

Assessment of Smallholder Farmers' Perceptions on Climate Change and Adaptations Strategies in Gombe State, Nigeria

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ABSTRACT

Changes in precipitation, temperature, and wind patterns are just a few of the difficulties that the agricultural industry faces as a result of climate change and variability. Smallholder farmers who depend on agriculture for a living are particularly vulnerable to these developments. The study aims to assess smallholder farmers' perception on climate change and adaptation strategies in Gombe State, Nigeria. The study's specific objectives are to identify farmers' perceptions of climate change and climate change adaptation strategies. Descriptive statistics were employed to analyse the data. The results indicated that majority (51.3%) of smallholder farmers perceived climate change and some adaptation strategies were employed to cope with the risk posed by it. About (56.4%) of the respondents perceived late onset of rainfall. Majority (78.46%) of the respondents perceived an increase in temperature in the study area. The most common adaptation strategies were crop-livestock diversification and good practices with (37.800%). Over 82% of farmers face poor soil fertility issues and early 78% struggle with high farm input costs. Smallholder farmers in Gombe State perceived a high level of climate change, that climate change is human-caused and a worrisome problem. It is recommended that government should promote conservation agriculture practices, such as crop rotation, organic amendments, and minimum tillage, to enhance soil fertility and reduce soil erosion.

Keywords: Climate change, Smallholder farmers, Perceptions, Adaptation

BACKGROUND OF THE STUDY

Climate variability could significantly impact the economies of developing nations, expansion. It can result in lower production, higher healthcare expenses, and harm to important ecosystems due to its interconnected effects on forestry, fisheries, tourism, health, and agriculture (Gedefaw et al., 2018; Kebede and Gizachew, 2017). Despite generally having lower greenhouse gas emissions, low-income nations are disproportionately affected by the climate vulnerability. To assist low-income nations adjust to climate change and make the transition to more sustainable practices, addressing it will require international cooperation and support. In addition, it is true that regular variations in temperature and precipitation patterns can upset the customary April–October rainfall cycle and the October–March harmattan, or dry season (Akande et al., 2017). At the impacted locations, these changes may have a substantial effect on water supplies, agriculture, and general climatic trends. However, precipitation that falls too soon and harsh weather conditions can seriously jeopardise agricultural investments. Unpredictable weather patterns can have a negative impact on livestock, crop yields, and overall agricultural output (Gershon and Patricia, 2019). An abundance of rain can encourage the growth of pests and illnesses in the livestock and agricultural industries. Crop yields and animal breeding can be greatly impacted by the growth and spread of several illnesses and pests, which are made possible by high humidity and standing water.

Scientific analysis overwhelmingly suggests that most of the greenhouse gases released into the atmosphere by burning fossil fuels and deforestation, such as carbon dioxide (CO₂), are the main cause of global warming.

(IPCC, 2019). Rainfall variability which is characterised by drought, flooding, high temperature, increased relative humidity and changes in atmospheric pressure. These occurrences have automatically pushed smallholder farmers to adopt new agricultural practices and abandon conventional farming, abandoning traditional crops that were known for their low productivity, labour-intensive nature, and low revenue (Anyadike and Obasi, 2017).

Several studies on climate change conducted in Gombe State mostly focused on the impact of climate change on crop production, not taking in to account the coping strategies employed by these farmers to mitigate it (Muhammad *et al.*, 2022; Menwowa *et al.*, 2019; Abdulhamid and Bamusa, 2018). While many farmers perceived the impacts of climate change and have adopted strategies to cushion the effects, this research will examine the various determinants of adaptation strategy employed by these farmers. These and other elements work together to influence how people and communities respond to the problems caused by climate change and how well they are able to adapt to its effects. However, improving smallholder understanding of climate change, are among the strategic ways to lessen the effects of climate change and ensure food security issues is reduce in the majority of developing countries are making alternative adaptation strategies available and identifying factors that influence farmers' capacity to adapt (Wondim *et al.*, 2018).

The study, if successfully completed, the following persons will benefit: farmers, important agribusiness and agriculture stakeholders, researchers, and policy makers. To the farmers, it will educate them on climate smart agriculture; also to the policy makers the output of the research could encourage them in ameliorating the impact of climate variability. Policy makers will also be able to design a farming roadmap that addresses critical concerns regarding crops and climate change with the help of this study, which will benefit society as a whole. To the researchers, it can leverage data and models to guide adaptation efforts, ensuring that measures are scientifically sound and targeted to specific vulnerabilities.

The broad objective of the study is assessment of smallholder farmers' perception on climate change and adaptation strategies in Gombe State, Nigeria, while the specific objectives were to; identify perceptions of farmers on climate change in the study area, assess the adaptation strategies employed among smallholder crop farmers and identify the constraints to climate change adaptations among smallholder crop farmers.

MATERIALS AND METHODS

Study Area

Gombe State was chosen for this study primarily because it has always been a key grain producing State (Discover Nigeria, 2011). Geographically, it is located in northeastern Nigeria, between latitudes 9°30' and 12°30'N and longitudes 8°45' and 11°45'E of the Greenwich Meridian. The State, located in the Sudan savannah zone, was formed in October 1996 from the previous Bauchi State. It is one of the country's 36 states, and its capital is Gombe. Gombe State borders Bauchi State to the west, Adamawa and Taraba States to the south, Borno to the east, and Yobe State to the north (Discover Nigeria, 2011). The state, located in the Sudan savannah zone, was created in October 1996 from the defunct Bauchi State. It is one of the country's 36 states, and its capital is Gombe. Gombe State borders Bauchi State to the west, Adamawa and Taraba States to the south, Borno to the east, and Yobe State to the north (Discover Nigeria, 2011).

The State has an area of 20,265 km² and a population of around 3,588,219 people as projected from the 2006 National Population Census, with eleven local government areas and 14 Emirates/chiefdoms across three senatorial districts: Gombe Central, Gombe North, and Gombe South. The people's primary occupation is farming, and the State is primarily an agricultural State. Gombe State has two distinct climates: the dry season (November-March) and the rainy season (April-October). Cereals (Millet, Maize, Sorghum, Rice, and Wheat), legumes (Cowpea, Groundnut, Soya beans, and Bambara nuts), fruits (Mango, Guava, Pawpaw, Orange, Lemon, and Grapes), vegetables (Tomatoes, Onion, Pepper, Okro, Pumpkin, and Melon), tree crops (Moringa), and livestock. As a result, changes in climate could have an impact on agriculture in a different way, including changes in average temperatures, rainfall, climate extremes, as well as pest and disease alterations, all of which can lead to agricultural production reductions.

Gombe is a hospitable state popularly known with Gombe grain market (Tudun hatsi), has predominantly Fulani, Tangle, waja, Tera, Bolewa, Kanuri tribe with a good presence of Yoruba, Igbo and many other Nigerian tribes within and outside the country.

MAP OF THE STUDY AREAS

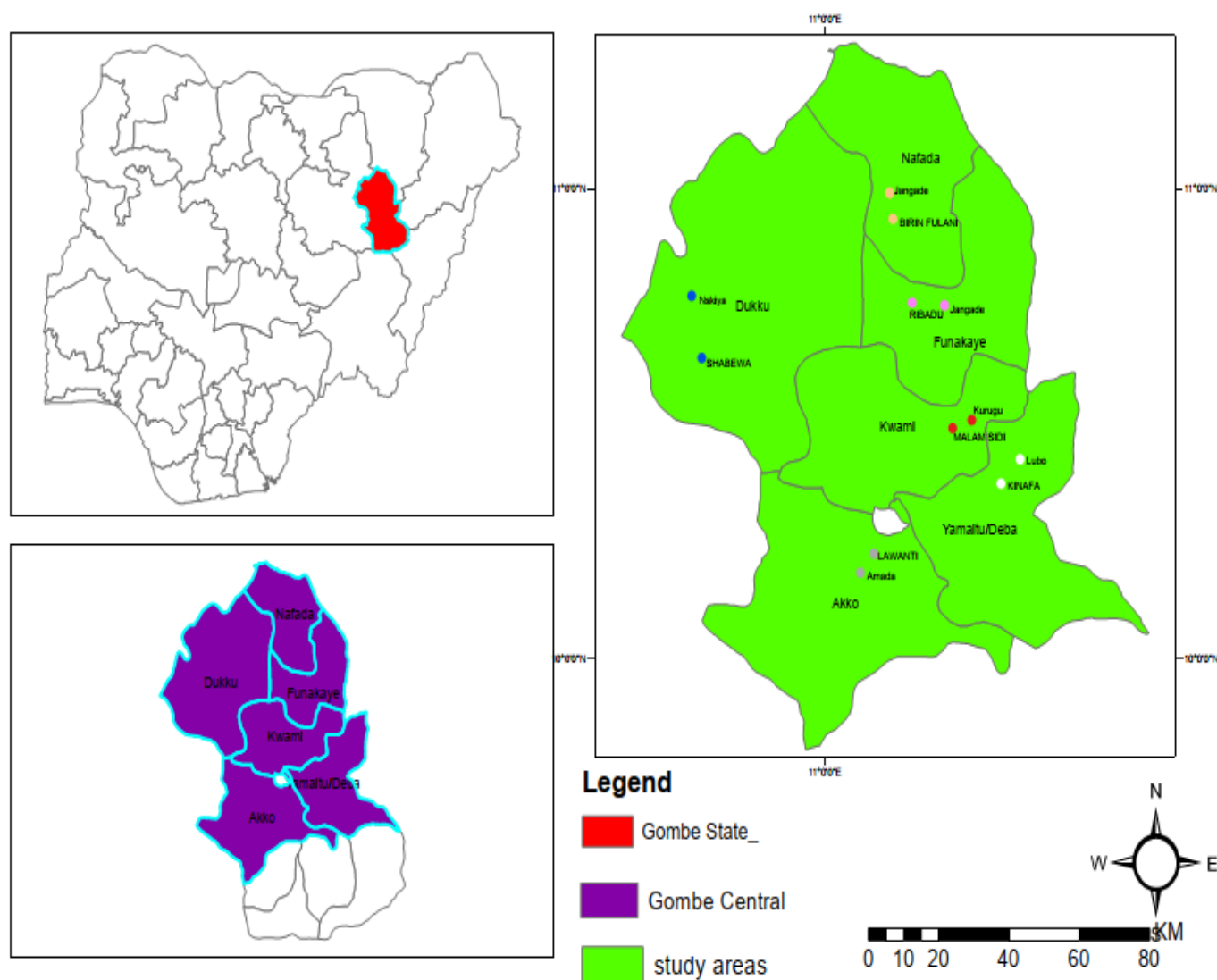


Figure 1.1: The Study area

Source: (Gspb Geo. Unit, 2024)

Sampling Frame and Sample Size

A multi-stage sampling technique was used to select the smallholder farmers. In the first stage Gombe central and Gombe North senatorial districts were purposively selected due to the predominance presence of farmers whom were adapting to climate variability. In the second stage six Local Government Areas (LGA's) were purposively selected because of the large number of farmers shifting from production traditional crops to crops that are more or less climate shock tolerance in the areas. The third stage involved the selection of one community each from the six LGA's where farmers adopted crop switching. The fourth stage witnessed the selection of two villages from each of the communities selected randomly. The fifth stage involved the selection of farmers at random from the overall population of farmers in the villages selected. A total 337 farmers were selected from a sample frame of 2,171 farmers that was avail by Gombe State Agricultural Development Program (GSADP), (2024). The sample size was estimated using Yamane's formula (1967) adopted from Addis and Abirdew, (2021).

N

$$n = 1 + N (e)^2$$

Where:

n = Sample size of the farmers in the study area.

N = Total number of famers who might have adopted crop switching in the study area with $\pm 5\%$ precision.

e = Error term.

The sample for this study was calculated by assuming a 95% confidence level, the study used this formula for the population, in which N = 2,171 with $\pm 5\%$ precisions. The population is based on the preliminary survey.

Table 1: Sampling Frame and Sample Size

S/No	Senatorial Zone	LGA	Ward	Village	Sampling Frame	Sample Size
1	Gombe Central	Akko	Akko	Amada	234	36
				Lawanti	251	38
2		Yamaltu Deba	Lubo	Lubo	160	25
				Kinafa	110	17
3	Gombe North	Dukku	Waziri North	Shabewa	200	31
				Nakuja	190	30
4		Funakaye	Ribadu	Ribadu	200	31
				Jangade	157	25
5		Kwami	MalamSidi	Malam Sidi	130	20
				Z. Kurugu	190	30
6		Nafada	Birin Fulani	Birin Fulani	200	31
				Madaki	149	23
		Total			2,171	337

Source: Gombe State Agricultural Development Program (GSADP), (2024).

Methods of DataCollection

This study employed quantitative collection of data. Data was collected and used for the study by the use of structured questionnaire that was administered to the smallholder farmers. Data was collected on farmers' perception of climate such as rainfall variability, increase in temperature, violent winds. Types of adaptation adopted to cope with climate change by the respondents were also asked. Research assistants fluent in major languages in Gombe State and with good knowledge of local traditions were recruited and trained before conducting the survey.

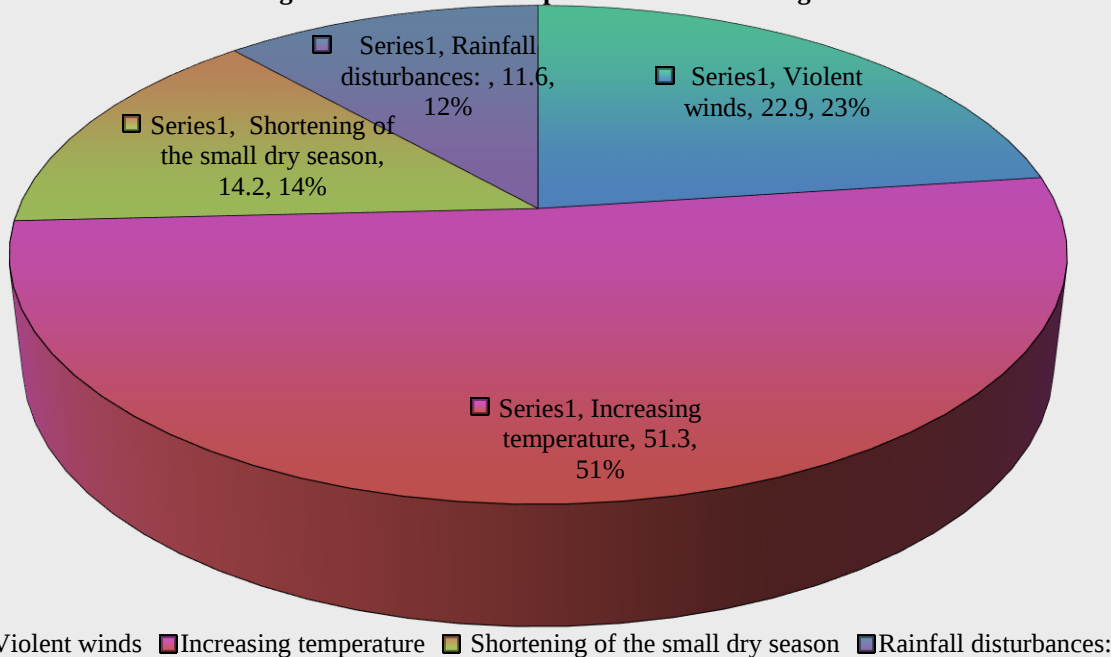
Methods of Data Analysis

Descriptive statistics employed to analyse the data. Descriptive statistics was used to analyse smallholder farmers' perception of climate change, climate change adaptation strategies and constraints encountered in climate change adaptation. Descriptive statistics such as frequency, percentage, mean, median, mode, standard deviations and standard errors used.

RESULTS AND DISCUSSIONS

Farmers' Perception of Climate Change

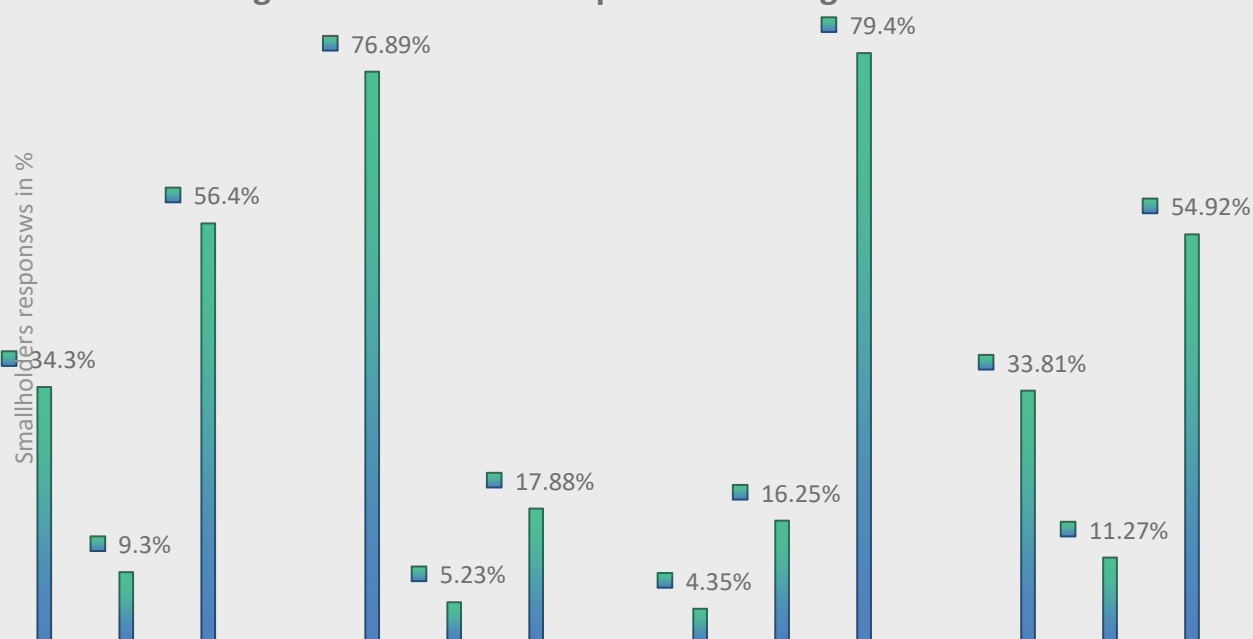
Figure 2: Farmers' Perception of Climate Change



Majority (51.3%) of the respondents perceived increasing temperature, about 22.9% of the respondents perceived violent winds, about 14.2% perceived shortening of the small dry season and about 11.6% of the respondents perceived rainfall disturbances.

Farmers' Perceptions of Changes in Rainfall Pattern

Figure 3: Farmers' Perceptions of Changes in Rainfall Pattern

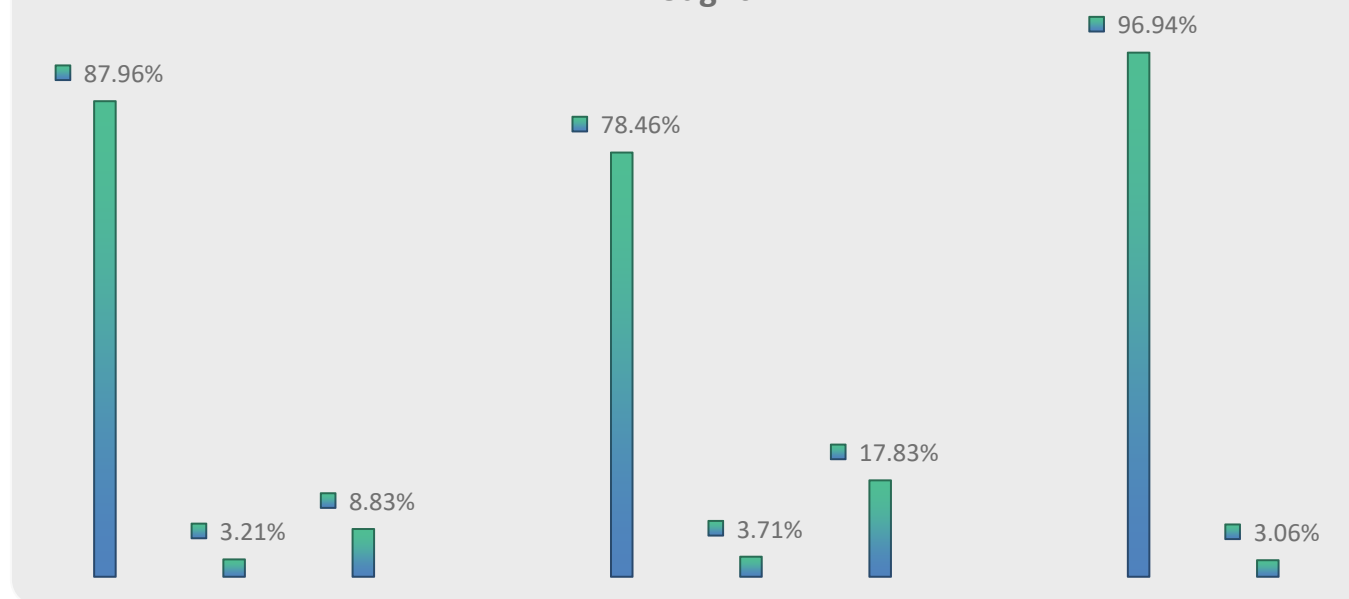


Most (56.4%) of the respondents perceived late onset of rainfall pattern, about 34.3% perceived early onset of rainfall pattern, only 9.3% perceived no change in the onset of rainfall pattern. Majority (76.89%) of the respondents perceived early cessation in rainfall pattern, about 17.88% of the smallholder farmers perceived late cessation of rainfall pattern, only 5.23% of the smallholder farmers perceived no change in the rainfall

pattern. Majority (79.4%) of the respondents perceived decreased of rainy season length, about 16.25% of the smallholder farmers perceived no change in the length of rainy season, only 4.35% of the respondents perceived a decreased in the length of rainy season in the study area. Majority (54.92%) of the smallholder farmers perceived a decreased in the quantity of rainfall in the study area, about 33.81% of the respondents perceived an increased in quantity of rainfall in the study area, only 11.27% of the smallholder farmers perceived no change in the quantity of rainfall in the study.

Farmers' Perceptions of Changes in Temperature and Drought

Figure 4: Farmers' Perceptions of Changes in Temperature and Drought



Majority (87.96%) of the respondents perceived length of the long dry season, about 8.83% of the smallholder farmers perceived a decreased in the length of the long dry season, only about 3.21% of the respondents perceived no change in the length of the long dry season. Majority (78.46%) of the smallholder farmers perceived an increased in temperature in the study area, about 17.83% of the smallholder farmers perceived a decreased in temperature in the study area, only 3.71% of the smallholder farmers perceived no change in the temperature of the study area. Majority (96.94%) of the smallholder farmers perceived shortening of the small dry season, only 3.06% of the smallholder farmers perceived shortening of the small dry season in the study area.

Smallholder Climate Change Adaptation Strategy

Table 3: Climate Change Adaptation Strategies

Variables	Frequency	Percentage
a. Crop-livestock diversification and good practices	144	37.80
b. Use of improved varieties, chemical fertilizers and pesticides	93	24.40
c. Agro-forestry and perennial plantation	63	16.54
d. Diversification of income-generating activities	81	21.26
Total	381	100

Source: Field survey, 2024.

Table 3 revealed that majority (37.80%) of the smallholder farmers employed crop-livestock diversification and good practices as the climate change adaptation strategy. About 24.40% adopted the use of improved varieties, chemical fertilizers and pesticides. While adoption of agro-forestry and perennial plantation and diversification of income-generating activities secured 16.54% and 21.26% respectively.

Smallholder Constraints to Climate Change Adaptations

Table3: The constraints to climate change adaptations ranked out of the respondents

Variables	Frequency	Percentage
1. Poor soil fertility	272	82.74%
2. High costs of farm inputs	257	78.14%
3. Inadequate access to credit facilities	192	58.32%
4. Limited access to extension services	177	53.97%
5. Unreliability of climate information	152	46.39%
6. Inadequate Improved Seed	117	35.61%

Source: Field survey, 2024.

The results in table 4 indicate that over 82% of farmers face poor soil fertility issues. Nearly 78% struggle with high farm input costs. More than half face inadequate credit access and limited extension services. Almost half experience unreliable climate information. Over a third lack access to improved seeds.

CONCLUSION AND RECOMMENDATION

The study aims to assess smallholder farmers' perception on climate change and adaptation strategies in Gombe State. Smallholder farmers in Gombe State perceived a high level of climate change, that climate change is human-caused and a worrisome problem. This plays a crucial role in shaping their beliefs and attitudes towards the issue. The farmers in Gombe State have developed diverse adaptation strategies to cope with climate change. However, they face significant challenges, including limited access to credit facilities and climate information. It is recommended that government should Promote conservation agriculture practices, such as crop rotation, organic amendments, and minimum tillage, to enhance soil fertility and reduce soil erosion and Implement input subsidies to support farmers in accessing affordable farm inputs, such as seeds, fertilizers, and pesticides.

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