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Indigenous Climate Change Adaptation Strategies among Crop Farmers in Osun State, Nigeria

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Abstract

The study assessed the indigenous climate change adaptation strategies employed by crop farmers in Osun State, Nigeria. Primary data were gathered from 170 crop farmers across the state. A pre-tested structured interview schedule was used to elicit quantitative information from the respondents. The data were analysed with percentages and means. The results showed that the chirping of crickets, the appearance of cattle egrets, an army of ants, and the abundance of flying termites were the major agroecological indicators used to predict seasonal climate change. Erratic rainfall patterns (94.1%) and unusual early rains followed by weeks of dryness (92.9%) were the noticeable features of climate variability. The major indigenous strategies used were Indigenous agroecological knowledge ($\bar{x}$=2.82) and diversifying cropping patterns ($\bar{x}$=2.82). Major constraints limiting the utilisation of indigenous adaptation strategies were insufficient documentation of Indigenous strategy (98.8%) and limited support from the younger generation (96.2%). Most crop farmers had in-depth knowledge of indigenous agroecological indicators in their environment and employed multiple indigenous strategies to cushion the effects of climate change. There is a need to

integrate indigenous adaptation strategies with modern scientific knowledge by relevant stakeholders to boost crop production and ensure food security.

Introduction

Climate change refers to alterations in climate patterns brought about by prolonged natural processes or human activity. National Aeronautics and Space Administration (NASA) (2023) describes climate change as a significant and long-term alteration in the statistical distribution of weather patterns that spans decades to millions of years. This change is often caused by anthropogenic (human) or natural activities that increase atmospheric concentrations of greenhouse gases (GHGs) such as carbon dioxide, methane, and nitrous oxide. The United Nations International Children's Emergency Fund (UNICEF) (2024) reported that climate change disrupts weather patterns, resulting in extreme weather, water uncertainty, scarcity, and contamination, posing significant risks to global water security. Along with these changes come high-temperature trends linked with global warming, with the attendant effects of increased flooding, high pest and disease infestations, loss in soil fertility, and various other extreme weather occurrences (UNICEF, 2024).

Climate change is a serious threat to agriculture worldwide which negatively impacts rain-fed agriculture on which the economies of most developing nations like Nigeria depend, with less adaptive ability to withstand climate shocks (Yakubu et al., 2020). Crop farmers have been identified to be susceptible to the negative effects of climate change ranging from poor quality and quantity of crop yield, food shortage and its associated hunger since the majority of them depend on rain-fed agriculture (Abuta et al., 2021; Asare-Nuamah et al., 2022). Rural farming households have relied more on the knowledge their ancestors passed down to them than on scientific procedures to overcome the problems associated with climate change and improve decision-making (Kom et al., 2022; Teka et al., 2022).

Adaptation is putting practical steps in place to cushion the impacts of climate risks. Most rural farmers adopt indigenous climate change adaptation strategies which are proven effective in minimising their vulnerability to climate-related shocks. These indigenous strategies are traditional practices and knowledge mostly passed down from parents and shared among farming communities to cope with the impacts of climate variability and change. According to Ekanem and Umoh (2024), rural farmers have adapted to climate variability by leveraging on natural resources and their expertise, indigenous skills, and accumulated knowledge of previous weather patterns and experiences.

These strategies are often based on observation, experience, and experimentation adapted to local conditions and ecosystems. Some of these strategies include using agroecological knowledge, rainwater harvesting, agroforestry, and manual watering among others as reported by Ekanem and Umoh (2024), Baffour-Ata et al. (2021) and Mbah et al. (2021). Although much is known about modern climate change adaptation strategies used by farmers, the issues of indigenous adaptation strategies used by crop farmers have not been fully explored in the study area. Proper understanding and documentation of these indigenous strategies become necessary due to limited access of crop farmers to metrological weather information and

modern adaptation strategies to mitigate climate-related risk. Hence this study specifically:

i. documented indigenous agroecological indicators used to predict weather and seasonal change by the crop farmers;
ii. identified features of climate variability as perceived by crop farmers;
iii. examined the indigenous adaptation strategies utilised by the crop farmers; and
iv. identified the constraints hindering the utilisation of indigenous adaptation strategies by crop farmers.

Methodology

This research was conducted in Osun State, Nigeria. It is located between latitude 7° 6' 0.0180" N and longitude 4° 50' 30.0984" E (Alabi et al., 2020). It has thirty local government areas (LGAs). The population for this study was the adult rural crop farmers in Osun State. A multistage sampling procedure was employed to pick the crop farmers. The proportionate selection of 10% of the LGAs in the State was adopted in the first stage, which translated into three LGAs namely Atakunmosa West, Ayedire and Ife North LGAs. The second stage involves the proportionate selection of six rural communities each from Ayedire and Ife North LGAs while five communities were selected from Atakunmosa LGA. Purposive sampling was adopted to select 10 adult crop farmers who had a good knowledge of indigenous adaptation strategies from each of the chosen communities, making a total sample size of 170. An interview schedule was used to gather information from the crop farmers. Percentages and means were used to analyse the data collected.

The utilisation of indigenous adaptation strategies by crop farmers was captured by listing about 18 indigenous adaptation strategies. Each strategy was rated on a 4-point scale with options ranging from never utilized (0 points), rarely utilized (1 point), occasionally utilized (2 points) and always utilized (3 points) as employed by Famakinwa et al. (2023). Their responses were summed up to form a utilisation score. Features of climate variability were captured by asking the respondents to indicate what they perceived as common features of climate variability in their communities, and measured with “yes” or “no”. Indigenous agroecological indicators were captured by requesting the respondents to provide information on indigenous ways they used to predict weather and seasonal climate. A list of indicators ranging from the behaviour of plants and animals and atmospheric conditions were presented to the crop farmers who were required to state how each was used to predict seasonal changes. Each response was scored one on the onset of rain and drought. Also, respondents were asked to indicate the constraints that prevented them from utilising the indigenous adaptation strategies. Option “yes” was scored 1 while “no” was scored 0.

Results and Discussion

Indigenous Agroecological Indicators

The results in Table 1 show that a combination of animal and plant behaviour and atmospheric conditions were used to predict seasonal climates. The majority (84.7%) of the respondents claimed that the movement of groups of millipedes was a major

signal of the onset of the rainy season. Also, 83.6% indicated that the chirping of crickets at night was another major signal of the onset of rain. Similarly, the consistent croaking of frogs in the evening and morning (80.6%) and the appearance of cattle egrets (73.5%) among others also signalled the onset of rain for the crop farmers. All these indicators inform them that the rain would soon start and the need to commence land preparation for a new planting season. Similarly, the majority (86%) of the respondents indicated that the chattering of Senegal-heeled birds explained that rain would soon fall because the bird only drinks water droplets on leaves and, it was also noticed that when it is chattering, it is calling for rain due to no water to drink. This is similar to the finding of Adesoji and Adesoji (2021), Baffour-Ata et al. (2021) and Radeny et al. (2019) that the majority of the rural farmers used the chirping of crickets and consistent croaking of frogs to predict the onset of rain. Also, the majority acknowledged that the appearance of hawks in the sky (90.5%), the appearance of dragonflies as they are seen swimming and playing around water bodies (88.8%), and the absence of earthworms near the ground (80%), laying of eggs by bush fowls on the field or farms (76%) among others served as signals for the beginning of dry season or drought.

Besides, some noticeable phenological changes in plants are also used for weather forecasts as shown further in Table I. The results show that respondents agreed that flowering of certain plants like locust bean plants (95.9%), fruiting of local trees like garden-eggplant (94.5%), and generation of new leaves by some tree species like baobab (68.8%) signified the onset of rainfall and planting season. This finding is supported by the observation of Baffour-Ata et al. (2021), and Adesoji and Adesoji (2021) that crop farmers depend on the flowering of locust bean plants and fruiting of certain tree species like garden egg-plant as a signal for the onset of rainy season.

However, respondents claimed that excessive flowering and fruiting of trees like mango, cashew and avocado (81.8%), and heavy or excessive fruiting of oil palm (68,8%) were signals of potential drought season. However, when few fruits of these plants are formed, they predict a good planting season with a good harvest. Concerning atmospheric indicators, respondents acknowledged that the onset of harmattan (84%) and high-intensity sunlight and heat (79.4%) were good indicators of dry seasons, while lightning and thunderstorms accompanied by rainfall around October (85%) mean that rainfall would soon cease and also marked the beginning of the dry season. These findings imply that crop farmers were familiar with agroecological knowledge used as a key indigenous adaptation practice for weather forecasting. This practice has been effective and reliable for them over the years.

Table 1: Perceived Indigenous agroecological indicators used to determine seasonal changes

Agroecological indicators	Onset of rain	The onset of the dry season
	%	%
Biological indicators		
Animal behaviour		
Chirping of crickets	83.5	
Appearance of cattle egrets	73.5	
Appearance of an army of ants	89.4	
Sighting of owl in the sky	64.0	
Movement of millipede	84.7	
Consistent croaking of frogs	80.6	
Appearance of certain birds	57.1	
Migration of insects like black butterflies and grasshoppers		63.5
Absence of earthworms near the ground		80.6
Chattering of Senegal lark-heeled bird		86.0
Appearance of dragonfly		88.8
Appearance of large numbers of grasshoppers on farmland		79.8
Appearance of hawk		70.5
Laying of eggs by bush fowl		76.0
Abundance of flying termites		
Crabs migrating out of the stream to land		
Plant behaviour		
Fruiting of locust bean tree	94.1	
Flowering of certain plants (eggplant)	95.9	
Heavy/excessive flowering of mango, cashew and avocado		81.8
Generation of new leaves by some tree species e.g baobab	68.8	
Heavy/excessive fruiting of oil palm		68.9
Atmospheric indicators		
High intensity of sunlight and heat		79.4
Onset of harmattan		84.0
Lightning and thunderstorms are accompanied by rainfall around October		89.0
Appearance of dark clouds	87.0	

Source: Field survey, 2023

Features of Climate Variability

Evidence in Table 2 was based on the noticeable features of climate variability as observed by the respondents. The results reveal that about (94.1%) of respondents indicated they mostly experienced erratic rainfall patterns (94.1%), unusual early rains followed by weeks of dryness (92.9%), high temperature (91.8%), delay in the onset of rain (89.4%), reduced rainfall (88.8%), increase in pest and disease problem

(88.1%), and drought (84.1%) among others as the indicators and signs of climate change in their communities. This finding suggests that the majority of the crop farmers were aware, and had good knowledge and experience of some changes in the seasonal climate of their communities based on observation and past experiences. Consequently, this has necessitated them to use local adaptive measures to mitigate its impacts on their crop production and other livelihood activities to prevent food insecurity. This submission is in line with the report of Eze et al. (2019) that crop farmers had good knowledge of climate variability which may likely influence them to adaptive measures to cushion its effects.

Table 2: Features of climate variability

Features	Percentage
Erratic rainfall pattern	94.1
Unusual early rains followed by weeks of dryness	92.9
High temperature	91.8
Delay in the onset of rain	89.4
Reduced rainfall	88.8
Increase in pest and disease problems	88.1
A long period of dry season/drought	84.5
Drying up of streams/rivers	81.2
Floods and erosion	60.0
Heavy wind storm	58.8
Heavy and long periods of rainfall	52.4

Source: Field survey 2023

Utilisation of Indigenous Adaptation Strategies

The results in Table 3 show that the indigenous agroecological knowledge for weather forecasting to prevent crop failure ($\bar{x}$=2.82) ranked first among the indigenous adaptation strategies used. This is due to the reliance of crop farmers on indigenous adaptation strategies that observe natural indicators, such as animal and plant behaviour, to forecast weather patterns This helps the farmers to adjust the planting calendar accordingly against any crop failure; which remains the most important option for mitigating climate risks among rural farmers. This strategy has been effective and has proven reliable to them over the years. This is similar to the submission of Baffour-Ata et al. (2021) who observed that traditional agroecological knowledge was mostly adopted by indigenous strategies among farmers in Ghana. Diversifying the cropping pattern ($\bar{x}$=2.80) was the second-ranked strategy employed to cope with the effect of climate variability among crop farmers. This is because the cultivation of different varieties of crops rather than relying on one crop would reduce vulnerability to climate-related risk, and withstand varying weather conditions and pests would also ensure food security in case of crop failure (Legide et al., 2024). The use of mixed farming ($\bar{x}$=2.76) unsurprisingly ranked third, because integrating livestock rearing and crop farming ensures a variety of options and makes crop farmers resilient in the face of negative climate change impacts like drought. Planting of local seed varieties of crops that can withstand and adapt to sudden changes in weather ($\bar{x}$=2.75), hence, ranked fourth.

This is because local varieties of seeds are rare and hardy, the quality that can withstand changing weather conditions due to the ability of these local seeds to adapt to the local climatic conditions. Praying for rain and good weather ($\bar{x}$=2.65) ranked next to the preservation and planting of local varieties of crops. This has been the common practice of crop farmers because of their level of attachment to God and they have the belief that it is only Him who can give good weather. This agrees with the finding of Famakinwa et al. (2023) that praying for rain was a major strategy utilized by rural crop farmers to cushion the climate impacts. Another indigenous adaptation strategy used by crop farmers is the use of agroforestry ($\bar{x}$=2.59). The practice of planting trees and shrubs alongside arable crops planting shade plants or trees, especially tree crops like cocoa has been utilized to adapt to the effects of climate change because they provide shade for young seedlings from direct sunlight during prolonged dry season; help to stabilise soil and ensure food security to support farm families before fruiting of the trees.

Table 3: Utilisation of Indigenous adaptation strategies

Indigenous adaptation strategies	Means
Indigenous agroecological knowledge	2.82
Diversifying cropping pattern	2.80
Mixed farming	2.76
Planting of local seed varieties	2.75
Praying for rain and good weather	2.66
Agroforestry	2.59
Adjusting planting calendars	2.50
Divert attention to livestock	2.40
Water harvesting	2.14
Acquiring more lands	2.02
Planting of cover crops	1.98
Manual watering	1.83
Temporary alternative source of employment	1.72
Early harvesting	1.55
Extended fallow period	1.45
Mulching	1.43
Migration or abandoning of one site for another	1.28
Delay harvesting	1.20

Source: Field survey, 2023

Constraints Hindering Utilisation of Indigenous Adaptation Strategies

The results in Table 4 reveal that most (98.8%) of respondents identified lack of proper documentation of indigenous adaptation strategies. Specifically, traditional agroecological knowledge of weather forecasting is not well-documented. This knowledge is usually passed down through generations, but is being lost as individuals with this knowledge pass away; leaving a significant knowledge gap. Limited support for the use of indigenous adaptation strategies by youth and educated people (96.4%) who believe only in the use of modern adaptation strategies may not fully appreciate or support the use of indigenous adaptation

practices. Also, the lack of policy support from the government (92.1%) is another constraint limiting the use of indigenous adaptation strategies. This is attributed to little or no government policy and programmes that support the use of indigenous adaptation strategies. Other problems identified include limited knowledge about the use of different indigenous adaptation strategies (88.8%); lack of integration of modern scientific knowledge with indigenous adaptation strategies (85.9%), and limited access to resources (67.8%). The use of indigenous adaptation strategies by farmers may depend on local resources or materials that are not always accessible, which can restrict their utilisation. The overall result supports the observation of Legide et al. (2024) who reported that despite the affordability, effectiveness and sustainability of indigenous adaptation strategies, insufficient documentation, lack of policy support, lack of integration with modern scientific knowledge and limited support from the younger generations limit their utilization to reduce the burden of climate change by farmers.

Table 4: Constraints hindering utilisation of Indigenous adaptation strategies

Constraints	Percentage
Insufficient documentation of adaptation strategies	98.8
Limited support from the younger generation	96.2
Lack of favourable government policy to support Indigenous adaptation strategies	92.2
Limited knowledge of Indigenous adaptation strategies	88.8
Poor integration with modern scientific knowledge	85.9
Limited access to resources such as varieties of some local seeds and planting materials	67.8

Source: Field survey, 2023

Conclusion and Recommendations

Crop farmers used traditional agroecological knowledge to make farm decisions and to predict weather and seasonal climates. Besides, crop farmers use multiple indigenous adaptation strategies to adapt to the adverse effects of climate change on their agricultural production. Despite the affordability, effectiveness and sustainability of Indigenous strategies, insufficient documentation, and lack of favourable policy to support indigenous adaptation strategies limit their utilisation. In addressing these limitations, there is a need to integrate indigenous adaptation strategies with modern scientific knowledge by relevant stakeholders. There should be the creation of more awareness and knowledge about traditional adaptation strategies, especially among young farmers and the use of indigenous strategies should be encouraged by extension organizations. Favourable policies should be enacted by the government to support and promote the use of traditional adaptation strategies that have been proven effective in mitigating the effects of climate change among farmers. Since local farmers still depend on indigenous knowledge for weather and climate information, there is a need to urgently carry out in-depth research on the scientific validity and accuracy of the strategies by the researchers. Finally, more effective strategies to mitigate the challenges that come with climate

variability should be developed by relevant stakeholders and communicated effectively to the crop farmers.

References

Abuta, C. M., Agumagu, A. C. & Adesope, O. M. (2021). Social media used by arable crop farmers for communicating climate change adaptation strategies in Imo State, Nigeria. *Journal of Agricultural Extension,* 25(1) 73-82

Adesoji, S. A. & Adesoji, A. O. (2021). The use of Indigenous Information System for weather and climate prediction for agricultural production in the age of the COVID-19 pandemic in Osun State, Nigeria. Proceeding of DAAD Alumni Event on sustainable health and Food Systems to Climate change and the COVID-19 pandemic held at Obafemi Awolowo University Ile-Ife, Nigeria between 28-31 March 2023. pp 23-34.

Alabi, D. L., Famakinwa, M. & Akinnawonu, O. E. (2020). Involvement of rural households in oil palm (Elaeis guineensis) fruits postharvest activities in Ondo State, Nigeria. *Journal of Agricultural Extension* 24 (1), 42-53

Asare-Nuamah, P., Antwi-Agyei, P. & Dick-Sagoe, C. (2022). Mitigating the risks of climate variability and change on mango seedlings in Ghana: Evidence from mango seedlings producers in the Yilo Krobo Municipality*. Environmental Challenges* 8 100594 Available at https://doi.org/10.1016/j.envc.2022.100594

Baffour-Ata, F. Antwi-Agyei, P., Apawu, G. O., Nkiaka, E., Amoah, E. A., Akorli, R., & Antwi, K. (2021). Using traditional agroecological knowledge to adapt to climate change and variability in the Upper East Region of Ghana. *Environmental Challenges* 4(2):1-9.

Ekanem, J. T., & Umoh, I. M. (2024). Cassava Farmers' Indigenous Strategies for Climate Change Adaptation and Mitigation in Akwa Ibom State, Nigeria. In: Leal Filho, W., Nagy, G.J., Ayal, D.Y. (eds) Handbook of Nature-Based Solutions to Mitigation and Adaptation to Climate Change. Springer, Cham. https://doi.org/10.1007/978-3-030-98067-2_98-1

Eze, G. N., Ani A. O., Mathews-Njoku, E. C., Anyanwu, J. A. & Okoroma, E. O (2019). Cassava farmers' adaptation strategies to climate change in Abia State, Nigeria. *Middle East Journal Agricultural Research*, 8(3): 947-953

Famakinwa, M., Adeloye, K. A., & Oni, O.O. (2023). Farmers' adaptation strategies to mitigate climate impacts on cocoa production: experience from Osun State, Nigeria. *Mustafa Kemal Üniversitesi Tarım Bilimleri Dergisi,* 28 (3), 489-501. https://doi.org/10.37908/mkutbd.1256780

Kom, Z., Nethengwe, N. S. & Mpandeli, S. (2022). Indigenous knowledge indicators employed by farmers for adaptation to climate change in rural South Africa. *Journal of Environmental Planning and Management*, 1–16. https://doi.org/10.1080/09640568.2022.2086854.

Legide,Y.Y., Feyissa, G. S. & Karo, T. M. (2024). Revitalizing indigenous practices employed by farmers to reduce agriculture's vulnerability to climate change: A systematic review*. Journal of Environmental Studies and Science,* 14;400-414

Mbah, M., Ajaps, S. & Molthan-Hill, P. (2021). Systematic Review of the Deployment of Indigenous Knowledge Systems towards Climate Change Adaptation in Developing World Contexts: Implications for Climate Change Education. *Sustainability*, 13, 4811. https://doi.org/10.3390/su13094811

National Aeronautics and Space Administration (NASA) (2023). Earth Observatory World of Change: Global temperatureshttps://earthobservatory.nasa.gov/world-of-change/global-temperatures (Accessed on June 26, 2024).

Radeny, M. A., Desalegn, D., Mubiru, F., Kyazze, H., Mahoo, J., Recha, K. & Solomon, D. (2019). Activities that raise the atmospheric concentrations of greenhouse gases (GHGs), such as carbon dioxide, methane, and nitrous oxide, are typically

responsible for this change. Indigenous Knowledge of seasonal Weather and climate forecasting across East Africa. *Climate Change* 156; 509-526.

Teka, B., Girma, M., & Alemayehu, R. (2022). Indigenous and improved adaptation technologies in response to climate change adaptation and barriers among smallholder farmers in the East Wollega Zone of Oromia, Ethiopia. https://doi.org/10.1016/j.resglo.2022.100110.

United Nations International Children's Emergency Fund (2024). Water and the global climate crisis: 10 things you should know. Available at https://www. Unicef.org/stories/water-and-climate-change-10-things-you-should-know (Accessed 25th June 2024).

Yakubu, D. A., Akpoko, J. G., Akinola., M. O. & Abdulsalam, Z. (2020). Climate change adaptation practices and rice farmers' level of living in North-West, Nigeria. *Journal of Agricultural Extension* 23(4): 49-60