
COMPARATIVE ANALYSIS OF THE EFFECT OF CLIMATE CRISIS ON RURAL LIVELIHOOD OPTIONS BETWEEN NORTHERN AND SOUTHERN AGRO-ECOLOGICAL ZONES OF KATSINA STATE, NIGERIA

¹Abdu Yaro, ¹Ibrahim Danladi Sule, ²Yahaya Olanrewaju Yusuf, ¹Bashiru Abdul'aziz Liman, ²Olasunkanmi Gabriel Jeje and ³Abdulrashid Ibrahim

1. Department of Environmental Resources Management, Federal University Dutsin-Ma

2. Department of Geography, Federal University Dutsin-Ma

3. Department of Urban and Regional Planning, Federal University Dutsin-Ma

*Corresponding author: comidanladi@fudutsima.edu.ng Phone no: +2348160849400

<https://doi.org/10.33003/jees.2025.0201/05>

ABSTRACT

This study conducted a comparative analysis of the effect of the climate crisis on rural livelihood options between the northern and southern agro-ecological zones of Katsina State. Data for this study were generated by administering structured questionnaires, and the data analysis was achieved using descriptive statistics. The study's significant findings revealed that 16.1% of the respondents engaged in regenerative and 10.9% extractive rural livelihood options, while 73% engaged in both options in the Northern zone. In the Southern zone, 20.2% and 15.7% of the respondents engaged in regenerative and extractive livelihood options, and 64.1% engaged in both options. The results also show that 30.8% of the respondents perceived a nuisance effect due to the climate crisis, while 44.2% and 25% perceived damage and disruption, respectively, in the Northern zone. In the Southern zone, 40.2% of the respondents perceived a nuisance, 29.8% perceived damage, and 30% perceived disruption. The result further shows that 38.6% of the respondents agreed that the possibility of the climate crisis hurting rural livelihood options is likely to continue happening in the Northern zone. In comparison, 42.9% of respondents in the Southern zone share a similar view to that of the Northern zone. The study concluded that the livelihood options were vulnerable to the climate crisis, and the possibility of hurting rural livelihood options will continue. The study recommended that rural communities should engage in and be aware of awareness campaigns on the dangers of the climate crisis to their resource base and livelihood options..

Keywords: Comparative analysis, effect, climate crisis, rural livelihood options, agro-ecological zones

INTRODUCTION

Globally, climate change is one of the pressing environmental challenges facing contemporary human societies today. This has manifested in increased temperatures and prolonged flood or drought conditions, as well as irregular rainfall patterns and distribution, which affect the livelihood options of ordinary people, particularly those who engage in agricultural activities. Murala Arokoyo and Weli (2020) pointed out that the significant causes of climate change include burning coal, oil, and natural gas to heat our homes, power our cars, and the emissions from industrial plants, as well as the illumination of our cities, which produce carbon dioxide and other gases as byproducts. Deforestation and the clearing of land for agriculture also release significant quantities of such gases into the atmosphere. They further added that over the last century, the industrial and transportation sectors have also been emitting gases such as Carbon dioxide (CO₂) and methane (CH₄) to the atmosphere at a rate faster than natural processes can remove them. During this time,

atmospheric levels of these gases have increased steadily and are projected to continue their steep ascent as global economies grow. Records of past climate change date back as far as 160,000 years, indicating a close correlation between the concentration of gases in the atmosphere and global temperatures (Nkii, 2012, in Murala Arokoyo and Weli, 2020).

Both climate change and crisis threaten the achievement of the UN Sustainable Development Goals (SDGs). This undermines progress toward various goals, such as achieving no poverty (SDG 1), ending hunger (SDG 2), and promoting gender equality and equity (SDG 5), among others. It is anticipated and projected that climate change and crisis will affect several aspects of global livelihood options, and Nigeria is not excluded; the overwhelming impact may be primarily on agriculture, ecosystem, hydrology and water resources. Abdulkadir et al. (2013) and Murtala, Arokoyo, and Weli (2020) noted that climate change in the agricultural sector may lead to significant changes in agricultural production, including both the quantity and quality of products, as well as the location of production. For instance, Abubakar (2001), as cited in Murala Arokoyo and Weli (2020), noted a shift from the output of long-duration guinea corn to millet, which requires shorter rainfall durations. He further revealed that in Borno, Yobe, Sokoto, and Zamfara states, the percentage production of Guinea corn and Millet was 70% and 30%, respectively, in 1980; as of 2000, it had changed to 40% and 60%, respectively. This clearly shows that rainfall duration and amount fluctuate in northern Nigeria. Climate change has also been identified as a significant contributor to the drastic ecological and socio-economic changes observed in Nigeria's semi-arid region (Abdulkadir et al., 2013). While the temperature has increased, rainfall has been declining in nearly all parts of the Country. This climatic change and the pressure on the natural resources such as land, forest and grazing reserves from intensive and extensive farming, overgrazing, deforestation, and desert encroachment posed a significant challenge to ecological degradation, such as loss of vegetation cover, decline in crops and livestock production and water scarcity and stressed among the inhabitants.

Sule *et al.*, (2024b) and United Nation Development Programme (2023) described the climate crisis as the serious problems that are being caused, or are likely to be caused, by changes in the planet's climate, including weather extremes and natural disasters, ocean acidification and sea-level rise, loss of biodiversity, food and water insecurity, health risks, economic disruption, displacement, and even violent conflict which were all resulted from the impact of climate change. While livelihood is a function of the climate of an area, it can be considered as a livelihood option is said to be sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets, while not undermining the natural resource base (Murala Arokoyo & Weli, 2020). This study further deems it necessary that livelihood analysis fully involve the local people, allowing their knowledge, perceptions, and interests to be taken into account. Some examples of livelihood assets are food stocks, stores of value such as gold, jewellery, cash savings, and resources (e.g., land, water, trees, livestock, farm equipment), as well as intangible assets such as claims (i.e., demands and appeals which can be made for material, moral or other practical support) and access, which is the opportunity in practice to use a resource, store or service or to obtain information, material, technology, employment, food or income (Murala Arokoyo & Weli, 2020). Furthermore, Sule *et al.* (2024a) and Oyediran and Olajide (2023) note that global food security is a pressing contemporary concern, reflecting the impact of the climate crisis on human development and livelihood options. IFAD and UNEP (2013) and Ibrahim et al. (2019) lament that the climate crisis, exacerbated by global climate change, is contributing significantly to increased poverty and food insecurity, leaving many smallholders vulnerable to numerous socio-economic problems. In Katsina State, agriculture contributes to food production, security, employment and the provision of raw

materials. It is therefore regarded as the backbone of the State economy as more than 75% of the population of the State is farmers and this important sector of economy support livelihood options of the majority of people of the State and it is vulnerable to climate crisis arising from global climate change (Ifo, 2016; Ladan & Sule, 2017; Sule, *et al.*, 2024a).

It is based on the established background that this study intends to: 1) identify the livelihood options of the rural households in the study area; 2) examine rural households perception to climate change in the semi-arid areas of Katsina State; 3) assess the effects of climate change on rural livelihood options of the people in the study area; and 4) identify the coping strategies employed by the affected communities to adapt to climate change within the study area.

Study Area

Katsina State is one of the states in the North–Western region of Nigeria. The state was established on September 23, 1987, with Katsina as its capital. The total landmass of the area is 24,192 km² (9,341 square miles) and has a total population of 3,753,133 persons, as per the 1991 census, and 5,801,584 persons in 2006 (NPC, 2006). Katsina State is located in the northwestern part of Nigeria. It is bounded at the south by Kaduna State, at the East by Jigawa and Kano States, at the West by Zamfara State and the North by the Sahara Desert and republic of Niger (Figure 1). Katsina state is located approximately between latitude 12°15' 00" and 12°25'00" N and longitude 7°30'00" and 7°50'00" E of the Greenwich meridian (Lawal, 2013; Murtala, Arokoyo and Weli, 2020)

The temperature in Katsina is consistently high throughout the year, with the highest values recorded from March to early May, ranging from 43°C to 46°C, and the lowest values from November to December (Murtala, Arokoyu, and Weli, 2020). The Sudan Savannah characterises the vegetation of Katsina State in the southern agro-ecological zone. At the same time, in the northern part, it is the Sahel Savannah, a semi-arid type, enriched with a variety of Grasslands, Shrubs, and drought-resistant trees (Murtala, Arokoyo, and Weli, 2020). The state experiences an annual rainfall of 800-1000 mm in the South, while to the north, it is usually between 450 mm and 700 mm per annum, with an uneven distribution throughout the year. The people of the State are mainly engaged in agriculture. They cultivate rice, millet, guinea corn, onions, tomatoes, sorghum, maize, groundnuts, and beans, among others (Lawal, 2013; Murtala, Arokoyo, and Weli, 2020). The people also engaged in local cottage industry, in which they produced goods that were sold to the outside world. They produced groundnuts, groundnut oil, and sugar. All these socio-economic activities are vulnerable and can be easily affected by climate change (Lawal, 2013).

Materials and Methods

This research adopted a cross-sectional design. The study was conducted in Kaita, Mashi, Mai'adua, and Baure, located in the northern agro-ecological zone. In the southern part of Katsina State, the LGAs where the study was conducted include Kankara, Kafur, Matazu and Sabuwa. The data for this study were generated from the administration of a questionnaire to respondents in the study area. Quantitative and qualitative data were used in this study, and they were generated from both primary and secondary sources. The types of data utilised by the study include socio-economic data of the households, such as the types and nature of livestock production practices, income and wages, occupation, and livelihood options.

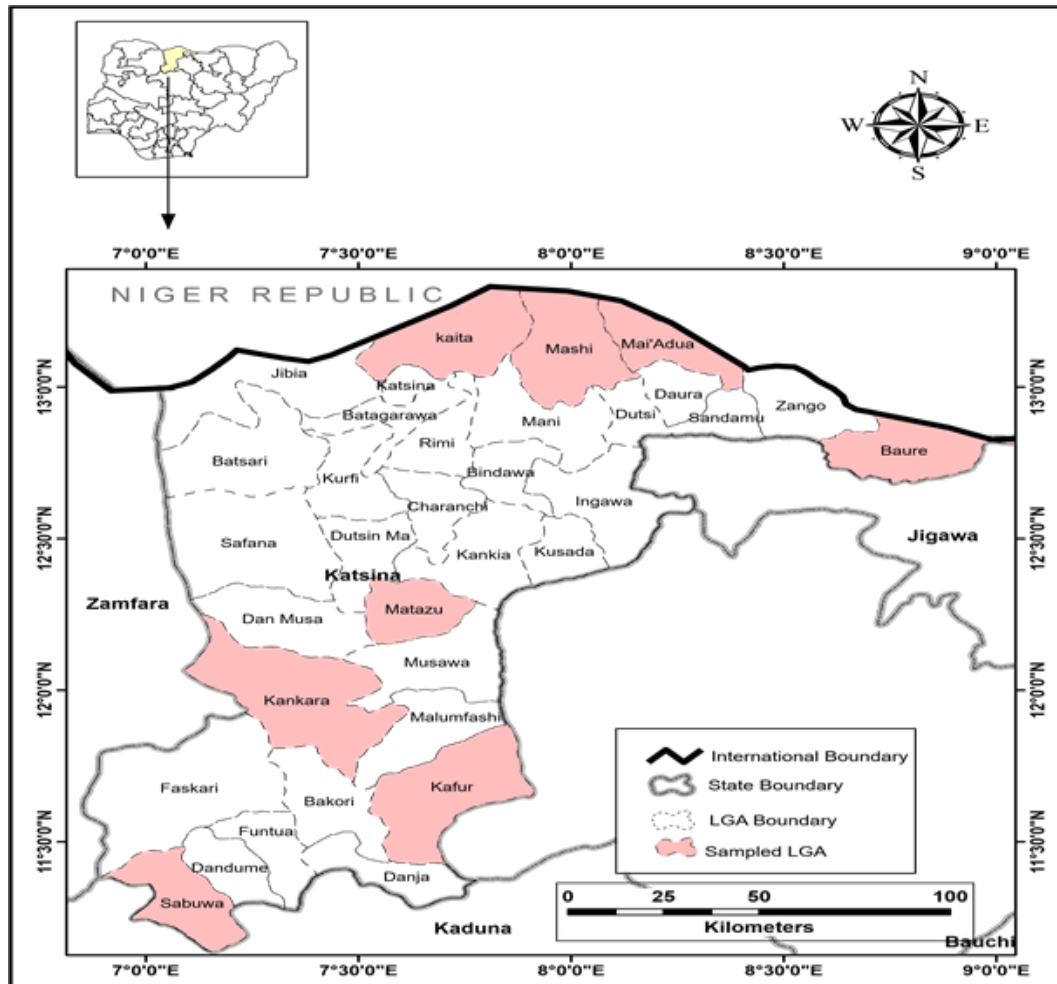


Figure 1: Map of the Study Area
Source: Field Survey 2024

Others include the household's perception of the magnitude of the climate crisis's impact on livestock production and the coping strategies adopted by livestock producers to mitigate its effects, among others. Furthermore, the data for this study were sourced from both primary means, including the administration of questionnaires and key informant interviews conducted with stakeholders in the livestock production sector and environmentalists. While data about poor and vulnerable households from the LGAs of the study area were obtained from the archives of the National Social Safety-Nets Coordinating Office (NASSCO), Katsina State Operation Coordinating Unit 2024 (KATSOCU)

The study was conducted in the eight (8) selected Local Government Areas from the northern and southern agro-ecological zones of the State. Katsina State had a total population of 5,801,584 persons as of the 2006 Nigerian Population Census (NPC, 2006). When this population is projected to grow at a rate of 3%, the state's population is estimated to be 9,717,206 persons as of December 2024. Thus, to ascertain the sample size for this study, the total number of Households in the 8 Local Government areas was determined to be 140,294, and further, the total number of households in the sampled LGAs was determined.

The Bartlett, Kotrlik and Higgins (2001) method of determining sample size was adopted. Based on this model, the population of the sampled households is 140,206, with a 95% confidence level and a 5% margin of error. Therefore, the sample size is 384 elements.

The method is computed as:

..... (Eq. 1)

Therefore, the required sample size for the population (N) of the study area is calculated as:

$n1 =$ (Eq. 2)

$n2 =$ (Eq.3)

For the adjusted sample size for the response rate

Where: t = value for selected alpha level of 0.025 in each tail, which is 1.96

$(p)(q)$ = estimate of variance, which is 0.25

d = acceptable margin of error for proportion being estimated, which is 0.05

$n0$ = sample size of not more than 5%

$n1$ = required return sample size

$n2$ = sample size adjusted for response rate

N = population size

r = anticipated response rate

To determine how the questionnaires were distributed, a proportionate distribution was adopted, where an equal number of respondents from each of the selected communities was maintained. Based on the determined sample size, a total of 384 copies of a questionnaire were administered to the eight (8) selected LGAs and one (1) community drawn from each of the eight (8) selected LGAs using simple random sampling. A purposive sampling technique was adopted in this research to select the households (respondents) to be involved in the study. This was accomplished through the careful selection of respondents from the register of selected communities, obtained from the LGA Desk officer. The basis for this was to gather information from the households that were genuinely enrolled on the State Social Register. The suitable respondent considered for selection was either the head of the household or an adult member of the household. During the questionnaire survey, each household was administered the data collection instrument for them to respond, and the outcomes were generated for data analysis.

The quantitative data used in this study were analysed using descriptive statistics, and the results were presented in cross-tabulated tables. SPSS version 26 was used to analyse the data. The results of qualitative data (key informant interviews) were presented in narrative statements and incorporated where necessary and appropriate in the discussion of the results.

Results and Discussion

Major Rural Livelihood Options of the Study Area

Table 1 shows the major livelihood options of rural communities in the study area. The result revealed that 16.1% of the respondents used Regenerative and 10.9% Extractive as major rural livelihood options, while 73% used both options for rural livelihoods in the North Agro-ecological zone. In the South Agro-ecological zone, 20.2% and 15.7% of the respondents used Regenerative and Extractive as their major livelihood options, respectively. 74.1% used both options for rural livelihoods in the region. This indicated that the majority of respondents used both regenerative and extractive options as a significant source of livelihood for the rural communities in the study area. Therefore, rural communities in the study area were found to adopt both regenerative and extractive livelihood options in all agroecological zones.

Table 1: Major Livelihood Options of Rural Communities of the Study Area

Agro-ecological Zones	Major Rural Livelihood Options			Total (%)
	Regenerative (%)	Extractive (%)	Both (%)	
North	16.1	10.9	73.0	100
South	20.2	15.7	74.1	100

Source: Field Survey, 2024.

Communities' Awareness of the Climate Crisis

The results in Table 2 show the level of awareness among rural communities about the climate crisis in the Northern and Southern Agro-ecological zones of the study area. The results show that 26% of the respondents demonstrated a low level of awareness of the climate crisis, 34.5% showed a moderate level of awareness, and 39.5% showed a high level of awareness of the climate crisis in the Northern Agro-ecological zones of the study area. While in the Southern Agro-ecological zone, 27% of the respondents showed a low level of awareness of the climate crisis, 35.8% showed a moderate level of awareness, and 37% showed a high level of awareness of the climate crisis in the study area. This implies that the majority of respondents in both the Northern and Southern Agro-ecological zones of the study area were somewhat aware of the climate crisis. Therefore, both agro-ecological zones of the study area were aware of the climate crisis, particularly the Northern part of the agro-ecological zone, where irregular rainfall, drought and desert-like conditions are becoming more prevalent. Afolabi and Tiamiyu (2021) maintained that seeking information about climate change through personal experience before consulting other sources may be crucial and beneficial for farmers.

Table 2: Community Awareness of the Climate Crisis

Agro-ecological Zones	Level of Awareness of Climate Crisis			Total (%)
	Low awareness (%)	Moderate awareness (%)	High awareness (%)	
North	26	34.5	39.5	100
South	27.2	35.8	37.0	100

Source: Field Survey, 2024.

Perception of Communities on the Consequences of the Climate Crisis on Livelihood Options

The results in Table 3 show the level of perception of the communities regarding the consequences of the climate crisis on their livelihood options in the study area. The results show that 30.8% of the respondents perceived Nuisance as a consequence of the climate crisis on their livelihood options, 44.2% perceived damage, and 25% perceived disruption, respectively, in the Northern Agro-ecological zone. While in the Southern Agro-ecological zone, 40.2% of the respondents perceived nuisance, 29.8% and 30% perceived damage and disruption, respectively, as consequences of the climate crisis on livelihood options in the study area. This indicated that most communities perceived damage (44.2%) as a consequence of the climate crisis in the North, while nuisance (40.2%) was in the Southern Agro-ecological zone of the study area. Therefore, rural communities' perceptions of the climate crisis play a critical role in adapting to climate crisis vulnerability, which impacts the livelihood options in the study area. In this regard, Oyekale (2009) further pointed out that small-scale farmers, having a limited resource base, are more vulnerable and less able to cope

with the consequences of climate change, as they also have a lower likelihood of accessing weather information or the capacity to develop technologies independently.

Table 3: Perception of Communities on the Consequences of the Climate Crisis on Livelihood Options

Agro-ecological Zones	Consequences of the climate Crisis on rural Livelihood Options			Total (%)
	Nuisance (%)	Damage (%)	Disruptive (%)	
North	30.8	44.2	25.0	100
South	40.2	29.8	30.0	100

Source: Field Survey, 2024.

Probability of Climate Crisis to Cause Negative Impact on Livelihood Options Over Time

Table 4 shows the probability of the climate crisis hurting rural livelihood options over time in the study area. The results show that 38.6% of the respondents agreed that the possibility of the climate crisis harming rural livelihood options was likely to continue within years, 34.3% believed it would continue within decades, and 32.1% believed it would occur within a century in the Northern Agro-ecological zone. In the Southern Agro-ecological zone, 42.9% were likely to continue happening within years, 30.6% were likely to continue happening within decades, and 26.5% were likely to happen within a century, respectively. This implies that there are possibilities (402.9%) and (38.6%) that the climate crisis will hurt rural livelihood options within the next few years in both the Northern and Southern Agro-ecological zones of the study area. Therefore, the climate crisis hurts the rural livelihoods of the communities in the study area.

Table 4: Probability of Climate Crisis to Cause Negative Impact on Livelihood Options Over Time

Agro-ecological Zones	Probability of the climate crisis hurting rural livelihood options over time			Total (%)
	Likely to continue happening within years (%)	Likely to continue happening within decades (%)	Likely to happen within this century (%)	
North	38.6	34.3	32.1	100
South	42.9	30.6	26.5	100

Source: Field Survey, 2024.

The severity to which the Climate Crisis is Currently Affecting the Livelihood Options and Socio-economic Activities of Communities

The results in Table 5 show the level of severity to which the climate crisis is currently affecting the livelihood options and socio-economic activities of the communities in the study area. The result shows that 17.1% of the respondents indicated that they were slightly affected by the current climate crisis, which is impacting their livelihood options and socio-economic activities in their communities. 35.2% of the respondents were severely affected, and 47.7% were extremely severely affected by the current climate crisis, which is impacting livelihood options and socio-economic activities in the Northern Agro-ecological zone. While in the Southern Agro-ecological zone, 34.1% of the respondents were slightly affected by the current climate crisis, 40.5% were moderately affected, and 25.4% were severely affected, all of which impacted the livelihood options and socio-

economic activities in their communities. This implies that in most communities of the two agro-ecological zones, the livelihood options and socioeconomic activities are currently affected by the climate crisis.

Table 5: Severity to which the Climate Crisis is Currently Affecting the Livelihood Options and Socio-economic Activities of Communities

Agro-ecological Zones	The severity of the climate crisis is currently affecting the options for rural livelihoods.			Total (%)
	Slightly severe (%)	Severe (%)	Extremely severe (%)	
North	17.1	35.2	47.7	100
South	34.1	40.5	25.4	100

Source: Field Survey, 2024.

Effectiveness of the Coping Strategies for Rural Livelihood Options amid the Climate Crisis

Table 6 presents the results of the effectiveness of coping strategies for rural livelihood options in the study area amid the climate crisis. The result indicates that 29.6% of the respondents were adopted drought resistance crop and animal varieties very effective, 44.6% of the respondents were adopted drought resistance crop and animal varieties effectively, 25.1% of the respondents were adopted drought resistance crop and animal varieties moderately effective and 0.7% of the respondents were not adopted drought resistance crop and animal varieties very effective in the Agro-ecological zones in the study area. This implies that the majority of the respondents adopted drought-resistant crop and animal varieties in the study area. This corroborates the findings of Kangalawe et al. (2007), who found that growing crops with different growth requirements ensures that even under stressful environments such as drought, some harvest can be obtained. Such experiences are also reported for other parts of semiarid Tanzania.

The results show that agroforestry practices serve as a coping strategy for rural livelihood options amid the climate crisis in the study area. The result revealed that 50.6% of the respondents adopted agroforestry practices as a coping strategy very effectively, 26.6% of the respondents have adopted agroforestry practices as a coping strategy effectively, 16.1% of the respondents were adopted agroforestry practices as a coping strategy moderately effective and 6.7% of the respondents have not adopted agroforestry practices as a coping strategy very effective in the Agro-ecological zones in the study area. This indicates that the majority (50.6%) of the respondents adopted agroforestry practices as coping strategies for rural livelihood options during the climate crisis in the study area.

The results show the adoption of a green and circular economy as a coping strategy for rural livelihood options in the face of the climate crisis in the study area. The result revealed that 37.8 % of the respondents adopted green and circular economy as a coping strategy for rural livelihood options very effectively, 41.6% of the respondents adopted green and circular economy as a coping strategy for rural livelihood options effectively, 16.1% of the respondents were adopted green and circular economy as a coping strategy for rural livelihood options moderately effective and 4.5% of the respondents were not adopted green and circular economy as a coping strategy for rural livelihood options very effective in the midst climate crisis in the study area. This implies that the majority of the respondents adopted green and circular economy as a coping strategy for rural livelihood options amid the climate crisis in the study area.

The results indicate that the adoption of climate-smart irrigation systems in production serves as a coping strategy for rural livelihood options in the face of the climate crisis in the study area. The result revealed that 36.7% of the respondents practiced climate innovative irrigation systems of production as coping strategies for rural livelihood options very effectively, 34.1% of the respondents were the practice of climate-smart irrigation systems of production as a coping strategy for rural livelihood options effectively, 18% of the respondents were practiced climate innovative irrigation systems of production as a coping strategies for rural livelihood options moderately effective and 11.2% of the respondents were not practiced climate-smart irrigation systems of production as a coping strategies for rural livelihood options very effective in the midst climate crisis in the study area. This implies that many respondents were practising climate-smart irrigation systems as a coping strategy for rural livelihood options amid the climate crisis in the study area. This is in contrast with the findings by Sieber *et al.*, (2015b) who argued that adaptation to none-climate innovative irrigation practice was poorly implemented (< 10%) in most of the traditional irrigation techniques practising areas (i.e. small scale practising areas) and relatively resulted to less positive impacts on mitigation and adaptation to climate change.

The results show the change in the cropping calendar as a coping strategy for rural livelihood options amid the climate crisis in the study area. The result shows that 28% of the respondents adopted the change of cropping calendar as a coping strategy for rural livelihood options very effectively, 30% of the respondents adopted the change of cropping calendar as a coping strategy for rural livelihood options effectively, and 41% of the respondents were adopted change of cropping calendar as a coping strategy for rural livelihood options moderately effective in the midst climate crisis in the study area. This implies that the majority of respondents adopted a change in cropping calendar as a coping strategy for rural livelihood options amid the climate crisis in the study area.

The results show that the practice of climate-smart on-farm and off-farm diversification serves as a coping strategy for rural livelihood options amid the climate crisis in the study area. The result revealed that 48.2% of the respondents practiced climate-smart on-farm and off-farm diversification as coping strategies for rural livelihood options very effective, 31% of the respondents were practiced climate smart on farm and off-farm diversification as a coping strategy for rural livelihood options effectively, 16.5% of the respondents were practiced climate smart on farm and off-farm diversification as coping strategies for rural livelihood options moderately effective and 3.4% of the respondents were not practiced climate smart on farm and off-farm diversification as coping strategies for rural livelihood options very effective in the midst climate crisis in the study area. This implies that the majority of respondents practised climate-smart on-farm and off-farm diversification as a coping strategy for rural livelihood options amid the climate crisis in the study area.

Table 6: Effectiveness of the Coping Strategies for Rural Livelihood Options amid Climate Crisis

Adoption of drought-resistant crop and animal varieties	Frequency	Percent
Very effective	79	29.6
Effective	119	44.6
Moderately effective	67	25.1
Not very effective	2	0.7
Total	268	100.0
Agro-forestry	Frequency	Percent
Very effective	135	50.6
Effective	71	26.6
Moderately effective	43	16.1
Not very effective	18	6.7
Total	268	100.0
Adoption of green & circular economy	Frequency	Percent
Very effective	101	37.8
Effective	111	41.6
Moderately effective	43	16.1
Not very effective	12	4.5
Total	268	100.0
Climate-smart irrigation systems for production	Frequency	Percent
Very effective	98	36.7
Effective	91	34.1
Moderately effective	48	18.0
Not very effective	30	11.2
Total	268	100.0
Change of cropping calendar	Frequency	Percent
Very effective	76	28.0
Effective	80	30.0
Moderately effective	111	41.0
Total	268	100
Climate-smart on-farm and off-farm diversification	Frequency	Percent
Very effective	130	48.2
Effective	84	31.0
Moderately effective	44	16.5
Not very effective	9	3.4
Total	268	100

Source: Field Survey, 2024.

In this regard, the finding of this study agreed with Sule et al. (2024) that argued adoption of climate change resilient practices can reduce vulnerability to severe food scarcity, especially in dry land areas, with devastating effects on livestock populations, reductions in the quantity and quality of feed (leading to less feed intake and higher mortality), change in species composition (hence reduction in biodiversity and genetic resources) of grasslands as well as effect on the digestibility and nutritional quality of forage.

Conclusion

This study concluded that the rural communities in the study area engaged in both regenerative and extractive livelihood options. The livelihood options of the northern and southern agro-ecological zones of Katsina State were vulnerable to the climate crisis, particularly those relying on

regenerative practices. The problem is more pronounced in the northern agro-ecological zone, where irregular rainfall, drought, and desertification are often present. The study found that the possibility of the climate crisis hurting rural livelihood options and socio-economic activities of communities is high if urgent action is not taken to mitigate the impact of climate change.

Recommendations

Based on the findings of this study, it is recommended that:

1. There should be a rural communities' engagement and awareness campaign on the dangers of the climate crisis on the resource base and livelihood options, most particularly in the Northern Agro-ecological zone in the study area
2. There is a need for stakeholder engagement and collaboration, given the possibility that a climate crisis may negatively impact rural livelihood options and socio-economic activities in the years to come.
3. Rural communities should be empowered with seasonal climate predictions and early warning systems to prepare for any eventuality.
4. Rural communities should be encouraged to adopt drought-resistant crop and animal varieties, agroforestry practices, a green and circular economy, climate-smart irrigation systems, and climate-smart on-farm and off-farm diversification as coping strategies for enhancing rural livelihood options amid the climate crisis.
5. There is a great need for capacity building to strengthen rural communities' ability to develop adaptation strategies and reduce vulnerability to the adverse impacts of climate change in the study area.
6. Rural communities should adopt afforestation, water, and soil management strategies to mitigate the adverse impacts of climate change on rural livelihood options. This can be achieved through the development partners and other national and international organisations.

References

- Abdulkadir, A., Usman, M. T. & Shaba, A. H. (2013). Climate change, aridity trend and agricultural sustainability of the Sudano-Sahelian belt of Nigeria. *International Journal of Development and Sustainability*, 2(2), 1436- 1456
- Afolabi, S.O. & Tihamiyu, M.A. (2021). Information Use Behaviour of Sedentary Livestock Farmers in Egbeda Local Government Area of Oyo State, Nigeria". *Library Philosophy and Practice (e-journal)*. 5646. <https://digitalcommons.unl.edu/libphilprac/5646>
- Ibrahim Danladi Sule, Amina Umami Shehu & Hussaini Shafii (2024a). Appraisal of Peasant Farmers' Crop Production and Food Security Status amidst Climate Crisis in Dutsin-Ma Local Government Area, Katsina State, Nigeria: *Confluence Journal of Environmental Studies Vol. 18 (Issue 2), 2024* www.confluencejournal.com.ng ISSN: 1597-5827
- Ibrahim, S., Usman, Z. A. & Mohammed, K. O. (2019). Analysis of Food Security Status among Rural Farming Families in Jigawa State: *Journal of Agricultural Economics, Environment and Social Sciences* 5(1&2). Department of Agricultural Economics, University of Maiduguri, Nigeria. Available online: <http://www.jaeess.com.ng> ISSN: 2476 – 8423

Ifo, B. (2016). *Unleashing Katsina State Agricultural Development through Value Chain Financing*: A paper presented at Katsina State Economic and Investment Summit: 9th -12 May 2016

International Fund for Agricultural Development (IFAD) and the United Nations Environment Programme (UNEP) (2013). *Smallholders, Food Security, and the Environment. The report was written under UNEP's World Conservation Monitoring Centre (UNEP-WCMC).*

Kangalawe, R. Y. M., Christiansson, C. and Ostberg, W., (2008). "Changing Land-Use Patterns and Farming Strategies in the Degraded Environment of the Irangi Hills, Central Tanzania," *Agriculture, Ecosystem and Environment, Vol. 125, No. 1-4, 2008, pp. 33–47. doi:10.1016/j.agee.2007.10.008.*

Kangalawe, R. Y. M., Liwenga, E. T., Kabumbuli, R., and Walingo, M. K. (2008). Livelihood Diversification and Implications on Poverty and Environment in the Lake Victoria Basin," *African Journal of Environmental Science and Technology, Vol. 2, No. 10, 2008, pp. 272-281.*

Katz, R.W., Brown, B.G. (1992). Extreme events in a changing climate: variability is more important than averages. *Climate Change, 21, 289–302.*

Ladan, S.I. and Sule, I.I (2017). Analysis of the Constraint to Agricultural Development in Bakori LGA, Katsina State, Nigeria: *Ewemen Journal of Plant Genetics and Chemotaxonomy 2(1):19-25*

Lawal, A. A. (2013). *Analysis of Rainwater Harvesting System in Katsina State, Nigeria* (Doctoral dissertation, Department of Civil and Environmental Engineering, Islamic University of Technology (IUT), Board Bazar, Gazipur, Bangladesh).

Murtala, A. M., Arokoyu, S. B., Weli. V. E. (2020). Perception of Climate Change and Its Effects on Rural Livelihood in Katsina State, Nigeria: *Journal of Natural Sciences Research ISSN 2224 3186 (Paper) ISSN 2225-0921 (Online) Vol 10, No.2, 2020*

Oyekale, A.S. (2009). Climatic variability and its impact on agricultural income and households' welfare in southern and northern Nigeria. *Electronic Journal of Environmental, Agricultural and Food Chemistry, 8(1), 13-34.*

Sieber, S., Jha, S., Shereef, A.-B.T., Bringe, F., Crewett, W., Uckert, G., Polreich, S., Ndah, T.H., Graef, F. and Mueller, K. (2015b). "Integrated assessment of sustainable agricultural practices to enhance climate resilience in Morogoro, Tanzania", *Regional Environmental Change. Doi: 10.1007/s10113-015-0810-5.*

Sule, I. D., Garba, M. G., Liman, A. B. and Tayo A. A (2024b). Appraisal of Sedentary Livestock Production amidst Climate Crisis in the Northern Agro-Ecological Zone of Katsina State, Nigeria: *Confluence Journal of Environmental Studies Vol. 18 (Issue 2), 2024 www.confluencejournal.com.ng ISSN: 1597-5827*

United Nations Development Programme (2023). *The Climate Dictionary: Speak Climate Fluently*