Rural Farmers Perception of Climate Variability, Impacts and Adaptation Strategies in Obanliku, Southeast Nigeria.

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Abstract
Climate change and variability is one of the major environmental crises that is confronting humanity daily. The problems of extreme temperatures and rainfall values threatens rural populations ability to sustain their livelihood. To understand the trend of climate variability and farm-level adaptation strategies among rural households in critical ecosystems of Obanliku Local Government Area of Cross River State, Nigeria, climate data of rainfall (mm) and air temperature (^{0}C) were obtained from the Nigerian Meteorological Agency Office, Calabar and subjected to descriptive analysis to establish trends. In addition, a questionnaire and Participatory Rural Appraisal (PRA) tools were employed to gather data from 175 heads of households in three communities (Anape, Leshikwel and Bebi 3) between March and July 2018 on their perception of climate variability trends, impacts and mitigation strategies put in place against vagaries of extreme weather. The data were analyzed using simple frequency count, percentage, tabulation and rank order of respondents' perceptions on extreme weather indices. Findings reveal that unlike temperature, rainfall showed marked interannual variability in its distribution from 2005 to 2017. A mean annual rainfall value of 130.9 mm and standard deviation of 3.8 was recorded within the study period while mean and standard deviation of air temperature 27.^{0}C and 0.20 respectively was observed between 2005 and 2017. On demographic characteristics of the respondents, 66.9% claimed to be secondary school leavers, and the highest daily income in respondents' income categories is less than $0.5 which is below the United Nations, recommended minimum. The survey results further revealed that 52.6% of the respondents believe there has been a reduction in rainfall, 59.4% said temperature has slightly increased, and there is significant reduction in soil quality and crop yield over the past 30 years. Consequently, farmers have employed some adaptation strategies in managing the impacts of these changes, especially since the crops of high market value (e.g. Dioscoera spp, Oriza sativa, Musa paradisiacal and Telferia occidentalis) which provide the main income for livelihood are crops with high water requirements. These strategies includes the cultivation of different types of crops at different periods of the year, cultivation of flood tolerant/drought resistant crops, cultivation of improved/high yielding crops,

employing conservation practices like mulching and planting of cover crops and the use of organic/inorganic fertilizers.

Key words: Adaptation, climate variability, farmers perception, Obanliku, Nigeria.

Introduction

Climate change/variability in Africa is one of the major problems accentuating the severity of her socio-economic challenges as it continues to exact significant bearing on the means of national economic development such as natural capital, farming, food security, forestry, service sector, business sector, health, utilities, among others (IPCC 2007; Noncebo R.U, Mafongoye, P.L & Unathi, K.O. 2017). This arises because large proportion of the population in these countries rely on climate dependent agricultural systems for the sustenance of their livelihood. The Food and Agriculture Organization (FAO 2015) report indicates that over 90% of Africa's landscape is under rainfed agriculture and with high level of uncertainty on rainfall amount, onset and cessations dates, most rural populace remain at high risk of food shortages and incendiary environmental crisis. Already, it is on record that over 33 million Africans are experiencing food insecurity attributed largely to inadequate rainfall and increased air temperatures which are the two readily accessible indices of climate change and variability assessment Intergovernmental Pannell on Climate Change (IPCC 2007; Akinsanola and Ogunjubi 2014). These perturbations of climatic systems are partly linked to human activities.

Although, the earth climate system is known to experience occasional oscillations, anthropogenic activities are accelerating the rate of these fluctuations (Afangideh I., Ekpe A, & Offiong A. 2013). The advent of the industrial revolution with the attendant population boom increased the amount of greenhouse gases freed into the atmosphere especially from fossil fuels burning and land use conversion or changes (Curtis P., Slay C., Harris, N., Alexander, T. & Hassen, M. 2018). In the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC 2014), it was observed that anthropogenic activities led to 40% increase of carbon dioxide in the atmosphere which is well above preindustrial estimates. This high percentage increase of Carbon dioxide (CO_2) was attributed to the destruction of forest biomass especially in the tropics which modifies the climate-atmosphere coupling processes. Biogeochemical and biophysical effects of Anthropogenic Land Cover Changes (ALCC) is often expressed in the quality of fluxes of radiation, heat, moisture and momentum between the surface and the atmosphere (Banon 2008). The removal of forest cover changes the characteristics of surface albedo and evapotranspiration modulating the way sensible, latent and ground heat exchanges can influence near surface temperature and precipitation (Pielke R., Gwyn, P., Steve, R. & Daniel, S. 2007).

The cumulative effects of deforestation and degradation was responsible for the increase in air temperature by 0.8% between 1901 and 2012 according to the IPCC (2014). Rainfall is also showing extreme indices across Africa as in elsewhere, as regions that used to be dry are getting drier while wet areas are incessantly inundated with flood waters (Adejuwon 2011). Specially, Daramola, J. (2017) recent analysis of rainfall and air temperature patterns over different climatic zones in Nigeria showed that these variables have seasonal variability. They attributed the oscillation to the influence of the Intertropical Discontinuity (ITD) with rainfall showing marked increase in the southern part of the country. This increase in rainfall and temperature is likely to have significant effects on the agricultural sector that constitute the bulk of the capital inflow for the rural population.

Further reports on Nigeria rural economy, indicates that 80% of her population engage in different agricultural ventures (FAO 2015). The value of this sector is further revealed in its contribution to the Gross Domestic Production (GDP). National Bureau of Statistics (2017) quarterly analysis showed that about 30% of the nations' GDP comes from agricultural sector. This mean that extreme climate or weather events can have a damming impact on the nations' economy. It is in view of the high dependency of Nigerians on rainfed agriculture that Odjugo (2010) and World Bank (2017) soberly warned that Nigeria is one of the countries in Africa that will continue to be heavily impacted by climate change due to her high vulnerability, attributed largely to her lack of adequate and timely information on climatic trends and predictions to the rural population, acute poverty that limit large set of the population access to vital interventions to climate change effects and the non-availability of facilities to prepare and manage the impact of climate variability and change on their farmlands.

These challenges expose them to the vagaries of climate change/variability on a high scale (UNICEF 2015), hence there is the need to investigate climate and rural population welfare dynamics. In view of these, it is therefore imperative to understand how farmers are coping with climate extremities in rural Obanliku Local Government Area of Cross River State, Nigeria. The specific focus of the study is to examine rainfall and air temperature trends in the study area from 2005 to 2017), to ascertain the rural farmers perception of climate variability, impacts and adaptation strategies and to identify the top food crops in order of economy ranking in five rural communities of Obanliku Local Government Area, of Cross River State-Nigeria.

Methodology

Study area

The study area is Obanliku Local Government Area. The area lies between latitude $6^0$21' 30" and $6^0$22" N and longitude $9^0$22'0" and 9^0'45"6". Obanliku is bounded in the north by Benue State, in the west by Obudu Local Government Area, in the east by Cameroun and in the south by Boki Local Government Area. It has an estimated population of 146, 000 people. (NPC 2006).

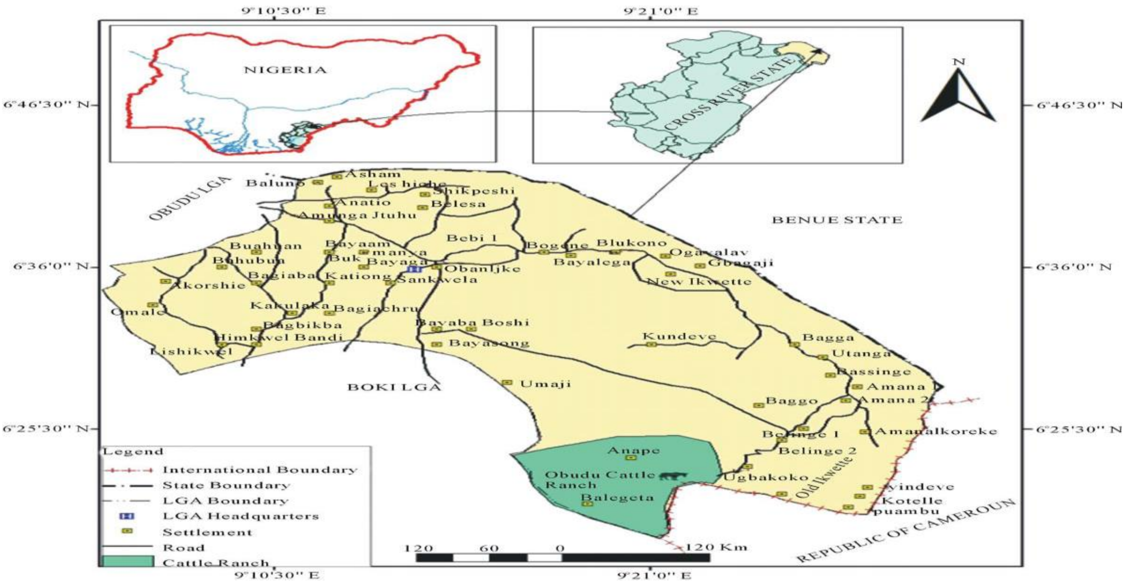

Fig 1: Study area
Source: Akpan-idiok&Ofem (2014)

Climate

Obanliku is located in the tropics but has temperate climate because of the altitudinal location. Mean daily temperature ranges between 15^0C and 22^0C. It has a mean annual rainfall of about 80cm, while December records the lowest. Two wind systems blow across Obanliku. The north-east trade winds, which begins in November – April and ushers in the dry season, and the south-west monsoon winds, which starts in late April to October and wets the whole area. Relative humidity is usually very high up to 70% in the morning and late evenings. These conditions are very suitable for the growth of Cassava (Akiang, J.U., Oko, E & Unimna, F.A. 2013).

Relief:
Obanliku is located within the Basement complex. It is a region of low seismicity. The area is generally undulating. The bedrock is very heterogeneous and includes gneisses, granite and bioititic rocks. Obanliku forms part of the Bamenda massif, which stretches from Cameroon into Eastern Nigeria. The dominant soil types are the steep shallow yellowish red soils. Others are silt, silty clay and silty sand (Amuyou, U.A & Kotingo, K.E. 2015).

Vegetation:
The area lies within the Guinea savanna but montane is found on the mountain top. This is a zone of a mixture of trees and tall grasses caused by local climatic variations. There is the existence of gallery forest along the stream channels. Bush burning and shifting cultivation has greatly altered the ecology of the landscape. Trees found here includes Mahogany, Locust been tree and Iroko (Amuyou, U.A & Kotingo, K.E. 2015). They are greatly exploited for commercial purposes.

Socio-economic activities:
The main occupation of the people of the area is farming. Farming is done at a subsistence level. Here farmers own small parcels of land, which may be hereditary and grow several crops such as yam, cassava, cocoa yam, rice, beans and millet. There is also bee farming in the area, particularly in Utanga, Amana, Ikette and Okwi. The only mechanized farming activity in this area is the Goddy Logo farms located at Bebi.

Research design: The causal–comparative design research design was used in the study. This design is considered appropriate to investigate the implications of climate variability on food crop production and farmers adaptation strategies in Obanliku LGA.

Types of Data: Three major types of data used in the study included:

(a) Data on yearly temperature and rainfall

(b) Data on effects of climate variability on food security and

(c) Data on farmer’s adaptation strategies to climate variability collections in Obanliku.

Research Questions: The study was guided by the following research questions:

1. What is the trend of temperature and rainfall in the study area in the last twenty (20) years?
2. What are the effects of temperature variability on farming activities in Obanliku L.G.A?
3. What farm level adaptation strategies are put in place by farmers to mitigate the effects of climate change/variability in the study area?

Field procedures: A reconnaissance survey of the study site was undertaken to identify sample communities in the study area and establish contact with the identified communities from the selected wards. The communities identified includes Anape, Leshikwel, and Bebi 3. These three communities have unique climatic conditions such that information gathered from them can be generalized for the entire Obanliku region.

Instrument of data collection included qualitative and quantitative tools. Questionnaire and participatory tools of Focus Group Discussion (FGD) were used to collect primary data which covered the socio economic characteristics of the study (Farmers perception on climate change/variability and adaptative strategies to climate change/variability); while data on rainfall and temperature in the last thirteen (13) years was used to analyze rainfall trends in the last thirteen (13) years.

Rainfall and temperature data: Data on rainfall and air temperature were collected from the Nigeria Meteorology office in Calabar. The monthly data of the variables covered 2005 to 2017. This is the period data on temperature and rainfall for the study were available. The secondary data (temperature and rainfall) were subject to some statistical analysis and inferences made about the results.

Techniques of data analysis: The data collected were analyzed using descriptive statistics of mean, standard deviations and standardized anomaly, while the results were presented using charts and tables. The descriptive models are given as;

(i) Mean $(\bar{x}) = \left(\frac{\sum x}{N}\right)$

Where;

x = the variable

N = the number of years

(ii) Standard Deviation, $S = \sqrt{\frac{\sum(X-\bar{X})2}{N}}$

Where;

x = the variable

$\bar{x}$ = the mean

N = the number of years

(iii) Standardized Anomaly $= \frac{(X-\bar{X})}{STD}$

Where;

$(x-\bar{x})$ = Deviation Score

STD = Standard Deviation

Results and Discussion

Analysis of rainfall anomaly in Obanliku 2005-2017

Table 1 and Figure 2 are the annual mean of rainfall, standard deviations and standardized anomaly in Obanliku from 2005 to 2017. From the table, it can be observed that the highest annual mean values of rainfall between 2005 and 2017 was 154.5 mm recorded in the year 2012 while the least amount of 90.6mm followed soon after in 2013. In 2005, the mean annual rainfall was 123.2 and the standard deviation was 2.2. In 2006, a mean value of 130 mm was observed, and the standard deviation was 0.3. More so, in 2009, an annual mean of 144.1 mm was recorded and a standard deviation of 3.8 was calculated for the year. Similarly, in 2010, the annual mean of 118.0mm and standard deviation of 3.7 was observed for the year. Between 2012 and 2014, an abnormal trend in rainfall was experienced. This corresponds to the period of highest rainfall (year 2012) and the lowest rainfall on record (year 2013).

Table 1: Annual mean of rainfall, standard deviations and standardized anomaly in Obanliku (2005-2017)

S/N	Years	Annual total (mm)	Annual mean-X	X- $\bar{X}$	(X- $\bar{X}$)^2	$\sqrt{\frac{\sum(\boldsymbol{X}-\bar{\boldsymbol{X}})2}{\boldsymbol{N}}}$	$\frac{(X-\bar{X})}{STD}$
1	2005	1477.8	123.2	-7.7	59.3	2.2	26.9
2	2006	1560.5	130	-0.9	0.8	0.3	2.7
3	2007	1691.0	140.9	10.0	100	2.9	34.5
4	2008	1642.7	136.9	06	36.0	1.7	21.2
5	2009	1729.6	144.1	13.2	174.2	3.8	45.8
6	2010	1415.9	118	-12.9	166.4	3.7	44.9
7	2011	1515.8	126.3	-4.6	21.2	1.3	16.3
8	2012	1853.4	154.5	23.6	1339.6	10.6	126.4
9	2013	1087.2	90.6	-40.3	1624.1	11.6	140.0
10	2014	1729.6	144.1	13.2	174.2	3.8	45.8
11	2015	1498.7	124.9	-6.0	36.0	1.7	21.2
12	2016	1582.8	131.9	1.0	1.0	0.3	3.3
13	2017	1640.7	136.9	5.8	33.6	1.7	19.8
			$\sum$=1702.1 $\bar{X}$= *130.9*				

Source: Analysis by authors (2018)

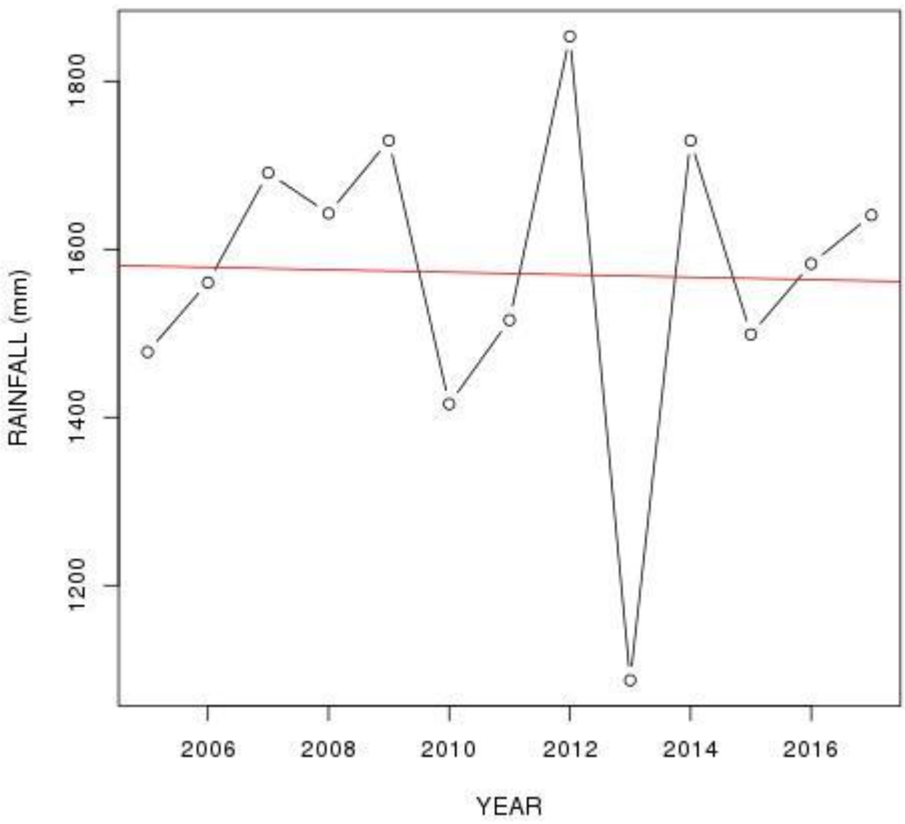

Fig 2: Rainfall trend in Obanliku (2005-2017)

Source: Nigerian Meteorological Agency Office, Calabar.

A cursory look at Table 1 further revealed a consistent variation in the mean of rainfall with exception in the years 2012 and 2013 in the study area between 2005 and 2017. The variability of rainfall observed here is in accordance with predictions over the African sub-region. For instance, reductions in precipitation amount was placed on probability note while variability was expected to surge (IPCC 2014). In fig 3, the anomaly in rainfall revealed the highest mean of rainfall was observed in 2012 while the least rainfall was recorded in 2013. The other years revealed fluctuations. In a brevity, between 2005 and 2017, rainfall exhibited great anomaly as no consistent trend was observed.

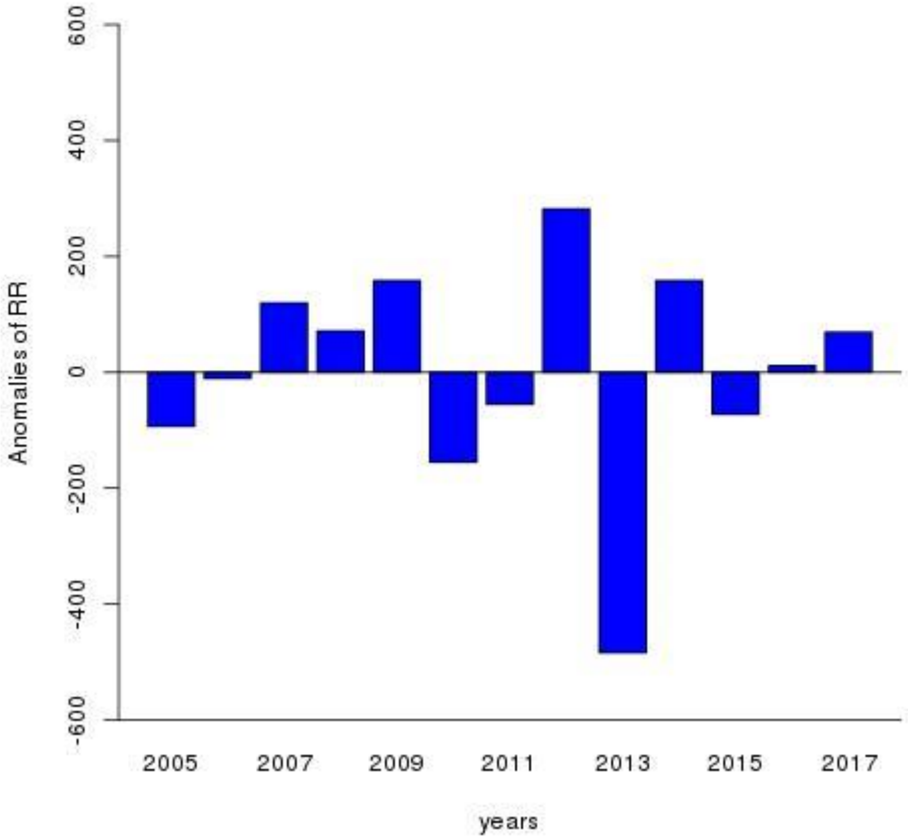

Fig 3: Standardized rainfall anomaly (annual) over Obanliku (2005-2017)
Source: Nigerian Meteorological Agency Office, Calabar.

Mean annual temperature from 2005 to 2017

Table 2 is the mean and standard deviations of yearly air temperature in the study area. From the table, the mean values of air temperature in 2005 was 27.2 degree Celsius (0C) while in 2006, 2007, 2008, 2009 and 2010, annual mean values of 27.3, 27.3, 27.3, 27.4 and 27.6 ^{0}C respectively were experienced. More so, from 2011 to 2017, the following yearly mean values of air temperature were recorded in Obanliku: 27.0, 27.4, 27.4, 27.6, 27.5, 27.7 and 27.9 ^{0}C respectively. On air temperature interannual distribution, figure 4 revealed the highest mean values of 27.9 ^{0}C of temperature were observed in the year 2017 while the least values of 27.0 ^{0}C were recorded in 2011. These values of air temperature are within the minimum optical range for staple food crop production in the tropics (Daramola, J., 2017). However, crop production is known not to rely on only temperature as other variables like soil fertility, duration of sunshine, intensity of temperature, biogeochemical processes etc. may either limit or enhance the growth and development of staple food crops in the region (Pielke et al., 2007).

Table 2: Annual air temperature means and standard deviations from 2005 to 2017

Year	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	X/SD
Mean values (^{0}C)	27.2	27.3	27.3	27.3	27.4	27.6	27.0	27.4	27.4	27.6	27.5	27.7	27.9	27.4/0.20

Source: Analysis by authors (2018)
Source: Nigerian Meteorological Agency Office, Calabar.

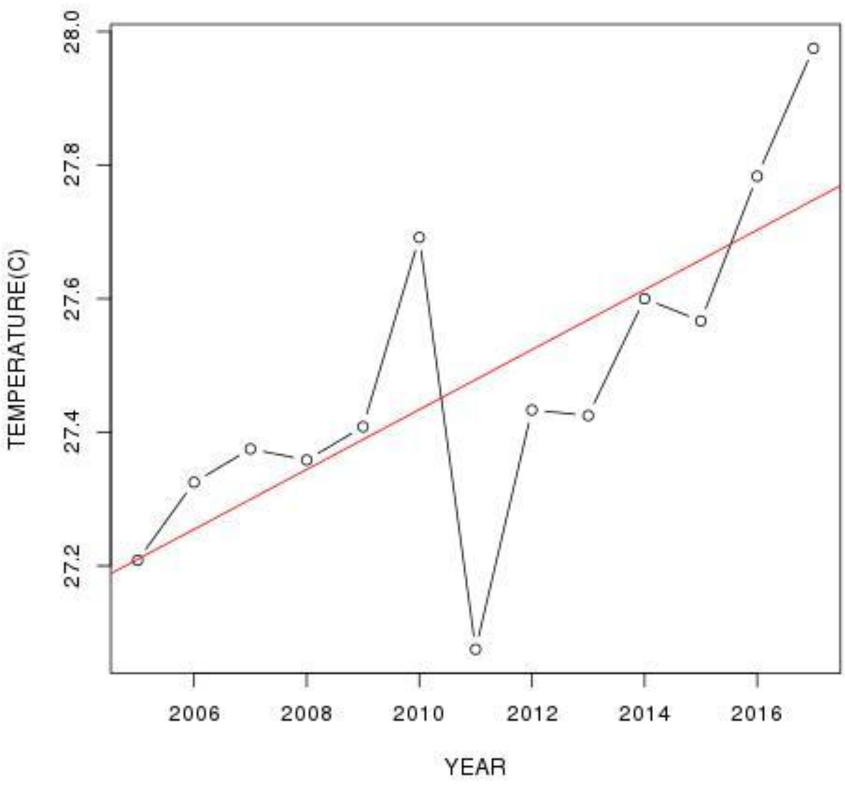

Fig 4: Temperature trend in Obanliku (2005-2017)

Perception of the people on variability/climate change (rainfall & temperature)

Table 3a shows farmers perception on rainfall and temperature trends in the study area. On the perception of farmers to climate change, the table revealed that rainfall have over the last thirty (30) years shown a decreasing trend as about 50 percent of the sampled heads of household claimed rainfall has been low. However, only 6.3 percent of the respondents expressed a contrary view to the fact that rainfall has been low. These set of respondents said they have rather experienced low rainfall in the last thirty years. More so, the table indicates that 17.1 percent of the respondents are of the view that they have in the last 30 years experienced prolong sessions while 12.0 percent rather argued that the rainfall duration has been shorter. It further revealed that 9.7 percent of the people sampled said rainfall has been irregular while only 1.1 percent submitted that they have seen no change in rainfall and I don’t know respectively.

Table 3a: Farmers perception of climate change

Variable Rainfall (Trend & amount in the last 30 years)	Frequency	Percentage
No change	02	1.1
Prolong session	30	17.1
Shorter session	21	12.0
Irregular	17	9.7
Heavy rainfall	11	6.3
Low rainfall	92	52.6
Don’t know	02	1.1
Total	**175**	**100**
Variable Temperature in the last 30 years		
Very hot	104	59.4
Hot	56	42
Not hot	14	8.0
Don’t know	01	0.6
Total	**175**	**100**

Source: Authors survey (2018)

On temperature trend in the study area, table 4a also indicates that a large proportion of the population sampled are of the view that temperature has been on the increase as 59.4 percent of those interviewed said that the atmospheric condition of their communities has been very hot in the last thirty years. It also shows that 42.0 percent of the study population said the ambient air of their community has been hot while only 8.0 percent said it has not been hot.

Table 3b is the view of the sampled population based on their age. From the table, it can be seen that 33.3 percent of those within age limit of 45 to 49 claimed the temperature has been very hot in the last thirty years while 40.7 percent said weather condition has been hot. Similarly, 67.7 percent of those within age cohort of 50 to 54 said the temperature of their communities has been very hot and 27.2 percent said it has just been hot.

Table 3b also revealed that 55.6 percent of those interviewed who are 65 and above years old claimed that the status of temperature in their communities has been very hot in the last thirty years while 33.3 percent said it has been hot. More so, the table showed that 11.1 percent claimed temperature of the area has not been hot while none said they don't know.

Table 3b: Farmers perception of temperature behavior based on age

Status of temperature	Respondents by age (%)				
	45-49	50-54	55-59	60-64	65 & above
Very hot	09 (33.3)	21(67.7)	60(68.2)	14(70.0)	05(55.6)
Hot	11(40.7)	10(32.3)	24(27.2)	05(25.0)	03(33.3)
Not hot	02(07.4)	00(0.00)	03(03.4)	01(05.0)	01(11.1)
Don't know	05(18.6)	00(0.00)	01(01.1)	00(0.00)	00(0.00)
Total	27(100)	31(100)	88(100)	20(100)	09(100)

Source: Authors survey (2018)

Effects of climate variability/change on farming activities

On the perceived impacts of climate change on farming activities and food crop production in the three sampled villages, it was observed that different farming practices were affected with negative effects on food crop production based on the responses obtained as shown in table 4.

Table 4: Impacts of climate change on crop production

Effects	Anape	Leshikwel	Bebi 3
	Frequency (%)	Frequency (%)	Frequency (%)
Increasing cases of crop	01 (2.0)	02 (3.1)	01 (1.6)
yields	13 (26.5)	16 (25.0)	14 (22.6)
Decreasing cases of crop	02 (4.1)	01 (1.6)	03 (4.8)
yields	01 (2.0)	03 (4.7)	02 (3.2)
Witling of crops	02 (4.1)	01(1.6)	01 (1.6)
Delay planting of crops	01(2.0)	02 (3.1)	01 (1.6)
Pest infestation	02 (4.1)	04 (6.3)	03 (3.8)
Early crop maturation	16 (32.6)	19 (29.7)	10 (16.2)

Increased cost of production Soil fertility depletion Increased soil wash downhill Total	11 (22.4) **49 (100)**	16 (25.0) **64 (100)**	10 (16.2) **62 (100)**

Source: Authors survey (2018)

On the effects of climate variability on crops in the study area, table 5 shows that in Anape 32.6 percent of those sampled agreed that climate change is responsible for the low fertility status of their soils. In addition, 26.5-4 percent of the sampled respondents identified decreasing reports in crop yield as another serious effects of climate variability in their communities. The table also revealed that 22.4 percent of the farmers interviewed linked increased downward wash of soil particles to climate change.

More so, Leshikwel community, received the highest responses as 29.7 percent of the sampled population associated the hike in cost of production to climate change. It was also reported in the community that soil fertility lost and decrease in the yield of crops were also linked to climate change. The table indicates that 25.0 percent of those sampled supported these views.

Farm-level adaptation measures to climate variability/change impacts

Table 5 is the ranked order of adaptation measures to climate change impacts in the Obanliku (Bebi 3) Mountain region. The Table revealed that farmers ranked the cultivation of different types of crops at different period first while the use of soil conservation practices such as mulching, cultivation of cover crops, use of organic/inorganic fertilizers was ranked second.

Table 5: Rank order of adaptation strategies to climate change impacts

S/N	Adaptation strategies	Rank
1	Cultivation of different types of crops at different periods (early/late, diseases/pest resistant, flood/drought tolerant, improve/high yielding crops etc).	1
2	Soil conservation practices like mulching, cover crop, use of organic/inorganic fertilizers	2
3	Cultivate by their river bank	3
4	Changing planting/harvesting date	4
5	Mixed farming	5
6	Diversification of income sources (Petty trade, hair plating etc)	6
7	Local irrigation practices (watering of crops/channelization)	7
8	Agro-forestry practices	8

9	Contour tilling/planting on ridges	9
10	Buying food items to supplement household food needs	10
11	Rain harvesting	11
12	Move to different sites	12
13	Use of pesticides	13
14	Increase farm plots	14
15	Prayers/rituals to God/gods	15
16	No adaptation (do nothing)	16
17	Securing credit facilities to support farming operations	17

Source: Authors survey (2018)

Table 5 also revealed that river bank cultivation is ranked third. It was observed in the field that most farmers cultivate along stream banks during the dry season. Other practices such as change in the planting date, agro-forestry practices, local irrigation schemes, among others were also prioritized differently as indicated in Table 5.

Crop diversity and market value as perceived by farmers

Table 6 revealed that yam (*Discoera spp*), upland rice (*Oriza sativa*), plantain (*Musa spp*), cassava (*Manihot spp*) and pumpkin (*Telferia occidentalis*) were rated high by the respondents while food crops like water yam (*Dioscora alaay*), maize (*Zea maize*), Banana (*Musa sapientum*) and ground nut were viewed to have medium economic value by the farmers in the Obanliku Mountain region.

Table 5 also indicated that most of the vegetable crops were rated low in economic value. Some of the crops include *pipper nigrum*, *daucus carota*, *Solanum tuberosum etc.* Some of these crops can easily be grown at homestead and this may be the reason for their low economic value.

Table 6: Major crops cultivated and perception of their market value in the sampled communities

S/N	Common name	Scientific name	Market value of crops
1	Yam	*Dioscoera spp*	High
2	Water yam	*Dioscora alaay*	Medium
3	upland Rice	*Oriza sativa*	High
4	Plantain	*Musa paradisiacal*	High
5	Cassava	*Manihot spp*	High
7	Maize	*Zea maize*	Medium
8	Potatoes	*Solanum tuberosum*	Low
9	Millet		Low
10	Banana	*Musa sapientum*	Medium
11	Leak onion, lettuce, strawberry, Parsley	*Allium porum, letuca sativa*	Low
12	Pumpkin	*Telferia occidentalis*	High
13	Carrot	*Daucus carota*	Low
14	Mellon	*Cucumis melo*	Low
15	Okro	*Abetmosaus exculentus*	Low
16	Ground nut	*Arachis hypogeal*	Medium
17	Cucumber	*Curcumas sativa*	Low
18	Pepper	*Pipper nigrum*	Low

Source: Authors survey (2017)

Conclusion and Recommendations

The study established that rainfall showed marked inter annual variability while no discernable variations was exhibited in air temperature. The study also revealed that local farmers through observation are aware of changes in their local weather and climate and its impact on their crop production. In response farmers have employed several adaptation strategies such as cultivation of different types of crops at different periods (early/late, diseases/pest resistant, flood/drought tolerant, improve/high yielding crops etc.), soil conservation practices like mulching, planting cover crop, use of organic/inorganic fertilizers, cultivating by the river bank and changing planting/harvesting dates. Farmers also demonstrate a satisfactory level of awareness of the food crops of high economic value. The concern here is that these high value crops are water demanding, thus farmers need accord special attention to adequate adaptation in order to maximize production. A major setback is the high poverty level which implies willingness but little accomplishment in the fight against the impacts of climate change, for instance, the data on the socio-economic characteristics of the respondents show that even the richest among the respondents live below the UN minimum living standard.

It is therefore recommended that:

i. More awareness programmes be organized by the government to sensitize the farmers about climatic uncertainties and the need for preparation for future eventualities.
ii. Institutionally supported experts in the field of climatology should synergize with agriculturist and get involved with rural farmers to minimize wrong practices for maximum crop output.
iii. Government should not relent in supporting farmers with improved crop varieties that are pest and disease resistant.
iv. More robust credit facilities and improved irrigation system should be introduced by the government where possible to complement the low rainfall.
v. More funding by the government into research could help develop easily adaptable crop species that could be drought or flood resilient.

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