ASSESSMENT OF CLIMATE-SMART AGRICULTURE TECHNOLOGIES AND PRACTICES AMONG VILLAGE ALIVE DEVELOPMENT INITIATIVE (VADI) FARMERS IN KWARA STATE, NIGERIA.

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ABSTRACT

This paper assessed the climate-smart agriculture (CSA) technologies and practices among Village Alive Development Initiative (VADI) farmers in Kwara State, Nigeria. The specific objectives were to assess VADI farmers' awareness of climate-smart agricultural technologies and examine the climate-smart agricultural technologies practised by VADI farmers. A multi-stage random sampling technique was used to select 160 respondents for the study. Data were collected through an interview schedule and analysed using frequency counts, percentages, mean, standard deviation and regression analysis. Findings show that the age of the respondents had a high frequency (66%) at 56 years, and above which signifies that the farmers were adults. Most respondents (82.4%) were male, 84.5% were married, 76.4% had formal education with an average household size of 6 persons and 9 years of farming experience. Majority of the respondents were aware of irrigation practices (98.8%), mulching (92.5%) and ridges (92.4%). The high cost of conservation agriculture equipment was indicated as the most severe constraint to practising climate-smart agriculture technologies. The study concluded that there is a promising foundation for the adoption of CSA technologies as a high percentage is aware of climate-smart agriculture technologies. The study recommends that constraints to the adoption of climate-smart agriculture technologies should be addressed.

***Keywords**:* Climate-smart agriculture, Greenhouse gas, VADI Farmers

INTRODUCTION

Climate change is a pressing global issue that has far-reaching impacts on agricultural systems, especially in developing countries like Nigeria (Amoo & Fagbenle, 2020). The increasing frequency of extreme weather events, unpredictable rainfall patterns, and rising temperatures pose significant challenges to food security and rural livelihoods. In response to these challenges, the concept of Climate-Smart Agriculture (CSA) has gained considerable attention as a promising approach to enhance agricultural productivity, resilience, and sustainability (Fekad & Bekalu, 2020).

Kwara State, located in the North Central region of Nigeria, is primarily an agricultural state with a predominantly rural population dependent on small-scale farming for their livelihoods. However, like many other regions in Nigeria, Kwara State is experiencing the adverse effects of climate change, including erratic rainfall patterns, prolonged droughts, and increased occurrences of pests and diseases. These climate-related challenges pose significant threats to agricultural productivity and food security in the region (Aderounmu, 2021).

Recognizing the need to address these challenges, the Village Alive Development Initiative (VADI) was established as a grassroots organization working towards sustainable agriculture and rural development in Kwara State. VADI aims to empower local farmers by promoting climate-smart agricultural technologies and practices that enable them to adapt to the changing climate while ensuring environmental sustainability.

Climate-Smart Agriculture (CSA) is an approach that seeks to enhance agricultural productivity, build resilience, and reduce greenhouse gas emissions. It encompasses a range of practices that include the efficient use of natural resources, conservation agriculture, agroforestry, integrated pest management, and climate information services (Mensah *et al.,* 2021). By adopting CSA, farmers can mitigate the adverse impacts of climate change, improve their livelihoods, and contribute to sustainable development.

While the concept of climate-smart agriculture holds great potential, its adoption and implementation among smallholder farmers in developing countries like Nigeria are still limited. There is a need to assess the current state of adoption, identify the barriers and enablers, and provide recommendations for scaling up climate-smart agriculture interventions. This study aims to fill this knowledge gap by assessing the climate-smart agriculture technologies and practices among VADI farmers in Kwara State. The findings will contribute to the design of targeted interventions that address the specific needs and constraints faced by farmers in the region.

The main objective of this study was to assess the climate-smart agriculture technology practised among VADI farmers in Kwara State, Nigeria. To achieve this main objective, the following specific objectives were considered;

i. describe the socio-economic characteristics of VADI farmers;
ii. examine farmers' awareness of climate-smart agriculture technologies;
iii. assess the climate-smart agriculture technologies practised by VADI farmers;
iv. identify the constraint to practising climate-smart agriculture by VADI farmers.

METHODOLOGY

The study was conducted in Kwara State, which is in the North Central part of Nigeria has 16 local government areas. The state's total land area is 36,825 square kilometres. The state borders the Gulf of Guinea between Benin and Cameroon. It lies within the geographical coordinates of longitude 4.5^0E of the Greenwich and Latitude 8.5°N of the Equator. The state has River Niger as its natural boundary along its northern and eastern margins and shares a common internal boundary with Niger State in the north, Kogi State in the east; Oyo, Ekiti and Osun States in the South and an international boundary with the Republic of Benin in the West. The State is characterized by a tropical climate, which ranges from humid to sub-humid at different times in the year. As reported by Joshua 2013, the vegetation of the state is mainly forest and savanna and it constitutes about 47.78% and 35.04% respectively. The state has a tropical climate with a good deal of rainfall that averaging at 1217 mm and an annual average temperature of 26.5 °C.

Agriculture especially arable cropping and other agro-related activities are the major occupations of the people despite it being an administrative state. Varieties of food and cash crops are farmed, thus it runs an agrarian economy with a vast majority of the populace taking to farming and other enterprises. The major crops grown in the state include cotton, coffee, kolanut, sesame, oil palm, tobacco and Cocoa are the major crops grown in the state. Popular tree species found include Shea butter, Acacia, Parkia, Afzelia and Terminalia. According to Nigerian Population and Housing Census (2006), Kwara State has an estimated population of 2,365,353 people with population density of 65 persons per square kilometer with a GDP of $3.841B (World Bank, 2013).

A multi-stage sampling technique was used in the selection of respondents. Due to the government's intervention through its agency-Agricultural and Rural Management Training Institute (ARMTI)-on livelihood development through its Village Alive Development Initiative (VADI), all the nine participating communities in Kwara state were purposively selected for the study. A list of VADI farmers was obtained from the farmers' association and used as a sample frame. Twenty percent of the sample frame was randomly selected to give a total of 160 respondents for this study. A well-structured questionnaire was used in collecting data based on the objectives of the study.

Table 1: Summary of Sampling Procedure and Sample Size

S/N	Communities	Population of Farmers	20% of Farmers
1	Fufu	95	19
2	Elerinjare	97	19
3	Amoyo	85	17
4	Omomere-Oja	81	16
5	Falokun-Oja	93	19
6	Jimba-Oja	91	18
7	Igbo-Owu	79	16
8	Ilota	89	18
9	Apa-Ola	88	18
	Total	**798**	**160**

(Source: VADI Farmers Association, 2023)

The collected data was analyzed using descriptive statistics of frequency count, tables, means and percentages.

RESULTS AND DISCUSSION

Socio-Economic Characteristics of VADI Farmers

Table 2 reveals the dominance of male gender in farming activities in the study area. This is in line with the study by Rogers *et al*., (2021) who reported that most farm activities are energy-demanding, hence men tend to be more involved than women. The result further shows that the respondents are of their active age. This corroborates with a study conducted by Kurgat *et al.*, (2020) who reported that the age of household farmers is on average, 41 and 48 years respectively.

Table 2 shows that the married respondents were more involved in farming. This is in line with Olaniyi *et al.*, (2008) who reported that marital status is a significant influencing factor in the adoption of new technologies. The majority had Western education. This implies that the respondent should be educated enough to be aware of climate-smart agriculture. Table 2 reveals that respondents have a mean of 9 years of farming experience. Most of the farmers do not have formal training in climate-smart agriculture technologies. This suggests that there may be inadequate access to training opportunities related to climate-smart agriculture among the farmers.

Table 2: Socio-Economic Characteristics of VADI Farmers

Variables	Frequency	Percentage	Mean
Sex			
Male	132	82.4	
Female	28	17.6	
Age			
≤18	0	0	
19-36	47	29.1	
37-55	47	29.1	48years
≥56	66	41.8	
Min=21			
Max=72			
Marital Status			
Single	23	14.3	
Married	135	84.5	
Divorced/Widowed/ Separated	2	1.2	
Education			
No Formal Education	38	23.6	
Primary Education	47	29.5	
Secondary Education	58	36.3	
Tertiary Education	17	10.6	
Household Size			
≤5	43	27	
6-10	98	61	7
>10	19	12	
Farming Experience			
≤5	68	42.4	
6-10	52	32.7	9years
11-15	16	10.1	
16-20	12	7.6	
21-25	7	4.3	
≥26	5	2.9	
Min=2			
Max= 32			
Formal course on CSA	45	28	

(Source: Survey, 2023.)

Awareness of Climate-Smart Agriculture by VADI Farmers

Results presented in Table 3 show farmers' awareness of climate-smart agriculture technologies. The result reveals that the majority of the farmers are aware of irrigation as a climate-smart agriculture technology, followed by mulching and ridge-making. This suggests a strong foundation for implementing climate-resilient farming techniques within the community. A similar study was conducted by Autio *et al*., (2021) who reported that lack of awareness of CSA is one of the major factors that constrained the use and practising of CSA. There is a relatively low awareness among VADI farmers regarding minimum disturbance to the soil also known as zero tillage, followed by terracing and contour Ploughing. This indicates potential areas for improvement and education in implementing climate-smart agriculture practices within the community.

Table 3: Distribution of Respondents based on their Awareness of Climate-Smart Agriculture Technologies

Statements	Frequency	Percentage
Irrigation	158	98.8
Mulching	148	92.5
Ridges	148	92.4
Rainwater harvesting	144	89.7
Cover cropping	122	76.3
Crop rotation	120	75.2
Fallowing	111	69.2
Agroforestry	111	69.2
Composting	110	69.0
Farmyard manure	94	58.7
Green Manure	81	50.7
Intercropping	80	50.2
Organic agriculture	73	45.7
Contour Ploughing	64	39.8
Terracing	56	35.3
Zero tillage	49	30.5

Average Awareness = 69.55%

(Source: Survey, 2023.)

Climate-Smart Agriculture Technologies Practiced by VADI Farmers

The result in Table 4 indicates that ridge-making is the most practised climate-smart agriculture technique among VADI farmers. Rainwater harvesting follows closely. This implies that these practices are well-established within the communities, potentially due to their effectiveness in managing water resources and improving agricultural resilience to climate change. The implication is that these practices could serve as successful models for promoting climate-smart agriculture in the region, potentially leading to improved agricultural productivity and resilience to climate change. The result indicates that zero tillage is the least practised climate-smart agriculture technique among VADI farmers. Terracing and green manure follow closely behind. This indicated that these practices are not widely adopted within the communities. This implies that there may be challenges or barriers hindering the adoption of these techniques such as lack of awareness, resources or technical knowledge. Addressing these barriers and promoting the benefits of these practices could be important for encouraging the farmer's adoption, thereby enhancing their resilience to climate change and improving sustainability in agriculture.

The result in Figure 1 suggests that the level of climate-smart agriculture practised among VADI farmers varies. The result suggests that the level of practising climate-smart agriculture by the farmers falls between average and moderate. This implies that while there is a baseline level of adoption of climate-smart practices, there is still room for improvement. Encouraging more farmers to move into the high category and providing support and resources to those in the low category could help enhance the overall resilience and sustainability of agriculture in the VADI community.

Constraints to Practicing Climate-Smart Agriculture Practices and Technologies

The result (Table 5) indicates the primary constraint to practicing climate-smart agriculture and adopting related technologies among VADI farmers is the high cost of conservation equipment. This suggests that financial barriers are a significant impediment to the adoption of climate-smart agriculture. The second constraint identified is the lack of technical know-how, which implies that farmers may require training or education to effectively implement these practices. Lastly, the laborious and time-consuming nature of certain climate-smart agriculture techniques is identified as a constraint. This suggests that the physical demands and time commitments associated with these practices may deter some farmers from adopting them. The implication is that interventions to promote climate-smart agriculture among VADI farmers should address not only financial barriers but also provide technical training and support to enhance farmers' capacity to implement this practice effectively. Additionally, efforts to streamline and simplify labour-intensive practices could help overcome resistance to adoption.

Table 4: Distribution of Respondent based on Climate Smart-Agriculture Technology Practiced

CSA Technologies	NP	RP	OP	AP	
	F (%)	F (%)	F (%)	F (%)	MS
Ridges	7(4.7)	32(19.8)	44(27.3)	77(48.2)	3.19
Rain water harvesting	11(6.8)	25(15.8)	50(31.3)	74(46.1)	3.17
Crop rotation	25(15.8)	29(18.0)	29(18.0)	77(48.2)	2.99
Agroforestry	25(15.5)	29(18.1)	29(18.2)	77(48.2)	2.99
Irrigation	16(9.7)	79(49.6)	10(6.5)	55(34.2)	2.65
Mulching	9(5.8)	85(53.2)	32(19.8)	34(21.2)	2.57
Organic agriculture	19(12.1)	88(55.3)	16(9.8)	37(22.8)	2.44
Fallowing	20(12.6)	88(55.0)	16(9.7)	36(22.7)	2.42
Intercropping	12(7.6)	86(53.6)	50(31.3)	12(7.5)	2.39
Cover cropping	77(48.2)	12(7.9)	35(21.6)	36(22.3)	2.19
Composting	13(7.9)	115(71.9)	26(16.2)	6(4.0)	2.16
Contour Ploughing	78(48.6)	20(12.2)	29(18.3)	33(20.9)	2.11
Farm yard manure	89(55.8)	8(4.7)	20(12.5)	43(27.0)	2.11
Green Manure	41(25.9)	81(50.7)	28(17.3)	10(6.1)	2.04
Terracing	77(48.2)	38(23.7)	36(22.7)	9(5.4)	1.86
Zero tillage	89(55.8)	59(37.1)	9(5.5)	3(1.6)	1.54

***NP=Never Practiced *RP=Rarely Practiced *OP= Often Practiced *AP=Always Practiced *MS=Mean Score**

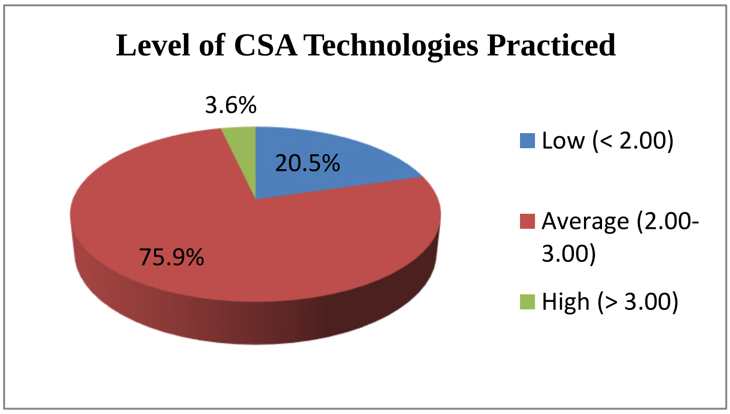

Figure 1: Distribution of the VADI farmers according to the level of CSA technologies practised,
Mean ± SD = 2.23 ± 0.24
(Source: Survey, 2023.)

Table 5: Distribution of respondents based on constraints to climate-smart agriculture technology

Constraints	Percentage	MS	Rank
High cost of conservation agriculture equipment	79.5	3.18	1st
lack of technical know-how	76	3.04	2nd
Laborious and time consuming	72.75	2.91	3rd
Insufficient resources including water, land, labour, time, financial means, knowledge, or training	70.75	2.83	4th
soil infertility	68.25	2.73	5th
Inadequate extension services	66.5	2.66	6th
Lack of knowledge/ awareness	64	2.56	7th
pest attacks	59.75	2.39	8th
Land size limitations	49.5	1.98	9th

***MS=Mean Score**
(Source: Survey, 2023.)

The least significant constraints to practising climate-smart agriculture and adopting related technologies among VADI farmers are land size limitations, followed by pest attacks and lack of knowledge and awareness. This suggests that compared to other factors such as financial barriers and technical limitations, land size limitations are relatively less inhibiting to the adoption of climate-smart practices. Pest attacks and lack of knowledge and awareness are also identified as constraints, but they are not as prominent as other factors.

CONCLUSION AND RECOMMENDATIONS

The study concluded that VADI farmer’s practice of CSA technologies was average. It also concluded that the farmers’ awareness of CSA technologies was above average. The most severe constraint faced by VADI farmers in practising CSA technologies was the high cost of conservation agriculture equipment followed by a lack of technical know-how. The findings underscore the importance of allocating resources towards rural public education, specifically aimed at equipping farmers with the necessary knowledge and skills in CSA practices and technologies. Further research is needed to consider gender in the practice of CSA.

The study also recommends that the Government should develop targeted training programs to enhance the knowledge and skills of VADI farmers in Kwara State regarding CSA technologies and practices. To address the constraints faced, there should be the exploration of opportunities for partnerships with Government agencies, NGOs and private sector stakeholders to improve resource availability for VADI farmers.

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