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# Adoption of indigenous practices for climate change adaptation by sweet potato farmers in Ebonyi State, Nigeria

**Loveday Chukwudi Njoku[1]*, Ngozi Ekunyi Umeh[1], Chidera Nicholas Akude[1], Joshua Chibudo Nwabuisi[2], Abraham Godwin Ominikari[3], Chibuzo Uzoma Izuogu[1], and Hamma Ismail Ibrahim[4]**

[1]Department of Agricultural Extension and Rural Development, Faculty of Agriculture, Alex Ekwueme Federal University, Ndufu Alike, Ebonyi State, Nigeria

[2]Department of Geography and Environment, Faculty of Social Science, Western University, London, Ontario, Canada

[3]Department of Agricultural Economics and Extension, Faculty of Agriculture, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

[4]Department of Agricultural Extension, Faculty of Agriculture, University of Maiduguri, Borno State, Nigeria

***Corresponding author:**
Loveday Chukwudi Njoku
(njoku.chukwudi@funai.edu.ng)

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## Abstract

Existing literature recognizes the role of indigenous practices in building resilience to climate change, yet few empirical studies have examined crop- and location-specific strategies. This research assessed that gap by assessing the indigenous adaptation practices of sweet potato farmers in Ebonyi State, Nigeria. Indigenous practices are defined as traditional farming approaches, skills, and strategies passed down through generations within a specific locality or culture. Data were collected through a multistage sampling procedure and analyzed using mean scores, percentages, and probit regression analysis. Results showed that most sweet potato farmers widely adopted indigenous practices such as changing planting dates ($\bar{x}$ score = 3.5), crop rotation ($\bar{x}$ score = 3.2), mixed farming ($\bar{x}$ score = 3.4), and crop diversification ($\bar{x}$ score = 3.1). The challenges associated with the utilization of indigenous practices included a lack of real-time and accurate information (74%), limited knowledge of potentially feasible options (79%), and competing resource use (87%). Age ($\beta$ = 0.326) positively influenced the extent of indigenous practice use, while distance to farm ($\beta$ = –0.101), religion ($\beta$ = –0.213), and membership in cooperative associations ($\beta$ = –0.652) had negative effects. Overall, sweet potato farmers extensively employed indigenous practices as part of their strategies for adapting to climate change. Christian organizations and cooperative associations should be encouraged to support the adoption of these strategies among farmers. Furthermore, the study recommends that agricultural credits and loans be provided through the national agricultural bank to help farmers overcome financial constraints in implementing indigenous climate change adaptation practices.

***Keywords:*** Adaptation practices; Challenges of indigenous practices; Determinants of use

## 1. Introduction

Climate change is a global phenomenon, although its impacts are not evenly distributed across the world. Its increasing threats have become a global problem, making it more difficult to achieve sustainable livelihoods. African countries, including Nigeria, are contending with the growing threats of climate change alongside a rising population. These challenges have resulted in a disturbing trend of reduced crop yields, soil degradation, decreased soil moisture, and accelerated desertification.[1] Grigorieva *et al.*[2] observed that the vulnerability of the agricultural sector is not assessed solely by the extent of environmental stress, like changes in climatic variables but also by the capacity to adjust and recover from the adverse outcomes of such changes. Although the ability of farmers to adapt and their degree of vulnerability are associated with environmental changes, these are also influenced by social factors such as indigenous practices and land tenure systems.

Indigenous practices are unique to specific cultural settings, developed through years of experience, ingenuity, sociocultural norms, belief systems, experimentation, and close observation of vulnerable natural systems. These practices represent strategies cultivated over generations,[3] often transmitted orally, and have significantly contributed to solving agricultural challenges, including those related to climate emergencies. The retention of indigenous knowledge by rural farmers and its application in farming activities serves as a reservoir of indigenous practices.[4] These practices offer valuable insights that extend beyond their cultural contexts, informing scientists and development planners in efforts to improve rural livelihoods. Farmers are among the households most severely affected by changes in weather patterns.[5] Hence, indigenous practices are actively implemented by experts in their interactions with the environment.

In agricultural production, indigenous experts have developed these practices as a form of social capital to support the survival of vulnerable farmers. Juah and Nhamo[6] emphasize that indigenous practices are essential for initiating successful climate change adaptation research and implementation in rural farming communities. They represent a reliable alternative for mitigating the adverse effects of a worsening climate. In farming, such practices include managing hazards induced by climate change through innate wisdom and approaches. However, these practices are at risk of extinction due to the incursion of development ideas that often promote unsustainable expectations of quick solutions to rural farmers' challenges.[7-9] Before the emergence of these foreign strategies, rural farming households relied on indigenous practices as their primary means of adapting to climate change.

Nigeria's gross domestic product benefits significantly from the production of sweet potato, an underappreciated tuber crop. The cultivation of sweet potato can substantially support food security and boost the income of rural households.[10] Most farmers in Ebonyi state cultivate sweet potatoes at both subsistence and commercial levels.[11] A report by Osuji *et al.*[11] shows that unexpected climate fluctuations have restricted the capacity of sweet potato farmers to scale up production, leading to decreased output, poor returns, and adverse effects on farmers' livelihoods. Rising temperatures and altered rainfall cycles have also affected the sweet potato production value chain. An increase in temperature distorts the germination of sweet potato tubers and poses a severe threat to leaf maturity in sweet potato cultivation. Researchers have observed notable changes in sweet potato farming practices in Ebonyi State. These challenges contribute to food insufficiency and insecurity in the state, as the demand for sweet potatoes exceeds the available supply.[11]

Studies have shown that the socioeconomic characteristics of farmers affect their adoption of indigenous practices in agriculture. According to Osuji *et al.*,[11] understanding the impact of these characteristics on the implementation of indigenous practices will help accelerate their adoption in agricultural production. Shelembe *et al.*[12] and Oparaojiaku *et al.*[13] reported that gender, age, level of education, and access to agricultural credit influence the use of indigenous practices among farmers. Osuji *et al.*,[11] Oti *et al.*,[14] and Onyeneke *et al.*[15] noted that farmers have developed resilience to climate change over many decades by employing agricultural risk management approaches. However, these studies have largely focused on the adoption of innovative farm practices, without giving adequate attention to the favorable disposition of farmers toward indigenous practices. This lack of attention has created a gap in the literature regarding why many farmers continue to implement traditional agricultural practices, despite efforts by governmental and non-governmental organizations to promote climate-smart agriculture aimed at strengthening farmers' adaptive and buffering capacities.

Although there are existing studies related to climate change and sweet potato cultivation,[11] including factors affecting the adoption of climate-smart agriculture by potato farmers[16] and the sweet potato processing capabilities of households,[10] none have assessed the application of indigenous practices in sweet potato farming. Ayi and Undiandeye[3] noted that governmental and non-governmental initiatives to build climate change resilience are unlikely to succeed if farmers fail to incorporate indigenous practices into their adaptation and

mitigation strategies. While it may be difficult to define what constitutes a favorable climate change adaptation among farmers, this study aims to provide insights into the indigenous practices currently implemented by sweet potato farmers. Therefore, this study makes a significant contribution by empirically assessing the application of indigenous practices for climate change adaptation in sweet potato production. The findings will help document the extent to which indigenous practices are utilized as physical adaptation strategies in sweet potato cultivation. Specifically, the study:

(i) ascertained respondents' awareness of climate change
(ii) described sweet potato farmers' perceptions of climate change
(iii) analyzed the extent to which farmers use indigenous practices
(iv) identified the challenges associated with implementing indigenous practices.

This study hypothesized that a significant relationship does not exist between respondents' socioeconomic characteristics and the extent of their use of indigenous practices in climate change adaptation.

## 2. Methodology

Nigeria's southeastern region is home to Ebonyi State. The land area is about 5935 km$^2$ and lies between latitudes 5°40' and 6°45' north and longitudes 7°30' and 8°46' east. Sweet potato and rice cultivation are the primary agricultural activities among farmers in Ebonyi State.[8] Sweet potato farmers in the state struggle with climate variability, as extreme temperatures, pests, diseases, and declining soil fertility directly affect their crops, which depend on natural rainfall. In addition to sweet potatoes, farmers also cultivate yams, oil palm, groundnuts, and cucumbers. The National Root Crop Research Institute, Umudike—mandated with research and development targeting root and tuber crops—has an outstation in Ebonyi state.

Data were collected through an interview schedule and analyzed using descriptive and inferential statistics. To validate the data collection instrument, its design was guided by the researcher's supervisors and other experts in agricultural extension, climate change studies, and rural sociology to ensure both face and content validity. Instrument reliability was established through the test–retest technique. The instrument was first administered to 20 sweet potato farmers in a neighboring state. A second round of questionnaires was distributed to the same farmers after four weeks. The scores obtained were correlated using Pearson's product-moment correlation coefficient. The resulting coefficient was 0.8; hence, the instrument was deemed reliable for the study.

A multistage sampling procedure was employed. The researchers purposively selected north and south of Ebonyi due to the concentration of sweet potato cultivation in these zones. Fifty percentages of agricultural extension blocks focused on sweet potato cultivation were selected from each zone—specifically, two blocks from north Ebonyi and four blocks from central Ebonyi, totaling six blocks, based on the list of extension blocks. From these, 40% of agricultural extension circles (from a total of 82 extension circles) focused on sweet potato cultivation were selected, resulting in the inclusion of 33 circles. In the final stage, 40% of sweet potato farmers (from a list of 3282 sweet potato farmers) were selected from each circle, yielding a total of 132 farmers who participated in the study.

Awareness and perception of climate change, as well as the challenges in using indigenous practices, were assessed using a binary scale ("yes" or "no") and scored accordingly (1 for "yes" and 0 for "no"). Data on respondents' extent of use of indigenous practices were measured using a Likert-type scale: very great extent = 5, great extent = 4, moderate extent = 3, low extent = 2, and very low extent = 1. Mean scores of 3.0 and above represented a high extent, while scores below 3.0 indicated a low extent. The following variables were also measured:

$X_1$ = Age (years)
$X_2$ = Gender (male = 1, female = 0)
$X_3$ = Distance to farm (actual kilometers between the farmer's residence and farmland)
$X_4$ = Access to weather information (yes = 1, no = 0)
$X_5$ = Access to credit (yes = 1, no = 0)
$X_6$ = Membership in a cooperative association (yes = 1, no = 0)
$X_7$ = Extension contacts (number of visits to/by an extension agent)
$X_8$ = Religion (Christian = 1, others = 0).

## 3. Results and discussion

### 3.1. Climate change awareness among farmers

Figure 1 indicates that 89% of sweet potato farmers are aware of climate change. This result suggests that farmers possess knowledge of the various ways climate change affects sweet potato production. Climate change awareness is a critical first step in forming perceptions and adopting resilient practices. This finding aligns with Oti *et al.*,[14] who reported a high level of climate change awareness among farmers in rural communities. The percentage of sweet potato farmers aware of climate change in this study is higher than in some other locations in the country. For instance, awareness levels were reported as 52.5% in Edo state[17] and 83% in Oyo state.[18] Oparaojiaku *et al.*[19] noted that even where climate change awareness is

relatively low, farmers in Nigeria have long implemented indigenous climate adaptation practices, even before the concept became a widely discussed topic in agricultural development. Although farmers may not fully understand all the effects of climate change on their farms, they leverage their awareness to apply indigenous practices, thereby contributing to agricultural development.

### 3.2. Perception of farmers toward climate change

Respondents held varying views on climate change, as shown in Table 1. Many perceived climate change as an increase in the intensity of sunshine (92%), temperature (86%), the occurrence of pests and disease (78%), rainfall intensity (74%), and the frequency of flooding (67%). In addition, 79% of the farmers perceived climate change as a decrease in soil moisture. These findings indicate that farmers have observed the consequences of climate change over the years. Reports from the Nigerian Meteorological Agency show an increase in temperature, rainfall intensity, and the frequency of flooding in the study area between 2011 and 2021.[20] The findings support Onyeneke *et al.*,[15] who noted that Nigerian farmers perceive climate change in various forms. The respondents' perception of increased pest and disease infestation aligns with the observations of Oti *et al.*[14] Similarly, the heightened perception of rising temperatures, sunshine intensity, and increased flooding frequency reflects the alarming impact of these hazards on sweet potato production. Osuji *et al.*[8] documented that an increase in temperature alters seed germination and leads to severe damage to sweet potato leaf development. Furthermore, it impacts sweet potato storage, contributing to the rising rate of post-harvest losses. Perception is an essential prerequisite for enhancing climate change adaptive capacity. However, Shrestha *et al.*[21] reported that indigenous farmers' perceptions of climate change may not always align with empirical meteorological data. Nonetheless, local knowledge and metrological data can complement each other in developing effective climate change resilience strategies.

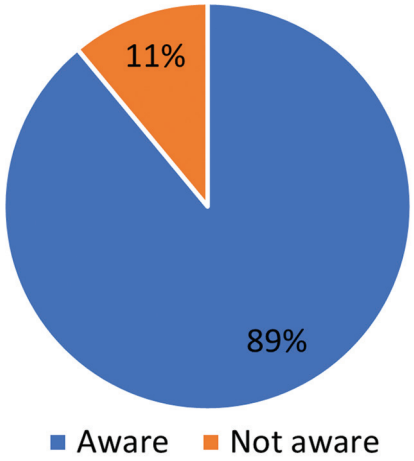


**Figure 1.** Awareness of climate change

### 3.3. Extent of indigenous practice application

Table 2 presents the extent to which farmers utilize indigenous practices as climate change adaptation strategies. The results show that respondents changed their planting dates ($\bar{x}$ = 3.5), practiced crop rotation ($\bar{x}$ = 3.2), engaged in mixed farming ($\bar{x}$ = 3.4), and diversified their crops ($\bar{x}$ = 3.1). These findings indicate that sweet potato farmers are employing indigenous practices to a great extent to ameliorate the harsh effects of climate change. The result aligns with Ayi and Undiandeye,[3] who identified crop rotation, mixed farming, and crop diversification as the main indigenous adaptation practices among Nigerian farmers.

Mixed farming enables farmers to generate additional income, thereby building their buffer capacity against

**Table 1. Respondents' perception of climate change**

| Variable | Increased (%) | Decreased (%) | No change (%) | Do not know (%) |
|---|---|---|---|---|
| Temperature | 86 | 17 | 25 | 4 |
| Rainfall intensity | 74 | 32 | 6 | 20 |
| Sunshine intensity | 92 | 22 | 10 | 8 |
| Drought | 34 | 23 | 3 | 72 |
| Flooding frequency | 67 | 16 | 34 | 15 |
| Soil moisture | 23 | 79 | 14 | 16 |
| Incidence of pests and diseases | 78 | 12 | 32 | 10 |

**Table 2. Extent of use of indigenous practice in climate change adaptation**

| Practices | $\bar{x}$ | SD |
|---|---|---|
| Changing planting dates | 3.5 | 1.0 |
| Mixed farming system | 3.4 | 1.1 |
| Crop rotation | 3.2 | 0.8 |
| Crop diversification | 3.1 | 0.9 |
| Manuring | 2.6 | 0.6 |
| Planting of cover crops | 2.6 | 0.6 |
| Use of ashes for on-farm pest control | 2.4 | 0.7 |
| Multiple cropping | 2.3 | 1.2 |
| Raising mounds and ridges | 2.1 | 1.1 |
| Late planting | 1.9 | 0.5 |
| Mulching | 1.7 | 0.8 |
| Fallowing | 1.5 | 0.9 |
| Terracing | 1.1 | 0.6 |

crop failure. It also supports the protection of rangeland and promotes its sustainable use for livestock production, rather than continuous ploughing, which can lead to soil compaction.[22]

Crop diversification enhances agricultural production by increasing variety. Ihenacho *et al.*[7] observed that diversification improves soil productivity, reduces the incidence of pests and diseases, and contributes to higher crop yields. This approach offers a more environmentally friendly and sustainable alternative to the use of agricultural chemicals.

Farmers in the study area consider adjusting planting dates crucial, as they rely on natural precipitation for agricultural production 8. Sweet potato farmers take advantage of early rains to ensure sufficient moisture for crop growth and reduce vulnerability to pests and diseases.

Atasie *et al.*[22] documented that most farmers in the zone practiced bush fallowing as a climate change adaptation strategy. However, the low extent of fallow use observed in this study could be attributed to increasing pressure on agricultural land caused by population growth and urbanization. Izuogu *et al.*[23] noted that Nigerian farmers face challenges such as competing land use, limited knowledge, and land tenure issues that hinder the implementation of fallow systems. As an indigenous adaptation strategy, late planting helps farmers avoid extreme weather.[13] However, climate variability has frustrated the effective use of late planting, as predicting rainfall patterns and duration has become increasingly difficult.

### 3.4. Challenges faced by farmers implementing indigenous adaptation strategies

The main obstacles to effective indigenous climate change adaptation, as presented in Table 3, include insufficient access to accurate information (74%), limited knowledge about viable alternative options (79%), and competing resource use (87%). These findings align with Juah and Nhamo,[6] who reported that insufficient resources and poverty hinder the use of indigenous climate change adaptation practices among farmers. For instance, the inability to strengthen adaptation strategies has led to a lack of information among rural farmers, leaving many unaware of viable alternatives.

Sweet potato farmers, however, do not consider the reliability of indigenous practices to be a major challenge (27%). These findings contradict Juah and Nhamo,[6] who argued that indigenous practices have lost credibility over time due to their unreliable predictions and inconsistent outcomes. However, because these practices are passed down through generations, sweet potato farmers continue to access, own, and rely on them. This response suggests that indigenous practices and knowledge systems remain effective tools for climate change adaptation among sweet potato farmers. In addition, these systems are easily accessible to them.

### 3.5. Factors determining the extent of indigenous practice utilization by sweet potato farmers

Table 4 reveals that several factors influence the extent to which farmers utilize indigenous practices. The age of sweet potato farmers shows a significant positive relationship ($\beta = 0.326$) with the extent of utilization of indigenous practices. This indicates that as respondents advanced in age, they implemented more indigenous adaptation strategies. These findings agree with Juah and Nhamo,[6] as well as Izuogu *et al.*,[23] who reported that indigenous adaptation practices become increasingly

**Table 3. Challenges in implementing indigenous climate change adaptation strategies**

| Challenges | % |
|---|---|
| Competing resource use | 87 |
| Inadequate knowledge about potentially feasible options | 79 |
| Absence of accurate and timely information and technical advisory services | 74 |
| Poor access to adequate information about climate change | 68 |
| Shortage of land | 66 |
| Unavailability and lack of access to inputs | 62 |
| Lack of promotion of indigenous practices | 38 |
| Concerns about the reliability of indigenous practices | 27 |
| Lack of adequate education on the role of indigenous practices in climate change adaptation | 23 |

**Table 4. Determinants of the extent of indigenous practice utilization**

| Variables | Coef. | SE | *z* | Prob |
|---|---|---|---|---|
| Age | 0.326*** | 0.315 | 3.461 | 0.001 |
| Gender | 0.421 | 0.120 | 2.856 | 0.085 |
| Distance to the farm | −0.101** | 0.166 | 1.459 | 0.060 |
| Access to weather information | 2.454 | 0.660 | 0.287 | 0.658 |
| Use of weather information | 1.032 | 0.111 | 4.739 | 0.031 |
| Access to credit | 0.112 | 0.121 | 7.633 | 0.006 |
| Extension contacts | −0.532 | 0.928 | 0.125 | 0.907 |
| Religion | −0.213*** | 0.145 | 0.114 | 0.004 |
| Membership in a cooperative association | −0.652 ** | 0.725 | 1.813 | 0.058 |
| Constant | 254.7 | 317.5 | -0.614 | 0.685 |
| $R^2$ | 0.567 | - | - | - |
| Observations | 132 | - | - | - |

Note: **$p<0.05$, ***$p<0.01$.
Abbreviations: Coef.: Coefficient; SE: Standard Error.

preferred over modern approaches as farmers grow older. As farmers age, tasks such as carrying a knapsack sprayer to apply chemicals or handling inorganic fertilizers become more cumbersome compared to sprinkling ash or using poultry droppings. Furthermore, the health risks posed by chemical inputs worsen with age.[6] Experienced farmers tend to implement agronomic practices that promote environmental conservation and sustainable food production. In contrast, younger farmers are more likely to adopt innovative practices such as using pesticides to maximize economic gains, often without fully considering environmental impacts.

The distance from the farmers' residence to the farm ($\beta = -0.101$) negatively influenced the extent of indigenous practice use. Farmers whose farms were located closer to their homes implemented indigenous practices to a greater extent than those with farms farther away. Home gardens are typically more carefully managed and tend to use fewer inorganic inputs, such as pesticides and herbicides more than long-distance farms. This is partly due to the proximity to children and other vulnerable individuals who may harvest crops directly, increasing the importance of minimizing chemical use. Rural households also often lack adequate knowledge of the safe handling and application of agrochemicals.[22]

Religious affiliation of respondents ($\beta = -0.213$) also had a significant negative relationship with the implementation of indigenous adaptation strategies. The result suggests that strongly Christian respondents are more likely to adopt modern climate change adaptation practices. Traditional beliefs, which promote deeper ties with cultural norms and values, tend to support the use of indigenous practices. Consequently, farmers are more inclined to implement practices that align with their cultural traditions. Chu *et al.*[24] and Ankrah *et al.*[25] documented that religious beliefs can positively or negatively moderate participation in traditional practices. They argued that religion can influence personal decisions by shaping farmers' perceptions and preferences, and that religious institutions can play a key role in promoting or discouraging the adoption of indigenous practices.

Membership in an agricultural cooperative association ($\beta = -0.652$) had an inverse relationship with the extent of indigenous practice use. This finding agrees with Izuogu *et al.*,[23] who reported that 76% of respondents in farmer associations adopted innovative adaptation strategies. Cooperative associations provide access to training and agricultural information that emphasizes improved farm practices with higher returns on investment, often overlooking indigenous methods.[23,26] As a result, members of these groups are more likely to discontinue the use of indigenous practices.[19]

## 4. Conclusion

This study highlights the essential roles of indigenous practices in developing climate change resilience among farmers in Ebonyi State. It also offers valuable insights into strategies that can be adopted for the efficient and sustainable management of climate change effects. Further studies are needed to assess the evolving trends in the adoption of indigenous practices for climate change adaptation and mitigation, ensuring that government interventions address the actual needs of farmers. To mitigate the effects of climate change, farmers have extensively adopted several indigenous practices. Age, distance to farm, religion, and cooperative membership were significant determinants of the extent to which sweet potato farmers adopted these practices. Competing resource use and limited knowledge of potentially feasible options were among the key challenges affecting the use of indigenous practices.

Cooperative organizations should encourage the adoption of indigenous climate change adaptation strategies by promoting the exchange of information and local resilience practices. Agricultural extension service providers should support the integration of indigenous knowledge with modern scientific adaptation strategies through training on climate-resilient farm techniques. Agricultural Development Banks should facilitate the adoption of indigenous practices by providing agricultural credits and loans. Access to credit will encourage greater investment in indigenous climate adaptation practices and enhance farmers' capacity for resilience. To support implementation, agricultural development agencies must expand channels for farmer education and training on indigenous climate strategies.

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## Conflict of interest

The authors declare that they have no competing interests.

## Author contributions

*Conceptualization:* Loveday Chukwudi Njoku, Ngozi Ekunyi Umeh

*Formal analysis:* Chibuzo Uzoma Izuogu, Abraham Godwin Ominikari

*Investigation:* Loveday Chukwudi Njoku, Ngozi Ekunyi Umeh
*Methodology:* Chidera Nicholas Akude, Joshua Chibudo Nwabuisi
*Writing–original draft:* Ngozi Ekunyi Umeh, Chibuzo Izuogu, Hamman Ismail Ibrahim
*Writing–review & editing:* Ngozi Ekunyi Umeh, Loveday Chukwudi Njoku

## Ethics approval and consent to participate

Informed consent was obtained from all respondents before their participation in the study. In addition, permission was secured from community leaders, including contact farmers, before the field investigation was conducted.

## Consent for publication

Respondents consented on the publication of their data.

## Availability of data

The data analyzed in this study are available from the corresponding author on reasonable request.

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