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IMPACT OF CLIMATE VARIABILITY ON LIVELIHOOD OF COMMUNITIES IN KAMUKU NATIONAL PARK, BIRNIN-GWARI, KADUNA STATE

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Abstract
Climate variability has serious effects on the livelihood of rural people who depend on agriculture. The dependency of local people on agriculture and its significant contribution to their socio well-being makes the situation more critical. The study examined the impact of climate variability on livelihood o communities around Kamuku National Park (KNP) Birni-Gwari, Kaduna State, Nigeria. Data for the study were collected with the use of structured questionnaire administered to 280 house heads in 8 villages (Birnin-Gwari, Mando, Doka, Bugai, Dagara, Sabolayi, Kakagngi) around the Park. The result reveal that majority of the respondent had little knowledge on the cause of climate variability. They are aware of the changes in climatic variables of their areas in terms of increase in temperature, changes in rainfall pattern and intensity. The Communities perceived decline in agricultural production as a major impact of climate variability. Other impacts perceived are shortage of water for irrigation, household and animal consumption, cases of diseases in human, plant and animals, decrease in soil fertility and migration of youths. The study recommended awareness on climate variability to the communities on causes and effect of climate variability, awareness on climate variability and its impact on livelihood must be raised in the communities. People are experiencing changing climate but they don't know the cause and consequences of it.

Key Words: *Climate Variability, Impacts, Perception, Livelihood, Adaptation, Kamuku*

Introduction

Climate variability refers to a measure of the frequency of changes in the values of climate variables and their range over a given time period. Temperature and rainfall are the climate variables most serious with regard to food production, because not only does the range between high and low value matter, but also the intensity and occurrence of their extremes (Zierovogel *et al*., 2006). Climate variability has serious effects on the livelihood of rural people who depend on agriculture. The dependency of local people on agriculture and its significant contribution to their socio well-being makes the situation more critical. Climate variability effect could be seen in declining agricultural production and productivity, increased

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pest and diseases in human, crop and animals, decline in food security, unemployment and poverty (Agbo *et al.,* 2015).

Climate variability and change is one of the most serious environmental and socio-economic threats facing the world (UNFCC, 2009). It is arguably the greatest contemporary threat to ecosystems services, biodiversity and livelihood of poor forest fringe communities in developing countries. Developing countries particularly the poorest people in these countries are the most vulnerable to the adverse impacts of climate variability. This is because their livelihood depends heavily on climate sensitive sectors such as agriculture, forestry, hunting, fisheries, water supply and other natural resources. These people are hindered by limited access to technology, human capacity and capital which limits their capacity to invest in risk reduction and adaptation to changing climate (UNFCC, 2009). The effects of climate variability and change deepen poverty, food insecurity, poor livelihoods and unsustainable development in developing countries (IPCC, 2007). Livelihoods consist of all factors that allow families to sustain themselves economically, socially, materially, emotionally, and spiritually (World Resources Institute (WRI) 2005). Poverty among most rural people creates an increase of pressure on available natural resources (water sources, firewood, and rangeland for grazing their livestock), most of which are found within the Preserved Areas (Thuy, 2014).

Unusual changes in rainfall and temperature together with increase in intensity and occurrence of drought and floods have long-term effect on the productivity of world agro-ecosystems (FAO 2007).

The rural people living around Kamuku National Park (KNP) are majorly farmers, which mean that they are working in climate sensitive sectors (the farming activities in the area is rainfed). As agriculture is one of the sectors that are more dependent on climatic factors, this rural people are more prone to impact of climate variability. While there are some evidences of climate change and its impact in the area, no comprehensive study has yet been conducted to determine the extent of these impacts on the livelihoods of the communities around the Kamuku National Park Birnin-Gwari Kaduna, Nigeria. Therefore, the paper examined the impact of climate variability on livelihood of 8 communities around the Park. These communities are Doka, Mando, Sabolayi, Kakangi, Kurgi, Bugei, Gwaska and Birni-Gwari.

Study Area

Kamuku National Park is located in Birnin-Gwari, in Birni-Gwari Local Government of Kaduna State, Nigeria. It is situated between latitudes 10°30′N and 11°00′N; Longitudes 6°11′E and 6°36′E in the North-Eastern Part of Nigeria. The Park is surrounded by Maseigi and Kakangi in the West, Kurgi and Dagara in the South, Gwaska, Kungi, Mando and Gworon-Dutse in the East and Nabango in the North as indicated in the Figure 2 The Park originally gazetted as Birnin-Gwari Native Authority Forest Reserve in 1936 before it was upgraded to the status of a National Park in May 1999 covering an estimated land of 1121sqkm of typical savannah woodland vegetation (NNPS, 2017).

The climate of the area is marked by two different seasons, the dry season and the rainy season. The dry season lasts from November to mid-April while the rainy season lasts between 6-8 months starting from March. The vegetation here is dominated by large trees, some of which grow up to a height of 40m. Smaller trees and shrubs are present in large numbers. The terrain is largely flat, rising gradually eastwards to the Birnin-Gwari Ridge, which forms part of the eastern boundary. Kamuku Environ is the home of two major tribes of Gwaris and the Kamukus which are mainly farmers with minority being hunters, pastoralist, weavers, blacksmiths, craftsmen and pottery makers. Other tribes also include; Hausa, Fulani, Yoruba, Ibo, Kataf, Kanikon, Jaba, Marwa and Kogoro. (KNP, 2010; Amusa *et al*., 2011).

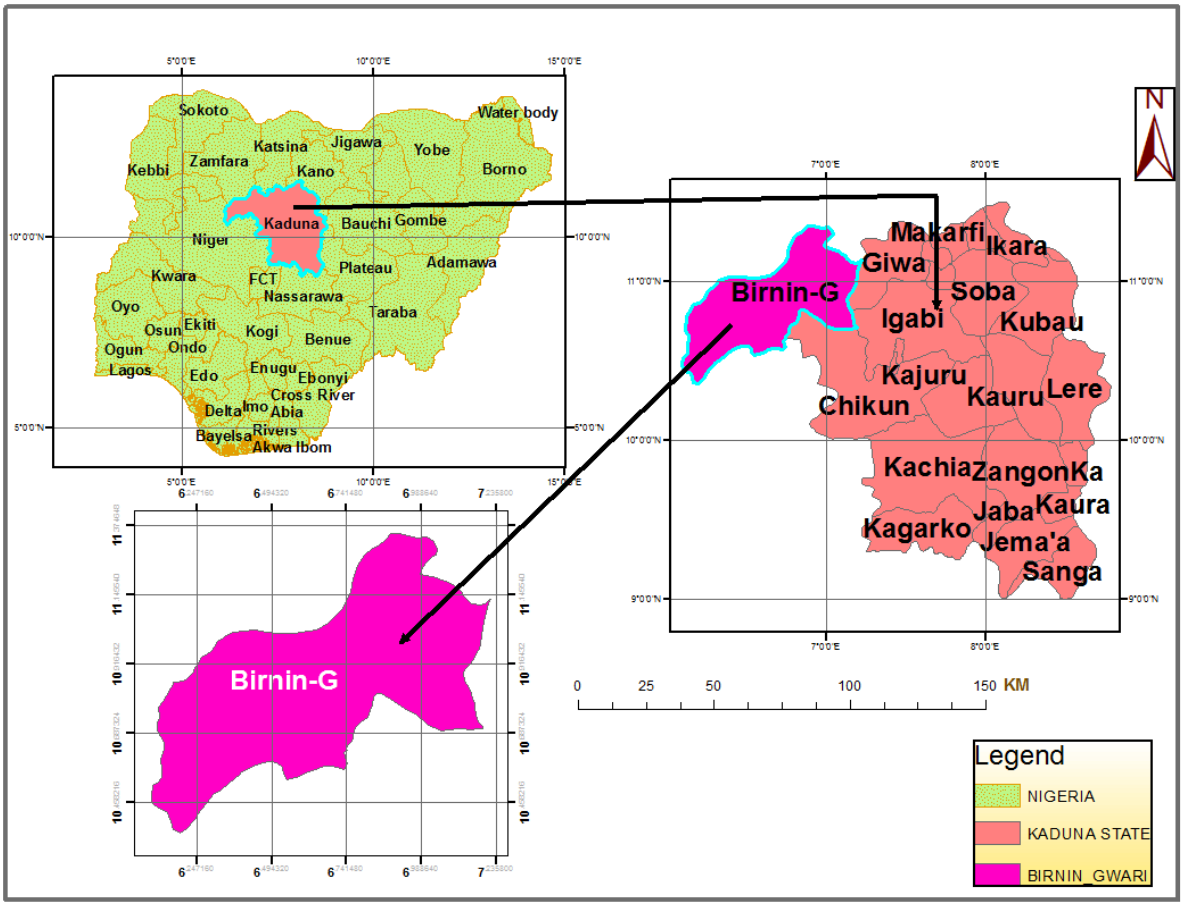

Fig. 1: Map of Nigeria Showing Kaduna State and Birnin-Gwari Local Government Area.

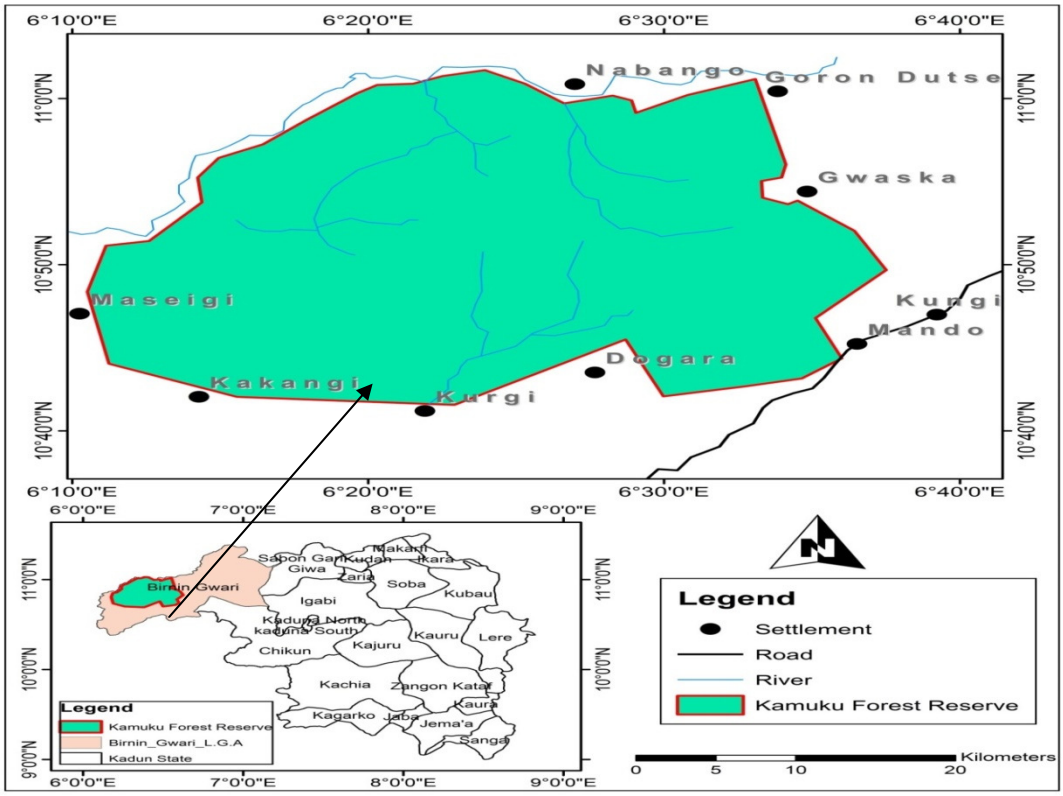

Fig. 2: Map of Kamuku National Park and Surrounding Villages
Source: Abdulkadri 2015 (Adapted from Kaduna state Administrative Map)

Literature Review

FAO (2012) reports that 60 to 70% of the world's ecosystem services are deteriorating, with dramatic consequences on forest dependent communities. Climate change is projected to aggravate these threats and the livelihoods of forest dependent communities (Boon and Ahenkan, 2011). Evidence in recent decades of escalating human impacts on ecological systems worldwide and climate change, raise concerns about the consequences of ecosystem changes for human well-being and livelihoods of forest dependent communities (Sokona and Dento, 2011).

People are highly vulnerable to the impacts of climate change. This is because it acts on the very essence of their sources of livelihoods, upon which they depend on daily basis for their sustenance. Directly, the impact is influencing the biophysical environment, especially water availability and temperature regimes that are interacting to reduce agricultural production and forest resource availability. Such an impact is intensified by the interaction of other social factors such as development, population growth, agriculture deforestation and urbanization, which can act in concert with climate change to impact on forest resources. Although the nature and intensity of climate change impact vary from place to place, there is no doubt that its effect on peoples' lives and welfare is enormous, and will only increase under current predictions of climate change, especially in Sub-

Saharan Africa (Onyekuru and Marchant, 2014).

Ahmed (2006) identified that Households in the Nigeria's Mangrove, Rainforest, Montane forest, Guinea savanna and Sudan savanna derive 47, 34, 31, 19 and 14% of their livelihood from the forest respectively. This was done with assessment of 5 different communities within five ecological regions (Mangrove, Rainforest, Guinea savanna, Sudan savanna and Mountain forest) in Nigeria using structured questionnaires to gauge the impact of climate change and adaption responses. More than 75% of households surveyed have experienced impacts of climate change on forest resources, except in the Montane forest zone where only 33% were impacted. In the mangrove and rainforest regions impacts were mostly manifest as excessive rainfall, in the Montane forest, Sudan and Guinea savanna, impacts were due to reduced rainfall.

Climate change had insignificant impact on livelihood of the people in Manaslu Conservation Area (MCA) of Gorkha district of Nepal (Anup, 2012). He identified that climate change impact was perceived as increase in frequency of landslides, increase in temperature resulting in faster melting of snow, unfavourable weather change phenomenon, snowfall in the month of May, decrease in agricultural productivity and economic instability affecting the livelihood of people of Manaslu Conservation Area (MCA) of Gorkha district of Nepal.

Dube and Keith (2013), evaluated the impact of climate change on the livelihoods of local communities, focusing on Matobo District in Zimbabwe. The objective of the study was to understand how communities have been affected by climate change and how they are adapting to it as well as their perceptions about the gravity of the climate change phenomenon. The findings of the study were that the effects of climate change on livelihoods in the study area are alarming. Climate change has altered the physical geography of Matobo District leading to a disappearance of flora and fauna and other natural habitat that constituted the livelihoods of the local people. Declining precipitation and rising temperatures are making farming increasingly more difficult, and thus aggravating food insecurity in the area. Urgent climate change programming steps must be taken to prevent a livelihoods catastrophe in semi arid regions in sub-Saharan Africa.

Materials and Methods

Five participatory and empirical research methods were used in carrying out the research. These include administration of questionnaires, key informant interview, focus group discussion, field observations and consultation of experts. These were used in collecting data on the socio-economic activities of the people, choices of livelihood and level of dependency on the resources in the park for livelihood, perceived effect of climate variability on the people's livelihood, and Mitigation and adaptation strategies by the communities. 280 questionnaires were administered to household heads in communities around Kamuku National Park. This study targeted household members who were above 30 year of age with appreciable knowledge of the changes in environment for the interview, focus group discussion and key informant interview because of their experience in

the study. These people were the Local Farmers, the Traditional Leaders and the Rangers of KNP.

Method of Data Analysis

The qualitative and quantitative information about socioeconomic components from household survey as related to the topic was summarized and analysed using Microsoft Excel 2010. The result was presented in statement forms, graphs, tables, Pie Chart and Bar charts and pictures as related to the objectives.

Results and Discussion

The findings show that the majority of the respondents are males (91.4%) while only 8.4% were females. The culture of the people made it difficult to assess the female which gave the reason for high percentage of Male respondents over female respondents. The age structured indicates that 11.4% were within 30 – 39 years, 75.0% of the respondents are within the age of40-60 years and 13.6% were above 60 years of age. This implies that the respondent are were within active and productive ages which are efficient in agricultural production. Also majority of the respondents were married with 86.4% with an average family size of 13, while 72.1% of the respondents have stayed in the villages for more than 30 years. This implies that the respondent have good knowledge of their environment and can give important information regarding climate variability.

Perception of the Communities towards Climate Variability

Majority (81.5%) of the respondent were not aware of the climate variability as a terminology but they were aware of the changes in the rainfall and temperature of their environment. The limited about climate variability could be as a result of their literacy level and inability to receive meteorological data. They perceived long term variability in amount and distribution of rainfall. They also perceived that the rainfall in the area had become unpredictable, delayed, and erratic. Majority of respondents of the respondents agreed that temperature in the area had increased than the way it used to be 10 – 20 year back. This implies that they were fully aware of the changes in climatic variables of their environments and also determines their level of adaption to climate variability.

Perceived Causes of Climate Variability

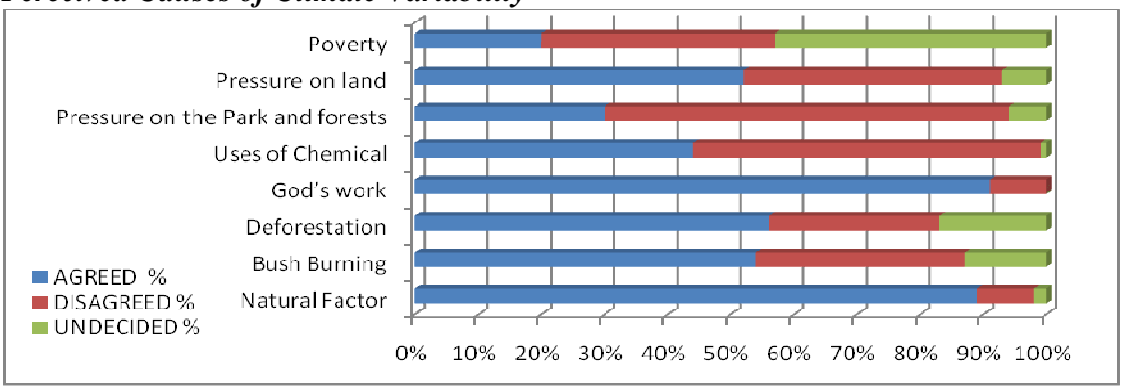

Fig. 3: Cause of Climate Change

Out of the 280 respondents, 91% agreed that changes in temperature and rainfall occurred as result of power of God "Allah". In terms of Natural factors, 89% agreed that the variation happened naturally, 9% disagreed while 2% were neutral. 54%, 56% and 52% agreed on bush burning, deforestation, and pressure on the land respectively, as part of human activities causing climate variability and change. This implies that the communities had little knowledge of the cause of climate variability in terms human (deforestation, bush burning, and degradation) and natural factor. This agrees with the finding of Ahmed (2006).

Livelihood Activities

The livelihood activities were grouped into Farming, Civil Service job, Trading and farming and other activities (Mining, weaving, crafting, carpentry, driving, mat making, pot making, calabash carving, meat selling and food selling).

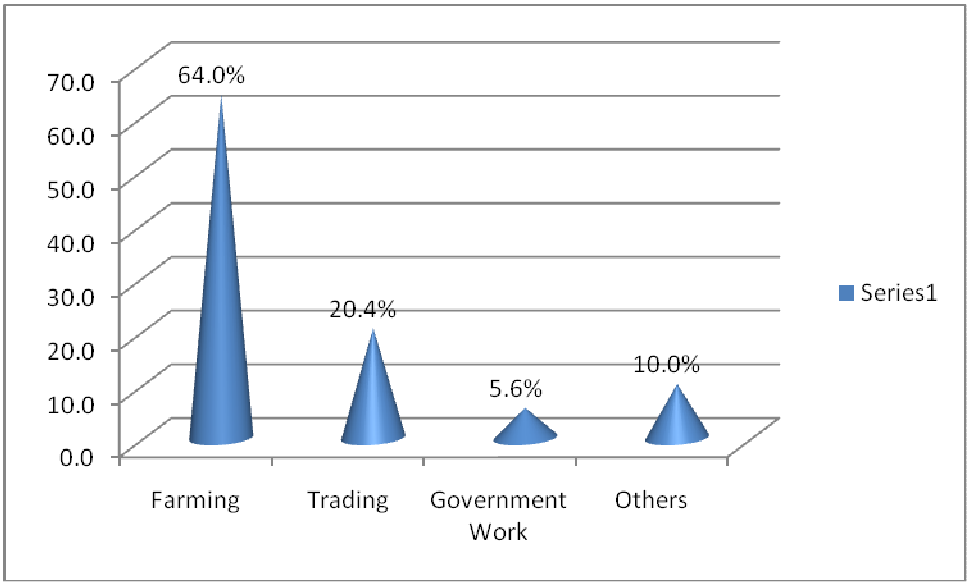

Figure 4: Livelihood activities

Ninety-one per cent of the total respondents engaged in Farming (crop and animal production) at subsistence or commercial level. In other words, the trader, Government workers, the Miners, the Hunters and blacksmiths also engaged in farming to support their income. As indicated in fig 64.0% of the respondents engaged purely on farming at commercial level, they were into majorly crop production and rearing of animals, 20.7% of the respondents were into trading (food stuff, agro-chemicals, firewood and tools), 5.6% of the respondents were Government workers which were some Rangers of Kamuku National Park, workers of Birnin-Gwari water board and Local Government Staff and 10.0% of the respondents were into other activities like Mining (especially at Bugai village), crafting, weaving mat marking and blacksmith. This implies the villagers are vulnerable to climate variability because they depend on Agriculture wish is climate sensitive as mean of livelihood.

Impact of Climate Variability on Livelihood

Table1: Perceived Impact of Climate variability in and around KNP

S/No	Impact	Evidences	Agreed (%)	Disagreed (%)	Undecided (%)	Mean
1	Agriculture	Decline in crop yields	90.7	7.3	2.0	70.3
		High rate of diseases/ pest	62.1	23.7	14.2	
		Increased pests infestation	66	24.5	9.5	
		Increased weed infestation	77	14	9	
		Increase in crop yield	10.4	86.5	3.1	
		Decrease in soil fertility	89	8.4	2.6	
		Increase in death of Livestock	65	30	5	
		Loss of crop due to flood	69.2	30	0.8	
2	Source of water	Drying up of streams and rivers	56.5	19	24.5	66.5
		Water shortage for household consumption and irrigation	61.4	12.5	26.1	
		Coloured and tasty water	74.3	20.5	5.2	
		Decrease in water availability	73.7	26.3	0	
3	People's Health	Exposure to new disease	57.4	20.5	22.1	72.0
		Increase in flies, mosquitoes and other insects	77.4	12.6	10	
5	The Park	Increase in Park vegetation/ Forest cover	17.6	81.4	0	69.4
		Decrease in Park vegetation/ Forest Cover	81.4	15.6	2.0	
		Increase in number of Tourist	8.5	82.5	9	
		Loss of animals in the Park	87.1	12.9	0	
		Reduction in the number of Tourist	91.5	2.5	6.0	
6	General Income	Loss of Land for farming	52	18	30	61.5
		Loss of Animals for Hunting	40	32	28	
		Loss of Livestock	60	12	28	
		Migration of people to city	87.6	5	7.4	
		Spend more money on pesticides and livestock drugs	78.5	10	11.5	
		High rate of Pest & Diseases	59	20	21	
		Spend more money on fertilizer than before	80	12.9	7	

The respondents answered to set of questions that inquired about their perception on the general impact of climate variability on their daily living. These impacts of climate variability on the peoples' livelihood were assessed base on the impact on agriculture, sources of water, peoples' health, income and the immediate environment.

Impact on Agriculture

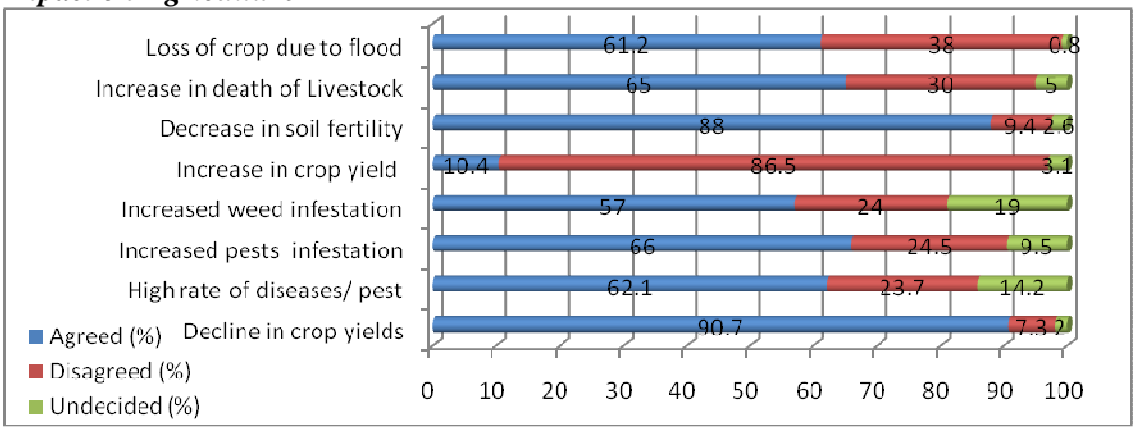

Fig. 5: Impact of Climate variability on Agriculture

As shown in Figure 5, the most commonly mentioned impact of climate variability on Agriculture as identified by the respondents was decline in the crop yields (90.7.7%), Increased in Pest (66%), loss of livestock (65%), and decrease in soil fertility (88%). It was mentioned during the focus group discussion that unseasonal rainfall, irregular rainfall, high temperature also lead to decline in crop yield. The community also attached declined in agricultural production to loss of soil fertility, low rainfall, stress on farmland close to residents, insecurity in the area, cases of kidnapping, and arm bandit which made it difficult for farmers to assess the farmland outside the villages.

Impact on Water Resources

On water availability, 61.4% agreed that there was shortage in water for household consumption, irrigation and livestock, 56.5% agreed that streams drying up, 74.3% were of opinion that the reduction in the level of well and streams as changed the colour of the water the use for washing drinking. This implies that the Communities around the Park except Birnin-Gwari town do not have access to clean water for domestic uses.

Impact of climate variability on the People's health

57.4% noticed that people are now exposed to diseases than before as a result of increase in temperature, 77.4 % noticed that there has been increase in the availability and amount of flies especially mosquitoes. This implies that the Communities are vulnerable to Malaria, Meningitis, Cholera and other water and air borne diseases.

Impact of Climate variability on the Park

The Park ecosystem also regulates the local weather of the area through its creation of rainfall, absorption and exchange of atmospheric gases like Nitrogen, Carbon monoxides (CO), Carbon dioxides (CO_2), and Methan CH_4. Unfortunately, impact of climate variability triggered by activities of man (such as deforestation and degradation of the forest illegally) had reduced the capability of ecosystem to provide its services to the surrounding communities. Majority of the respondents agreed that there was decrease in vegetation, decrease in forest cover, decrease in number of animal sited and decrease in

number of tourist of the park, by 81.4 %, 79%, 96.6% and 89.7% respectively.

Impact on the General Income

78.5% of the respondents agreed that they spend more money on pesticides and livestock drugs than in the past 10-15years ago. 52% accepted that they experience lost farmlands and farm produces than the past. 60% of the respondents accepted that the rate of pest and diseases has increased in both crops and livestock. On spending more money on fertilizer, 80% of the respondents agreed to this. This implies that the impact of climate variability might wide the rate of poverty in the villages.

Conclusion

They perceived long term variability in amount and distribution of rainfall, that rainfall in the area had become delayed, and erratic. The respondents agreed that temperature in the area had increased than the way it used to be 10 – 20 year back. The major source of livelihood in the communities is farming. The majority of households in Mando, Kakangi, Doka, Sabolayi, and Kurgi, were predominantly farmers. They engaged in farming activities at subsistence and commercial level. Birnin-Gwari is like commercial city in the Local Government, it has the highest number of educated people.

The respondents are facing decline in crop yield shortage in water for household consumption, irrigation and livestock, decline in crop yield and animal production, loss of income, reduction in park vegetation, forest and animals, reduction in number of tourist, increase in flies and mosquitoes, high rate of diseases like malaria, diarrhoea, and malnutrition, as a result of changes in temperature and rainfall. This variation threatens food security and wellbeing of the people. Hence, the villagers had to work harder than before with the uses of fertilizer to meet their necessary food need.

Recommendations

i. The study has observed different impact of climate variability on livelihood of villages around Kamuku National park, to address these impacts and other challenges to livelihoods, the following recommendations are made: Rain water harvesting, uses of subsidised Fertilizer from the Government, expansion of farm land, digging wells, using improved agricultural technologies, using adequate and appropriate fertilizer on crops, placing big stones/concrete on roofs to avoid rain storm and violet winds and planting of drought resistance species

ii. Government should establish a meteorological station at Birnin-Gwari to serve the Park and the farmer with quick and accurate information about the weather around them.

iii. Awareness on climate variability and its impact must be raised in the communities. People are experiencing changing climate but they did not know the cause and consequences of it.

iv. To reduce damage from natural hazards like rain storm water hazard (flood, flash flood/drawn, droughts) and changing rainfall weather forecast system must be developed in kamuku National Park or Birni-Gwari water board station in other urgent and accurate weather

information and to disseminate it to the farmers.

v. To reduce encroachment on forest of the park, farming should be discouraged at the edges of the Park so that wild animal could also be protected and their habitat is preserved too.

vi. There is need for Government to provide more security for the communities around Kamuku National Park, in other to protect lives and properties of the people against Arm Bandits, Kidnapper and Cattle rustlers.

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