EFFECT OF CLIMATE SMART AGRICULTURAL PRACTICES ON FARMING
HOUSEHOLDS’ FOOD SECURITY STATUS IN IKA NORTH EAST LOCAL
GOVERNMENT AREA, DELTA STATE, NIGERIA

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ABSTRACT
This study investigates the effect of Climate Smart Agricultural Practices on farming households’ food security status in Ika North East Local Government Area, Delta State, Nigeria. The study utilized primary data. The data was collected using structured questionnaire. A three-staged sampling technique was used to select 140 respondents for the study. The data collected was analyzed using descriptive statistics, FGT model and logit regression model. The result of the study shows that majority of the farmers were aware of the CSA practices, and the following practices were the most utilized practices among the respondents: Agro-forestry, Crop rotation, Mixed cropping, Improved crop varieties, Intercropping, Compost making, Improved fallowing, Organic manure, Mulching and Cover crops. The headcount ratio showed a poverty head count ratio of 0.29, food insecurity shortfall 0.28, and food insecurity severity of 0.13. The regression result indicated age (p<0.05), gender (p<0.01), household size (p<0.01), and years of farming experience were the major determinants of food security in the study area. The study concluded that though climate smart agricultural practices have positive coefficient but however not significant have the potential to enhance food security. The study also recommended that policy be put in place help confront the constraints being faced by the farmers from adopting CSAs in the study area.

Keywords: Climate Smart, Practices, Food security, Nigeria

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INTRODUCTION
Climate change is recognized as one of the greatest threats to agricultural productivity in several regions of the world (Niang et al., 2014). Many developing countries are sensitive to climate change because they are located in the tropics, with temperatures that already compromise agricultural production (Kurukulasuriya, and Mendelsohn, 2006; Mendelsohn et al. 2006), and also they have limited access to the human and physical capital that might help mitigate its effects (Di Falco, 2014). Climate change is evolving as the most vital environmental challenging problem confronting the modern society. Climate is an important factor for agricultural productivity and any variation in these factors is bound to result in a larger impact on crop yield (Ashalatha et al., 2012).
According to Muller et al., (2011) most African countries are projected to be severely compromised by the effect of climate change. This is because most part of the region rely so much on rain-fed Agriculture which is affected by climate change (Cooper et al., 2008). Harvell et al., (2002) have shown that climate change would impact on agriculture along with high population growth with great implication on consumption pattern of people in the region. The world population is projected to be about 8 and 10 billion in 2020 and 2050 respectively (Serdenczny et al., 2016). With such a population trend, agriculture will require a significant transformation to ensure adequate food supply for the growing population and meet the challenges of climate change (Kaczan et al., 2013). Integrating the effects of climate change into agricultural development planning is therefore a major challenge as climate change would likely leave many more people vulnerably to poverty.

Nigeria is highly vulnerable to the whims of climate change because of its long (800km) coastline which is prone to sea level rise and the risk of flood. Also it is at the risk of fierce storm and drought as a result of its closeness to desert lands up North (Apata, Samuel and Adeola (2009). Ayinde et al., (2010) in a study showed that change in climate has significant effects on agricultural productivity in Nigeria. Another study on the impact of climate change on grain yields in Nigeria reveals that climate change through extreme temperature, frequent flooding, drought and increased salinity of water used for irrigation has become a recurrent subject of debate globally, (Ajetomobi et al., 2010). However, the evidence of sudden increase in air temperature in Nigeria was observed as from the early 1970s until 2005. This abrupt increase could be linked to the effect of climate change and its associated global warming previously reported in Nigeria by Ikhile (2007) and supported by the global trend (IPCC, 2007).

The concept of Climate Smart Agriculture (CSA) offers a suite of approaches for transforming and reorienting agriculture systems to support food security in the face of climate change, by focusing on the potential synergies and trade-offs between agricultural productivity and food security, adaptive capacity, and mitigation benefits (Campbell et al., 2014). Incremental change may be inadequate to bring about the societal changes needed to mitigate and adapt to climate change and enhance food security (Biermann et al., 2012), particularly in the long term as the impacts of climate change become increasingly obvious (Rickards and Howden, 2012; Cooper et al., 2013). In addition, there is the need to move beyond small incremental changes, there is also a need to move from working small numbers of farmers to achieving outcomes among large portions of farming population, in efficient and effective ways.

Agriculture in Nigeria must undergo a major transformation in the coming decades in order to meet the intertwined challenges of achieving food security, reducing poverty and responding to climate change without depletion of the natural resource base. Climate smart agriculture include proven practical techniques like; mulching, intercropping, conservation of agriculture, crop rotation, integrated cop-livestock management, agro-forestry, improved grazing, and improved water management. Although there has been a rapid uptake of CSA by national organizations and the international community, implementation of the approach is still in its infancy and equally challenging partly due to lack of tools, capacity and experience in developing countries. CSA is still evolving and faces a number of challenges related to awareness, adoption, practice, conceptual understanding,
policy, environment, social and economic issues. Observation shows that there is still limited in-depth understanding of the public on climate smart agricultural and especially among the rural people or communities (FAO, 2013). According to FAO (2010), CSA practices are seen as the means to achieve resilience at the same time reducing environmental degradation. There is paucity of literature on the possible effects of CSA practices farming households food security status, it is against this backdrop that this study seeks to examine the effect of the adoption of CSA practices on farming households food security in Ika North East local Government Area, Delta State, Nigeria. This study aimed to fill the identified gap in knowledge.

The adoption of CSA practices has the potential to significantly help increase farmers’ resilience to climate change. Development experts and farmers would need this research as an agent of change and development to have better understanding adequate for proper actions. Furthermore, the results of the study will be used to provide reference for better understanding of the importance of practicing CSA by farmers. This will further help to inform policy makers and program designers on climate change response of agricultural systems in Delta State as well as Nigeria in general knowing fully well that early action in climate smart agriculture is essential to build up capacity, experience and guide future choices. The main objective of the study is to examine the effect of the adoption of climate smart agricultural practices on farming households’ food security in Ika North East Local Government Area, Delta State, Nigeria. The specific objectives are to:

i. describe the socio-economic characteristic of farming households in the study area;

ii. identify the level of awareness and utilization of climate smart agricultural practices in the study area;

iii. examine the food security situation in the study area;

iv. examine the effects of the adoption of climate smart agricultural practices on farming households food security status in study area; and,

v. identify the constraints to climate smart agricultural practices adoption in the study area.

MATERIALS AND METHODS

The Study Area

The study was conducted in Delta State, Nigeria. The state was created on the 27th August, 1991 and lies between Longitudes 5°00 and 6°30’ North. It has a total land area of 17,440 square kilometers, about one-third of this is swampy and water logged (Delta State Diary, 2003) and the area ranks 23rd out of 36 states. According to National Population Commission (2006), Delta State has a population of 2,074,306 males and 2,024,085 females. Delta State consists of 25 Local Government Areas (LGA). The state is divided into three Agricultural Zones by Delta Development Program (DADP), these zones are Delta North, Central and Delta South agricultural zones with Agbor, Effuru and Warri as the headquarters, respectively. Delta State is one of the highest producers of crude petroleum products in the country with anticipated exploration, exploitation and regular gas flare. However, as with most part of the country, agriculture is the dominant aspect of the rural economy of the state. A lot of farming activities are carried out in the study area and these includes perennial crops and annual crops farming, livestock and fish farming.

Sampling Procedure

The population for this study comprises of farming households in Agricultural Zone in Ika North-East Local Government Area, Delta
State. A three-stage sampling method was used for the study. In the first stage, a purposive selection of Ika North East Local Government Area due to the pre-dominance of farming activities carried out in the communities. In the second stage, a random selection of four farming communities in the area. In the third stage, 35 farming households was randomly selected to give a total of 140 respondents for the study.

**Method of Data Collection**

Primary data was used for the study. The data was collected from the respondents with the use of structured questionnaire administered to farming households. The questionnaire was structured to help achieve the study objectives.

**Analytical Techniques**

The study data was analyzed using descriptive statistics, FGT model, logit regression mode and mean score from likert-type rating scale.

Objective one and two of the study was achieved using descriptive statistics, and Objective three was achieved using the Foster Greer Thorbecke (FGT) model. Objective four of the study was achieved using a Logit regression mode, while objective five using mean score from the Likert-type rating scale.

**Food Security Status**

The household food security was measured using household calorie acquisition adjusted for Adult Equivalent (A.E). From the estimates, households whose calorie consumption are greater than or equal to 2260 Kcal/AE will be categorized as food secure while those less were categorized as insecure (FAO, 2012).

FGT model is given as:

$$\text{FGT} = \frac{1}{N} \sum_{i=1}^{q} \left( \frac{y_i}{z} \right)^{\alpha}$$

Where

- $y_i$ = calorie intake of each food insecure households
- $q$= number of food insecure households
- $N$= total number of size
- $z$ = minimum of requirements per day per adult equivalent (2100 kcal/AE)
- $\alpha$ = weight attached to food insecurity (0.1 and 2 for poverty headcount, poverty gap and poverty severity respectively).

**Logit regression model**

The effect of adoption of CSA practice on farming household food security of the respondents was achieved using a logit regression model.

The generalized logit regression model is given as:

$$logit (P) = \log \left( \frac{P}{1-P} \right) = \ln \left( \frac{P}{1-P} \right) = a_0 + b_1x_1 + b_2x_2 + b_3x_3 + \ldots + b_nx_n + u$$

Where Y is binary dependent variable valued as 1 when household is food secure and 0 when is food insecure. Independent variables include the following:

- $X_1$= gender of respondent (1=male, 0= female)
- $X_2$= access to extension (1=access, 0= otherwise)
- $X_3$= credit access (1=access, 0=otherwise)
- $X_4$= educational status of respondent (non-formal, primary, secondary, tertiary)
- $X_5$= labour (naira)
- $X_6$= age of the respondent (years)
- $X_7$= farming experience of respondent (years)
- $X_8$ = land ownership (1= owned, 0= not owned)
Results and Discussion

Socio-Economic Characteristics of Respondents

The socio-economic characteristics of the respondents examined were: age, sex, marital status, household size, educational level and farming experience, primary occupation, annual income, co-operative society and extension services.

Table 1 shows the mean age is 40 years implying that there were more economically active people who engage in agricultural activities in the study area. The result shows 60.71% of the respondents were males while 39.29% were females. This shows that majority of the rural farmers were males and this may be attributed to intensive labor requirement of farming activities and their easy access to farmland. Table 1 shows that the majority (64.29%) of the respondents were married. This implies that greater proportion of farmers in the area were married.

The result further indicates the household size of most of the respondents range from 4-6 members (55.71%), while the average household size was 4 persons. A large household increases a household’s labor endowment. Also, the result shows that 28.57% of the respondents had no formal education, 15.71% had primary education and 20.00% had secondary education. The result of the study revealed that most of the respondents had some form of formal education. The result has implication for technology adoption. According to Henri-Ukoha, et al., (2011) the level of education of a person not only increases his farm productivity but also enhances his ability to understand and evaluate new technologies. The educational level of a farmer typically correlates positively with the adoption of technological innovations because of the assumed link between education and knowledge accumulation and the farmer’s capacity in decision making (Gebrehiwot and Van Der Veen 2013).

The result shows majority (66.43%) of farmers affirm to have not had contact with extension agent in the last 12 months, while the remaining 33.57% have contact extension agent. Regular contact with extension agents motivates and exposes the farmers to innovations and gives them information on how to use the technologies (Osisakwe and Agomuo, 2011).

Table 1 shows that majority (47.14%) of the respondent earned below ₦200,000 annually. The mean annual income was ₦256,123.60. This is in line with the report of Oluwatayo (2013) that respondents’ income distribution was of low income group who might not be in position to readily afford or access new agricultural technology. Majority (57.55%) of farmers do not belong to cooperative society while the remaining 42.49% belonged. Cooperative societies play a very important role in the enlightenment of their members. Farmers who belong to such groups are easily enlightened and exposed to new farming technologies that will help boost agricultural production. Result shows that (32.14%) of the respondents were workers who receives salary, 27.86% were farmers, 16.43% engaged in other types of work such as catering, tailoring, driving e.t.c. 15.00% of the respondents were into trading (engaged in buying and selling of good).

Table 2 indicates that most respondents with 99.29% were aware of climate smart agriculture. According to Vera et al. (2017) and Teklewold et al., (2013), farmers enjoy more benefits when they adopt multiple strategies, as some of the strategies can be complementary to one another and enable the farmers to exploit relevant synergies. As a result, the adoption of multiple CSA practices

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helps in building a sustainable agricultural system that is very resilient to shocks which are related to climate change and other factors posing challenges to agricultural production. The result reveals that mixed cropping and mixed farming ranked both ranked 1st. Improved crop varieties ranked 3rd. Cover crop, mulching, intercropping, organic manure, compost making, crop rotation and agro-forestry ranked 4th, 5th, 6th, 7th, 8th, 9th, and 10th respectively.

The result of the study on the food security situation in the study area as presented on Table 3 indicated that majority (71%) of the farming households were food secure while only 29% were food insecure. Furthermore, based on the recommended daily calories intake of 2260 Kcal, the headcount ratio shows 0.29, with short fall index and severity of 0.28 (28%) and 0.13 (13%) respectively. The result revealed the head count ratio of 29%, the result also further revealed that the food insecure households fell short of the recommended calorie intake by 28% and core food insecurity of 13% respectively.

From the result in Table 4 it is noteworthy that the model was correctly estimated with chi² value of 98.50 overall, the model was significant at 1%. Four (4) out of the eight (8) explanatory variable included in the model significantly influence food security status of the households. These variables are; age, sex, household size and extension visit. The coefficient of age (β=-0.11) is negative but significant at p < 0.05 level of probability. This implies that a decrease in age of the respondents will lead to the likelihood of the household been food secure. This is in conformity with the a priori expectation. This result also agrees with the findings of Kayunze et al., (2017) who reported age to be negatively related with food security, and reported that households with older age are less food secure. Sex had a significant negative effect on food security. The coefficient (β= -3.11) of the variable was significant at p < 0.01 level of probability. This implies that the probability of food security decreases with increase in female headed household heads. That is, households heads that are male are more likely to be food secure than household with female. This result was not in conformity with that of Arslan et al., (2014) who observed that female headed were more food insecure. Household size had a significant negative effect on food security. The coefficient (-0.97) of this variable was significant at p < 0.01 level. This implies that the probability of household food security increases with decrease in the household size of the respondents. That is, large household size is more likely to be food insecure than small household size. This result is in conformity with that of Idrisa et al., (2008) who observed that the larger the household size, the more the household expenses, especially in a situation where majority of the household income is generated by only household heads. The coefficient (0.14) of farming years was positive and significant at p < 0.05 level. This means that the higher the farm experience, the more the likelihood of the rural households to be food secure. This is in conformity with Kayunze et al (2017) who observed that farming years has the potential to increase households’ food security.

**Constraints to Climate Smart Agricultural Practices by Crop Farmers**

The mean score from the constraints confronting the ability of the farmers to adopt Climate Smart Agricultural practices in the study area is shown in Table 5.

The result shows that high cost of input (mean score = 2.83) was a very serious problem. Lack of access to agricultural credit (mean score = 2.79) was a very serious problem. Also, the result shows that high cost of production (mean score =2.69) was also a very serious constraint. Inadequate financial
resources (mean score = 2.47) was rated as very serious constraint by respondents in the area. This implies that majority of the respondent do not have adequate financial resources to adapt CSA practices. This corroborates the report by Oyekale (2009), that small-scale farmers, having low resource base, are more vulnerable and less able to cope with the consequences of climate change.

**Conclusion**

The study assessed the effect of Climate Smart Agricultural practices on farming households’ food security status in Ika North-East Local Government Area of Delta State. The major finding shows that climate smart agricultural practices has positive coefficient though not statistically significant. The result shows that CSA has a potential to enhance food security but probably needs to be combine in a manner to make it more effective.

Based on the findings of the study, the study recommends that farmers should be encouraged to combine CSAs as much as possible to reduce the negative effect of climate change and to have a higher effect on food Security status. The study also recommended that policy be put in place help confront the constraints being faced by the farmers from adopting CSAs in the study area.
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### APPENDIX

#### Table 1: Socio-Economic Characteristics of the Respondents

| Socio-economic characteristics | Frequency | Percentage | Mean/mode |
|-------------------------------|-----------|------------|-----------|
| **Age**                      |           |            |           |
| 20-29                         | 7         | 5.0        |           |
| 30-39                         | 35        | 25.0       |           |
| 40-49                         | 35        | 25.0       |           |
| 50-59                         | 34        | 24.29      | 40 years  |
| ≥60                           | 27        | 20.71      |           |
| **Total**                     | 140       | 100        |           |
| **Sex**                       |           |            |           |
| Male                          | 85        | 60.71      |           |
| Female                        | 55        | 39.29      |           |
| **Total**                     |           |            |           |
| **Marital status**            |           |            |           |
| Single                        | 22        | 15.71      |           |
| Married                       | 90        | 64.29      |           |
| Widow(ed)                     | 18        | 12.86      |           |
| Divorced                      | 10        | 7.14       |           |
| **Total**                     |           |            |           |
| **Household size**            |           |            |           |
| 1-3                           | 49        | 35.00      |           |
| 4-6                           | 78        | 55.71      | 4 persons |
| 7 above                       | 13        | 9.28       |           |
| **Total**                     |           |            |           |
| **Educational level**         |           |            |           |
| Non-formal education          | 40        | 28.57      |           |
| Primary education             | 22        | 15.71      |           |
| Secondary education           | 28        | 20.00      |           |
| ND/NCE                        | 27        | 19.28      |           |
| HND/First degree              | 23        | 16.43      |           |
| **Total**                     |           |            |           |
| **Extension service**         |           |            |           |
| Yes                           | 47        | 33.57      |           |
| No                            | 93        | 66.43      |           |
| **Total**                     |           |            |           |
| **Annual income**             |           |            |           |
| ≤200000                       | 63        | 47.14      |           |
| 201000-300000                 | 15        | 10.71      |           |
| 301000-400000                 | 15        | 10.71      |           |
| 401000-500000                 | 17        | 12.14      |           |
| ≥500000                       | 27        | 19.29      |           |
| **Total**                     |           |            |           |
### Cooperative society

|       |   |          |
|-------|---|----------|
| Yes   | 59| 42.49    |
| No    | 80| 57.55    |
| Total |   | 100      |

### Primary occupation

| Occupation      |   |          |
|-----------------|---|----------|
| Farming         | 39| 27.86    |
| Salaried        | 45| 32.14    |
| Trading         | 21| 15.00    |
| Craft & Artisans| 12| 8.57     |
| Others          | 23| 16.43    |
| Total           | 140| 100     |

Field survey, 2020.

**Table 2: Climate Smart Agricultural Practices Utilized by the Farmers**

| CSA Practices                      | Frequency | Percentage | Rank |
|-----------------------------------|-----------|------------|------|
| Awareness about CSA Practices     |           |            |      |
| Aware of CSA                      | 139       | 99.29      |      |
| Not aware                         | 1         | 0.71       |      |
| CSA Practices utilized            |           |            |      |
| Agro-forestry                     | 38        | 27.34      | 10   |
| Crop rotation                     | 74        | 52.86      | 9    |
| Mixed cropping                    | 140       | 100        | 1    |
| Improved crop varieties           | 138       | 98.57      | 3    |
| Intercropping                     | 128       | 87.86      | 6    |
| Compost making                    | 81        | 58.27      | 8    |
| Improved fallowing                | 26        | 18.57      | 12   |
| Organic manure                    | 115       | 82.14      | 7    |
| Mulching                          | 133       | 95.00      | 5    |
| Cover crops                       | 135       | 96.43      | 4    |
| Mixed farming                     | 140       | 100        | 1    |

*Source: Field survey, 2020.*  
*Multiple responses were recorded*
Table 3: Indices of Farming Households Food Security

|                          | Households          |
|--------------------------|---------------------|
|                          | Food-secure | Food insecure | All    |
| Percentage household     | 99 (71%)     | 41 (29%)      | 100    |
| Daily per capita Calorie consumed | 4079.90   | 1634.04       | 3604.09|
| Food security index (z)  | 1.96         | 0.72          | 1.60   |
| Head count ratio (H)     | 0.71         | 0.29          |        |
| Shortfall index (P₁)     | 0.28         |               |        |
| Severity (P₂)            | 0.13         |               |        |

Source: field survey. 2020.

Table 4: Effect Adoption of CSA on Farming Household Food Security in the Study Area

| Food security            | Coefficient | Std. error | P > |z| |
|--------------------------|-------------|------------|-----|--|--|
| Age                      | -.1057934   | .0440518   | 0.016 |
| Gender                   | -.3.114827  | .7360879   | 0.000 |
| Household size           | -.9722147   | .2734742   | 0.000 |
| Educational level        | .1110799    | .248611    | 0.655 |
| Farming years            | .1435878    | .0615197   | 0.020 |
| Extension visit          | -.3.49462   | .5379032   | 0.516 |
| Last farming income      | 8.854e-07   | 1.62e-06   | 0.597 |
| No. of CSA practice      | .0954333    | .1778518   | 0.592 |
| Constants                | 12.63805    | 3.75834    | 0.001 |

LR chi² = 98.50
Prob > chi² = 0.000
Pseudo R² = 0.5818
Log livelihood = -35.406343

Number of observation = 140  * = sig 5%, ***= sig 1%
Table 5: Constraints to the adoption of Climate Smart Agricultural practices

| Constraints                                         | Not serious | Serious | Very serious | Mean score |
|-----------------------------------------------------|-------------|---------|--------------|------------|
| Lack of awareness of CSA practice                   | 102         | 33      | 5            | 1.31       |
| Poor extension service                              | 51          | 74      | 15           | 1.74       |
| Low dissemination of information on CSA options     | 54          | 71      | 15           | 1.72       |
| Limited availability of equipment                   | 80          | 45      | 15           | 1.54       |
| Illiteracy of farmers                               | 70          | 66      | 4            | 1.53       |
| Limited availability of inputs                      | 76          | 47      | 17           | 1.58       |
| inadequate financial resource                       | 7           | 60      | 73           | 2.47*      |
| Poor technical capacity of farmers                  | 67          | 50      | 23           | 1.69       |
| Lack of access to agricultural credit               | 2           | 25      | 113          | 2.79*      |
| High cost of improve crop variety                   | 8           | 20      | 112          | 2.74*      |
| Non-availability of farm labor                      | 129         | 8       | 3            | 1.1        |
| Lack of inadequate government policy                | 75          | 54      | 11           | 1.54       |
| High cost of production                             | 6           | 33      | 101          | 2.69*      |
| Pest and disease                                    | 90          | 34      | 16           | 1.47       |
| Shortage of labor                                   | 123         | 13      | 4            | 1.15       |
| High cost of input                                  | 0           | 24      | 116          | 2.83*      |
| Lack of improved storage facilities                 | 91          | 27      | 22           | 1.51       |

Source: Field survey, 2020