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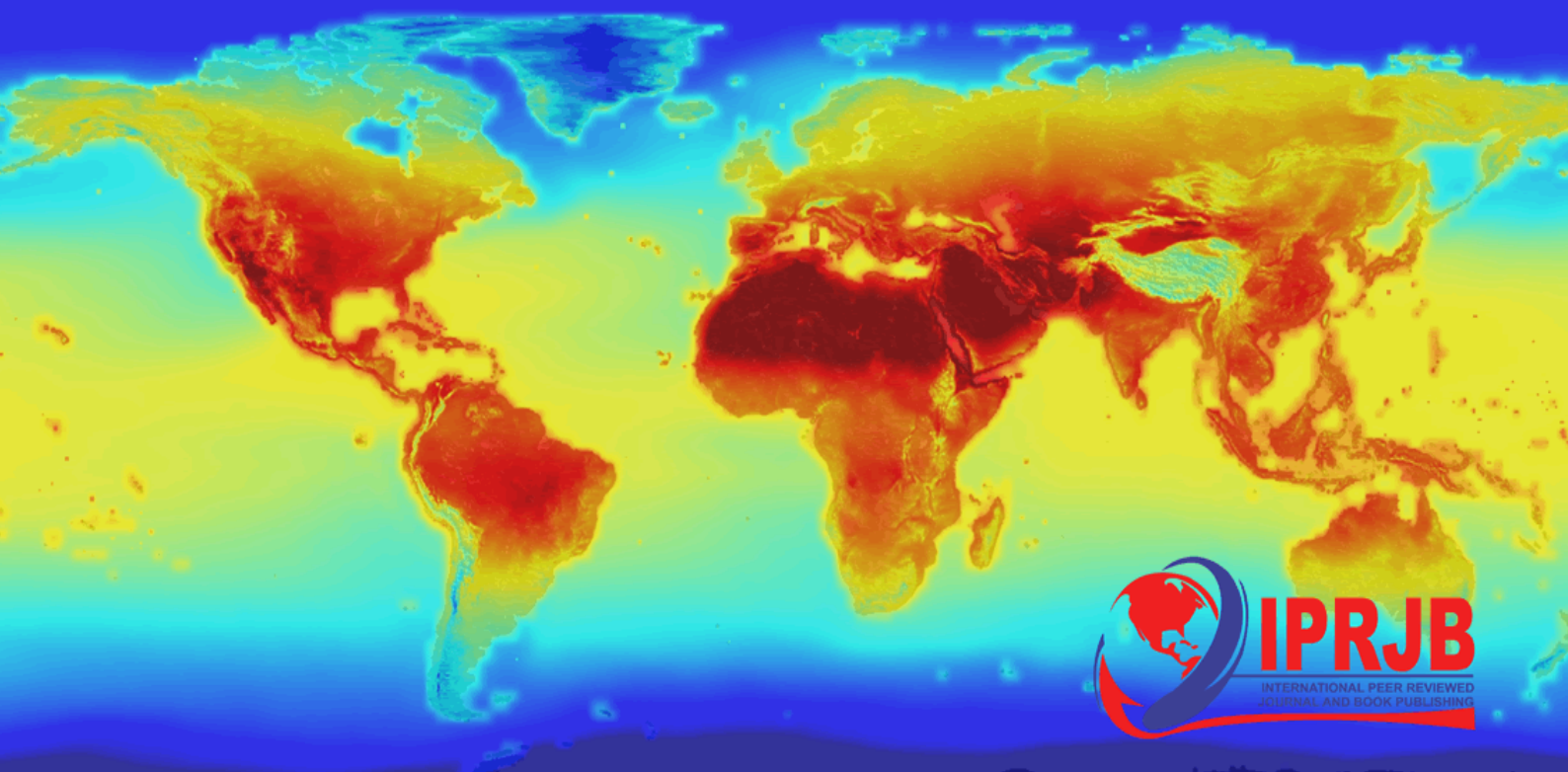

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CLIMATIC VARIABILITY AND LIVELIHOOD VULNERABILITY IN KADUNA STATE, NIGERIA

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Abstract

Purpose: This paper focused on livelihood vulnerability induced by climatic variability amongst farming households in Kaduna state, Nigeria.

Methodology: The research used a sample population of 400 using Taro Yamane formula which represents about 0.05% of the population of the three selected local government areas and it purposively targeted farming households heads (FHHH) in one of each of the three eco-climatic zones in the state. Kagarko, BirninGwari and Makarfi local government areas were based on their eco-climatic location and rurality to represent humid, sub-humid and dry sub humid zones of the state respectively. A multi stage sampling technique was further adopted in which farming districts and villages were selected for the administration of 400 structured questionnaires proportionately distributed proportionately to the three local government areas. The Department for International Development (DFID) sustainable livelihoods framework was adopted in the design of the structured questionnaires. Coefficient of Variation (CV %) was deployed to determine the variability of rainfall and temperature of the three eco-climatic zones of the past thirty six years (1981-2016) which was employed into the Micah Hahn's Livelihood Vulnerability Index model.The results show that Kagarko (humid) had a CV% of 105.43 of rainfall, 9.06 CV% of maximum temperature and CV% of 17.63 in minimum temperature. BirninGwari (sub-humid) had a CV% of 119.64 in rainfall, CV% of 14.17 in maximum temperature and CV% of 15.92 in minimum temperature while

Makarfi (dry sub-humid) had a CV% of 124.71 in rainfall, CV% of 9.72 in maximum temperature and 16.29 CV% in minimum temperature. The livelihood vulnerability index (LVI) of Kagarko was calculated to be 0.35, Makarfi and BirninGwari were calculated to be 0.36 respectively and vulnerability spider diagrams were used to capture and compare results. On a vulnerability scale of 0-1, the three eco-climatic zones were found to be very vulnerable to climatic variability**.** The paper has proved the applicability of Co-efficient of Variation (CV %) into the LVI model which is a departure from previous users who have consistently deployed Mean Standard Deviation into the model.

Results: This study will serve as a spring board to meet the Sustainable Development Goals (SDGs) targets on vulnerable communities in Kaduna state. It is discovered that farmers in Makarfi and BirninGwari, even though in different eco-climatic zones of sub-humid and dry sub humid zones respectively, share equal level of livelihood vulnerability index of 0.36 while Kagarko area which is in humid zone, is having 0.35. These indicated that all the areas are within the very vulnerable values on a vulnerability scale of 0-1. The vulnerability levels of the study area can be attributed to weak Natural, Financial and Physical capitals.

Recommendations: The paper recommended Integrated Farmers' Livelihoods Support Strategy (IFLISS) so as to build the resilience of farming households' livelihood capitals and reduce vulnerability levels.

Keywords: *Climatic variability, vulnerability, Kaduna state, integrated livelihood support strategy.*

1.0 INTRODUCTION

A change in climatic element or weather elements for any place of the world is likely to portend serious consequences with respect to the manner of life for the people of the region, particularly as it relates to their agricultural practices and livelihoods. Climatic variation has a substantial impact on human activities and on the economy in general. There have been observed extreme variations in rainfall and other climatic elements leading to droughts and floods, and that has always been a cause of concern(Rashid, and Vijaya, 2012). The concern for climate change has deepened from being an environmental issue to a critical developmental issue. Climate change can significantly influence the way a community is living, more specifically, the underdeveloped communities of the world(IPCC, 2007). The reliance of the key sectors such as agriculture, energy, health, transportation and water resources on climate variation requires an in-depth analysis, particular the extent to which climate induced vulnerability of the population. The increasing negative impacts of climate on socio-economic activities in Nigeria are becoming worrisome (NIMET, 2017).

Vulnerability assessment can only be with particular reference to how a human system can respond to vagaries of nature or any shock. Vulnerability represents the interface between exposure to the physical threats to human well-being and the capacity of people and communities to cope with those threats. Threats may arise from a combination of social and physical processes. Since everyone is vulnerable to environmental threats, in some way, the issue cuts across rich and poor, urban and rural, North and South, and that may undermine the entire sustainable development process in developing countries. Reducing vulnerability requires identifying points of intervention in the causal chain between the emergence of a hazard and the human consequences (FAO, 2013). The international community is continuing to grapple with the likely socio-economic and environmental impact that shall result from climate change (Ogbo and Onyedinma, 2012). Livelihood can be viewed as sources through

which people derive their means of sustenance. It is established that various factors affect livelihood assets ranging from social, environmental, political system, climate change and or its variability. Household's capability, being the micro unit that make up communities go a long way in determining how community as a whole responds to vagaries of influencing components of climatic events. The concept of livelihood vulnerability is defined in three different levels. The first is rise of vulnerable situation due to high level of Green House Gas emission (GHG), global warming, climatic variability and extreme events like, flood, pest, drought and community's capacity to adapt to this change and its sensitivity to those exposures. Secondly, is the infusion of vulnerability context to community's livelihood strategies, assets and process that are likely to affect overall sustainability of community's development as illustrated by Sustainable Livelihood Framework of the Department for International Development (DFID, 1999). The need for support to such vulnerable communities to make their livelihood sustainable and adaptable to climatic variation through various policies and programs is the third phase of the overall concept of livelihood vulnerability assessment (Kumar, 2010).

Vulnerability studies as useful concept has been surrounded by debate in recent decades, with discussions including the ability to measure vulnerability statistically and even compare it between different groups and locations (FAO, 2013). This paper has employed the Sustainable Livelihoods Approach (SLA) as its conceptual framework. The central focus of sustainable livelihood is to help stakeholders engage in debate about the many factors that affect livelihoods, their relative importance and the way in which they interact. This should help in identifying appropriate entry points for supporting livelihoods (John, 2001).

2.0 BACKGROUND OF THE STUDY

Kaduna State experiences a tropical continental climate with two distinct seasonal climates, dry and rainy seasons. The wet season (May to October) is very much heavier in the Southern part of the State in places like Kafanchan, Kachia and Kagoro, which have an average rainfall of over 1,524 mm, than in the Northern part like Makarfi and Ikara, which have an average rainfall of 1,016mm. There are more serious water shortage problems in the North, especially in, Soba, Makarfi and Ikara LGAs(Kaduna State Government, 2017).The spatial and temporal distribution of the rain varies, decreasing from an average of about 1733mm in Kafanchan-Kagoro areas in the Southern Kaduna to about 1203mm in the central part (Kaduna) and about 1032mm in Zaria, lkara and Makarfi LGAs in the north(Iliya*etal*, 2015).Kaduna state has three different Eco-climatic zones which are: Humid climate in areas like, Kagarko, Jema'a, Sanga, Kachia, Sub-humid climate in areas like, BirninGwari, Giwa, Igabi and Dry sub-humid climate in areas like, Zaria, Soba,Makarfi, Sabon Gari (Abdulkadir*etal*, 2015). This problem of climatic variation poses a serious threat to livelihood assets of the people especially farming households in the different eco-climatic zones who are mainly small scale farming households.

There have been inadequate livelihood vulnerability studies in the study area however, the work of Nasa'i, etal (2010), investigated the factors that influence rural farmers' engagement in livelihood diversification activities in Giwa Local Government area of Kaduna and concluded that farmers' involvement in livelihood diversification activities is as a result of overwhelming need to increase households' income portfolio and to maintain livelihood. According to Aliyu (2014), in climate change impacts on agriculture in Zaria Local government area, submitted that there was variability of 7mm, 0.50, 0.30 and 0.40^{o}C in

rainfall, maximum temperature, minimum temperature and mean temperature, respectively using the differences between the two means of equal-length time scales of 1971-2000 and 1981-2010. Equally, the work of Mortimore (2000) on Profile of Rainfall change and Variability in Kano Maradi region, 1960-2000, focused on rainfall variability as it affect rural household adaptive capacity to climate change and discovered that while a majority of rural households are poor in both the Maradi and the Kano regions, climate change has not undermined the basis of economic life. In the work of Adakayi (2012), he assessed rainfall and temperature variations in parts of Northern Nigeria and found out that the general trend in rainfall amounts indicates a gradual decrease from the southern parts of Kaduna and Bauchi to the northern parts of Nguru, Maiduguri and Sokoto. There is also a general improvement of rainfall amounts from the 1970s and 1980 to the 1990s to 2006.Gbahabo (2011), whose work was on desertification and rural livelihood in Gursulu, a border village in Yobe state discovered that the major problem of the desert prone areas of Northern Nigeria may not necessarily be desertification but low and erratic rainfall. Also, the research findings show that rural households have evolved livelihoods strategies in the face of their precarious environment and that they do not rely solely on farming for their livelihoods, because farming alone is increasingly becoming incapable of providing adequate livelihoods for households in the Sahel.Otun (2005), submitted that there is high temporal variability in the amount and distribution of rainfall and the low level reliability of the amount of seasonal rainfall observed within the region have to a large extent, contributed to the persistent and exemplified post 1967 drought occurrences in the region.

From the foregoing, it is established that no study was conducted on livelihood vulnerability in the study area and the field of vulnerability assessment has emerged to address the need to quantify how communities will respond to changing environmental conditions, climate change and variability so as to meet the Sustainable Development Goals targets on vulnerable communities by 2030. The focus of Climatic Variability and Livelihood Vulnerability in Kaduna state, Nigeria, hinges on the need to provide scientific information about livelihood vulnerability levels of farming Households (FHH) in Kaduna state with respect to spatial and temporal rainfall and temperature variation between humid, sub-humid and dry sub-humid parts of the state. Therefore, the aim of this research is to assess livelihood vulnerability induced by climatic variability in farming households of Kaduna State, with the determination of the climatic (rainfall and temperature) variability and the calculation of livelihood vulnerability indexes (LVI) of farming households of humid zone, sub-humid zone and dry sub humid zone of Kaduna state as specific objectives.

3.0 METHODS AND MATERIALS

3.1 Study Area

Kaduna State is located in the Northern Guinea Savanna ecological zone. It occupies almost the entire central portion of the Northern part of Nigeria and shares common borders with Zamfara, Katsina, Niger, Kano, Bauchi, Nassarawa and Plateau States. To the Southwest, the state shares border with the Federal Capital Territory, Abuja. The global location of the state is between 09^0 02'N and 11^0 32'N and between longitude 06^0 15'E and 08^0 38'. The state occupies an area of about 48,473.2 square kilometers with a population of the state according to 2006 census stood at 6,113,503. Using 3.18% growth rate as allowed by the National Population Commission, the projected population of Kaduna State stands at 8,216,037(2016 projection) using compound interest method of population projection.

3.2 LVI Model

The Livelihood Vulnerability Index (LVI) model stipulates that various subcomponent were to be assessed in different unit of measurements during the FHHH survey and therefore must be standardized to eliminate differentials in unit of measurement through the use of Human Development Index (HDI), Hahn etal (2009).

Index = Observed value-Minimum value/ Maximum value – Minimum value

This is equally represented as:

$$\text{Index } S_b = \frac{S_b - S_{min}}{S_{max} - S_{min}} \qquad \text{[Eqn 1]}$$

In the index, S_b is the original subcomponent of the block *b* and S_{min} and S_{max} are the minimum and maximum values for each subcomponent determined using data from the five Livelihood capitals of the district. The percentage of households reporting in their community was set at a minimum of 0 and a maximum of 100, Hahn etal (2009). More succinctly put, in terms of subcomponent being measured in percentage, the Maximum value and Minimum values are fixed while where otherwise, the maximum and minimum values are determine from the array of data collected for each subcomponent where Minimum and Maximum would be decided.

More so, after each observed parameter was standardized, the subcomponent was averaged using equation two to calculate the value of each major component, and in this case, Human, Financial, Social, Natural or Physical capital:

$$M_b = \frac{\Sigma_i^n indexs_{b^i}}{n} \qquad \text{[Eqn 2]}$$

Where:

$M_{b:}$ is one of the major components for the community *b* (Social capital, Human capital, Financial capital, Natural capital, Physical capital).

$indexs_b^i$: represents the subcomponents, indexed by *i*, that make up each major component.

n: is the number of subcomponents in each component.

Once values for each of the five major components for a block were calculated, it was averaged using Equation 3 to obtain the LVI at block level:

$$LVI_b = \frac{\Sigma^5_{i=1} W_{Mi} M_b}{\Sigma^5_{i=1} W_{Mi}} \qquad \text{Eqn 3}$$

Where LVI_b is the livelihood vulnerability index for the community *b*, and weightage of the five major components, W_{Mi}, determined by the number of subcomponents that make up each major component, contribute equally to the overall LVI (Hahn *et al*. 2009;Koirala, 2015).

3.3 Data collection

The study area, Kaduna, was purposively selected from Northern Nigeria and three local government areas were selected based on their eco-climatic zone in Kaduna state, and rurality. Kagarko with a projected population of 321273 is selected to represent the humid zone, BirninGwari with a projected population of 347511 to represent sub-humid zone, and Makarfi with a projected population of 196983 to represent dry sub-humid zone of the study area. The proposed sample size is 400 which represent about 0.005% of the entire population of the study area and 0.05% of the population of three selected Local Government Areas. Multi-stage sampling technique was employed whereby in each selected local government in the study area one district was selected at random via lottery method and thereafter, one settlement was selected using simple random method. The questionnaire administration purposively targeted farming household's head.

The data collected were both quantitative. The quantitative data were used to calculate the Livelihood Vulnerability Index (LVI) of the study area. The study depended largely on primary data from farming households and archival data on rainfall and temperature. Information on Rainfall, Maximum and Minimum temperature for 36 years were obtained from Nigeria Meteorological Agency (NIMET) and Hydrology unit, Meteorological department, Kaduna State Water Board for Humid, sub-humid and dry-sub-humid zones of Kaduna state.

The instrument used to collect farming Household data were structured questionnaires (Hahn, 2008, Kumar, 2010 and Koirala, 2015) that covered five livelihood capitals (Natural, social, financial, physical and human capitals), 13 major components (health, knowledge and skills, Land, energy etc) and 62 subcomponents(Average time to the nearest health center,

Percentage of FHHs not having TV/radio sets at home, Percentage of FHHs where no family member has taken any kind of vocational training, Inverse of land productivity index etc) and other livelihood characteristics of the study population. The structured questionnaire was designed and pretested and modified to suit the peculiarities of the study area, and the questionnaires were administered by the researcher and two trained field assistants in each district in each sampled Local Government area. On getting to a selected Local Government for the purpose of this research, visit was paid to the Department of Agriculture of the council which in turn advice the researcher on farming districts in the local government area and a district is selected via lottery system by the Agricultural Head of the each local government council. Thereafter, the Chief of Farmers (*Sarkin Noma)* of the selected districts were contacted by the Agricultural department to ease access to farmers because there was general lack of trust and suspicion of strangers and more so for the intermittent local skirmishes in the study area, hence the need to have a local guide whom the farmers would be comfortable with. The *SarkinNomas* introduced the researcher to the District Head (*Hakimi*) so as to enjoy acceptance from the local farmers. And where Household heads were not available efforts were made to follow them to their farms with the help of local guide and field assistants who were purposively chosen from the communities where surveys were conducted.However, when heads could not be reached then the eldest in the FHH were interviewed. Copies of livelihood questionnaires were distributed proportionate to the population of each local government area. The farming household heads (FHHH) surveys elicited data on livelihoods assets. Therefore, to determine climatic variability of the study area, coefficient of variation was used, and to calculate Livelihood vulnerability, Micah Hahn (2008) Livelihood Vulnerability Index (LVI) was deployed. Vulnerability Spider diagram was used to capture and compared results amongst the three eco-climatic zones that made up the study area.

4.0 RESULTS AND DISCUSSION

4.1 Climatic Variability

It could be inferred that for the period 1981-2016, the three eco-climatic zones have recorded different levels of variability with Zaria-Makarfi having the highest CV% of 124.71 for rainfall, with maximum temperature CV% of 9.72 and minimum temperature CV% of 16.29, followed by Kaduna-BirninGwari with rainfall CV% of 119.64, maximum temperature CV% of 14.17 and minimum temperature CV% of 15.92, then Kafanchan –Kagarko axis with the least variability in the period under review with rainfall CV% of 105.43, with maximum temperature CV% of 9.06 and minimum temperature CV% of 17.63.

In 2003-2016, Zaria- Makarfi axis recorded the highest variability with rainfall CV% of 126.57, maximum temperature CV% of 8.57 and minimum temperature CV% of 15.89, Kaduna – BirninGwari axis recorded rainfall CV% of 120.42, maximum temperature CV% of 20.07 and minimum temperature CV% of 18.20 while Kafanchan- Kagarko axis recorded rainfall CV% of 104.36, maximum temperature CV% of 8.08 and about 16.06 CV% of minimum temperature.

In 1992-2002 periods, rain fall CV% had dropped to 120.16 in Zaria-Makarfi axis with maximum temperature CV% of 11.46 and minimum temperature CV% of 16.26. Kaduna – BirninGwari axis recorded rainfall CV% of 114.07, with maximum temperature CV% of 8.40 and minimum temperature CV% of 14.93. Equally, Kafanchan-Kagarko axis recorded the least variation with rainfall CV% of 104.31, maximum temperature CV% of 9.13 and minimum temperature CV% of 18.80.

In 1981-1991 periods under review, Kafanchan- Kagarko recorded the least rainfall CV% of 104.19, with maximum temperature CV% of 9.32 and minimum temperature CV% of 18.09. Zaria-Makarfi axis recorded the highest variability with rainfall CV% of 126.0, with maximum temperature CV% of 8.49 and minimum temperature CV% of 16.60 while Kaduna- BirninGwari axis recorded rainfall CV% of 120, with maximum temperature CV% of 8.05 and minimum temperature of 13.50.

However, the focus of this paper is 1981-2016 (36 years); therefore, Coefficient of Variation (CV%) for the climatic elements covering this period for each of the eco-climatic zones have been used to determined vulnerability of the study area.

4.2 Analysis of Livelihood Capitals

The Department for Foreign and International Development (DFID) sustainable livelihood framework was adopted for it identified five livelihood assets of social, physical, human, financial, and natural as bases upon which sustainable livelihood can be assessed. In table 1 Social capital vulnerability index, thirteen subcomponents were assessed and three major components.The results show that, BirninGwari recorded a vulnerability index of 0.21, in terms of Demography, Kagarko 0.13while Makarfi 0.19. In terms of Network and relationship vulnerability, Makarfi recorded a vulnerability index of 0.60, BirninGwari recorded vulnerability index of 0.43 while Kagarko recorded a vulnerability index value of 0.38.

Also in terms of Livelihood strategies vulnerability, BirninGwari recorded vulnerability index of 0.43 which is the highest, Kagarko recorded vulnerability index value of 0.37 while Makarfi recorded 0.31. In Human Capital vulnerability index, ten subcomponents and two major components were used. In terms of Health vulnerability, Kagarko recorded a Vulnerability index value of 0.35; BirninGwari recorded 0.34 while Makarfi recorded 0.25. In terms of Knowledge and skills vulnerability, Makarfi recorded the highest value of 0.40, Kagarko recorded 0.28 and Birnin recorded. In Natural Capital vulnerability index, twenty six subcomponents and four major components were assessed. In terms of Land vulnerability index, BirninGwari recorded the highest value of 0.31 of vulnerability index; Kagarko recorded 0.19 while Makarfi recorded 0.18. In terms of Energy Vulnerability index, Kagarko recorded the highest vulnerability index of 0.82, BirninGwari recorded 0.81 while Makarfi recorded vulnerability index of 0.78. In water vulnerability, BirninGwari recorded the highest index of 0.56; Makarfi recorded 0.44 while Kagarko recorded a vulnerability index of 0.43. However, in terms of climatic variability vulnerability index,BirninGwari recorded a vulnerability index of 0.15, while Kagarko and Makarfi recorded vulnerability index value of 0.13 respectively.

In Financial capital vulnerability index, seven subcomponents and two major components were assessed for the study area and in terms of asset vulnerability, Kagarko recorded the highest vulnerability index of 0.25, while BirninGwari and Makarfi recorded Vulnerability index of 0.16 respectively. In Physical capital vulnerability index, six subcomponents and two major components were calculated for the study area, and in terms transport and infrastructure vulnerability index, Kagarko recorded a highest value of 0.50, Makarfi recorded 0.39 while BirninGwari recorded 0.32. In terms of school vulnerability index, Kagarko again recorded vulnerability index value of 0.26, Makarfi recorded 0.17 and BirninGwari recorded 0.11.

Table 1: Major Component vulnerability index

Major Components	Kagarko (Humid zone)	BirninGwari (Sub-humid zone)	Makarfi (Dry sub-humid zone)
		Social Capital	
Demographic Vulnerability	0.13	0.21	0.19
Network and relationship vulnerability	0.38	0.43	0.60
Livelihood strategies vulnerability	0.37	0.43	0.31
		Human Capital	
Health vulnerability	0.35	0.34	0.25
Knowledge and skills Vulnerability	0.28	0.25	0.40
		Natural Capital	
Land Vulnerability	0.19	0.31	0.18
Energy Vulnerability	0.82	0.81	0.78
Water Vulnerability	0.43	0.56	0.44
Climatic variability Vulnerability	0.13	0.15	0.13
		Financial Capital	
Asset Vulnerability	0.25	0.16	0.16
Finance Vulnerability	0.59	0.56	0.69
		Physical Capital	
Transport and infrastructure Vulnerability	0.50	0.32	0.39
School Vulnerability	0.26	0.11	0.17

Source; Data Analysis, 2017

4.3 Livelihood Vulnerability Index (LVI)

Table 2 shows the Livelihood Vulnerability Index levels of the three sampled local government areas that represent each of the three eco- climatic zones in the study area. In

terms of social capital, BirninGwari as depicted also in fig. 1 recorded a very vulnerability value of 0.36 and Makarfi as depicted in fig. 1 recorded the highest level of vulnerability of 0.37 and Kagarko as depicted in fig. 1 recorded the least, even though very vulnerable at 0.30. In terms of Human capital, Makarfi is very vulnerable at 0.33, Kagarko at 0.32 while BirninGwari is very vulnerable at 0.30. In terms of Natural Capital, BirninGwari is the very vulnerable at 0.46, Kagarko at 0.40 while Makarfirecorded a very vulnerable value of 0.38. In terms of financial capital, Makarfi is very vulnerable at 0.43, Kagarko at 0.42 while BirninGwari at 0.36. Equally, in terms of physical capital, Kagarko is every vulnerable at 0.38, Makarfi at 0.28 while BirninGwari at 0.22. On the overall Livelihood Vulnerability Index(LVI) assessment, the study area is very vulnerable on a scale of 0-1, Kagarko is very vulnerable at 0.35; BirninGwari and Makarfi are of the same level of very vulnerability value at 0.36 all as depicted in figure 2.

Table 2: Livelihood Capital Vulnerability index

Major components	Kagarko	BirninGwari
3	0.30**	0.36**
2	0.32**	0.30**
4	0.40**	0.46**
2	0.42 **	0.36**
2	0.30**	0.22*
Overall LVI	0.35**	0.36**

Source: Data Analysis, 2017
Scale:
≤ 0 = Not Vulnerable, 0.1- 0.25 = Least Vulnerable*
0.26- 0.50 = Very Vulnerable, 0.51-1.00 = Most Vulnerable*****

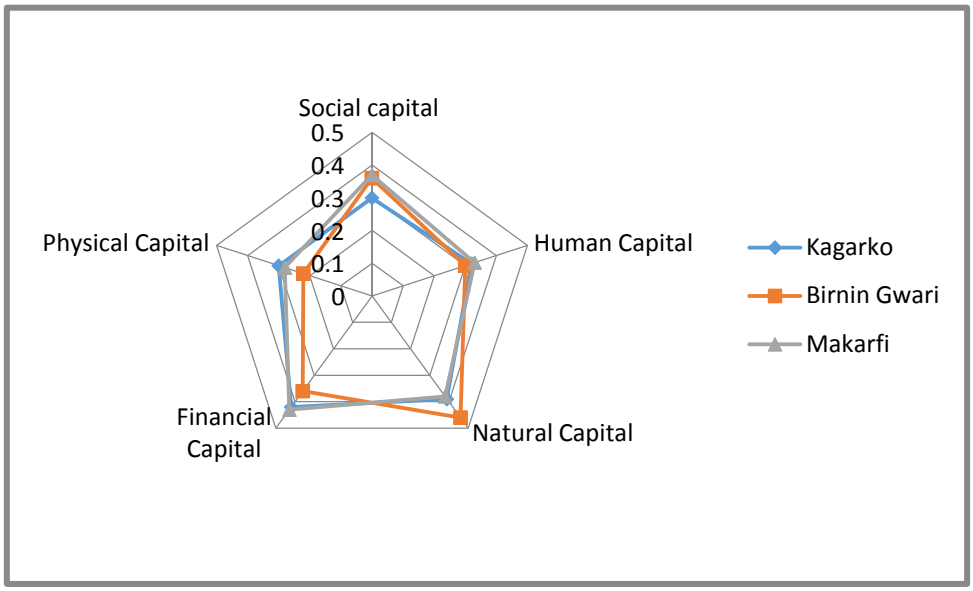

Figure 1: Livelihood Capital Vulnerability Spider diagram of Kaduna State farming households.

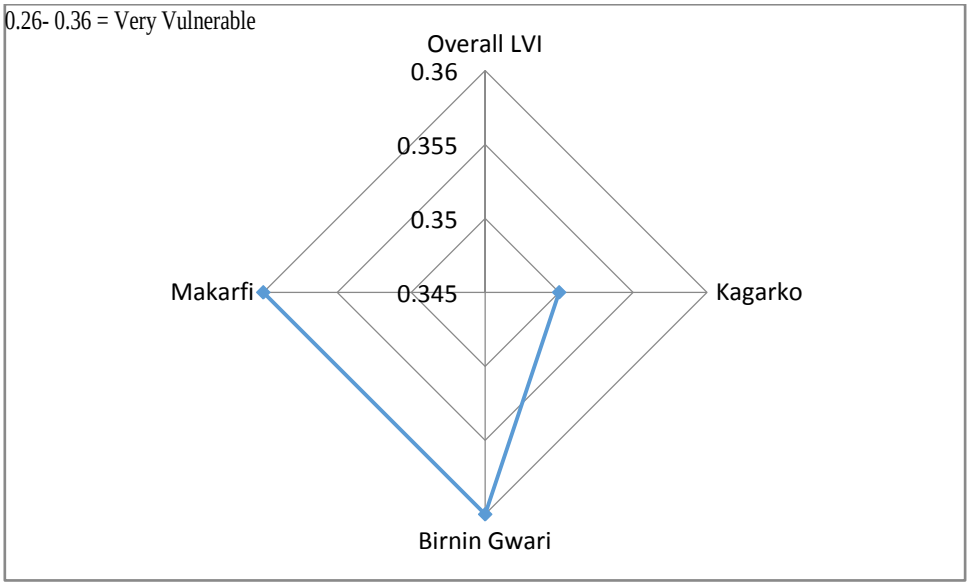

Figure 2: Overall Livelihood Vulnerability Index

5.0 CONCLUSION

It is an established reality that each and every human society is vulnerable but rain fed farming households are in the most vulnerable situation not only in terms of their heavy dependence on rainfall for their livelihood but more so because of their weak livelihood capitals base. In a study published by Nordic Africa Institute in 2012 on drought, rain fed agriculture and food security, concluded that in sub-Saharan Africa, 95% of agriculture is rain fed. And Climate change or its variability represents an increased vulnerability for farmers, who face poverty, hunger and famine aggravated by weak livelihood capital base, when the erratic rain fails. This study will serve as a spring board to meet the Sustainable Development Goals (SDGs) targets on vulnerable communities in Kaduna state.It is discovered that farmers in Makarfi and BirninGwari, even though in different eco-climatic

zones of sub-humid and dry sub humid zones respectively, share equal level of livelihood vulnerability index of 0.36 while Kagarko area which is in humid zone, is having 0.35. These indicated that all the areas are within the very vulnerable values on a vulnerability scale of 0-1. The vulnerability levels of the study area can be attributed to weak Natural, Financial and Physical capitals.

5.1 Recommendations

5.1.1 Proposed Integrated Farmers' Livelihood Support Strategy (IFLISS)

This strategy is being proposed to engender synergy amongst stakeholder in the agricultural sector to boast farmers' livelihoods and enhance their resilience to climatic variability and reduce vulnerability levels.

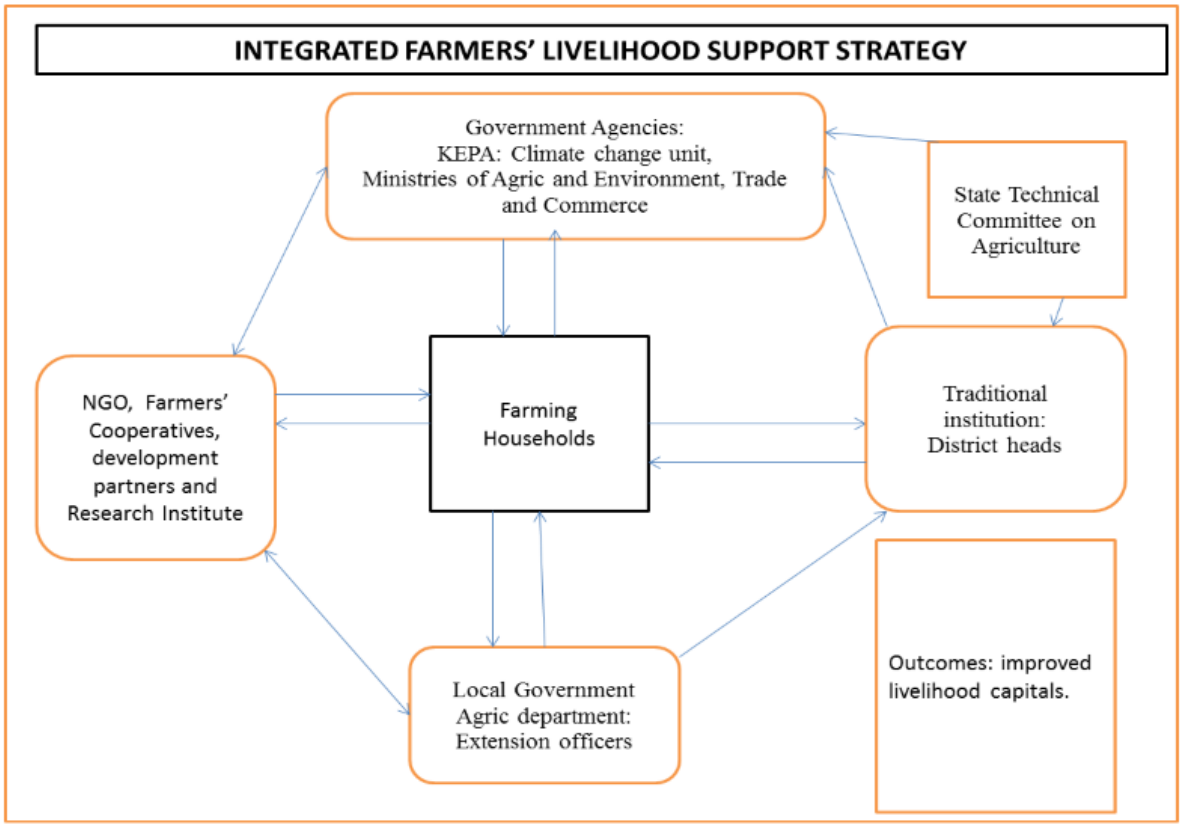

Figure 3: Proposed Integrated Farmers' Livelihood Support Strategy (IFLISS)

5.2 Definition of Roles

a. **State Government Agencies**

i. Kaduna state Environmental Protection Agency should, through its Climate change unit, with active collaboration with Nigerian Meteorological Agency provide leadership in collating data on climatic elements and monitor variability and change in the state. In the same vein, should provide needed information to farmers about climate events, weather forecasting, and evolve strategies for rural forest restoration programmes.

ii. Ministry of Agriculture and natural resources should, within the strategy provide, early maturing and drought resistance maize seedlings to farmers and necessary farm inputs. In the same vein, the ministry in partnership with private sector should on quarterly bases organize on-field workshops for farmers especially on specific aspects of processing, cultivation of crops that require some agricultural dexterity and also to get feedback on emergence of pests. Training on greenhouse farming for farmers in the state can be provided by the ministry, so as to improve farmers' human capital.

iii. Ministry of trade and commerce within this IFLISS approach should organize agricultural exhibition once every harvesting season in every local government area in collaboration with other relevant stakeholders in the agricultural sector in the state. This will open market for farm produce, check the activities of middle men, and thereby improving farmers' financial capital.

b. Non-Governmental Organization (NGO), Farmers' cooperatives, Development partners and research institutes; The NGOs should mount advocacy on young graduates to embrace farming as a gainful means of employment and not as a last resort. Equally, NGO should provide rural energy solutions like save 80% stoves at subsidized prices to farming households. Farmer's cooperatives should provide platforms for farmers to get credit facilities from banks or government sources of funding. Development partners should focus on rural infrastructures like feeder roads, schools and health care facilities for farmers. Research institute is incorporated into this strategy to provide answers to queries from farmers especially on scientific solutions to pests and crop infestations. Research institute like International Institute for Tropical Agriculture (IITA) and Institute for Agricultural Research (IAR) should, in partnership with the state government provide services to farmers on demand.

c. Local government agricultural extension officers: The local government councils through their agriculture department with active participation of agricultural extension officers should provide farmers with extension services via mobile phones as majority of the farming household heads have GSM handsets. In line with this, each local government should have farmers' customer care hot lines for easy access to extension services and support.

d. Traditional institution: this component of this strategy is included so as to get the cooperation of the farming household heads. The traditional institutions through the district heads and other local chiefs could galvanize support from farmers for the success of the strategy. They will serve as entry point to their communities.

e. Farming households: this is the target of the strategy and improvement of their livelihood capitals is the focal point, so as to reduce their vulnerability to climate induced shocks. They would participate in the evolution of projects through their cooperatives. They should express their felt needs through their local farmers' cooperatives and traditional institution closest to them for onward transmission to the

state committee on agriculture for necessary action. This channel will enhance the social capital base of the farming households.

f. State Technical Committee on Agriculture: the state technical committee on agriculture is to provide the needed driving force for the strategy. The committee is to organize other units of the strategy and to source for funding from budgetary allocation, federal government agricultural support funds, Agricultural development banks, agricultural donor agencies, and global climate finance agencies.

5.3 Proposed Farmers Model Villages

It is recommended that the state government should establish Farmers' Model Villages (FMVs) in each of the eco-climatic zones as a pilot scheme for the next three years and thereafter, it can be replicated in other farming local government areas. The FMVs should be fully equipped with basic facilities, utilities and services, like feeder roads, electricity, water and processing plant of a major crop in the area. The FMV should further be equipped with agricultural inputs, like fertilizers (organic and inorganic), farm implements, early maturing seedlings, insecticides, herbicides at required quantity and on timely bases. A designated agricultural extension field office is to be established in each FMV for quick response and to provide extension services to farmers. This will greatly reduce the vulnerability of farming villages over time and improve Natural capital of farming household heads in Kaduna state.

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