Journal of Agriculture, Environmental Resources and Management
ISSN2245-1800(paper) ISSN 2245-2943(online)
8(5)1-650; **May** .2026; pp 21- 26

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Knowledge and Attitude of Practices of Climate-Smart Agriculture among Smallholder Crop Farmers in Bosso Local Government Area, Niger State, Nigeria

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Abstract

Climate change has become a major challenge to agricultural productivity and food security, particularly in developing countries where smallholder farmers depend largely on rain-fed agriculture. Climate-Smart Agriculture (CSA) has been promoted as a sustainable approach for improving agricultural productivity, strengthening resilience to climate variability, and enhancing environmental sustainability. This study examined the knowledge and attitude of practices of Climate-Smart Agriculture among smallholder crop farmers in Bosso Local Government Area, Niger State, Nigeria. A multi-stage sampling technique was used to select 120 crop farmers from selected farming communities. Primary data were collected using structured questionnaires and analyzed using descriptive statistics such as frequencies, percentages, and mean scores. The results revealed that farmers were at an active mean age of forty (40), had an average household size of six (6), and had a low level of education. Farmers obtained information about CSA mainly from local radio stations (87.5%), friends/family (66.7%), and cooperatives (50%). Hence, expressed positive attitudes toward CSA practices due to their perceived benefits in improving crop productivity and resilience to climate variability. The study concluded that farmers' knowledge and attitudes significantly influence the adoption of CSA practices. Strengthening agricultural extension services and improving farmers' access to climate-related information are essential strategies for enhancing CSA adoption among smallholder farmers.

Keywords: Knowledge, Attitude, Climate-smart Agriculture, Smallholder farmers, Nigeria.

Introduction: Agriculture remains a critical sector for economic development and food security in many developing countries, particularly in sub-Saharan Africa (Ngongolo & Gayo, 2024; Gnedeka & Wonyra, 2023). In Nigeria, agriculture contributes significantly to employment, rural livelihoods, and the national food supply. However, the sector is highly vulnerable to climate variability and change due to its heavy dependence on rainfall and limited use of irrigation infrastructure and climate-resilient technologies (Ugwuoti *et al.*, 2023; Salisu, 2022) . Climate change has significantly affected agricultural production through rising temperatures, unpredictable rainfall patterns, and increased frequency of extreme weather events such as droughts and floods. These climatic changes pose serious threats to smallholder farmers who rely mainly on rain-fed farming systems. As a result, climate change has become a major concern for agricultural sustainability and food security globally (Abdul-Razak *et al.*, 2024) . Climate-Smart Agriculture (CSA) has been widely promoted as a sustainable agricultural approach aimed at addressing the challenges of climate change while improving agricultural productivity. CSA seeks to achieve three main objectives: increasing agricultural productivity, strengthening farmers' resilience to climate change, and reducing greenhouse gas emissions where possible. These goals are achieved through practices such as conservation agriculture, crop diversification, agroforestry, improved seed varieties, and soil conservation techniques (Food and Agriculture Organization, 2023). Despite the potential benefits of CSA, its adoption among smallholder farmers remains uneven in many parts of Africa. Farmers' knowledge and perceptions of agricultural innovations play an important role in influencing their adoption decisions. Studies have shown that farmers' awareness, knowledge, and attitudes

toward climate-smart agricultural practices significantly affect their willingness to adopt these practices (Saadu *et al.,* 2024).

Similarly, empirical studies conducted in Nigeria have found that farmers obtain information about CSA practices from various sources such as extension agents, radio, television, and fellow farmers. However, inadequate access to reliable climate information and extension services continues to limit farmers' knowledge and adoption of climate-smart agricultural practices (Goni *et al.,* 2024). Understanding farmers' knowledge, attitudes, and practices regarding CSA is therefore essential for designing effective agricultural extension programs and policies aimed at promoting climate resilient agriculture. However, the knowledge of CSA remains low across most of Africa (Njeru *et al.,* 2016). Smallholder farmers' limited adoption of CSA practices can be attributed to a lack of awareness and knowledge regarding CSA practices and their benefits, limited access to information and resources, financial constraints, adherence to traditional farming practices and risk aversion, inadequate supportive policies and institutional frameworks, inadequate infrastructure and access to services, as well as social and cultural factors influencing decision-making processes. Although it is evident that smallholder farmers in Nigeria are applying CSA practices (Olagunju *et al.,* 2017; Afolayan *et al.,* 2019; Ogunjimi *et al.,* 2020), there is a dearth of empirical studies to ascertain the level of knowledge and the farmers' attitude towards CSA among smallholder farmers in Bosso Local Government Area. More so, owing to the near-absence of documented evidence on their knowledge and attitude towards CSA and the inherent challenges of adoption, adopting the practices has remained an area that has been neglected, requiring investigation to guide policy thrust by the State in the quest to mitigate the adverse consequences of climate change.

Agriculture is the most climate-sensitive sector in Nigeria and serve as a primary source of livelihood to a large population of rural households. However, the increasing variability in the weather condition poses significant challenges to agricultural productivity across the country, particularly for smallholder crop who heavily rely on rain-fed agriculture and possess limited resources to adapt to changing environmental conditions (Alhassan *et al*., 2023). To mitigate this challenges, climate-smart agricultural practices have been promoted to enhance resilience, improve productivity and ensure sustained food production. Studies by Ayinla *et al*., (2024) and Mbanasor *et al*., (2024) have shown that farmers' knowledge and attitudes significantly influence their perception, acceptance and practice of agricultural innovation. Farmers with limited knowledge may lack understanding of the benefits and applications as well as the long term implications of improved practices while negative attitudes toward the practices may reduce willingness to adopt sustainable farming techniques. Consequently, poor knowledge and unfavorable attitudes among farmers may contribute to low or lack of practice or adoption of climate adaptation measures, reduced productivity and increased vulnerability to food insecurity. Bosso Loal Government Area in Niger State is an agrarian area where crop farming is a major economic activity with potential for increased agricultural productivity. Despite this, farmers face challenges associated with climate variability, declining farm productivity, poor access to information, inadequate extension services and limited access to modern adaptation technologies (Adisa *et al.,* 2024, Idris *et al.,* 2024) if these conditions persist without adequate understanding of farmers' knowledge and attitudes, effort aimed at promoting sustainable agricultural practices and improving food productivity may yield limited result.It is on this backdrop, that this study seeks to assess the knowledge and attitude of practice of climate-smart agricultural crop farmers in Bosso Local Government Area of Niger state with the view of providing empirical evidence that could guide agricultural extension services, policy-makers and development agencies in designing more effective farmer education and climate adaptation programmes. Based on the foregoing, the following research questions were formulated to guide the investigation: What are the socio-economic and demographic characteristics of smallholder farmers in Bosso Local Government Area, Nigeria. What are the sources of information about climate-smart agricultural practices among these farmers. What is the level of knowledge and attitude of climate-smart agricultural practices among these farmers The broad objective of the study is to assess the knowledge and attitude of practices of climate-smart agriculture in Bosso LGA of Niger State, Nigeria The specific objectives are to: describe the socio-economic and demographic characteristics of smallholder farmers in the study area; identify the sources of CSA information among smallholder farmers; describe the level of knowledge and attitudes of CSA practices of smallholder farmers.

Methodology: Study Area

This study was conducted in Bosso, Minna, the capital of Niger State. It is one of the twenty-five local government areas (LGAs) in Niger State, with its headquarters in Maikunkele with a land mass of 1,592 km^2 (Eze *et al.,* 2018). The study area is located between Latitude 9º23'00" - 9 º45'00" North and Longitude 6º10'0 – 6 38' 00" East. It covers a total area of about 297.5 km^2 and has a population of about 147,359 as at 2006 census. The projected population of the LGA as at 2022 was 220,078 at 3.2% population growth (NBS, (2022). Bosso is a commercial urban area or more of a central place in Minna. The study area has two distinct seasons the dry and wet seasons. Precipitation per year varies between 1000-1400 mm on the average. The duration of rainy season ranges from 150 to 210 days or more from the north to the south. Mean maximum temperature remains high throughout the year, hovering about 37ºC and 20º C respectively (Eze *et al.,* 2018). However, the lowest

minimum temperature occurs between December and January when most parts of the state come under the influence of the tropical continental air mass that blows from the north.

Sampling Procedure: A multi-stage sampling technique was used to select respondents for the study. In the first stage, four communities were purposively selected from Bosso Local Government Area with their sampling frame; Shata (167), Kodo (184), kampala (110) and Gidan kwano (150). These communities are predominantly agrarian with smallholder crop farmers and are known for the cultivation of maize, rice, millet, yam, sorghum and cassava. In the second stage, thirty (30) respondents were randomly selected from each community for a sample size of 120 respondents Primary data were collected from the selected respondents by the use of structured questionnaire administered and personal interview. The questionnaire was designed to elicit information on the socio-economic ana institutional characteristics, sources of information, knowledge and attitude of climate agricultural practices. Descriptive statistics such as frequencies and percentages analyzed objective 1 and 11, while mean scores were used to analyze objective 111. To measure farmers knowledge and attitude on climate change, a total of 20 knowledge indicative questions were posed to the farmers where 20 is the maximum score and 0 is the minimum score, each farmers knowledge level was calculated from their responses. Farmers were then categorized based on their responses as follows:

14-20 = High knowledge level

10- 13= Low knowledge level

0-9= Poor knowledge level

Results and Discussion: Socioeconomic and institutional characteristics: The result in Table 3.1 indicated that the mean age of the respondents was forty (40) years, with an average household size of six (6), a low level of education, and mostly engaged in full-time farming (80.8%). This is consistent with the studies of Mbossoh & Udoh (2026). Ajuonuma *et al.*, 2024; Adebayo *et al.,* 2024; Saadu *et al.*, 2024 that respondents were in their active age with moderate household size and low level of education. This indicated the availability of an active and productive labor force capable of implementing climate adaptation measures. However. the general low level may limit their ability to understand complex climate smart information, highlighting the need for simplified and inclusive climate information approaches. Moreover, the predominance of full-time farming among respondents reflects their high dependence on agriculture and vulnerability to climate-related risk, hence, the relevance of the study to enhance resilience, productivity and sustained livelihood.

Sources of information on CSA: The results in Table 3.2 reveal that the majority (87.5%) of smallholder farmers source their information on CSA from a local radio station, specifically from Radio Niger. More than half (66.7%) sourced their information on CSA from friends and family, while half (50%) sourced their information on CSA from a cooperative. Notably, the majority of smallholder farmers in the study area had access to mobile phones with radios installed, and MP3 players with radios are prevalent in households. Farmers utilize these devices to listen to their favorite radio programs, especially agricultural broadcasts, during leisure time. The high reliance on a local radio station, facilitated by the widespread availability of mobile phones and MP3 players with radios, highlights the pivotal role of radio in reaching and engaging smallholder farmers. This accessibility suggests that

leveraging radio platforms for targeted CSA messaging could be an effective strategy for communication and knowledge dissemination. The second most important sources of information in the study areas w friends and relatives. The study area has a homogeneous community with a relatively small population and exclusive mutual relationships, making it easier to disseminate knowledge on CSA across the agricultural communities.The third most common source of information on CSA was cooperative; this is because of the prevalence of cooperative membership among smallholder farmers in the study area. This indicated a strong social structure and collective engagement within the community. Cooperatives serve as platforms where farmers can collaborate, share experiences, and collectively address challenges, including those related to CSA. More so, information disseminated through cooperatives has the potential to reach a larger audience, as cooperative members can share their knowledge with others in the community. This cascading effect can contribute to the scaling up of CSA practices across a broader segment of the smallholder farmers in the study area. This agrees with the study of Meaza (2010); Demisew (2016), and Sunday *et al* (2015), who reported that radio, friends, and relatives were the major sources of information among small-scale farmers.

Level of Knowledge and Attitudes of CSA Practices by Smallholder Farmers : The results in Table 3.3 showed the Likert rating scale on the knowledge and attitudes of CSA practices by smallholder farmers. The Table revealed that CSA helps to attain food security (3.8), CSA helps to protect soil erosion (3.8), and CSA promotes higher yield and household income (3.6) were the major perceptions of smallholder farmers on CSA. The high rating for the perception that CSA helps attain food security suggests that smallholder farmers recognize the role of climate-smart practices in ensuring a reliable and sustainable food supply. This is because CSA practices are designed to enhance the resilience of farming systems to climate variability. By adopting these practices, farmers can better withstand the impact of unpredictable weather patterns, reducing the risk of crop failures and ensuring a more stable food supply. More so, CSA often involves diversifying crops and selecting varieties that are better suited to changing climate conditions. This diversification can contribute to a more diverse and resilient food supply, addressing potential challenges associated with the impact of climate change on specific

crops. This is in line with the study of Saadu *et al*., (2024) and Sani *et al*., (2023). The acknowledgment that CSA practices are essential for addressing climate change challenges reflects an awareness of the specific risks and vulnerabilities associated with climate change in agriculture. CSA is seen as a proactive and necessary response to mitigate and adapt to these challenges. Farmers, recognizing the essential role of CSA in addressing climate change, suggest a commitment to long-term sustainability. CSA practices contribute to building resilience, reducing greenhouse gas emissions, and promoting environmentally friendly farming systems.

Farmers' Knowledge of Climate-Smart Agriculture: The results indicated that farmers knew climate-smart agricultural practices. Many respondents were aware of practices such as crop rotation, agroforestry, soil conservation, and the use of improved crop varieties. Studies conducted in Nigeria have also shown that farmers' awareness of CSA practices is increasing, although adoption levels remain moderate due to limited access to information and resources (Saadu *et al*., 2024; Sani *et al.*, 2023).

Farmers' Attitudes toward Climate-Smart Agriculture: The findings revealed that farmers generally had positive attitudes toward climate-smart gricultural practices. Many respondents agreed that CSA practices can improve crop productivity, reduce climate-related risks, and enhance farm sustainability. While several studies (Shah *et al.*, 2024; Alhassan & Haruna, 2024; Mitter *et al*., 2024 and Hassan & Knight, 2023) agreed with the research carried out that farmers had a positive attitude towards climate change practice, other studies recorded negativity toward the adoption of climate-smart agriculture (Madaki *et al.*, 2023 and Manh *et al*., 2023) Positive attitudes toward CSA practices often result from farmers' previous experiences with climate variability and their desire to adopt strategies that improve resilience to climate change.

Conclusion: This study examined the knowledge and attitudes of Climate-Smart Agriculture among crop smallholder farmers in Bosso Local Government Area in Niger State, Nigeria. The findings revealed that farmers were in their active age with an average household size, having low level of education. Majority of the farmers obtained information about CSA mainly from local radio stations, friends/family, and cooperative which they expressed positive attitudes toward CSA practices due to their perceived benefits in improving crop productivity and resilience to climate variability. The positive disposition of farmers toward climate-smart agriculture indicated their willingness to adopt innovative and sustainable practices. The findings also imply that, although farmers in Bosso were increasingly aware of climate change and recognized the benefits climate-smart agriculture practices, there is still a gap between knowledge, attitude and the actual practice of CSA. Nevertheless, CSA remains a viable pathway for improving agricultural productivity, enhancing resilience to climate change and ensuring sustainable livelihood among smallholder farmers. The study recommends efforts by Government agencies, agricultural extension organizations, research institutions are necessary to strengthen farmers' knowledge and improving farmers' access to climate information to sustain positive attitude. These measures will enhance farmers' capacity for practical adoption of sustainable CSA practices thereby improving resilience to climate change, sustainable agricultural practices and food security

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Table 3.1: Distribution of Respondents according to Socioeconomic Characteristics

Variable	Frequency	Percentage	Mean
Age			
20 and below	19	15.8	
21 – 40	56	46.7	40years
41 – 60	45	37.5	
Total	120	100.0	
Marital status			
Married	88	73.3	
Single	27	22.5	
Widow(er)	4	3.3	
Total	120	100.0	
Household size			
1-3	30	25.0	
4-6	38	31.6	6 persons
7-9	33	27.5	
10 and above	19	15.8	
Total	120	100.0	
Level of formal education			
No formal education	52	43.3	
Primary	37	30.2	6 years
Secondary	18	15.0	
Tertiary	13	10.8	
Total	120	100.0	
Level of involvement in crop farming			
Full time	97	80.8	
part time	23	19.2	
Total	120	100.0	

Source: Field survey, 2025

3.2 Sources of information on CSA

Table 3.2 Distribution of respondent according to sources of information on CSA

Sources	Frequency*	Percentage
Local radio station	105	87.5
Friend and family	80	66.7
Cooperative	60	50.0
NGOs and Development Organizations	40	33.3
Internet	25	20.8
Whatsapp	18	15.0
Facebook	14	11.6
Twitter	3	2.5
Youtube	7	5.8
Community Workshops/Seminars	10	8.3

Source: Field survey, 2025
* Multiple response

Table 3.3 Distribution of respondents based on level of knowledge and attitude of CSA practices by smallholder farmers

Statement	WS	WM	Remark	Rank
CSA helps to attain food security	376	3.76	A	1st
CSA helps to protect soil erosion	376	3.76	A	1st
CSA promotes higher yield and household income	359	3.59	A	3rd
CSA practices can help me adapt to changing weather patterns	352	3.52? P	A	4th
CSA reduces crop production cost	344	3.44	A	5th
CSA practices are essential for addressing the challenges posed by climate change in agriculture	335	3.35	A	6th
CSA positively influences the quality of agricultural products	338	3.38	A	7th
CSA practices help to maintain optimum irrigation	326	3.26	A	8th
Proper land use management and pest control management are improved due to CSA	320	3.20	A	9th
CSA ensures sustainable agriculture	312	3.12	A	10th
CSA practices influence the reduction of labour price	308	3.08	A	11th
CSA practices are essential for the long-term sustainability of agriculture	306	3.06	A	12th
CSA provides a fresh opportunity to improve market facility	293	2.93	DA	13th
CSA helps to minimize the production cost of vegetable yield	285	2.85	DA	14th
CSA is built for strengthening resilience to climate change risk and variability	269	2.69	DA	15th

Source: Field survey, 2025
WS = Weighted sum, WM Weighted mean