CLIMATE SMART AGRICULTURE, FOOD SECURITY AND SUSTAINABLE DEVELOPMENT

GLOBAL ISSUES & LOCAL PERSPECTIVES volume One

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Preface

This book adopts an exegetical approach as well as a pedagogic model, making it attractive agriculture and environmental economics teachers, professional practitioners and scholars. It is eschews pedantry and lays bars the issues in such clarity that conduces to learning. The book elaborates on contemporaneous **Climate Smart Agriculture, Food Security and Sustainable Development** issues of global significance and at the same time, is mindful of local or national perspectives making it appealing both to international and national interests. The book explores the ways in which climate smart agriculture (CSA) food security, Sustainable Development issues are and should be presented to increase the public's stock of knowledge, increase awareness about burning issues and empower the scholars and public to engage in the participatory dialogue climate smart agriculture, food security, and sustainable development necessary in policy making process that will stimulate increase in food production and environmental sustainability.

Climate Smart Agriculture, Food Security and Sustainable Development: *Global Issues & Local Perspectives* is organized in three parts. Part One deals with The Concept of **Climate Smart Agriculture**, Part Two is concerned with The Concept of **Food Security And** and Part Three deals with the Concept of **Sustainable Development**

Eteyen Nyong; October 2025

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Chapter Twenty
Integrating Crop Farmers Adaptation Stategies Against Climate Change In Ondo State, Nigeria

Emmanuel Olasope Bamigboye and Lateef Ayodeji Ola

INTRODUCTION

Nigeria's economy heavily relies on the agricultural sector. According to the National Bureau of Statistics (NBS) (2022), it made up almost 22% of Nigeria's GDP in the first quarter of 2020 and 26.84% in 2022. It generates a significant portion of the country's income and employs roughly 70% of the labour force (O'Brien, O'Keefe, Rose and Wisner (2006) cited in Solaja, Kolawole, Awe, Oriade, Ayojimi, Ojo, Nayan, Adedayo, Etta- Oyong, Olasehinde, Asemokhai and Nsikak 2024). Many of the materials used in the processing industries, including those that make textiles, soap, cocoa, sugar, cigarettes, and fruit canning, come from this important sector of the economy. Additionally, it offers the markets for a few non-agricultural goods.

Nigerian small farmers are especially susceptible to the consequences of climate change because of their considerable reliance on rain-fed agricultures. Natural and human systems on every continent, including the oceans, have been impacted by climate change in recent decades (International Panel on Climate Change, 2021). According to the IPCC's 2021 report, climate change impacts include how extreme weather and climate events affect both natural and human systems. While both positive and negative effects of climate change are possible, most of the world is expected to have negative or adverse effects. For instance, the IPCC report from 2021 discovered that agriculture production is more negatively impacted by climate change than positively. The effects of climate change on agriculture and ecosystems include rising temperatures, altered seasonality and variability of rainfall patterns, and extreme weather events like droughts and floods. For instance, Hurricane Stan in October 2005 caused flooding, fatalities, and agricultural losses in several towns in the Ilaje region of Ondo State, affecting around 600,000 people along the Chiapas coast (Oladapo and Aladejebi, 2022).

Climate change has the potential to exacerbate the issue in the future because of its greater ability to affect agricultural production. Because of the current climate change tendency, agricultural operations are more uncertain (Owagbemi, 2022). Thus, climate change will have a significant direct and indirect impact on food production. Effective climate change adaptation in agriculture is hampered by a number of obstacles and limitations, notwithstanding the tenacity displayed by farmers. These include a lack of technical knowledge and information, restricted access to credit and financing, and insufficient institutional frameworks and governmental

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assistance (Naazie, Agyemang, and Tampah-Naah, 2024). Multi-stakeholder cooperation, legislative changes, infrastructure spending, capacity training, and research and development are all necessary to address these issues.

Rainfall patterns and biomass output are two ways that climate change impacts land degradation. Land degradation is naturally influenced by rainfall intensity in relation to vegetation cover. Land degradation and climate change are, in fact, related in a number of ways. For example, soil salination is directly impacted by climate change brought on by rising atmospheric carbon dioxide.

In her synthesis report on climate change, the Intergovernmental Panel on Climate Change (IPCC) described how difficult it is to establish evidence of adverse climate effects on global agricultural productivity in aggregate agricultural statistics. One explanation is the benefits of global warming that temperate regions have seen, such as extended growing seasons and a lower risk of frost. The other significant factor is that, although Nigeria is in a tropical region, major technological advancements (such as improved fertility, breeding, and the management of pests and diseases) have led to a noticeable increase in the productivity of most crops in world agriculture, especially in temperate regions.

Therefore, adaptation is crucial for identifying ways to support farmers in Africa's rural economies by offering practical adaptation strategies like modern farm mechanisation, improved and resistant crop varieties, and irrigation facilities, among others, to counteract the negative effects of climate change (Ige, Akinnagbe, Odefadehan, and Ogunbusuyi, 2021). The discussion around farmers' adaptation to climate change has been influenced by a number of academics. Akinkuolie, Ogunbode, and Oyebamiji (2024) assess the limitations of farmers' adaptation plans to the effects of climate change on tropical farming. Oladapo and Aladejebi (2022) studied crop growers' adaption techniques to climate change. Simultaneously, Owagbemi (2022) conducted research on climate change adaptation options, problems, and rewards for rural farmers. These academics talked about how farmers are adapting to climate change, but they made little to no attempt to integrate crop producers' climate change adaptation methods (ICCAS).

Purpose of the study

Thus, the goal of this study was to increase the amount of information and knowledge about ICCAS that is available, as well as to provide packages of suggestions for the production of arable crops in situations of chaotic change. Additionally, it sought to improve stakeholders' capacity to apply ICCAS both within and outside of the study area.

i. document the personal characteristics of the respondent;
ii. examine the extent of utilization of integrated climate change adaptation strategies;
iii. determine the sources of information of climate change; and

iv. analysis the factors influencing utilization of climate change adaptation strategies among arable crops farmers.

Research Questions

The following research questions guided the study:

i. What are personal characteristics of the arable crop farmers in the study area?

ii. To what extent does the respondents utilize integrated climate change adaptation strategies in the study area?

iii. What are the sources of information on climate change in the study area?

iv. What are the factors influencing utilization of climate change adaptation strategies among arable crops farmers in the study area?

METHODOLOGY

This research was conducted in Ondo state, Nigeria. The state is located on Latitude 7.5875° North of the equator and latitude 4.5623° East of the Greenwich meridian. A sociological survey was conducted in three agro-ecological zones of the state to obtain primary data for the study. The identified Integrated climate change adaptation strategies were presented to experts in the institute of Ecology and Department of Geography at the Obafemi Awolowo University to rate the strategies with respect to their conformity to climate change adaptation options. The experts indicated that all the adaptation strategies were good support of climate change adaptation features.

While the experts' rating Improved validity, a test-retest method was used to improve the research instrument's reliability. The re-test was carried out by administering the research instrument twice at an interval of two weeks in Irele LGA which was not part of the study sites but bears similarities with the areas. Spear-man's rank order correlation was used to determine how aligned the responses were in relation to the first and second tests carried out among respondents. The second test scores were correlated with first scores for the reliability and a coefficient of 0.86 was obtained, which was far beyond the critical threshold value of 0.61 as adjudged by Ola (2023).

Three hundred and sixty-five (365) arable crop farmers were selected using simple random samples across agricultural zones in the study area. Besides information on personal characteristics, the respondents were asked to indicate the extent to which they utilized a particular integrated climate change adaptation strategies on a 4-point rating scale of CC utilization thus: never utilized (1), rarely utilized (2), often utilized (3) and always utilized (4).

Arable crop farmers utilization index for each of the ICCAS was established by calculating the mean score of all the responses.

The respondents were also asked to rank the motivating and demotivating factors to their utilization of ICCAS Descriptive statistics such as frequency, mean, percentage and standard deviation were used to describe the data while Pearson Product Moment Correlation was used to make inferential deductions.

RESULTS and DISCUSSION

Personal characteristics of Respondent

The respondents' mean age was 54.48±2.86 years, suggesting that they might still make a substantial contribution to their families' and society's socioeconomic well-being. This coincided with the NBS (2020) report that the economically active age group encompassed those between the ages of 15 and 64. The results also revealed that a sizable percentage of respondents (63.8%) were married. This suggests that the farmers have easy access to family labour. The respondents appear to be small-scale farmers, as shown by the mean farm size of 3 ha. This supports the findings of Solaja *et al.* (2024), who found that the majority of farmers in Kebbi State operate tiny farms with an average size of two hectares.
Furthermore, majority (63.8%) of the respondents were married (63.8%), followed by single respondents (24.9%), widowers/widows (6.8%), and divorced/separated respondents (4.1%). The fact that the respondents were married suggests that they may feel more accountable for their everyday actions. The average household size was six individuals, suggesting that the respondents had a sizable household, which might be helpful for their farming operation. This outcome was comparable to that of Ige *et al.* (2021). The most prevalent kind of labour, which is typically found in smallholder farm setups, is home labour. The respondents' monthly income was N150,000. Although the income is low but the respondents make more than the N70,000.00 monthly minimum wage in Nigeria. Low output, which typically results from the negative consequences of climate change, may also be the cause of the low income generated by farmers that grow arable crops (Ige *et al.,* 2021).

Respondents Extent of Utilization of Integrated Climate Change Adaptation Strategies

Finding in Table 2 showed the respondents always utilize ICCAS such as supplemental irrigation cum rainfed (mean=3.76). they often utilise early maturing crops cum late maturing crops (mean=3.45), breeding for desirable cultivars cum planting of native crop (mean= 3.34), Use of organic manure cum inorganic manure (mean=3.32). In addition, the respondents rarely utilize mulching of planted crops cum plastic mulch (mean=2.47) while they never utilize hydroponic cum open cultivation (mean=1.35) and greenhouse cum open cultivation (mean=1.34). Physical observation revealed that the category of these respondents is those working with

Ondo state ministry of Agriculture and other NGOs in the state. What could be inferred from this result is that respondents are quite aware of integrated climate change adaption options. This supports the findings of Oladapo and Aladejebi (2022), who found that adaptation is a crucial part of assessing the impact and susceptibility of climate change. It could be inferred that a flexible and dynamic approach is necessary for climate change adaptation. As the climate changes, farmers must constantly adjust and create resilient farming systems to meet the challenges. In order to cope with climate change and maintain the stability of agricultural production in the study area, farmers have implemented various measures. By diversifying risks, this strategy reduces financial losses brought on by crop failure. Using an integrated approach makes people more resilient to climate uncertainty. For instance, yields from early-mature, more tolerant crops might compensate for losses when a crop fails owing to late maturity. Growing a variety of crops that can withstand a range of climatic conditions and pests will not only reduce exposure to climate-related risk but also provide food security in the event of crop failure (Legide, Feyissa, and Karo, 2024).

Sources of information

The result in Table 3 showed the various sources of agricultural information which respondents accessed on their utilization of integrated climate change adaptation strategies. Majority (74.5%) of the respondents claimed that extension agents always provided the information. Radio was always and often a source of information on ICCAS utilization to 53.4 percent of the respondent respectively About (27.4%) of the respondents indicated that they always and often heard the information from arable crop farmers in the community. However, religious groups (10.7%), newspaper (16.9%) and research institutions (13.4%) provided the information relatively infrequently to the respondents in the study area. The implication is that farmers can obtain information about climate change from a variety of sources, particularly radio and extension personnel. Thus, information sources are viewed as critically pertinent for the efficient dissemination of information. The results corroborated Popoola, Yusuf, and Monde's (2020) assertion that neighbours, input dealers, intermediaries, and conventional media including radio, television, and newspapers have been the primary sources of information for rural farmers. The findings are also in line with those of Pickson and He (2021), who discovered that farmers are better prepared to adopt adaptive measures to lessen the effects of climate change when they have greater access to climate information and agricultural extension services and are involved in farmer-based organisations.

Factors influencing utilization of Indigenous Climate Change Adaptation Strategies among Arable Crops Farmers

The factors contributing to crop farmers utilization of ICCAS are presented into categories. These are motivation and demotivation factors. The finalizing revealed motivation factors that

influencing crop farmers utilization of ICCAS included access to extension message and technology, government support and cultural believed systems conversely. The identified demotivating factors included farmers poor perception about climate change, land tenure issues and poor knowledge and acceptance of agriculture.

Motivating factors influencing the utilization of ICCAS among crop farmers.

Results in Table 4 show that 45.0 percent of the farmers claimed that access to extension message and technology, which ranked as number one, was the most motivation factors that contributed to the utilization of ICCAS. Further analysis showed statements that were favorably disposed. Crop farmers will be abreast of early warning from the metro political agency due to information dissemination through appropriate channels that are opened to farmers not that alone. Similarly, about (28.5%) of the respondents reported that government support for the utilization of ICCAS among crop farmers was a motivation factor which positively influenced crop farmers utilization of the strategy and was ranked 2nd. Kephe (2020) poised that there is a need for the intervention of funding institutions to enable the farmers utilize their services. Moreover, 26.5 percent of the respondents reported that cultural belief system was another motivation factor, which influenced farmers utilization of ICCAS in the crop production and was ranked 3rd. This study supports the findings of Bamigboye (2015), who found that farmers' cultural beliefs must be taken into account in order for improved agricultural techniques to be implemented in rural Nigeria. This result supported the findings of Feder and Savastano (2017), who also noted that for agricultural innovation to be delivered effectively, modernisation and culture must coexist.

Demotivating Factors of crop farmers utilization of ICCAS

Result in Table 5 shows the mean distribution of crop farmers demotivating factors impeding their utilization of ICCAS. The results revealed that 39.18% of the respondents indicates that their perception about climate change and its attendant effects is one of the factors that discouraged their utilization and was ranked 1st

On one hand, 38.08% of the respondents claimed that knowledge and acceptance of the innovation is one of the factors which demotivated them in utilizing the ICCAS. Knowledge production and sharing acts as an influencing factor to people's understanding and perception. It is a factor that has foremost important in establishing the interest of the respondents and was ranked 2nd

On the other hand, 22.74% of the respondents reported that land tenure issues have been a major factor demotivating them in utilizing ICCAS in their crop production. This implies that majority of the respondents utilizes less of ICCAS in crop production because of the problems associated with land acquisition and was ranked 3rd.

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Pearson correlation showing relationship between socio-economic characteristics of respondents and their utilization of ICCAS

The result in Table 6 shows the relationship between some selected socio-economic characteristics of the respondents and their utilization of ICCAS. This result shows that socio-economic characteristics of the respondents like annual income (r= 0.472, P≤0.05), sources of information (r=0.568, P≤0.01), association membership (r= 0.442 P≤0.01), number of people assisting on farm (r=0.382 P≤0.01) had positive and significant correlation results with Arable crop farmers and extent of utilization of ICCAS.

The correlation between number of people assisting on the farmers farm and extent of utilization off\ ICCAS reflects the general features of small holder farmers as a system heavily dependent on family labour (Okorie, 2020). In order to maintain a sustainable future, farmers must be able to react to climate change, and this requires information (Pickson and He, 2021). The findings on income and social organisation membership, which were positively correlated with the use of ICCAS, provide credence to Okorie's (2020) assertion regarding the impact of social and economic concerns on smallholders' environmental stewardship.

Table 1: Distribution of respondents by selected personal characteristics

(n=365)

Variable	Frequency	Percentage	
Age (years)			
<30	52	14.2	54.2±12.5
30-59	233	68.8	
60>	80	21.9	
Sex			
Male	305	83.6	
Female	60	16.4	
Farm size (ha)			
<1	80	29.9	
1-2.99	158	43.3	2.52±0.13
3.0-4.99	99	27.1	

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5>	28	7.7	
Marital Status			
Single	97	24.9	
Married	233	63.8	
Divorced /Separated	16	4.1	
Widower/Widow	25	6.8	
Household Size			
<4.0	64	17.5	6.35±2.33
4.0-8.0	234	67.1	
12 >	58	15.9	
Income (Naira)			
Less than 100,000	200	54.8	
201,000-300,000	45	12.3	150,000±21,033
301,000-400,000	68	18.6	
400,000>	52	14.2	

Source: Field survey, 2024

Table 2: Distribution of Respondents Extent of Utilization of ICCAS

ICCAS	Never	Rarely	Often	Always	Mean
Supplemental integrated Cum rainfed	5(1.4)	30(8.2)	20(21.9)	2.50(68.5)	3.76
Early maturing crops cum Late Maturing crops	10(2.7)	20(5.4)	100(27.4)	230(63.0)	3.45
Breeding for desirable Cultivers cum planting of native crop	10(2.7)	35(9.6)	95(26.0)	225(61.6)	3.34

Use of organic manure cum inorganic manure	15(4.1)	29(7.9)	74(20.4)	246(67.4)	3.32
Mulching of planted crops cum plastic mulch	98(26.8)	80(21.9)	137(37.5)	50(13.7)	2.47
Hydroponic cum open cultivation	257(70.4)	88(24.5)	6(1.6)	4(1.1)	1.35
Greenhouse cum open cultivation	260(71.2)	90(24.7)	20(5.5)	5(1.7)	1.34

Source: Field survey 2024

Table 3: Distribution of respondents by the sources of agricultural information on ICCAS utilization (n=365)

Sources of Agricultural information	Frequency	Percentage
Extension Agent	272	74.5
Radio	195	53.4
Arable Crop Farmers	100	27.4
Newspapers	62	16.9
Research Institutions	49	13.4
Religious Groups	39	10.7

Source: Field Survey,2024

Multiple responses.

Table 4: Motivating factors influencing the utilization of ICASS among arable crop

Variables	$\overline{X}$	S. D	RANK	Freq.	%
Motivating factors					
Access to extension Message and Technology	1.94	0.84		165	45.21
-Correct use of fertilizer	2.35	1.02			
-Regular advising service from extension	2.56	0.52			

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-Use of Irrigation techniques	3.01	0.42			
-Use of improved seeds and seedling	2.05	1.00			
-Use of technological devices for information search	2.02	1.12			
-Extension training	2.64				
Grand mean			1ST		
Government support				105	28.77
-There is an easy access to government	2.12	0.10			
Fund	2.35	0.02			
-I get regular extension messages	2.42	0.72			
-Get advice from MET	3.25	0.68			
-I get satisfying help from agricultural institution	2.52				
Grand mean			2ND		
Cultural belief system				95	26.02
-The practice does not contradict belief system	3.2				
	3.4				
-Culture promotes the usage of ICCAS	2.15				
-No restriction to the planting of any arable crops in this community	2.01				
-Involvement in decision making Is made open	3.01				
	2.42				
-Decision is familistic			3rd		
Grand mean					

Source; Field survey, 2024

Table 5-Demotivating factors impeding the utilization of ICCAS among crop farmers

	Mean	S. D	Rank	Freq.	%

Demotivating factors			1st	143	39.18
Farmers perception about climate change	1.35	0.60			
-Crops are being decreased	1.48	0.54			
-Poor crops growth	1.65	0.48			
-Delay in planting	2.59	1.00			
-Repeated crop failure	3.66	0.48			
-Decrease in moisture content	2.13				
Grand mean					
Land tenure issues			2nd	139	38.08
-The process to acquire land which I used	3.8	0.62			
is outright purchase	3.1	1.1			
-Land is leased or rented	1.2	0.5			
-The land owners are not friendly	2.9	0.22			
-The land I'm using belong to my parents	1.2				
Grand mean					
Knowledge and acceptance			3rd	83	22.74
-I have been farming for 20years	2.94	1.11			
-I learnt art of farming from my parents	2.78	1.23			
-Farming is my major occupation	3.49	0.98			
-Farming is a rewarding job	4.20	0.61			
-Extension training updated my	3.40	0.62			
knowledge	5.00	0.64			
-I have deep passion for farming	3.03				
Grand mean					

Source; Field survey, 2024

Table 6: Pearson correlation showing relationship between socio-economic characteristics of respondents and their utilization of ICCAS

Variable	Pearson Correlation	Coefficient determination
Age	-0.072	0.0065
Education	-0.060	0.0041

Farm size	-0.081	0.156
Annual Income	0.472*	0.02362
sources of information	0.568**	0.0065
Association Membership	0.442 **	0.0175
Number of people Assisting	0.382**	0.0156

** Significant at P≤0.01; *Significant at P≤0.05
Source: Field survey, 2024

Conclusion and Recommendations

This study identified 7 ICCAS that met the basic principle of climate change and in which crop farmers were the major beneficiary. These adaptation practices addressed the economic growth as well as those boarding on the environment. Furthermore, the main sources of agricultural information in ICCAS utilization were extension agents and print media. Majority were found to be involved in the utilization of ICCAS. Whereas, the foremost demotivating factor to respondents' utilization of ICCAS was land tenure issues

Based on the findings of this study, it was concluded that respondents participated actively on the utilization of ICCAS, the motivating factors for their utilization of ICCAS includes; extension an information technology, government supports and conversely, demotivating factors includes; farmers perception about climate change, knowledge acquisition and acceptance and land tenure \issues. The study also revealed that income a membership in social organization were positive correlates of respondent's participation in the utilization of ICCAS. This result supports the view that some ICCAS meet the growth demands as well as environmental concerns of anthropocentric.

The study therefore recommends that crop farmers should be given the requisite training, access to land and credit which need to be supported with inputs and services to enable them embark on sustainable crop production under climatic condition.

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