

Research

## Mitigating Climate Change through Organic Agriculture: A Case Study of Farmers' Participation in Organic Farming Practices in Nasarawa State, Nigeria

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### Abstract

*The study was designed to assess the level of farmers' perception of what constitutes climate change and their participation in organic farming practices in a rural farming community using a sample of 63 randomly selected farmers. The results show that there is a general awareness of climate change among the respondents. In addition, majority of the farmers considered the rise in temperature as the most prominent indicator of climate change in the study area. The major specific index of climate change was the late onset of rainfall. The farmers moderately participated in organic farming practices but not deliberately to mitigate climate change. It was therefore recommended that extension agents should enlighten farmers on the potentials of organic farming practices in mitigating climate change.*

**Keywords:** Organic farming; Mitigation; climate change

### Introduction

Climate change refers to a change of climate attributed directly or indirectly to human activities, which alters the composition of the global atmosphere in addition to natural climate variability observed over comparable time period (Adejuwon, 2006). The Inter-

governmental Panel on Climate Changes has evolved its own usage of the term climate change as any change in climate over time whether due to natural variability or as a result of human activities. The features of climate change have impacts that could be measured in

terms of the sensitivity of agro-ecological systems to higher concentration of carbon dioxide in the atmosphere, changes in available soil water, higher inter-annual variability, and higher rate of mineralization of organic matter, higher rates of soil erosion, higher incidents of pest and diseases, and sea level rise.

As global temperatures rise and weather patterns become more erratic, the intersection between climate change and agriculture is crucial to understanding the role agriculture plays in contributing to and mitigating global warming. The Institute of Science in Society (2008), reported that modern or conventional agriculture contributes a great deal to climate change: it is the main source of the potent green house gases such as nitrous oxide and methane. According to Sanchez (2000), 20% of all green-house gas (GHG) emission is as a result of synthetic agro chemicals. Conventional agriculture is heavily dependent on the use of fossil fuels and contributes to the loss of soil carbon to the atmosphere through deforestation to make land available for plantations. However, carbon sequestration, lower-input of fossil fuel dependent resources, and use of renewable energy all present opportunities for organic agriculture to lead the way in reducing energy consumption and mitigating the negative effects of energy emissions.

Organic agriculture represents a broad set of practices that emphasize farming based on ecosystem management, integrated cropping and livestock systems, diversity of product, and reliance on natural pest and disease control without the use of synthetic inputs (Ziesmer, 2007). The objectives of organic agriculture are to produce sustainable and healthy food through harnessing natural biological and ecological processes. According to United State Department of Agriculture (2006), organic farming practices include: use of cover crops, green manures, animal manures and crop rotations to fertilize the soil, maximizing biological activity and maintain long-term soil health; use of biological control, crop rotations and other techniques to manage weeds, insects and diseases; use of rotational grazing and mixed forage pastures for livestock operations; reduction of external and off-farm inputs and elimination of synthetic pesticides and fertilizers; and, focusing on renewable resources.

Organic agriculture enables ecosystem to better adjust to the effects of climate change and has major potential for reducing agricultural green house gas emission through restoring soil organic matter content as well as reducing soil erosion and improving physical structure; and, emission of less nitrous oxide (NO<sub>2</sub>) due to lower N inputs (less N from organic manure, higher C/N ratio of applied organic manure

giving less readily available mineral N in the soil as a source of denitrification) and efficient uptake of mobile N in soil by using cover crop (Ho and Ching, 2008).

Adrian (2009), observed that organic agriculture as a mitigating strategy addresses both emission avoidance and carbon sequestration. Emissions avoidance is achieved through lower N<sub>2</sub>O emission (due to lower nitrogen input), Less CO<sub>2</sub> emission through erosion (due to better soil structure and more plant cover); and, Lower CO<sub>2</sub> emission from farming system inputs (pesticides and fertilizers produced using fossil fuel). Soil carbon sequestration is enhanced through agriculture management practice (such as increased application of organic manures, used of intercrops and green manure etc), which promote greater soil organic matter structure. Organic agriculture also performs better than conventional agriculture on a per hectare scale, both with respect to direct energy consumption (fuel and oil) and indirect consumption (synthetic fertilizers and pesticides), with high efficiency of energy use (Ho and Ching, 2008).

FAO (2003) identified some of the effect of climate change on crops production which is already seen to be advancing at a higher rate than previously anticipated to include: heat stress increased to crop and livestock e.g. high temperature in the night time; decline in precipitation in some crop insecure areas;

concentration of rainfall into small number of rainy event with increases in number of days with heavy rain, increasing erosion and flood risks; evaporation rate increased as a result of higher temperature and lower soil moisture level; and, change in seasonal distribution of rainfall, with less falling in the main crop growing season and crop supply and distribution through more frequently extreme event. Akeh *et al.* (2006), observed that climate variability has been, and continues to be, the principal source of fluctuations in global food production, and more so in the semi-arid tropics of developing world. According to FAO (2008), lower green house gas emissions for crop production and enhanced carbon sequestration, coupled with additional benefits of biodiversity and other environmental services, makes organic agriculture a farming method with many advantages and considerable potential for mitigating climate change.

Based on the foregoing, this study aims to determine the perceptions of farmers in north central Nigeria on the indicators and effects of climate change in order to elicit information on their awareness and understanding of the concept. In addition, the level of participation of farmers in organic farming practices was also determined to ascertain their readiness in adapting to and mitigating climate change. Most importantly, the study would provide additional empirical data for policy formulation towards mitigating climate change in Nigeria.

## Methodology

### Description of Study Area

The study was conducted in Nasarawa Eggon Local Government Area, Nasarawa State Nigeria. The area is located within latitude 08°33'N and longitude 08°32'E with altitude of 181.53m above sea level. It has an annual rainfall of 1,288mm and average temperature ranges from 22.7°C-36.8°C. It covers an estimated land mass of about 2,035Km<sup>2</sup> and with a population of 149,129 people; made up of 77888 males and 71241 females. Majority of the population are subsistence farmers that cultivate crops such as yam, maize, sorghum, millet, cowpea and fruits on predominantly sandy loam soil. Nasarawa Eggon Local Government Area comprises of five (5) districts, namely Unme, Alogani, Alizaga, Agungi, and Nasarawa Eggon.

### Sampling Techniques

Random sampling was used in selecting respondents for the study. Three districts were randomly selected from the five districts that make up the Local Government Area. Furthermore, three farming communities were also randomly selected from each of three districts. Finally, seven crops farming household heads were randomly selected from each of the nine communities to give a total of 63 respondents for the study.

### Method of Data Collection

Primary data were used for the study. These were collected with the aid of structured questionnaire. Data were collected on organic farming practices, farmers' perception of the climate changes and level of participation in the organic farming practices.

A total of six organic farming practices were identified, and these include; crop rotation with legumes as a component, green manuring, use of cover crops, application of animal manure, application of compost manure and use of natural pest control. The level of participation in organic farming practices by a farmer was determined by dividing the number of organic farming practices a farmer is involved in by the total number of practices observed in the study area and multiplying by 100 as shown below:

$$POF = NP/TNP * 100$$

POF= participation in organic farming practices  
NP= number of organic farming practices a farmer is involved in

TNP= Total number of organic farming practices observed in the study area.

Furthermore, based on the value of POF obtained, the scale below was used to classify the level of participation for each farmer.

POF value	Level of participation
1 – 20.9	Very low
21 – 40.9	Low
41 – 60.9	Moderate
61 – 80.9	High
81 – 100	Very high

### **Method of Data Analysis**

Descriptive statistics was used for data analysis.

### **Results and Discussion**

#### **Farmers' Perception of the indicators and effects of Climate Change**

The perceptions of the indicators on climate change are presented in Table 1. The farmers considered rise in temperature, unpredictable weather, prolong drought and high incidence of flooding as the indicators of climate change in the study area. However, majority of the farmers (83%) recognized the rise in temperature as the major indicator of climate change.

On the other hand, the late onset of rainfall, high occurrence of erosion, high incidence of pests and diseases and reduction in yield were considered by the respondents as the specific changes they have observed over the years to be as a result of climate change (Table 2). Majority of the farmers (95%) considered the late onset of rainfall as the major effect of climate change. This finding agrees with the observations made by Odeyemi and Ogunkoya (2006) from the analysis of annual rainfall in Nigeria from 1901 to 1990. The analysis reveals that there has been a forward shift in the months that usually mark the onset and cessation of the rainy season as well as reduction in the length of rainy season and the total annual rainfall in Northern Nigeria. Oladipo (1995) equally observed that there has

been a persistent decline in the total rainfall and rising temperature which is an indication of an abrupt change in climate resulting in unpredictable timing of rainfall and planting.

The results in Tables 1 and 2 imply that there is a wide variability among the sampled farmers in terms of their perceptions of the indicators and effects of climate change. However, the results imply that there is a general awareness of climate change among the farmers in the research area.

#### **The prevailing Organic Farming Practices in the study area**

The identified organic farming practices in the study area are presented in Table 3. The result shows that, the application of animal manure, cultivation of cover crops, crop rotation with legumes, use of green manuring, application of compost manure and natural pest control were the organic farming practices common among farmers in the study area. Umar and Okoye (2010) noted the sustainability of agricultural productivity in organic farming depends largely on environmentally friendly farming practices like the use of organic manure, green manure, and natural pesticides. The most prevalent practices are the application of animal manure and cultivation of cover crops. These were practiced by about 63% and 62% of the respondents respectively. These findings differ

from the observation in a study by Obinne *et al.* (2008) in Benue State, in which manuring and mulching were found to be the major organic farming practices. The variations in cropping system could be responsible for the observed difference. The result implies that organic farming practices are widespread among farmers in the research area. However, the farmers pointed out that these practices were not specifically adopted to mitigate or adapt to climate change. This implies that the farmers are not deliberately proactive towards climate change. The following practices, planting of cover crops, crop rotation with legumes and

green manuring will help farmers increase their resilience or adaptation to climate change. On the other hand, the use of natural pest control, application of compost and animal manure are relevant in mitigating climate change.

#### **Level of Participation in Organic agriculture**

The result in Table 4 shows that majority of the farmers moderately participate in organic farming practices. This result disagrees with the findings of Obinne *et al.* (2008) that the level of utilization of organic farming practices is low in Benue State, Nigeria.

Table 1: Farmers' perception of the indicators of climate change

Signs of climate change	Frequency*	%
Prolong drought	26	41
Unpredictable weather	36	57
Flooding	02	3.2
Increase in temperature	52	83

Source: Field survey, 2010

\* Multiple choices are considered; therefore the total frequency is higher than the sample size.

Table 2: Farmers' Perception of the effects of climate change

Effects of climate	Frequency*	%
High occurrence of erosion	56	89
Late onset of rain	60	95
High incidence of pests and diseases	51	81
Reduction in yield	27	43

Source: Field survey, 2010

\* Multiple choices are considered; therefore the total frequency is higher than the sample size.

Table 3: Organic Farming Practices in the study area

Organic farming practice	Frequency*	%
Crop rotation with legumes	38	60
Green manuring	35	56
Cover crops	39	62
Application of animal manure	40	63
Application of compost manure	24	38
Use of natural pest control	17	27

Source: Field survey, 2010

\*Multiple choices are considered; therefore the total frequency is higher than the sampled size

Table 4: Level of Farmers Participation in Organic Farming Practices

Scale	Frequency	Level of participation
1 – 20.9	08	Very low
21 – 40.9	07	Low
41 – 60.9	30	Moderate
61 – 80.9	13	High
81 – 100	05	Very high

Source: Field survey, 2010

### Conclusion and Recommendations

There is a general awareness on climate change and its effects on crop farms in the research area. Although the level of participation in organic farming practices was moderately high, it was not a deliberate measure adopted in adapting to or mitigating climate change. Extension agents should enlighten farmers on the potentials of these practices in mitigating and adapting to climate change. There is need for a follow up study to identify the constraints to farmers'

participation in organic agricultural practices in the research area.

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