the value of land for agriculture in Baringo Kenya. However, the coefficient of temperature was negative and significant at 1% respectively, indicating that increase in temperature leads to a decrease in the value of land for agriculture in Baringo Kenya.

The result in Table 3 showed that the coefficient of multiple determinations (R^2) on land for agriculture, livestock keeping, maize farming, horticulture, bee keeping, poultry farming, fruit production, charcoal production, fish farming, Sesame farming, millet farming beans farming and sorghum farming models varied between 0.352-0.867. This implies that about 65.7%, 56.3%, 35.2%, 64.9%, 75.0%, 64.5%, 44.9%, 86.7%, 66.4%, 65.4%, 54.7%, 73.2% and 49.3% of the variations in the value of land for agriculture, livestock keeping, maize farming, horticulture, bee keeping, poultry farming, fruit production, charcoal production, fish farming, Sesame farming, millet farming, beans farming and sorghum farming among rural populace in Jigawa state, Nigeria respectively was explained by the regressors (independent variables) included in each of the models. The F-statistic for each of the models was significant at $P < 0.05$, implying that the entire model was significance.

The result further showed that rainfall positively influenced land for agriculture, livestock keeping, maize farming, horticulture, bee keeping, fish

farming and beans farming among rural populace in Jigawa state, Nigeria at 10%, 5%, 1%, 5%, 5%, 1% and 1% levels of significance respectively indicating that increase in rainfall leads to an increase in the value of land for agriculture, livestock keeping, maize farming, horticulture, bee keeping, fish farming and beans farming among rural populace in Jigawa state, Nigeria. Agriculture in Nigeria (Olayide, *et al.*, 2016; Nnamerenwa *et al*., 2017) is rainfed. However, rainfall negatively influenced sesame farming among rural populace in Jigawa state, Nigeria at 5% level of significance, indicating that increase in rainfall leads to a decrease in Sesame farming among rural populace in Jigawa state, Nigeria.

Table 3: Ordinary least square multiple regression result of the implication of variability on livelihood assets of rural populace in Jigawa state, Nigeria.

Model		Constant	Rainfall	Temperature	R^2	Adj.R^2	F-statistic
1	Land for agriculture	0.892 (7.891)***	0.061 (1.923)*	-0.043 (-2.692)***	0.657	0.633	5.282***
2	Livestock keeping	5.006 (4.170)***	2.092 (2.160)**	-0.190 (-2.320)**	0.563	0.544	8.156***
3	Maize farming	3.859 (3.170)***	3.105 (4.520)***	0.117 (0.900)	0.552	0.539	8.431***
4	Horticulture	4.680 (5.620)***	1.166 (2.200)**	-0.513 (-3.040)***	0.649	0.626	6.045***
5	Bee keeping	7.569 (3.820)***	2.561 (2.420)**	-0.414 (-6.590)***	0.750	0.736	5.665***
6	Poultry farming	9.030 (3.040)***	-0.114 (-0.590)	-0.683 (-3.990)***	0.645	0.623	4.491***
7	Fruits production	4.487 (2.620)**	2.207 (0.990)	-0.451 (-4.240)***	0.449	0.423	3.022***
8	Charcoal production	-2.005 (-8.190)***	0.060 (1.150)	0.125 (1.060)	0.867	0.842	5.206***
9	Fish farming	6.014 (3.380)***	0.173 (5.780)***	-3.633 (-3.030)***	0.664	0.643	6.001***
10	Sesame farming	4.319 (3.460)***	-0.040 (-2.620)**	0.185 (0.850)	0.654	0.631	5.247***
11	Millet farming	1.489 (13.074)***	0.026 (0.690)	1.080 (2.241)**	0.547	0.522	4.716***
12	Beans farming	8.629 (3.590)***	6.960 (4.690)***	0.507 (3.870)***	0.732	0.719	5.301***
13	Sorghum farming	1.743 (13.380)***	-0.540 (-2.390)**	0.115 (2.433)***	0.493	0.469	8.831***

Source: Author's computation from field survey data, 2017
Note: ***, ** and * represents 1%, 5% and 10% levels of significance

The result also showed that temperature positively influenced millet farming, beans farming and sorghum farming among rural populace in Jigawa state, Nigeria at 5%, 1% and 1% levels of significance respectively indicating that increase in temperature leads to an increase in millet farming, beans farming and sorghum farming among rural populace in Jigawa state, Nigeria. In contrast, temperature negatively influenced land for agriculture, livestock keeping, horticulture, bee keeping, poultry farming, fruits production and fish farming among rural populace in Jigawa state, Nigeria at 1%, 5%, 1%, 1%, 1%, 1% and 1% levels of significance, indicating that increase in temperature leads to a decrease in land for agriculture, livestock keeping, horticulture, bee keeping, poultry farming, fruits production and fish farming among rural populace in Jigawa state, Nigeria.

Effects/Consequences of Climate Variability in Baringo County, Kenya and Jigawa State, Nigeria

Table 4 shows the mean rating of the respondents on the extent of the effect of climate variability in Baringo county, Kenya and Jigawa state, Nigeria.

Table 4 : Mean rating of the respondents on the extent of the effect of climate variability in Baringo county, Kenya and Jigawa state, Nigeria

Effects of Climate Variability	Baringo county, Kenya Mean Score	Jigawa State, Nigeria Mean Score	S.D
Drought	3.78	3.95	0.12
Flood	2.47	1.74	0.52
Wild fire	1.84	1.97	0.09
Crop pests & diseases	3.65	2.92	0.52
Livestock pests & diseases	3.70	3.46	0.17
Cases of human diseases	4.01	3.46	0.39
Drying water bodies	3.53	4.14	0.43
Overall mean score	3.28	3.09	0.18
Number of respondents	338	153	
Decision cut point	3.00	3.00	

Source: Field Survey Data, 2017
S.D = Standard deviation of the mean score

In Baringo county, Kenya, climate variability to a high extent affects the rural populace by causing drought ($\bar{X}$ = 3.78), crop pest and diseases ($\bar{X}$ = 3.65), livestock pest and diseases ($\bar{X}$ = 3.70); cases of human diseases ($\bar{X}$ = 4.01) and drying of water bodies ($\bar{X}$ = 3.53) with an overall mean score of 3.28 (Table 4). This implies that there is drought, incidence of crop and livestock pest and diseases, cases of human diseases and drying of water bodies due to climatic variability in the rural area of Baringo County, Kenya. Similarly, In Jigawa, state, Nigeria, climatic variability to a high extent affects the rural populace causing drought ($\bar{X}$ = 3.95), livestock pest and diseases ($\bar{X}$ = 3.46); cases of human diseases ($\bar{X}$ = 3.46) and drying of water bodies ($\bar{X}$ = 4.14) with an overall mean score of 3.09.

The perception of the respondents on the effect of climate variability on food security among rural populace in Baringo County, Kenya and Jigawa State, Nigeria is presented in figure 5 below.

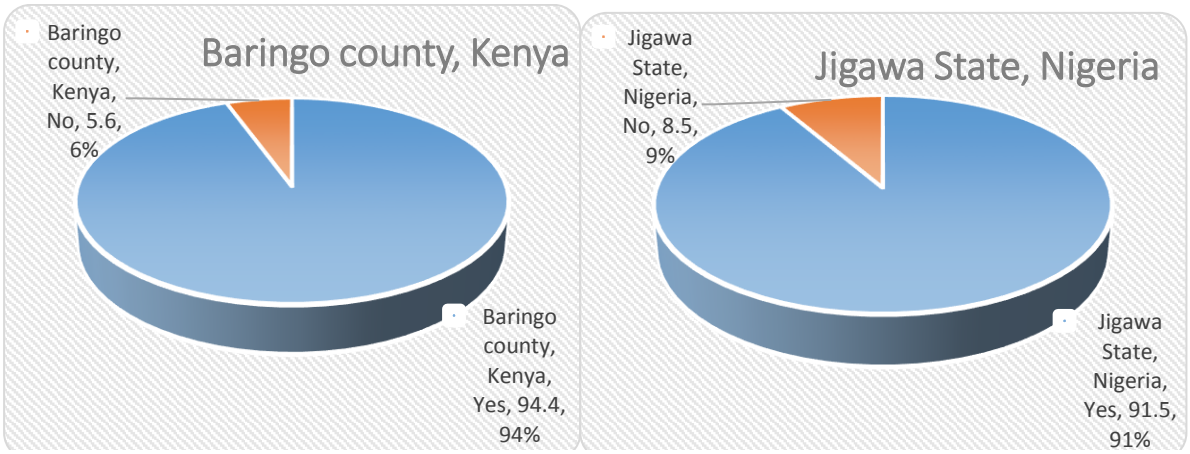


Figure 5: Perception of the effect of climate variability on food security in Baringo County, Kenya and Jigawa State, Nigeria

The result shows that preponderances (94% and 91%) of the respondents in both Baringo County, Kenya and Jigawa State, Nigeria respectively reputed that they face food availablity challenges in their locations due to climate variability while only

few (6% and 9%) of the respondents in both Baringo County, Kenya and Jigawa State, Nigeria respectively averred that climate variability does not affect their food security.

DISCUSSION

Socio-economic Characteristics of the Respondents in Choice Location

The plethora of married people has huge implication for family labour supply (lronkwe and Olajede, 2012). Marriage predispose an individual to become responsible than even being since they must cater for their family needs (Nnamerenwa *et al.*, 2017). The number of family members in the study area shows that most (50% and 75.16%) of the rural populace in Baringo County, Kenya and Jigawa State, Nigeria respectively had at most 5 persons per household. This implies that the households were moderately sized. The moderate household size is of benefit to rural populace since it has been observed in various studies like Ali and Erenstein (2017) that family labour is most essential in any household business. This helps to reduce the cost of hired labour.

Effects of Climate Variability on Livelihood Assets of Rural Populace in Kenya and Nigeria

Livestock keeping is dependent on fodder production, and the regeneration ability of most fodder plants is dependent on rainfall. At high temperature, fodder plants die and result in reduction in livestock feed. Also, high temperature increases the body temperature of most livestock and often results in death of animals. This will negatively affect the dependency on livestock keeping as a livelihood asset among the rural populace. The result on maize farming showed that rainfall and temperature significantly influenced the maize farming in Baringo County, Kenya. The coefficient of rainfall was positive and significant at 5% indicating that increase in rainfall leads to an increase in maize farming in Baringo Kenya. However, the coefficient of temperature was negative and significant at 1% respectively, indicating that increase in temperature leads to a decrease in maize farming in Baringo Kenya and vice versa.

The result showed that rainfall and temperature significantly influenced bee keeping in Baringo County, Kenya. The ability of a plant to grow and produce flowers is dependent on rainfall. Therefore, increase in rainfall will increase flower and plants production of nectar for honey formation by bees. At high temperature, flower and plants wilts, and nectar collection by bees reduces. This will negatively affect the dependency on bee keeping as a livelihood asset among the rural populace. Also the result on poultry production showed that rainfall and temperature significantly influenced the poultry farming in Baringo County, Kenya. High rainfall dampens the environment and causes disease outbreaks in poultry farms. This causes reduction in poultry farming. Thus, fluctuations in rainfall and temperature will negatively affect the dependency on poultry farming as a livelihood asset among the rural populace.

Similarly, the coefficient of temperature was positive and significant at 5%, indicating that increase in temperature leads to an increase in charcoal production in Baringo Kenya and vice versa. The fast rate of burning of charcoal due to variability in temperature increases the quantity of charcoal that is burn. As a result, Charcoal burning increases with increased variability in temperature.

Effects/Consequences of Climate Variability in Baringo County, Kenya and Jigawa State, Nigeria

The results above imply that there is drought, incidence of livestock pest and diseases, cases of human diseases and drying of water bodies in the rural area of Jigawa State, Nigeria due to climate variability. This further validates the fact that developing economies (especially Africa) of the world are most vulnerable to climate variability and its impact (Stefan, 2008; Deressa and Hassan, 2009; Lobell *et al.*, 2011; Antw-Agyei *et al*., 2014). This situation affects their economic growth and development.

However, the perception of the respondents on the effect of climate variability on food security among rural populace in Baringo County, Kenya and Jigawa State, Nigeria implies that there is evidence of extreme hunger in Baringo County, Kenya and Jigawa State, Nigeria necessitated by climate variability. This will not only incubate social vices but will predispose the rural populace to health challenges due to malnutrition (Hawkes and Ruel, 2006; Barton and Morton, 2001; Lloyd, 2011; IPCC, 2014).

CONCLUSION

The paper presents the comparison of the impact of climate variability on livelihood choices in two locations within the Africa continent (Baringo County, Kenya and Jigawa state, Nigeria). It was observed that there is variability of climate as seen in the decreasing rainfall and increasing temperature, which was substantiated by the response of the household head from questionnaires administered and during focused group interactions. The variability is influenced by livelihood choices of the rural populace in both locations. The two locations (equatorial region and sub-Saharan region respectively) have a climate-dependent (rain-fed) agro-based economy and are known to experience drought (mild – severe) because of decreasing rainfall and increasing temperature respectively. This makes the rural populace vulnerable to climate variability.

Perception of farmers to climate variability was noted to be very high and they are already adapting to the climate variability. This was evident in the degradation of land for agriculture, declining crop yield (maize farming, fruit production etc) and a reduction in livestock output over the years. This was observed by most of the household in both locations since livestock and crop production are their main source of livelihood. In Jigawa state, Nigeria, the evidences of climate variability include drying of water bodies, drought, crop pest and diseases, livestock pest and diseases and cases of human diseases. In the Baringo country, Kenya, the evidences of climate variability are cases of human diseases, drought, livestock pest and diseases, crop pest and diseases and drying of water bodies. This indicates that the Baringo County is prone to increasing human diseases more than other evidences while in Jigawa state the most felt evidence of climate variability is that of water bodies drying up than other evidences of climate variability like drought, livestock pest and diseases, cases of human diseases and crop pest and diseases.

From the ongoing, there should be pro-active measures in place to avert the negative implications of climate variability and maximize the positive influences. The relevant government agencies in both Nigeria and Kenya should as a matter of urgency provide relevant and up-to-date adaption strategies to the rural populace especially water management and conservation methods like extensive irrigation schemes to assuage the impact of climate variability. Likewise, the farmers should be ready to adopt an integrated approach to sustainable agricultural practices.

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