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Crop Farmers' Access to E-information for Climate Smart Agriculture Production, in Cross River State, Nigeria

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Abstract

The study ascertained crop farmers' access to e-information for climate-smart agriculture production in Cross River State, Nigeria. Using a multistage sampling procedure, 191 respondents were selected and data were collected with the aid of a structured questionnaire. Percentages, means and Spearman rho correlation were used to analyse the data. Results showed that the least used climate-smart agriculture (CSA) practices were agroforestry (27.7%), water harvesting practices (25.1%), construction and use of irrigation facilities (14.1%) and land reclamation practices (16.2%). The majority (72.3%) of farmers got e-information on climate-smart agriculture from the radio, while 8.9% and 12.6% got it from internet websites and social media respectively. E-information that was less accessed by the farmers was information on zero tillage ($\bar{x}$=2.33), and minimum tillage. There was a weak, positive monotonic relationship (γ_s= 0.029) between farmers' use of climate-smart agriculture practices and access to e-information. Reliable and timely climate-smart agriculture information targeting tillage, cropping, and water harvesting and use should be developed by extension service providers, uploaded and broadcasted via traditional electronic media and other non-e-sources for easy access and use by farmers.

Introduction

Agriculture remains the key sector that plays a vital role in the growth of most economies of the countries in sub-Saharan Africa. However, the sector is greatly impacted by changes in climate because its activities are climate-dependent (Halliru, 2021). Climate change has altered rainfall patterns, agroecological zones, cropping calendars, increased the frequency of flooding/drought, diseases and pest outbreaks and infestations, etc (Musafiri et al., 2022). The resultant effects have been poor crop yields, livestock loss, food insecurity, hunger, poverty and severe threat to the well-being of small-scale farmers who bear the brunt of these effects (Chitakira and Ngcobo, 2021). The negative consequences of climate change on food production, food security and the environment have attracted global interest, prompting the need to work with farmers to adopt innovative agricultural practices that will enable them to cope, hence the birth of climate-smart agriculture [CSA] (Waaswa, et al., 2021). CSA is defined as an approach that helps to transform agricultural systems to sustainably increase productivity, adapt and build resilience, and reduce or remove greenhouse gas (GHG) emissions so as to support food security (Hellin and Fisher, 2019). CSA combines devices and tools of conventional agriculture with innovative technologies (which may also be precise information or accurate data from datasets at the farm level or outside sources such as weather stations) to furnish farmers with recommendations for good decision-making in the face of uncertainties caused by climate change (Mizik, 2021). CSA is not "a one-size-fits-all practice" rather it is a mixture of practices (traditional and innovative) that are incorporated into an agricultural system for climate change adaptation thereby making it context-specific (Chitakira and Ngcobo, 2021).

For farmers to practice CSA, they need to engage in farming activities that help the soil to capture and/or prevent GHG emissions and store carbon; adopt pro-water conservation practices and innovative technologies that ensure water efficiency and access during periods of water scarcity; adopt weather smart practices by using information and communication technologies (ICTs) such as the radio, television, mobile phones or internet to access weather information; adopt climate risk insurance; and form and participate in farmer-to-farmer knowledge sharing associations (Anuga et al., 2019). Small-scale farmers especially those in sub-Saharan Africa are already adopting some of these practices in a bid to cope with the adverse effects of climate change (Abegunde et al., 2019).

The adoption of CSA practices by farmers has resulted in improved crop yields, nutrient and water use efficiency, enhanced food security, reduced GHG emissions and subsequently reduced the impact of climate change (Makate et al., 2018; Issahaku and Abdulai, 2019). In spite of these benefits, the adoption and upscaling of CSA practices have remained very low (Issahaku and Abdulai, 2019; Trendov et al., 2021). This is attributed in part to a lack of awareness of CSA technologies/practices, limited skills, and infrastructure (Chitakira and Ngcobo, 2021). It is generally believed that part of the solution to this lies in the use of digital technologies and innovations to disseminate e-information to farmers (Trendov et al.,2019). The incorporation of digital technologies and services in CSA entails the use of a wide variety of Information and Communication Technology (ICT) services, tools or applications such as basic phones, drones, sensors, smartphones, computers, internet, satellite imagery, radio, television for data/information collection or exchange (Trendov et al.,2019; Wally, 2021).

Although digital devices provide resource-poor farmers with updated e-information on CSA technologies as well as weather/climate information, access to this information has remained a challenge (Diamini and Worth, 2019; Jiménez et al., 2019). The resultant effects are poor adaptation to climate change by farmers, perpetual poor yields, low income and poverty (Branca et al., 2021). In Cross River State, these claims have not been empirically verified. Thus, the objectives of this study were specifically to: identify climate-smart agriculture practices used by the farmers; identify farmers' sources of information on CSA; ascertain farmers' access to CSA information from e-sources; and determine the association between farmers' use of climate-smart agriculture practices and access to e-information.

Methodology

The study was conducted in Cross River State situated in the south-south geopolitical zone of Nigeria. It lies between latitude 4^{0} 28^{1} and 6^{0} 55^{1} North of the equator and Longitude $7^{0}50^{1}$ and 9^{0} 28^{1}East of the Greenwich meridian. The state is made of three agricultural zones namely: Calabar agricultural zone comprising Biase, Calabar Municipal, Odukpani, Calabar South, Akamkpa, Bakassi, and Akpabuyo agricultural blocks; Ogoja agricultural zone consisting Bekwarra, Yala, Ogoja, Obudu, and Obanliku blocks; and Ikom agricultural zone covering Abi, Obubra, Yakurr, Ikom, Etung, and Boki blocks. A multi-stage sampling procedure was used to select respondents for the study. In the first stage, purposive sampling was used to select Ogoja and Ikom agricultural zones. This is because the bulk of food crops in the state comes from these zones. These agricultural zones are made of five and six agricultural blocks respectively. In the second stage, simple random sampling was employed to select two blocks from each of the selected agricultural zones giving a total of four blocks. The selected blocks were: Ogoja, Bekwarra, Obubra and Yakurr. In the third stage, 3 cells were selected from each of the selected blocks using simple random sampling making a total of 12 cells. In the fourth stage, simple random sampling was used to select 10% of registered crop farming household heads from each of the cells giving a total of 204. However, only one hundred and ninety-one (191) farmers participated effectively in the research; hence a sample size of 191. A structured questionnaire was used to collect the data and data were analysed using percentages and means. The Spearman rho's correlation analysis was used to test the association between farmers' use of climate-smart agriculture practices and access to e-information.

To identify climate-smart agriculture practices adopted by the farmers, twenty-three (23) CSA practices were obtained from literature and presented to farmers to indicate either 'yes' or 'no' against the ones used. A list of possible sources of e-information on CSA was also presented to the farmers to indicate either 'yes' if they were used or 'no' if otherwise.

With respect to farmers' accessibility of e-information from the identified e-sources, twenty-five (25) CSA e-information types were presented to respondents to rate the ease of access using a four-point Likert-type scale. The rating scale had response categories of 'very difficult', 'difficult', 'easy' and 'very easy' with rating scores of 1 to 4 respectively. E-information types with mean score values above or equal to 2.5 indicated that they were easily accessible; while those with mean score values less than 2.5 represented difficult accessibility.

The association between farmers' use of CSA practices and access to e-information was determined using Spearman rho's correlation coefficient (ρ).

Results and Discussion

Types of Climate Smart Agriculture Practices Used by Farmers

Table 1 shows the types of CSA practices employed by arable crop farmers in the state. The main ones used were crop rotation practices (100%), crop diversification practices (100%), and proper timing of farm operations such as planting and harvesting dates (99.5%). These results support the finding of Fawole and Aderinoye-Abdulwahab (2020) that crop diversification and use of cultural management practices such as crop rotation are key CSA practices adopted by farmers in Nigeria. However, these results contradict those of a study conducted in Kenya by Muriithi *et al.* (2021) where climate-smart agriculture technologies such as intercropping; crop rotation and crop diversification had low adoption rates of 16.88%, 15.09% and 10.06% respectively. Furthermore, results on Table 1 show that the least used CSA practices by the farmers were agroforestry (27.7%), water harvesting practices (25.1%), construction and use of irrigation facilities (14.1%) and land reclamation practices (16.2%).These results are consistent with findings in Kenya where the low adoption rates of 12.82% and 9.79% were observed for agroforestry and water harvesting practices by small scale farmers respectively (Muriithi et al., 2021).The implication of these results is that climate change is affecting farming activities in Cross River State; hence farmers are employing various ways to cope and build resilience even though rates of adoption of the practices may vary from one agro-ecological zone to another (Fawole and Aderinoye-Abdulwahab, 2020).

Table 1: Types of climate smart agriculture practices used by farmers

Climate smart agriculture practices	Percentage (n=191)
Fallowing	91.6
Minimum tillage	33.5
Mechanical weeding	46.1
Use of early/late maturing crop varieties.	77.5
Mixed farming	97.9
Proper timing of farm operations such as planting and harvesting dates	99.5
Intercropping	96.9
Proper planting depths	95.8
Crop rotation practices	100
Crop diversification practices	100
Drought resistant varieties	87.4
Pest and disease-resistant varieties	99
Crop-livestock integration practices	55.5
Agroforestry	27.7
Afforestation/reforestation practices	38.2
Soil conservation practices e.g. mulching/ cover cropping.	82.2
Appropriate fertiliser application rates	26.7
Compost manure practices	48.7
Use of green manure practices	84.3
Water storage practices and management	33
Water harvesting practices	25.1
Construction and use of irrigation facilities	14.1
Land reclamation practices	16.2

Sources of e-Climate Smart Agriculture Information

Table 2 shows the various sources of e-CSA information available to crop farmers in the study area. The majority (72.3%) of farmers got e-information from the radio. It is also worth noting that a large proportion (64.4%) of the farmers consulted non e-sources such as friends and extension agents for information on CSA practice. Only 8.9% and 12.6% got e-CSA information from internet websites and social media respectively. These results infer that farmers rely heavily on traditional electronic media such as the radio and television for CSA information. This corroborates the findings of a study by Ncoyini et al., (2022) that the radio and television were widely used to disseminate climate information to farmers. However, it was also noted that such information were non-specific and restricted interaction between the end-users and information source. The results reveal further that new media such as mobile phones (24.6%), internet websites (8.9%) and social media (12.6%) were not widely used by farmers for CSA information. This might be attributed to the high cost of obtaining these devices as well as low skills for manipulating them. This finding agrees with that conducted by Rashid (2020) where it was observed that farmers rarely consulted e-sources such as the computer, digital camera and internet for information on CSA due to socioeconomic variables like income, education and the social category of the farmer.

Table 2: Crop farmers' sources of e-CSA information

E-CSA information	Percentage (n=191)
Radio	72.3
Mobile phone	24.6
Internet websites	8.9
Television	31.4
Tablet computer	0.5
Social media (Whatsapp, Instagram, Facebook, Zoom, etc)	12.6
Non e-sources (Friends, extension agents, personal experience etc)	64.4

*Multiple responses

Access to e-Climate Smart Agriculture Information

Results on access to e-CSA information are presented on Table 3. Access to information on methods and practices that increase organic nutrients ($\bar{x}$=3.7) was ranked 1st and that on compost manure practices ($\bar{x}$=3.59) 2nd.These results suggest that over the years, farm lands in the study area have become less fertile due to climate change and continuous cultivation. Hence, farmers tend to seek for information that will boost soil fertility. Such information, especially from agriculture computer applications or artificial intelligence sources, are timely and scientific-based that will help farmers improve soil fertility and consequently crop productivity (Food and Agriculture Organization-FAO, 2021). Again, Table 3 shows that accessibility of information on water harvesting and storage practices ($\bar{x}$=3.58) was ranked 3rd. This information is critical as it probably aids crop farmers living in drought prone areas to make timely decisions concerning water management for agricultural and domestic purposes. Bahn et al., (2021) posited that digital agriculture makes smart irrigation options available to farmers thereby helping them put scarce water resources to more efficient use.

Table 3: Crop farmers' access to e-information on climate smart agriculture

Type of e-CSA information	Mean score
Information on methods and practices that increase organic nutrients	3.7*
Information on Compost manure practices	3.59*
Information on water harvesting and storage practices	3.58*
Information on agrochemical use e.g., herbicides, pesticides, insecticides etc.	3.51*
Information on soil protection practices e.g., mulching/use of cover crops	3.45*
Information on the timing of farm operations such as planting and harvesting dates	3.44*
Information on marketing of agricultural produce	3.40*
Information on fertiliser rates consistent with climatic conditions	3.39*
Information on crop varieties resistant to pests and diseases attack	3.39*
Information on green manure practices and use	3.34*
Information on the precise matching of nutrients with crop needs	3.17*
Information on crop varieties better adapted to the expected length of the growing season, water availability and new conditions of temperature and humidity.	3.11*
Information on the weather and knowing when to plant.	3.09*
Information on intercropping	3.09*
Information on irrigation systems and use	3.04*
Information on agro-forestry/planting of trees	2.97*
Information on drainage systems construction	2.91*
Information on exploitation of wetlands/river valleys (e.g., fadama)	2.87*
Information on crop-livestock integration practices	2.85*
Information on land reclamation practices	2.85*
Information on planting depths	2.58*
Information on zero tillage	2.33
Information on minimum tillage	2.17
Information on climate risk-prone zones	2.02
Information on mechanical weeding	1.97

*Easily accessible. (mean scores ≥ 2.5 indicate easily accessible)

Furthermore, farmers ranked accessibility of information on agrochemical use e.g., herbicides, pesticides, and insecticides ($\bar{x}$=3.51) 4th. This infers that farmers readily turn to e-information sources to get information on the management of crop diseases and pest infestations, especially where extension services are scarce.

According to FAO (2021), digital information can help farmers identify diseases and pests, prevent their spread or lessen the damage caused, thereby increasing output. Additionally, access to information on soil protection practices e.g., mulching/use of cover crops ($\bar{x}$=3.45) and that on the timing of farm operations such as planting and harvesting dates ($\bar{x}$=.44) were ranked 5th and 6th respectively. Due to growing unpredictability of weather patterns as a result of climate change, there is the tendency for crop farmers to resort to e-information sources for reliable information that will guide in planning farming activities. In Cambodia and Kenya, it was observed that farmers made use of apps that provided guidance and specific information on suitable planting dates and cultural practices for specific crops (Simelton and McCampbell, 2021). Accessibility of e-information on zero tillage ($\bar{x}$=2.33) and minimum tillage ($\bar{x}$=2.17) were ranked 22nd and 23rd respectively. These are information related to land preparation. Similarly, the accessibility of information on climate risk-prone zones ($\bar{x}$=2.02) and mechanical weeding ($\bar{x}$=1.97) was ranked 24th and 25th respectively. These low rankings might be attributed to the nonalignment of the information to farmers' pressing needs or low awareness of the need to consult e-sources for such information. Popoola et al. (2020) found that limited access to certain CSA information by small-scale farmers was related to a low level of awareness, thus poor adaptive capacities.

In general, out of the first ten (10) e-CSA information accessed by the farmers, seven (7) were information relating to soil nutrient management and pest and disease control (i.e., information on methods and practices that increase organic nutrients, compost manure practices, agrochemical use, soil protection practices, fertiliser rates consistent with climatic conditions, crop varieties resistant to pests and diseases attack, and green manure practices and use). Bahn et al., (2021) opined that farmers' access to these sets of information will expose them to smart soil fertilization and smart pest control options that are relevant for coping with adverse climate effects and result to increased crop yields.

Association between Farmers' Use of Climate Smart Agriculture Practices and Access to E-Information

There is a weak, positive relationship (γ_s= 0.029) between farmers' use of climate-smart agriculture practices and access to e-information. The conclusion is that there is no significant association between farmers' use of climate-smart agriculture practices and access to e-information. This means that though farmers employ various CSA practices for crop production, information on these practices does not necessarily come from e-sources. This finding upholds the views of Ncoyini et al., (2022) who purported that farmers need information that meets their specific needs and would consult any information source (whether e-sources or otherwise) in order to build resilience and enhance food production

Conclusion and Recommendations

Practices such as agroforestry, water harvesting and land reclamation were adopted by a small proportion of them. Besides, the bulk of the farmers depended on traditional electronic media such as the radio and television as well as non-e-sources (like friends, and extension agents) for information on CSA. Furthermore, farmers had easy access to information relating to soil nutrient management and pest and disease control. Results showed a weak, positive relationship between farmers' use of climate-smart agriculture practices and access to e-information. Reliable and timely climate-smart agriculture information targeting tillage, cropping, and water harvesting and use should be developed by agricultural extension service providers, uploaded and broadcasted via traditional electronic media and other non-e-sources for easy access and use by farmers.

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