JCCR
Journal of Community and Communication Research

**Journal of Community & Communication Research**
**ISSN: 2635-3318**
Volume 5, Number 2, June 2020
Pp. 190-199

# Socioeconomic Determinants of Rural Farmers' Use of Ecosystem-based Adaptation Practices for Climate Change Adaptation in Anambra State, Nigeria

Accessible at: https://jccr.sccdr.org.ng

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Review Process: Received: 27/02/20 Reviewed: 17/05/20 Accepted: 03/06/20

**ABSTRACT**
The study analysed socioeconomic determinants of farmers' use of ecosystem-based adaptation practices for climate change adaptation among rural farmers in Anambra State, Nigeria. A sample of 150 rural farmers participated in the study. Data were collected using interview schedule and analysed using mean and percentages. It was found that about 93% of the farmers was aware of ecosystem-based adaptation practices. Intercropping (96%), crop diversification (95%), manual weeding (88%), mulching (83%) and contour cropping across hills (83%) were the dominant ecosystem-based adaptation practices used. The practices were perceived effective in reducing loss of soil fertility ($\bar{X}$= 2.5), soil degradation ($\bar{X}$= 2.5), pest attack ($\bar{X}$ = 2.4), increasing crop yields ($\bar{X}$ = 2.3), reducing rate of evapotranspiration ($\bar{X}$ = 2.3) and reducing rate of spoilage of agricultural produce ($\bar{X}$ = 2.2). Multiple regression analysis result showed that at p-value $\leq$ 0.05, $R^2$ = 44 and F-value = 6.816, age (p-value = 0.000, t = -5.6) and monthly income (p-value = 0.001, t = 3.6) determined the farmers' use of ecosystem-based practices for climate change adaptation in the state. The use of the practices was constrained by poor extension coverage ($\bar{X}$ = 4.9), inadequate capital ($\bar{X}$ = 4.8), poor government policies ($\bar{X}$ = 4.4) and limited information on ecosystem adaptation ($\bar{X}$ = 3.9). Innovative agricultural extension approaches were recommended to promote the dissemination of information on the practices.
***Keywords: Ecosystem-based adaptation; socioeconomic determinants, rural farmers; climate change; use of practices.***

## INTRODUCTION

Scientific observations have shown that near surface temperatures have increased by 0.5°C or more during the last 50 to 100 years over most parts of Africa, with minimum temperatures warming more rapidly than the maximum temperatures (Grab & Craparo, 2011; Hofman *et al*., 2011; Nicholson *et al*., 2013). This trend indicates an overall warming that is significantly beyond the range of changes due to natural (internal) variability (Barkhordarian *et al*., 2012).

These projected and observed changes in the African climate portend very negative implications for agricultural production in the continent. The most vulnerable group is smallholder farmers due to their dependence on rain-fed agriculture, small farm size, location in often remote and marginal lands and their restricted access to technical expertise, credit and institutional support which limits their ability to adapt to changing conditions (Vermeulen, 2014). However, the urgency of helping smallholder farmers build resilience to climate change has been recognized.

As Harvey *et al*. (2011) noted, ecosystem-based adaptation is one approach that could help farmers adapt to climate change. Ecosystem-based (EbA) approach is a way of using biodiversity and ecosystem services as part of an overall strategy to help people adapt to the adverse impacts of climate change (NatureUganda, 2015). EbA practices address the crucial link between climate change, biodiversity and sustainable resource management and thus provide multiple benefits. They take into account anticipated climate change impacts and reduce the vulnerability of communities to these impacts by using sustainable management, conservation and restoration of ecosystems. Implementing such approaches can contribute to both the reduction of greenhouse gas emissions and the enhancement of sinks as well improving biodiversity conservation, livelihood opportunities and health and recreational benefits (Ecologic, 2010).

Ruppel *et al*. (2014) reported Africa's long-standing experiences with natural resource management, biodiversity uses and ecosystem-based responses such as afforestation, rangeland regeneration, catchment rehabilitation and community-based natural resource management. Djoudi *et al*. (2013) reported the use of mobile grazing to deal with both spatial and temporal rainfall variability in the Sahel. Robledo *et al.* (2012) reported the reduction of negative impacts of drought and floods on agricultural and livestock-based livelihoods through forest goods and services in Mali, Tanzania and Zambia. Jalloh *et al.* (2011) observed the maintenance of food security and improved livelihoods among the indigenous and local communities in West Africa through the rich diversity of plants and animal genetic resources. Water harvesting practices have increased soil structure, soil organic matter and increased agricultural yields at sites in Burkina Faso, Mali and Niger and are used by 68% of farmers in Burkina Faso (Barbier *et al.*, 2009; Fatondji *et al*., 2009; Larwanou & Saadou, 2011).

Niang *et al.* (2014) observed that in spite of the increasing use and positive contributions of EbA practices towards environmental protection in Africa, scaling-up to prioritize their integration in plans and policies has been slow. According to Loevinsohn *et al.* (2013) farmers' decision about whether and how to adopt new technologies are conditioned by the circumstances surrounding the technologies and the farmers. Akudugu *et al*. (2012) grouped the determinants of agricultural technology adoption into three – economic, social and institutional factors. Lavison (2013) broadly categorized them into social, economic and physical factors. Mwangi and Kariuki (2015) contend that an understanding of the factors influencing this choice is crucial for generators and disseminators of the technologies. However, literature is scanty on the use of EbA practices in Nigeria. Consequent upon this, the study sought to investigate socioeconomic determinants of the use of ecosystem-based adaptation practices for climate change adaptation among rural farmers in Anambra State, Nigeria. The specific objectives include to:

i. identify sources of information on ecosystem-based adaptation strategies;
ii. identify ecosystem-based adaptation practices used;
iii. determine the perceived effects of the use of ecosystem-based adaptation practices by the farmers; and
iv. identify the perceived constraints to the use of ecosystem-based adaptation practices.

**Hypothesis**
There is no significant relationship between the use of ecosystem-based adaptation practices and the socioeconomic characteristics of the farmers.

**METHODOLOGY**
The study was carried out in Anambra State Nigeria. Anambra State is among the five states in the southeastern part of Nigeria. Despite the increasing rate of urbanization in the state, agriculture remains the main occupation of the majority of the people. All rural farmers in the study area constituted the population for the study. All the agricultural zones in the State were purposively selected to ensure representativeness. In each of the four zones, one Local Government Area that is typically rural was selected using purposive sampling technique. From each of the four LGAs, 30 farmers were selected using snowball sampling technique to give a total of 120 farmers. This was because no list of registered farmers using ecosystem-based adaptation practices in the area could be obtained as at the time of the research. Usage of EBA practices was measured by listing practices that conserve biodiversity and asking the farmers to indicate the ones that are applicable to them. Data were collected from the respondents using structured questionnaire and were analyzed using descriptive and inferential statistical tools. The hypothesis was tested using multiple regression analysis.

**RESULTS AND DISCUSSION**
***Socioeconomic characteristics***
Table 1 shows that the majority (63.00%) of the farmers were aged 21 – 40 years while 46.30% were between 41 – 60 years. The mean age was 40 years. The majority (57.10%) of the farmers was female while the remaining 42.90% was male. The majority (61.10%) of the farmers was married; a greater proportion (32.20%) of the farmers completed secondary school; the majority (35.50%) engaged in farming while the major source of credit was friends/neighbours (42.90%).

The prevalence of young farmers in the area could be as a result of the increasing scarcity of white collar jobs which has made agriculture the only available option for survival. The dominance of female farmers affirms the several claims that women contribute largely to agricultural production in developing countries (Ani, 2000). Marriage encourages synergy among farming households as every household member is a potential source of farm labour and agricultural information. The sourcing of agricultural credit from friends/neighbours showcases the strong informal ties among people in rural communities.

**Table 1: Socioeconomic characteristics of the farmers**

| Socioeconomic characteristics | % | ẍ |
|---|---|---|
| Age (Years) | | |
| ≤ 20 | 0.8 | |
| 21 – 40 | 63.00 | 40 |
| 41 – 60 | 46.30 | |
| **Sex** | | |
| Male | 42.90 | |
| Female | 57.10 | |
| **Marital Status** | | |
| Single | 32.20 | |
| Married | 61.10 | |
| Divorced/widowed | 6.70 | |
| **Educational qualification** | | |
| Primary school completed | 10.80 | |
| Secondary school not completed | 6.60 | |
| Secondary school completed | 32.20 | |
| TTC/NCE/OND | 24.80 | |
| HND/Degree Holder | 21.50 | |
| **Occupation** | | |
| Farming | 35.0 | |
| Transportation | 8.30 | |
| Artisanship | 14.20 | |
| Trading/business | 28.20 | |
| Civil service | 13.30 | |
| **Household size (No. )** | | |
| 1 -3 | 35.00 | |
| 4 – 6 | 60.83 | |
| > 6 | | |
| **Monthly income (₦,000)** | | |
| ≤ 19 | 15.80 | |
| 19.001 – 59.00 | 39.20 | 58.00 |
| > 59.00 | 45.00 | |
| **Sources of credit other than personal savings** | | |
| Friends/Neighbours | 42.90 | |
| Cooperative societies | 28.60 | |
| Loan from banks | 21.00 | |
| Thrifts/Esusu/Akawo | 6.60 | |
| From government sources | 2.50 | |
| **Social organization membership** | | |
| Church organizations | 45.30 | |
| Age grades | 25.40 | |
| Cooperative societies | 30.30 | |

Source: Field Survey Data, 2017

***Awareness of ecosystem-based adaptation strategies***

Figure 1 reveals that the majority (93.3%) of the farmers were aware of ecosystem-based adaptation strategies while the remaining 6.7% were not aware of it. This could be attributed to the more or less traditional nature of EbA practices and their specificity to a particular ecosystem. Similarly, their affordability, compatibility and effectiveness might have contributed to their popularity. As practices originating from an area, they will likely be well-known among the people using it. Also, awareness of a practice is very necessary for its use.

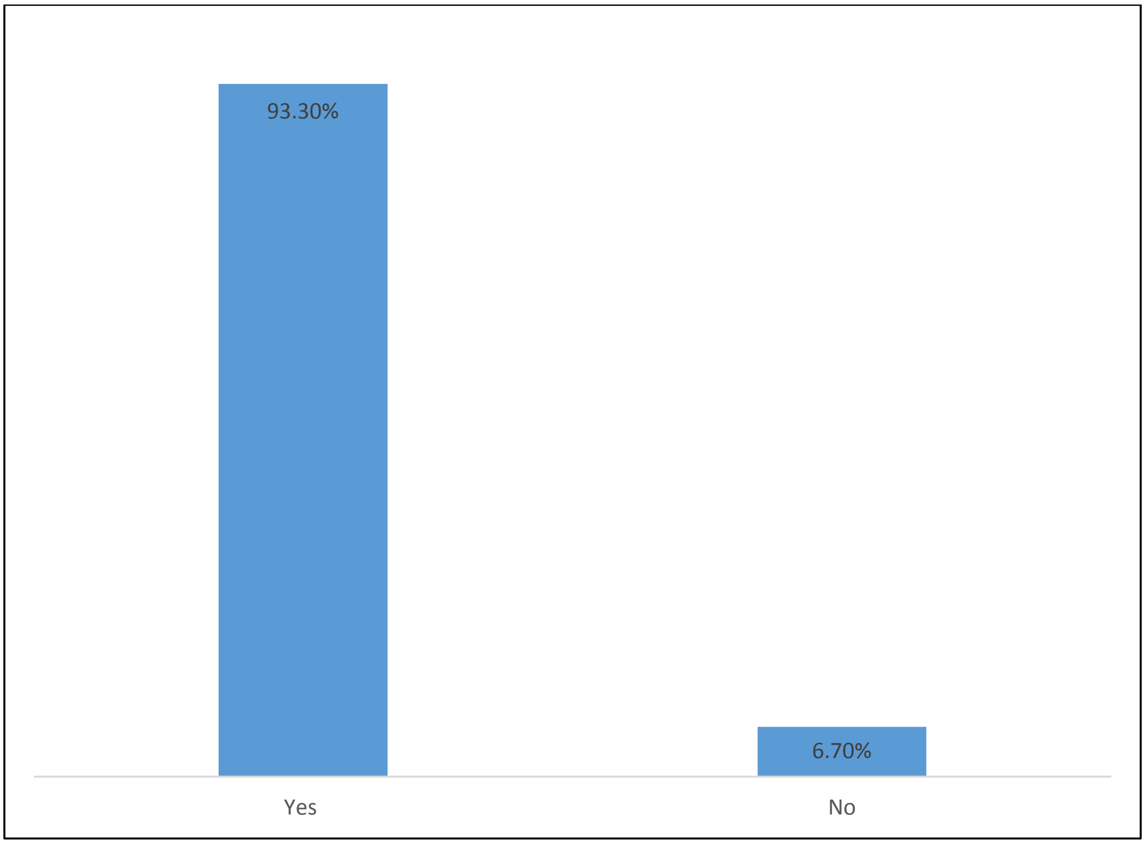

Figure 1: Awareness of EbA

***EbA practices used in the study area***

Table 2 shows the popularity of ecosystem-based climate change adaptation practices in the area. This is indicated by the large number of the practices used by the farmers. However, the major ones used included intercropping (95.8%), crop diversification (95.8%), manual weeding (87.7%), mixed farming (86.7%), mulching (83.3%), contour cropping across hills (82.5%) and cereal intercropping with leguminous plants (80.0%). The popularity of EbA practices in the area could be as a result of their relative advantage such as cheapness and ease of use. Also, their efficacy could have influenced their large-scale use. Harvey *et al.* (2013) and Lavorel *et al.* (2015) noted that the use of EbA practices in agriculture systems can help small holder farmers adapt to climate change by providing both on-site and off-site benefits. Harvey *et al.* (2011) reported the high use of EbA practices by farmers in Central America. According to the report EbA practices ranged from one to eight practices per farm. The prevalence of EbA practices likely reflects the fact that many of these practices are now increasingly being promoted for their ability to reduce the effect of climate change (Harvey *et al.,* 2015).

**Table 2: Ecosystem-based climate change adaptation practices used by the farmers**

| Adaptation practices used | F* | % | Ranking |
|---|---|---|---|
| Intercropping | 115 | 95.8 | 1st |
| Cropping diversification | 114 | 95.0 | 2nd |
| Manual weeding | 105 | 87.5 | 3rd |
| Mixed farming | 104 | 86.7 | 4th |
| Mulching | 100 | 83.3 | 5th |
| Contour cropping across hills | 99 | 82.5 | 6th |
| Cereal intercropping with leguminous plants | 96 | 80.0 | 7th |
| Landscape diversification | 96 | 80.0 | 7th |
| Construction of earth dams | 93 | 77.5 | 8th |
| Enhancing/creating habitat for pests | 69 | 57.5 | 9th |
| Growing of drought resistant crop varieties | 63 | 52.5 | 10th |
| Early spring harrowing to prevent capillary rise and evaporation | 55 | 45.0 | 11th |
| Planting and protection of trees in wetland to regulate water level | 53 | 44.2 | 12th |
| Multiple sowing | 49 | 40.8 | 13th |
| Alternating grazing of different livestock species to deter parasites | 45 | 37.5 | 14th |
| Use of irrigation | 44 | 36.7 | 15th |
| Protection of early flowering plants | 43 | 35.8 | 16th |
| Social protection of pest controlling species | 30 | 25.5 | 17th |
| Trees as shade | 25 | 16.7 | 18th |

Source: Field Survey Data, 2019. * Multiple response

***Perceived effects of ecosystem-based adaptation practices***

Table 3 indicates that the use of EbA had an overall positive effect in the study area. The major effects as indicated by the farmers were reduction in soil fertility loss ($\overline{X}$ = 2.52), reduction in soil degradation ($\overline{X}$ = 2.50), reduction in pest attack ($\overline{X}$ = 2.40) and increased yields ($\overline{X}$ = 2.35). This could be as a result of the close connection between the practices and the ecosystem. According to the United Nations Framework on Climate Change Convention (UNFCCC) (2012) the use of EbA practices such as diversification of crops in time and space reduced the risk of crop failure, pest resistance and revitalized soils. Jackson *et al.* (2010) noted that EbA practices can improve crop abilities to adapt to climate variabilities. Pramova *et al.* (2012) reported that EbA practices generate diversified products which served as safety nets for communities for coping with climate shocks and livelihood strategy. In Tanzania for instance, forest products provided additional incomes during dry spells and diversification with firewood, timber and charcoal. Morris *et al.* (2018) reported that the planting of trees helped to reduce the incidence of erosion in Southern China and while reducing disaster risk and promoting carbon sequestration in Republic of Korea. Seddon (2018) contend that EbA can reduce coastal flooding and enhance yields in drier more variable climates.

**Table 3: Perceived effects of Ecosystem-based climate change adaptation practices**

| Effects | ẍ | S.D. |
|---|---|---|
| Reduction in loss of soil fertility | 2.52* | 0.54 |
| Reduction in soil degradation | 2.50* | 0.57 |
| Reduction in pest attack | 2.40* | 0.50 |
| Increased yields | 2.35* | 0.56 |
| Restoration of degraded lands | 2.34* | 0.55 |
| Reduction in the rate of evapotranspiration | 2.32* | 0.52 |
| Reduced spoilage of agricultural produce | 2.20* | 0.46 |
| Improved water availability | 2.10* | 0.55 |
| Reduced flooding | 2.10* | 0.46 |
| Reduced erosion | 2.10* | 0.65 |
| Increased income | 2.05* | 0.28 |
| Contribute to the sustainable use of natural resources | 2.01* | 0.63 |
| Reduction in disease infestation | 2.00* | 0.37 |
| Causes contamination | 1.44 | 0.68 |
| Involves professionalism | 1.35 | 0.69 |
| Cost effective | 1.35 | 0.63 |
| Reduction in access to inputs | 1.30 | 0.57 |

Source: Field Survey Data, 2019 * Effects of EbA practices

***Constraints to the use of EbA practices***

Table 4 reveals that many factors constrained the use of EbA practices in the study area. The finding however suggests that the constraints were mainly institutional factors. Poor extension coverage, poor government policies, inadequate training and inadequate infrastructure reveal the lack of capacity to transfer EbA practices in the study area. For example, the extension organization is primarily charged with the transfer of proven technologies to farmers and when it lacks adequate facilities for this task will become ineffective. Poor training on EbA may limit successful transfer and application of such practices.

Jha *et al.* (2014) noted that some EbA practices will require farmers to make difficult some trade-offs between the adaptation benefits they can provide in the longer term and the significant labour investment needed for their establishment (in the short term) or their maintenance. Also, some EbA practices are based on external technical assistance and they require information and knowledge that are not readily available to producers in marginal areas where technical assistance is limited or inexistent (Anderson & Feder, 2004).

**Table 4: Constraints to the use of EbA practices**

| Constraints | ẍ | S.D |
|---|---|---|
| Poor extension coverage | 4.89* | 0.49 |
| Inadequate capital | 4.75* | 0.69 |
| Poor government policies | 4.38* | 0.89 |
| Limited information on ecosystem adaptation | 4.29* | 0.74 |
| Knowledge intensiveness | 4.11* | 0.87 |
| High technical involvement | 3.99* | 0.99 |
| Unsuitable agricultural practices | 3.93* | 1.00 |
| Low institutional capacity | 3.80* | 1.01 |
| Inadequate training on EbA | 3.79* | 1.03 |
| Multistakeholder involvement | 3.50* | 0.84 |
| High labour requirement | 3.72* | 0.91 |
| Inadequate infrastructure | 3.25* | 1.20 |

Source: Field Survey Data, 2019

***Socioeconomic determinants of use of ecosystem-based climate change adaptation practices***

The regression result in Table 5 shows that the socioeconomic characteristics of the farmers accounted for about 44% of their use of ecosystem-based climate change adaptation practices. According to the result, two socioeconomic characteristics age (t-value = - 5.185) and monthly income (t-value = 3.588) at $p \leq 0.05$ determined the use of EbA practices by the farmers in the study area. Age of the farmers was inversely proportional to the use of EbA practices implying that the older the farmers are the less likely their use of EbA practices and vice versa. However, monthly income had a direct relationship with the use of EbA practices implying that the higher the farmers earn per month the more likely they are to use the practices. Harvey *et al.* (2015) reported the influence of socioeconomic characteristics on farmers' use of EbA practices in Central America. According to the study, farmers with higher income which was supposedly as a result of their ownership of larger farmers used more of EbA practices to protect their crops. Below *et al.* (2012) and Deresa *et al.* (2010) reported the influence of age and experience in the use of farm management practices in Ethiopia and Malawi. Hisali *et al.* (2011) found that age influenced the practice of agroforestry in Uganda. Harvey *et al.* (2015) in their study found that age was positively related with the number of EbA practices on farms suggesting that experience may lead farmers to use more sustainable practices.

**Table 5: Socioeconomic determinants of use of ecosystem-based climate change adaptation practices**

| Explanatory variable | B | Unstandardized coefficient Standard error | Standardized coefficients Beta | t. value | Sign. |
|---|---|---|---|---|---|
| **Constant** | 42.82 | 3.658 | | 11.71 | 0.000 |
| Sex ($X_1$) | -1.276 | 0.812 | -0.142 | - 1.571 | 0.120 |
| Marital status $X_2$) | 1.282 | 0.871 | 0.155 | 1.472 | 0.145 |
| Age ($X_3$) | -0.272 | 0.053 | -.0.572 | -5.185 | 0.000* |
| Educational Level ($X_4$) | -.0.075 | 0.342 | -0.023 | -0.221 | 0.826 |
| Occupation ($X_5$) | -.0.037 | 0.295 | -0.125 | -0.127 | 0.899 |
| Household Size ($X_6$) | 0.375 | 0.280 | 0.350 | 1.341 | 0.183 |
| Monthly income ($X_7$) | 0.064 | 0.000 | 0.350 | 3.588 | 0.001* |
| Source of capital ($X_8$) | -.0.527 | 0.416 | -0.118 | -1.266 | 0.209 |
| Membership of social organization ($X_9$) | -.0.114 | 0.355 | -0.028 | -0.321 | 0.749 |
| $R^2$ | 43.9 | 43.9 | 43.9 | 43.9 | 43.9 |
| F-Value | 6.816 | 6.816 | 6.816 | 6.816 | 6.186 |
| No. observations | 120 | 120 | 120 | 120 | 120 |
| Degree of freedom | 97 | 97 | 97 | 97 | 97 |

Source: Field Survey Data, 2019

## CONCLUSION AND RECOMMENDATIONS

The study concludes that ecosystem-based adaptation practices were effective for climate change adaptation in the study area and as a result the farmers used many of them. However, some constraints limited the use of the practices. There was a significant relationship between socioeconomic characteristics of the farmers and their use of EbA practices. It was therefore recommended that ecosystem-based adaptation practices be scaled-up. This could be achieved by mounting sensitization campaigns targeting farmers especially the rural ones who lack the capacity to afford expensive technologies. There is also the need to build the capacity for the use of these practices among the farmers through routine training organized by extension agents.

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