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STRATEGIES FOR PROMOTING CLIMATE SMART-AGRICULTURAL PRACTICES AMONG SMALLHOLDER FARMERS FOR SUSTAINABLE DEVELOPMENT IN ENUGU STATE, NIGERIA

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ABSTRACT

The study examined strategies for promoting climate smart-agricultural practices among smallholder farmers for sustainable development in Enugu state, Nigeria. Multistage and random sampling techniques were used in selecting 180 farmers as respondents for the study. Data were collected using a structured questionnaire and interview schedule. Data were collected with the help of three research assistants who are ADP staff in the three selected LGAs. Out of the 180 copies of the questionnaire administered to the farmers, 167 copies were considered suitable for use in data analysis. The data collected were analyzed using descriptive statistics such as frequency, percentage, charts, mean and standard deviation. The results of the study showed that the use of agricultural extension agents to promote climate smart agriculture recorded (100.0%), farmers' cooperatives (94.6%), agriculture-based NGOs (75.9%), agricultural bulletins (68.5%), broadcast through radio or television channels (53.4%) are some of the channels for creating more awareness and disseminate information on climate-smart agricultural practices to farmers. Out of the 20 identified climate-smart agricultural practices, only seven were appreciably practiced by the farmers which indicate very low adoption of climate-smart agricultural practices by farmers in the state. In addition, the study identified 13 strategies for enhancing farmers' practice of climate smart agriculture. Based on the findings, the study among others recommended intensified and increased awareness creation about climate-smart agricultural practices among smallholder farmers through various media channels to sensitize the farmers on the procedure and what they stand to benefit from the practices.

Keywords: Strategies, Climate Change, Climate Smart-Agriculture, Smallholder Farmers, Enugu State.

INTRODUCTION

Smallholder farmers in Nigeria are increasingly facing climate-related challenges in a way that threatens food security and livelihoods of majority of the people in the country. Ng'ang'a, Miller and Girvetz (2021) admitted that majority of smallholder farmers in sub-Saharan Africa countries, Nigerian inclusive depend to a large extent on agriculture for income and food security which are currently been threatened by climate change. According to Musafiri, et al (2022), climate change manifests as dry spells, meteorological droughts, flooding, unreliable rainfall, cropping calendar changes, increased atmospheric temperature, flooding, induced crop failure, heat stress and dryness resulting in livestock losses culminating in food insecurity and severe threats to human's wellbeing. Similarly, the report of World Bank (2021) showed that climate change's negative impacts are already being felt, in the form of reduced crop yields, diminished nutritional quality of major cereals, and lowering livestock productivity. Traore, et al (2013) observed that unfavourable effects of climate change in agriculture will lead to further loss of income and decreased potential to generate employment among smallholder farmers in the rural areas. To address this ugly trend, World Bank (2021) suggested substantial investments in climate-smart agricultural practices to maintain current yields and to achieve increased food production to meet the rising demand.

Climate smart agriculture is an integrated approach that involves management of landscapes, cropland, livestock, forests and fisheries that address the interlinked challenges of food security and climate change (World Bank, 2021). According to FAO (2022) climate-smart agriculture is an approach that helps guide actions to transform agricultural systems towards green and climate resilient practices. Rainforest Alliance (2022) noted that climate-smart agriculture is not different from sustainable agriculture; rather it is a way of combining various sustainable agricultural practices to tackle specific climate-related challenges of farming and agricultural production. The World Bank (2021) reported that the major aim of climate smart agriculture is to simultaneously achieve three outcomes which are: increased productivity, enhanced resilience and reduced emissions.

Environmentally friendly climate smart agricultural practices such as cover cropping, mulching, minimum tillage, crop rotation, improved varieties, organic manuring and improved nutrient management practices among others (Ng'ang'a, Miller and Girvetz, 2021) have been shown to reduce greenhouse gas emissions by up to 20% in only one year; and by reducing greenhouse gas emissions, climate smart agriculture can enable agricultural systems adapt to climate change (Cramer, 2019). Similarly, Climate smart agriculture practices can reduce or eliminate greenhouse gas emissions and have the propensity to increase farm income and productivity for sustainable development (Agbenyo, et al., 2022).

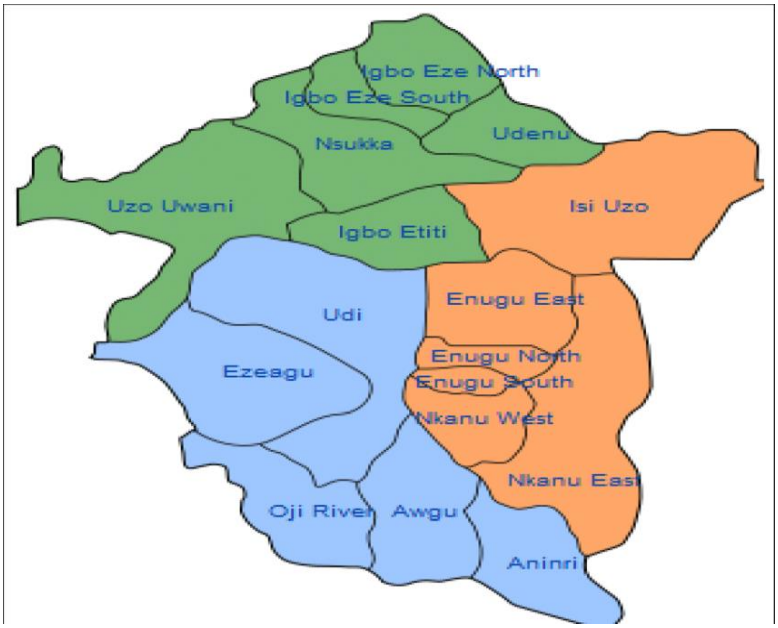
In the context of this study, sustainable development according to (Willers 1994) is the process of improving the quality of human life while living within the carrying capacity of supporting ecosystems The author asserted that Sustainable development is viewed in terms of a per capita consumption path that is constant or rising over time.

There have been several attempts and programmes channelling resources into climate smart agriculture for improving smallholder livelihoods and food security in sub-Saharan African countries (Ng'ang'a, Miller and Girvetz, 2021). Unfortunately, the rate of adoption and use of climate smart agricultural practices among smallholder African farmers, Nigeria in particularly is still relatively low. For instance, Musafiri, et al (2022) noted that the current low adoption of climate smart agricultural practices in sub-Saharan African countries is worrisome more so that agriculture contributes to greenhouse emission and

worsening climate change. World Bank (2017) stated that currently, agriculture, forestry and land use changes generate about 24% of the world's greenhouse gases and about 80% of deforestation worldwide is driven by agriculture. Hence, efforts aimed at improving farm related practices to cut down emission and increase productivity for better incomer and livelihoods of smallholder farmers should be prioritized. It was based on the background that this study identified strategies for promoting climate smart-agricultural practices among smallholder farmers using Enugu State as case study.

METHODOLOGY

The study was carried out in Enugu State. The state is located between longitudes 6º 53' and 7º 55' East of the Greenwich meridian and latitudes 5º 56' and 7º 05' North of the equator. Enugu State is made up of 17 administrative Local Government Areas with headquarters in Enugu. The State is bounded in the north with Benue and Kogi States, in the west with Anambra State. It is bounded in the east by Ebonyi State and in the south by Abia State. Enugu State is divided into three agricultural zones which are: (i) Enugu North, Enugu East and Enugu West. The population of Enugu State according to the report of National Bureau of Statistics (2016) is 4,411,119 people. Farming activity is the main occupation of the people of Enugu State. The main agricultural cash crops in Enugu State include: cashew, mango, citrus and oil palm among others while food crops grown in the state include yam, cassava, maize, cocoyam and different types of vegetables such as cucumber across the state. Poultry beds, goats, pigs, cattle, fishes and snails are some of the mostly reared livestock by farmers in the state.



Map of Enugu State indicating the Area of the study

Multistage, random sampling techniques were used in selecting the respondents for the study. Firstly, Enugu North agricultural zone was randomly selected for the study from the existing three agricultural zones in the state. At the second stage, three LGAs namely: Nsukka, Udenu and Uzo-uwani LGAs were randomly selected within the zone. The third stage involved random selection of four farming communities from each of the three LGAs making a total of 12 farming communities for the study. At the fourth stage of the selection, 15 arable crop farmers were randomly selected from each of the 12 villages making 180 farmers that constituted the sample for the study. Data were collected using a structured questionnaire and interview schedule. Items in the structured questionnaire focused mainly on channels for promoting climate smart agricultural practices, extend of use of climate smart agricultural practices and strategies for enhancing climate smart agricultural practices among smallholder farmers in the state.

Data were collected with the help of three research assistants who are ADP staff in the three selected LGAs. The research assistants helped in interpreting the items to some of the farmers who could not read, write or understand English Language. Out of the 180 copies of the questionnaire administered to the farmers, the data collected were cleaned and 167 copies of the questionnaire were considered suitable for use in data analysis. The data collected were analyzed using descriptive statistics such as frequency, percentage, charts, mean and standard deviation. Mean values were computed on 4-point rating scale and were assigned values as follows:

Response Categories	***Value***	***Boundary limits***
Highly Practiced (HP) / Strongly Agreed (SA)	4	3.50 – 4.00
Fairly Practiced (FP) / Agreed (A)	3	2.50 – 3.49
Less Practiced (LP) / Disagreed (D)	2	1.50 – 2.49
Not Practiced (NP) / Strongly Disagreed (SD)	1	1.00 – 1.49

Based on this computation, any item with mean value, any item with mean within the range of 3.50 and above is interpreted as Highly Practiced or Strongly Agree as the case may be. Any item with mean within the range of 2.50 - 3.49 was interpreted as Fairly Practiced or Agree as the case may be. Items with mean within the range of 1.50 - 2.49 were interpreted as Less Practiced or Disagree while items with mean values within the range of 1.00 - 1.49 were interpreted as Not Practiced or Strongly Disagree as the case may be.

RESULTS AND DISCUSSION

Information Channels for Promoting Climate Smart Agricultural Practices

The result in Figure 1 below present multiple response percentage distribution of various channels suggested by farmers for promoting information dissemination on climate smart agriculture practices. From the chart, the use of agricultural extension agents to promote climate smart agriculture recorded (100.0%), followed by farmers' cooperatives (94.6%), agriculture-based NGOs (75.9%), agricultural bulletins (68.5%) and broadcasting climate smart agricultural practices through radio or television channels (53.4%). Adebayo, *et al* (2011) found that radio and television programmes among other channels promote climate change awareness among farmers. Gbetibouo (2009) confirmed that access to extension services will further improve awareness of changes in the climate among farmers. In addition, Sani, Boadi, Oladokun and Kalusopa (2014) reported

that in Nigeria, like most African countries, agricultural information are mostly spread through farmers' cooperatives, policy makers, extension workers and agro-allied industries. Abdul-Aziz and Baba (2017) reported that radio, television, community newspapers, agricultural bulletins and extension workers have been identified as major sources of agricultural information to farmers.

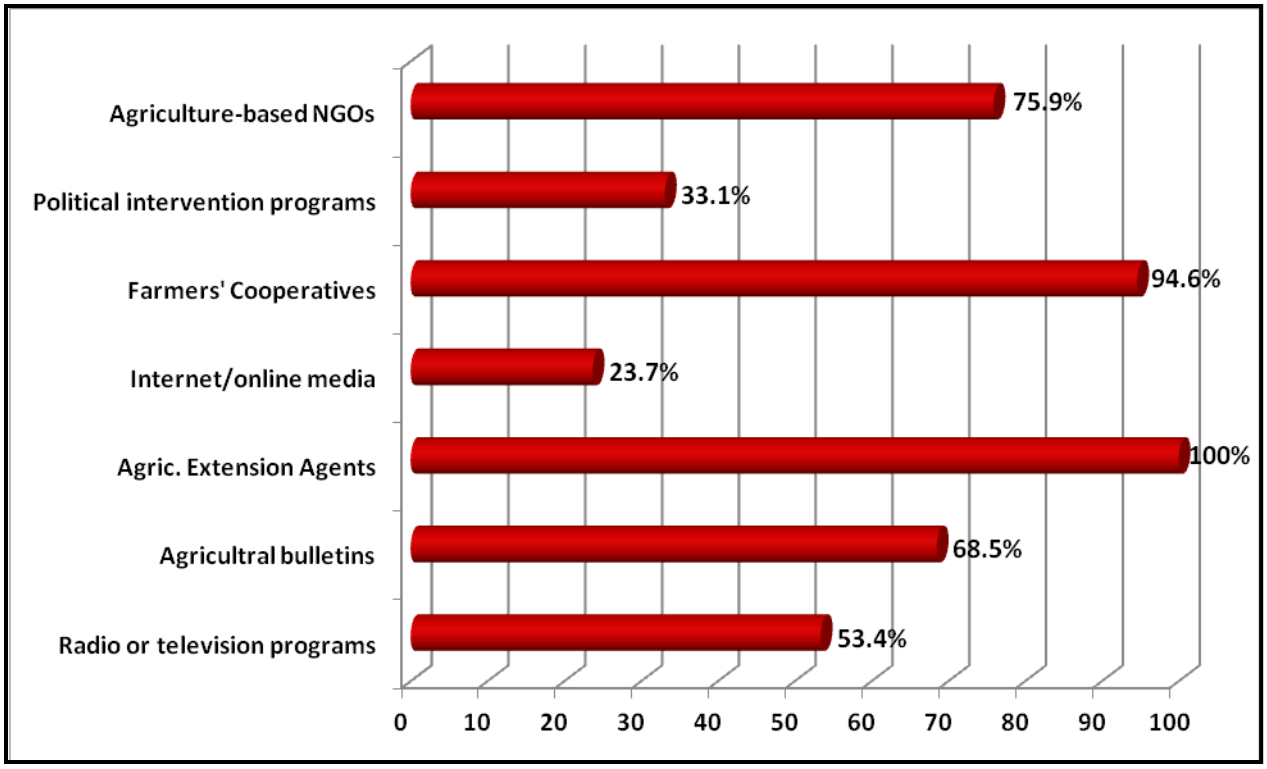


Figure 1: Information Channels for Promoting Climate Smart Agriculture

From the chart above, using political intervention programmes and internet/online media as channels to promote climate-smart agricultural practices recorded 33.1% and 23.7% respectively. These percentages were relatively low possibly due to very poor perceived interest of political class in agriculture and low level of education among smallholder farmers who may not really be able to benefit from any agricultural-related information from the internet or online media. Abdul-Aziz and Baba (2017) submitted that farmers' use internet is low and the factors that limit farmers use of internet range from; low awareness, low internet access, lack of knowledge and skills to use the Internet.

Extend of Use of Climate Smart Agricultural Practices

The results in Table 1 present the intensity of climate-smart agricultural practices among farmers in Enugu State. From the result, it was showed that: rainwater harvesting (3.52) with mean value within the boundary limit 3.50 – 4.00, which indicated highly practiced. Planting drought resistant crops (2.65), mulching (2.82), intensified use of organic matter (3.19), use manual weeding instead of herbicides (3.32), mixed cropping (3.45) and integrated soil nutrients management (3.20) all have their mean values within the boundary limit 2.50 – 3.49, which indicated fairly practiced. The remaining 13 climate-smart agricultural practices in the Table have their mean values within the boundary limit 1.00 – 2.49 which indicate less practices of climate smart agriculture. Hence, the less practiced climate-smart agriculture with their respective mean values include: planting ground cover (2.28), build drainage systems (1.84), construction of trenches (1.76), planting on contours (2.35), investing in pest-resistant crops (2.10), planting shade trees (1.76), planting nutrients building species of trees (1.68), irrigation (2.40), minimum tillage (1.68), zero bush burning (1.82), bush fallowing (1.62), crop rotation (2.18) and zero deforestation (1.75). From the above results, the level of intensification of climate-smart agriculture among farmers in the state is still very low as only few of the identified climate smart agricultural practices are practiced by the farmers. This finding supported that of Gebrehiwot and Veen (2013) who observed poor climate-smart agricultural practices among farmers and blamed the situation on lack of information on adaptation measures and lack of finance are seen as the main factors inhibiting adaptation to climate change.

Similarly, Zanmassou, et al (2020) reported that the practice of climate-smart agriculture among smallholder farmers is still relatively low in sub-Saharan African countries, Nigeria inclusive. The findings of this study also substantiated that of Georgieva, Gaspar and Pazarbasioglu (2022) the poorest countries of the world mostly found in Africa face the greatest risks from climate change and more vulnerable due to their poor adoption of climate-smart practices requiring international support through finance.

Table 1: Mean Ratings of Smallholder Farmers on the Intensity of their Use of Climate Smart Agricultural Practices (n= 167)

SN	Climate smart agricultural practices	HP	FP	LP	NP	$\bar{x}$	SD	Rmks
1	Planting ground cover	13	47	80	27	**2.28**	0.83	**LP**
2	Build drainage systems	4	17	95	51	**1.84**	0.69	**LP**
3	Construction of trenches	-	22	83	62	**1.76**	0.66	**LP**
4	Planting drought resistant crops	31	60	63	13	**2.65**	0.87	**FP**
5	Planting on contours	8	59	83	17	**2.35**	0.73	**LP**
6	Mulching	44	62	48	13	**2.82**	0.91	**FP**
7	Intensified use of organic matter	58	87	18	4	**3.19**	0.71	**FP**
8	Investing in pest-resistant crops	4	44	84	35	**2.10**	0.74	**LP**
9	Use manual weeding instead of herbicides	76	70	21	-	**3.32**	0.68	**FP**
10	Planting shade trees	5	19	74	69	**1.76**	0.77	**LP**
11	Planting nutrients building species of trees	-	9	96	62	**1.68**	0.57	**LP**
12	Rainwater harvesting	100	51	13	-	**3.52**	0.65	**HP**
13	Irrigation	10	64	76	17	**2.40**	0.75	**LP**
14	Minimum tillage	-	17	80	70	**1.68**	0.65	**LP**
15	Zero bush burning	-	31	76	60	**1.82**	0.72	**LP**
16	Bush fallowing	-	5	93	69	**1.62**	0.55	**LP**
17	Crop rotation	13	25	66	63	**2.18**	0.76	**LP**
18	Mixed cropping	89	64	14	-	**3.45**	0.64	**FP**
19	Integrated soil nutrients management	78	53	27	9	**3.20**	0.90	**FP**
20	Zero deforestation	-	22	81	64	**1.75**	0.67	**LP**

Note: ***HP*** *= Highly Practiced;* ***FP*** *= Fairly Practiced;* ***LP*** *= Less Practiced;* ***NP*** *= Not Practiced*

$\bar{x}$ **=** *Mean;* ***SD =*** *Standard Deviation;* ***Rmk*** *= Remark.*

Strategies for Enhancing Farmers' Practices of Climate Smart Agriculture

The results in Table 2 revealed strategies that could be adopted to enhance intensity of climate-smart agricultural practices among farmers. From the result, 10 out of the identified 13 strategies having mean values within the boundary limit 3.50 – 4.00 were "strongly agreed" upon by the respondents as measures for enhancing farmers' practices of climate-smart agriculture. The 10 strategies and their respective mean values are: intensified agricultural extension visits (3.66), capacity building of farmers through training and retraining (3.62), increased awareness creation about climate-smart agriculture (3.69), distribution of resistant crop varieties to farmers (3.54), strengthened agricultural technology transfer (3.57), improved irrigation facilities and efficiency (3.68), subsided farm inputs (3.59), improved funding of agricultural research (3.66), provision of credit to farmers to increase climate-smart practices (3.64) and intervention programs by global agencies such as FAO, IFAD, World Bank etc (3.52).

Furthermore, the remaining three items in the table with their respective mean values: provision tree seedlings for planting (3.35), improved research-extension-farmers linkages (3.21) and intensified precision/site specific farming (2.81) have their mean values within the boundary limit 2.50 – 3.49 which indicates that the respondents "agreed" that the three items are part of the strategies for enhancing farmers' practices of climate-smart agriculture. Ivanchuk (2020) in his study identified improved irrigation efficiency and precision/site specific farming advocacy as part of the notable strategies for enhanced climate-smart agriculture among farmers. In another submission, Herald (2020) recommended improved education and capacity building of farmers as strategies to enhance adoption of climate-smart agriculture among smallholder farmers. As a measure to improved climate-smart agriculture in sub-Saharan African (SSA) countries, World Bank (2019) advocated increased financing and funding of climate-smart agriculture programmes. In addition, Mondal (2022) suggested strengthened agricultural technology transfer and irrigation water supply projects as efforts that must be put in place to ensure improved climate-smart agriculture among smallholder farmers.

Table 2: Mean Ratings of Smallholder Farmers on Strategic Measures for Enhancing farmers' Practices of Climate Smart Agriculture (n= 167)

SN	Strategies for enhancing farmers' practice of climate smart agriculture:	SA	A	D	SD	$\bar{x}$	SD	Rmks
1	Intensified agricultural extension visits	111	56	-	-	**3.66**	0.47	**SA**
2	Capacity building of farmers through training and retraining.	103	64	-	-	**3.62**	0.49	**SA**
3	Increased awareness creation about climate-smart agriculture	115	52	-	-	**3.69**	0.46	**SA**
4	Distribution of resistant crop varieties to farmers	95	68	4	-	**3.54**	0.55	**SA**
5	Strengthened agricultural technology transfer	107	48	12	-	**3.57**	0.63	**SA**
6	Improved irrigation facilities and efficiency	119	45	3	-	**3.68**	0.51	**SA**
7	Provision tree seedlings for planting	83	64	16	4	**3.35**	0.75	**A**
8	Subsided farm inputs	99	68	-	-	**3.59**	0.49	**SA**
9	Improved funding of agricultural research	112	55	-	-	**3.66**	0.47	**SA**
10	Provision of credit to farmers to increase climate-smart practices	107	60	-	-	**3.64**	0.48	**SA**
11	Intervention programs by global agencies such as FAO, IFAD, World Bank etc	87	80	-	-	**3.52**	0.50	**SA**
12	Improved research-extension-farmers linkages.	76	63	16	12	**3.21**	0.89	**A**
13	Intensified precision/site specific farming	48	56	47	16	**2.81**	0.96	**A**

Note: ***SA*** *= Strongly Agreed;* ***A*** *= Agreed;* ***D*** *= Disagreed;* ***SD*** *= Strongly Disagreed*

$\bar{x}$ **=** *Mean;* ***SD*** **=** *Standard Deviation;* ***Rmk*** *= Remark.*

CONCLUSION

Adoption of climate smart agriculture is crucial to adaptation and residence of farmers to the negative effects of climate change for sustainable food production. The devastating effect of climate change has continued to be worse in Nigeria like other sub-Saharan countries. Hence, this study examined strategies for promoting climate smart-agricultural practices among smallholder farmers using Enugu State Nigeria as case study. From the data collected and analysed, it was revealed that the present level of adoption of climate-smart agricultural practices is very low in Enugu State. It is therefore concluded the observed low practices of climate-smart agriculture contribute to the worsened effects of climate change in Nigeria and Enugu State in particular. Strategies to for enhancing practice of climate-smart agriculture among smallholder farmers were identified for adoption by government and other stakeholders in agriculture. Based on the findings and conclusion, the study recommended:

i. Intensified and increased awareness creation about climate-smart agricultural practices among smallholder farmers through various media channels to sensitize the farmers on the procedure and what they stand to benefit from the practices.
ii. Steady capacity building of smallholder farmers through training and retraining on required skills and knowledge to effective carry out climate-smart agriculture practices in their day-to-day farm operation.
iii. Proactive and constant agricultural extension visits to smallholder farmers for training and provision on necessary guide to the farmers on climate-smart agriculture.
iv. Strengthened agricultural technology transfer through improved research-extension farmers linkages that will facilitate transmission of new knowledge on climate-smart agriculture to farmers.

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