

SMALL FARMERS' PERCEPTION OF CLIMATE CHANGE AND ITS EFFECTS ON THEIR LIVELIHOODS ASSESTS IN JIGAWA STATE, NORTHERN NIGERIA

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Abstract

This study examined the perception of small holder's farmers on climate change, its pattern of change and how it affects their livelihoods in Jigawa State, Northern Nigeria. A survey research design was employed using semi structured questionnaire. Four hundred (400) respondents were selected randomly from the selected 24 villages from seven local government areas in the state. The data obtained was analyzed using descriptive statistic in the SPSS version 20.0. The study revealed that smallholders' farmers in the area have very good knowledge on climate change, its pattern of change and effects on livelihood. The study further revealed that the existence of climate change due to its effects on agricultural activities in the area makes farmers to have a positive perception on the changing pattern of climate change and their effects on livelihood. Also, the study established that the farmers' positive perception on the presence of changing pattern of climatic variables in the area affects the growth of agricultural inputs and the outputs. The result of the study established that cash, saving, availability of credit, wages, liquid assets (livestock, poultry, and jewelry), pensions and remittances play an essential role in cushioning households against drought-related livelihood insecurity. The study recommends that Jigawa state government and non-governmental organizations should motivate the farmers to actively adopt mitigating measures of climate change for sustainable farming system and sustenance of livelihood options in the area. The farmers' association and the agric department of the local government in collaboration with government at both state and federal levels should put more efforts in providing drought resistance seedling to farmers and adopt effective mitigation measures through early warning to control loss of farm products during harvesting. Creating awareness on effects of climate change and crop management practices to control dreadful crop loss in the area is also recommended.

Keywords: Climate Change, Crop yield, Small holders Farmers, Perception and Livelihoods

Introduction

The threat of climate change, manifesting as increase in extreme weather condition such as drought, deforestation and flood, has been recognized as a global priority issue (Sabine, 2004). Climate change is a sustainable development challenge, with broad impact not only on the environment, but also on economic and social development. The effect of climate change varies among regions, and between different generations, income groups and occupations as well as between women and men (Odjugo, 2010). A number of countries in Africa already face semi-arid

conditions that make agriculture challenging, and climate change will most likely reduce the length of the growing season as well as force large regions of marginal agriculture out of production (IPCC, 2007). Due to their lower adaptive capacities, developing countries and people living in poverty are likely to experience a significant impact (Salick *et al.*, 2007). Nigeria is already experiencing a range of impacts from climate change including more frequent heavy rainfall episodes, erratic rainfall and unpredictable onset/retreat of rain and increasing air temperature which threaten the ecosystem, food production, livelihoods and infrastructure (Babatolu and Akinnubi, 2016). These changes are not the same in the country as some areas are severely impacted and hence, more vulnerable to climate change than others.

The livelihoods approach is concerned first and foremost with people. So an accurate and realistic understanding of people's strengths (here called "assets" or "capital") is crucial to analyze how they endeavor to convert their assets into positive livelihood outcomes (Bebbington, 1999). People require a range of assets to achieve their self-defined goals, whereas no single capital endowment is sufficient to yield the desired livelihood outcomes on its own. This is particularly true for poor people whose access to any given category of assets tends to be very limited. The DFID Livelihood Approach presents five core asset categories or types of capital upon which livelihoods are built (DFID, 2000), and these include human, social, natural, physical and financial capital.

Agriculture is the major source of livelihood in many African countries including Nigeria. Large numbers of rural population are dependent on agriculture for their livelihoods. In Sub-Saharan Africa, more than 60% of the economically active population and their dependents rely on agriculture for their livelihoods. Jigawa State is vulnerable to climate change which adversely affects its agricultural productivity. Rural households in Jigawa state obtain livelihoods through agriculture, rural labor market and self-employment in rural non-farm economy and others through migrating to towns, cities (Ci-rani) and other countries (Halliru, 2015). However, the existence of warming and rainfall variability leads to reduction in the agricultural production of farmers. Therefore, the state is seriously affected by climate change and weather variability which has pushed farmers, especially small holder farmers to adopting a number of strategies to mitigate the adverse effect of climate change.

Smallholder farmers are largely vulnerable to climate change, and knowledge on cognitive factors and processes is required to successfully support their adaptation to climate change. Literature have revealed Smallholder farmers are consistently facing the possibility of tragic crop collapses, reduced agricultural productivity, increased hunger, malnutrition and diseases and reduced income as a result of impacts of climate and weather extremes Zoellick, (2009); Moyo *et al.*, (2012); IPCC, (2014). Due to the fact that their livelihoods purely depends on rain-fed agriculture on small farmlands using family labor and little modern inputs. Hence, the need to understand the Smallholder farmers knowledge about climate change.

On the basis of this background the study assessed the smallholder farmers' perceptions of climate change, its pattern of change and how it affects their livelihoods in Jigawa State.

Description of study area

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 mean 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 shares borders with 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 the state is about 4,348,649 (NPC, 2009), with an approximate land area of 23,154 km².

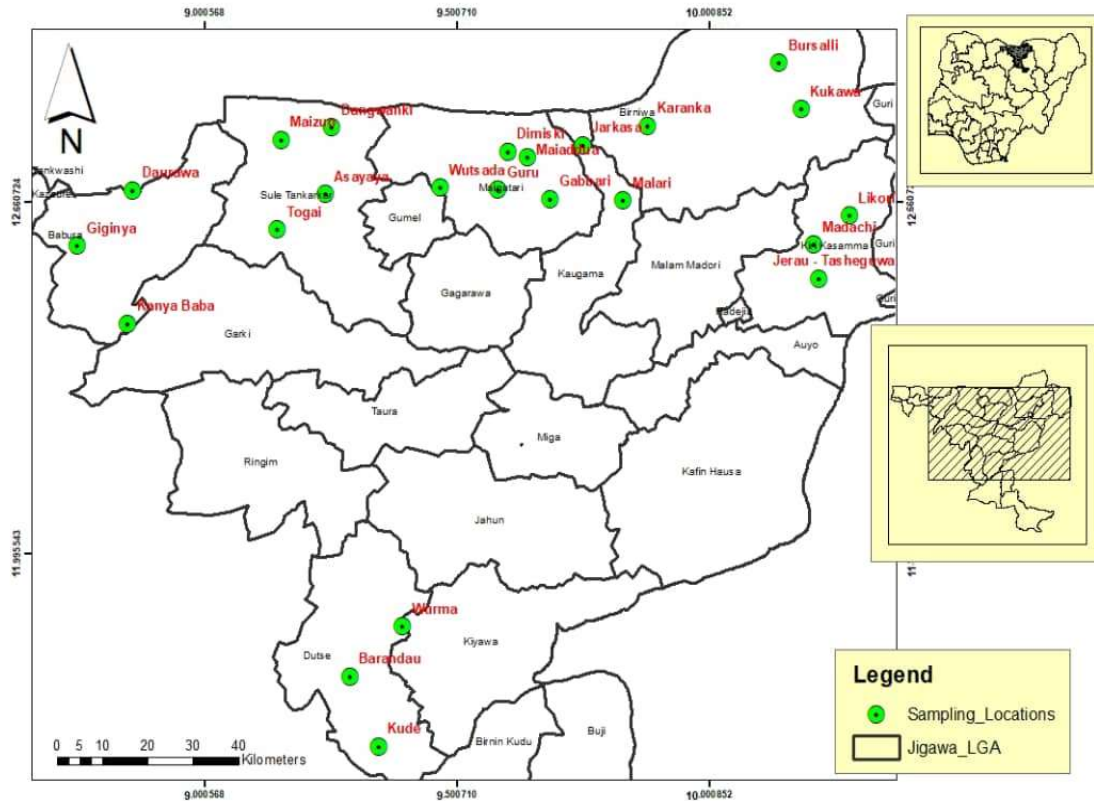


Figure 1 Map of Jigawa state showing the Study Area

Materials and Methods

The research adopted a survey design conducted on small holder farmers living around the selected areas in order to have good and clear perspective of their perceptions of climate change and how it affects their livelihoods in Babura, Birniwa, Kaugama, Maigatari, Sule-Tankarkar, Dutse and Kirikasamma Local Government Areas, in order to ascertain their dynamic knowledge on the effects of climate change on livelihood for sustainable agricultural practice. Four hundred (400) respondents were drawn from the 24-farming communities such as; Kanya Babba, Dorawa, Giginya, Takwasa in Babura LGA, Bursali, Karanga, Kukawa in Birniwa LGA, Dalari-Lungu, Jarkasa-Girtigini, Rangyana in Kaugama LGA, Bulama Dutsi, Kokoci, Jobi, Garin-sule in Maigatari LGA, Togai, Dangwanki, Asayaya, Maizuwo in Sule-Takarkar LGA, Barandau, Kude, Wurma in Dutse LGA and Tasheguwa, Likoro, Madachi in Kirikasamma LGA, using stratified sampling frame for the study based on their availability

The data obtained for the study pertaining to the perception of farmers on climate change were sourced from primary data using self-administered questionnaire survey designed on five-point Likert scale (Strongly agree 5, Agree 4, Undecided 3, Disagree 2, Strongly disagree 1). The questionnaire contained open ended questions and was divided into three sections, the first

section deals with demographic characteristics of the respondents (gender, age, level of education, length of residency, household size, size of the farmland, means of acquiring the farmland and net income). Section two addressed the farmer's perception on climate change and its changing pattern. Section three addressed their perception on climate change effects and how it affects Agricultural activities as well as their livelihoods. The data was analyzed using descriptive statistics in Statistical Package for Social Sciences (SPSS) version 20. Frequencies and percentages were used to analyze the demographic variables of the respondents. The mean values and standard deviations were used to analyze the farmer's perception on climate change, its changing pattern and how it affects Agricultural activities as well as their livelihoods. Data obtained from the mean value on each farmer's perceptions on a scale of 1-5 (Very good 4.0-5.0, Good 3.00-3.99, Fairly Good 2.00-2.99, Poor 1.00- 1.99, Very poor 0.00-0.99) was also used to judge the positive and negative perceptions on the farmer's perception on climate change, its changing pattern and how it affects Agricultural activities as well as their livelihoods.

Results and Discussion

Demographic characteristics of the respondents

The demographic characteristics of the respondents are presented in Table 1. From the Table, 93% were male due to the influence of culture in the state which dictates that men shoulder the responsibility of family feeding. The higher percentage of male respondents serves as factor in explaining the reason of high level of farmer's perception of climate change and its effects on livelihood in the area.

Table 1: Demographic characteristics of Smallholder farmers in Jigawa State

		Frequency	Percent	Cumulative Percent
Sex	Male	373	93.3	93.3
	Female	27	6.8	100.0
	Total	400	100.0	
Age	21-30	76	19.0	19.0
	31-40	142	35.5	54.5
	41-50	35.5	36.8	91.3
	51 and Above	35	8.8	100.0
	Total	400	100.0	
Level of Education	Primary	105	26.3	26.3
	Secondary	157	39.3	65.5
	Tertiary	80	20.0	85.5
	others	58	14.5	100.0
	Total	400	100.0	
Length of Residency	Less than 10 years	31	7.8	7.8
	11-20 years	53	13.3	21.0
	21-30 years	152	38.0	59.0
	31 and above	164	41.0	100.0
	Total	400	100.0	
Household size	1-5	117	29.3	29.3
	6-10	196	49.0	78.3
	11-15	48	12.0	90.3
	16 and above	39	9.8	100.0

	Total	400	100.0	
Size of the farmland	Less than 5 hectares	167	41.8	41.8
	6-10	171	42.8	84.5
	11-15	33	8.3	92.8
	16 and above	29	7.3	100.0
	Total	400	100.0	
Means of acquisition of the land	Inheritance (<i>Gado</i>)	203	50.8	50.8
	Purchase (<i>Siya</i>)	136	34.0	84.8
	Lease (<i>Jingina</i>)	53	13.3	98.0
	inheritance and Purchase	8	2.0	100.0
	Total	400	100.0	
Bag of agricultural produce	Less than 20 bags	61	15.3	15.3
	21-39 bags	189	47.3	62.5
	40--59 bags	67	16.8	79.3
	60 bags and above	83	20.8	100.0
	Total	400	100.0	
Net income	Less than N 50000	34	8.5	8.5
	N51000- N100000	151	37.8	46.3
	N101000-N150000	115	28.8	75.0
	N150000 and above	100	25.0	100.0
	Total	400	100.0	

Source: Fieldwork, 2022

Data in Table 1 indicates that 36.8% of the respondents were between the ages of 41 to 50 years. This shows that they are at their youthful ages and are in a better position to explain any observed changes in their environment. However, 8.8% of the respondents with age of 51 and above years are the most advantage group with more knowledge of climate change and its effects on livelihood. The result of the study revealed that 74% of the respondents can read and communicate in the formal language to an appreciable level. The level of access to formal education by the respondents enhances their awareness levels relating to their perception of the changing pattern of climatic variables such as rainfall, temperature and wind and their effects in the area. In terms of Length of Residency of the respondents 41% lived in the area for over 30 years while 49 % of the respondents have family size ranging 6-10. However, 42.8% respondents in the area have farmland size between 6 to 10 hectares of land and 50.8 % of the total farmers in the area acquire their land through inheritance (*Gado*). Also, Table 1 further indicated that due to limited number of the acquired farmland of between 6 to 10 hectares of land in the area makes only 47.3% of the farmers are able to produce 21-39 bags throughout the farming season. As indicated in the table also, the low level of production by individual farmers in the area makes 37.8% of farmers to earn between N51, 000 to N100, 000 in a year as net income.

Perception of farmers on climate change

Table 2 revealed the perception of farmers on climate change. Farmers in the study area have very good perception of mean value of 4.2425 on the knowledge of changes in rainfall pattern due to changes in climate variability. It was further revealed that over the last 39 years farmers in the area have very good perceptions on observed changes of the onset and cessation period of

rainfall received with mean value of 4.0375 and 4.3100 respectively. Based on the findings the onset of rainfall in the study area and the general pattern of the onset of rainfall in the state, deviate from what was observed in the past where rainfall start from end of March to early April. Presently rainfall begins late usually from May and early June and ceases early which consequently have direct effects on growing season in agricultural productions which is their major livelihood means

Table 2: Farmers Perception on Climate Change

	N	Mean	Std. Deviation	Variance
Farmer's Perception of Climate Change				
Have you noticed any change in rainfall pattern (1981- 2020)	400	4.2425	0.76167	0.580
Onset	400	4.0375	1.11992	1.254
Cessation	400	4.3100	0.80344 0	0.646
Intensity	400	3.8675	0.94189	0.887
Observed August peak	400	3.8550	1.13455	1.287
decrease in Temperature	400	1.0575	0.23309	0.054
Farmer's Perception on the Changing Pattern of Climate Change				
Drought	400	4.0000	1.26253	1.594
Floods	400	3.5075	1.40530	1.975
Off seasonal rainfall	400	3.6875	1.02590	1.052
High wind	400	3.7075	1.14465	1.310
Cold	400	3.9825	1.14694	1.315
Higher rainfall	400	3.7475	1.02781	1.056
Heat	400	3.9350	.89598	0.803
Dew	400	3.5825	1.08911	1.186
Effects of Climate Change on Livelihood Capital Assets				
Human Capital Asset	400	4.4900	0.87281	0.762
Natural Capital Asset	400	4.5600	0.81120	0.658
Physical Capital Asset	400	4.5575	0.77343	0.598
Financial Capital Asset	400	4.6550	0.59317	0.352
Social Capital Asset	400	4.5375	0.84876	0.720

Source Field work 2022

The findings supported the study of Umar *et al.* (2019) which shows that the onset and cessation of annual rainfall in Northern Nigeria is relatively distant from the early onset in recent time which makes the area to relatively experience dryness. In Table 2, it was further established that farmers have good perception on the intensity of rainfall and peak (August) period. Also from the Table 2, observed changes in decrease in temperature recorded poor perception by the farmers with mean value of 1.0575. The farmers' opinions toward pattern of observed change in decrease in temperature in the study area tilt towards total of highly decrease by implication the farmer observed increase in temperature in the study area.

Farmers Perception on the Changing Pattern of Climate Change

On the observed pattern of drought over time in the area, the result from table 2 indicated that the perceived mean value of drought occurrence in the area is very good (4.0000). This indicated that the pattern of observed occurrences of droughts in the area over time is frequent in all the sampled communities in the local government due to high level of the respondents' knowledge of what drought is.

The perceived occurrence of flood in the area based on Table 2 revealed that the mean value of the farmers' perception on the incidence of drought is found to be Good (3.5075). This indicated that the change of climatic elements that causes flood in the area is evidently visible by the respondents. Similarly, the findings from off-seasonal occurrence of rainfall in the area based on the farmer's good perception of mean value of 3.6875 of the incidences of off-season of rainfall in the area adjudge to be evidently visible. This indicated that off-seasonal rainfall occurs outside the range of the usual rainy days, either at beginning (onset) or at the end (cessation) of the days.

Table 2, also revealed that strong winds often damage cereals crops especially before harvesting period due to climate change. Farmers' perception on the changing pattern of climate change in the area is perceived to be good with mean value of 3.7075. This indicated that strong winds often occur in the study area over time. On the observed pattern of change in cold (harmattan) over time in the area, the farmers perception on the changing pattern of the cold season indicates Good perceived value of 3.9825 on the changes. The farmers in the area observed that there is change in the patterns of cold (harmattan) season towards the extreme as a result of change in climate. From Table 2, the result indicated that farmers have good perception on the changes of higher rainfall with mean value of 3.7475. The finding shows that there is observed evidence of higher rainfall amount received in the area which had been occurring often in the area.

Meanwhile on the observed pattern of change in heat over time in the area, the findings of the study from table 2 revealed Good mean perceived value of 3.9350 due to their good awareness of climate change. The table further shows that there is Good farmers' perception of the observed pattern of dew (*raba*) over time as indicated by the mean value of 3.5825. The observed changes in dew in the area occurred due to the importance of dew (*raba*) for the maturity and amount of yield for certain crops and is greatly further affected by other elements of weather such as rainfall and wind. A study by Elemo *et al.*, (2021) in Abuja indicates that the dew point temperature and the relative humidity (RH) for each month of the year 2020 showed that the peak of the relative humidity was at 51%, while the peak of the dew point temperature (D) was at 18°C.

Effects of Climate Change on Livelihood Assets

The farmers' opinions on the effects of climate change on livelihood assets over time were observed in the study area. The result of the study from table 2 established that the effects of climate change on livelihood assets is evidently observed and experienced to be Very good by the farmers as the effects of climate change on human capital assets as indicated by the mean value of 4.4900. These findings confirm earlier findings from Ajaero *et. al.*, (2021) on the impact of climate change on human capital assets. The findings agree with the National Emergency Management Agency NEMA, (2012) flooding displacement report in Nigeria, where it was reported that in Jigawa State, 18 local governments were affected, 1000 communities were destroyed, 32,462 internally displaced persons further displayed 182,212 people were affected, and 9,315 houses were destroyed or damaged .

The study also revealed the effects of climate change on Natural assets as indicated by mean value of 4.5600. The rural population depends entirely or partially on resource-based activities like farming, fishing, and foraging in the forest for their livelihoods, then natural capital like land, private wood lots, orchards, tube wells, wash bores, trees (economic and medicinal), and numbers of hectares owned are very important to them (Nicol, 2000). These findings agree with Kameron's (2022), findings from 2022 that extreme droughts and flooding are caused by climate change. Fruit trees may become less robust as a result of these alterations because they are more vulnerable to pests, fungal diseases, poor growth conditions, and other factors. The study found that the effects of climate change have caused groundwater levels to drop, which has an effect on tube wells in the study area.

Physical capital (assets) of smallholders farmers were affected by the impacts of climate change as indicated in table 2, with mean value of 4.5575. According to Pandey, *et. al.*, (2017) physical assets mostly refer to the foundational infrastructure components that improve agricultural productivity and livelihood. The quantity of livestock, irrigation farms, ox-driven carts, shelter, tractors, bicycles, motorcycles, and cars may be a good indicator of farmers' physical asset allocation, because these assets help farmers improve the quality of life for farm residents in order to achieve a socio-environmentally holistic livelihood, while also assisting agriculturalists in increasing productivity and livelihoods. Climate change affects physical such as the livestock and irrigation were direct while others were indirect. According to the Focus Group Discussions findings, the respondents from the study areas reported that over the last ten years, floods and windstorms had destroyed personal properties in the LGAs.

The result of the study from table 2 also established that the effects of climate change on financial assets is evidently observed and experienced by the farmers as indicated by the mean value of 4.6550. Financial capital (assets), viz., cash, savings, availability of credit, wages, liquid assets (livestock, poultry, and jewelry), pensions, and remittances play an essential role in cushioning households against drought-related livelihood insecurity (Mahendra-Dev, 2011). Extreme weather events such as droughts, high temperatures, and erratic rainfall would greatly deplete the financial resources of the rural poor, who heavily depend on agriculture, a climate-sensitive sector, for their livelihoods, by destroying crops and animals, resulting in a decrease in yields, hence a loss in income, forcing migration, leading to a loss of income-earning opportunities (Bebbington, 1999). The respondents suggested that the impact of climate change has resulted in a decrease in the financial capital (assets) of individual farmers, which has a negative impact on their livelihood.

From table 2, it was revealed that social capital (asset) often affected by climate change especially natural events like drought, prolonged rain, or high temperatures due to climate change can isolate people from social functions. The perceived knowledge of farmers' perception on the effects of climate change on social capital (asset) in the area perceived to be good with mean value of 4.5375. This indicated that climate change events have a negative effect on products and services, which could induce food deficits, price rises, shortages, discriminatory distribution, etc., and threaten social harmony among people.

Social capital (assets) found in the study area consists of extended family linkages, Social Clubs, Farming Associations, Political Associations, Community-Based Associations, and Non-Governmental Organizations (NGOs). Similarly, Climate change has the capacity to increase forced migration depending on the environment, thus exposing groups to new socio-cultural areas.

Generally, the view of respondents on the effects of climate change on human capital (asset), Natural capital (asset), Physical capital (asset), financial capital (asset) and social capital (asset)

have multiplier effects on smallholders' farmers' livelihood due to prolonged incidence of climate change in the area. It can be deduced from the findings that the effects of climate change on farmer livelihood could have a profound influence on their inability to adapt to climate change due to low of adaptation capacity.

Conclusion and Recommendations

From the highlighted findings, it could be concluded that smallholder farmers across the seven local government areas in Jigawa state have very good knowledge of climate change, its pattern of change and effects on their livelihood asset. The ranges of farmers' perception from Good to Very good clearly shows their understanding, perceptions of climate change and its attendant consequences on physical asset, human asset, natural asset, financial asset and social asset. The existence of climate change due to its effects on individual farmer's livelihood in the area makes farmers in the area to have a positive perception on the changing pattern of climate change and their effects on agriculture as a major means of livelihood. The farmers positive perception on the changing pattern of climate change are evidently visible on drought, occurrence of flood, off-seasonal occurrence of rainfall, strong winds, change in cold (harmattan), changes of higher rainfall, change in temperature over time in the area and changes in dew (*raba*) over time. The presence of changing pattern of climatic variables in the area affects agricultural inputs and the outputs generally in the study area. These can be seen in the positive perception of farmers on the observed and experienced effects on the spoilage of farm produce, increase in pests and diseases, food shortage, increase in cost of inputs and shortage of income which consequently create an un-sustainable farming system in the area and have direct effect on the agricultural production and invariably the livelihoods of smallholders' farmers in the area.

Following the findings in this study, the following recommendations were made:

- i. Government (at both Federal and State levels) and non-governmental organizations should gear up towards motivating the farmers to actively adopt mitigating measures of climate change for sustainable agricultural system and sustenance of livelihood options in the area.
- ii. The smallholder farmers' association and the agricultural department of the local government in collaboration with other governments should put more efforts in providing drought-resistant seeds to farmers and adopt effective mitigation measures through early warning to control loss of farm products.
- iii. Jigawa state Ministry of Agriculture and Ministry for Rural Development in collaboration with farmers' associations and related non-governmental organizations should be engaged in creating more awareness on the effects of climate change on farmers' livelihood.
- iv. Smallholder farmers' perception should always be considered when designing climate change coping and adaptation strategies for effective implementation. That is bottom to top approach.

References

- Ajaero, J.O., Aminu, G.O., Chikaire, J.U. (2021). Effects of Climate Change On Human and Social Livelihood Assets of Rural Farm Families in Orlu Agricultural Zone of Imo State, Nigeria. *Journal of Earth and Environmental Science Research*. SRC/JEESR-171. DOI: [https://doi.org/10.47363/JEESR/2021\(3\)151](https://doi.org/10.47363/JEESR/2021(3)151)
- Babatolu, J. S and Akinnubi, R. T. (2016). Smallholder Farmers' Perception of Climate Change and Variability Impact and Their Adaptation Strategies in the Upper and Lower Niger River Basin Development Authority Areas, Nigeria. *Journal of Petroleum & Environmental Biotechnology*, 7, 1-7
- Bebbington, A. (1999). Capitals and Capabilities A Framework for Analyzing Peasant Viability, Rural Livelihoods and Poverty. *World Development*, 27 (12): 2021: 2044.
- Bidoli, T.D; Isa, A.G; Shehu, B; Kezi, D.M. and Abdullahi, M.Y. (2012) Assessment of the Effects of Climate Change on Livestock Husbandry and Practices in Jigawa State, Nigeria, *Journal of Agricultural Extension*, 16 (1), Pp 20 – 30.
- DFID. (2000). Sustainable Livelihoods Guidance Sheet. Department for International Development.
- Elemo, E. O., Ogobor, E. A., Ayantunji, B. G., Mangete, O. E., Alagbe, G. A., Abdulkareem, M. L., Obarolo, A. E., & Onuh, B. O. (2021). *Relationship between Relative Humidity and the Dew Point Temperature in Abuja, Nigeria* 8, 1–13. <https://doi.org/10.4236/oalib.1108086>
- Halliru, S.L (2015). The Impact of Climate Change on Population Migration in Mai Adu'a Local Government Area, Katsina State, Nigeria. Unpublished M.Sc thesis. Department of Geography, Kampala International University, Uganda.
- IPCC. (2007). *Climate change; Impact, Adaptation and Vulnerability. Fourth Assessment*. Cambridge: Cambridge University press.
- IPCC (2014): Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA (2014), p. 688
- Kameron C. (2022) Climate change and fruit Trees: Flooding and Drought. [https://orchardpeople.com/climate-change-and-fruit trees](https://orchardpeople.com/climate-change-and-fruit-trees). Retrieved on 8/3/2023 1:47pm.
- Mahendra-Dev S., (2011). Climate Change, Rural Livelihoods and Agriculture (focus on Food Security) in Asia Pacific Region. Indira Gandhi Institute of Development Research, Mumbai. <http://www.igidr.ac.in/pdf/publication/WP-2011-014.pdf>
- M. Moyo, B.M. Mvumi, M. Kunzekweguta, K. Mazvimavi, P. Craufurd, P. Dorward (2012). Farmers' perceptions on climate change and vulnerability in semi-arid Zimbabwe in relationship to Climatology evidence Afr. Crop Sci. J., 20 (Suppl. ment) (2012), pp. 317-335
- National Emergency Management Agency (2012). Post Disaster Assessment for Nigeria.
- National Population Commission, (2009). Official Gazette of Federal Republic of Nigeria N0 2, Vol 96

- Nicol, A. (2000). Adopting a Sustainable Livelihoods Approach to Water Projects: Implication for Policy and Practice, IDS, Cambridge. *Sustainable Livelihoods Working Paper Series*, 133.
- Odjugo, P.A.O. (2010). Global and regional analysis of the causes and rate of climate. In R.N.C. Anyandike, I. A. Madu and C.K...Ajaero (Eds.), *Climate Change and the Nigerian Environment* (pp. 65-83). Enugu: Jamoe Publishers (Nigeria).
- Pandey, R., Jha, S. K., Alatalo, J. M., Archie, K. M., and Gupta, A. K. (2017). Sustainable livelihood framework-based indicators for assessing climate change vulnerability and adaptation for Himalayan communities. *Ecol. Indic.* 79, 338–346. doi:10.1016/j.ecolind.2017.03.047
- R.B. Zoellick (2009) *A Climate Smart Future*. The Nation Newspapers Vintage Press Limited, Lagos, Nigeria (2009), p. 18
- Sabine P.N (2004). Understanding the effect of climate change in Human migration. The contribution of mathematical and conception models. Diploma Thesis, Department of environmental sciences, Swiss federal institute of technology.
- Salick, J., and Byg, A. (2007). *Indigenous people and climate change*. Tyndall Center for Climate Change Research, Oxford.

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