MONOGRAPH

CPED Monograph Series

Adapting to Climate Change by Small Scale Farmers in Nigeria's Niger Delta Region: Challenges and Opportunities

This publication is supported by International Development and Research Centre (IDRC)

IDRC · CRDI
International Development Research Centre
Centre de recherches pour le développement international

Canada

CPED Monograph Series

Adapting to Climate Change by Small Scale Farmers in Nigeria's Niger Delta Region: Challenges and Opportunities

Andrew G. Onokerhoraye

Job I. Eronmhonsele

Published by

Centre for Population and Environmental Development (CPED)

46 Akenzua Street, Off Airport Road

P.O. Box 10085, Ugbowo Post Office

Benin City, Nigeria

First Published in 2021

Series Editor:

Professor Emeritus Andrew G. Onokerhoraye

Executive Director, CPED, Benin City

PREFACE

This monograph is part of the outputs of the on-going research of the *Centre for Population and Environmental Development (CPED)* on the research project titled *"Empowering women as key leaders in promoting community-based climate change adaptation and disaster risks reduction initiatives in Niger Delta region"* funded by the International Development and Research Centre (IDRC). The monograph reports on the major methods used by households to adapt to climate change in the various ecological zones of Delta State, the factors that affect their choice of method, and the barriers to adaptation. It was observed that a variety of adaptation measures, which are influenced by the geographical location of the communities, are adopted by small scale farmers in the communities of the various ecological zones in Delta State to mitigate the impact of climate change. These we believe can be improved upon through guidance and support by state and non-state actors to the small scale farmers most of whom are women.

We are particularly grateful to IDRC for the financial support to CPED which has enabled the Centre to carry out the study and the publication of this policy monograph. We want to take this opportunity to appreciate the support provided to the project by IDRC through mainly the Senior Program Specialist, Dr. Melanie Robertson, who is in charge of the project on behalf of IDRC. She has consistently guided the Project Team in the implementation of the various activities carried out. Finally, we appreciate and acknowledge the contributions of the following Team Members to the execution of the project: Professor May Nwoye; Professor Dicta Ogisi; Professor Gideon E.D. Omuta; Professor Felicia Okoro; Professor Onovughe Ikelegbe; Professor Peter Odjugo; Dr. Johnson Dudu; Dr. Francis Onojeta; Dr. Godwin Atedhor; and Dr. Eddy Akpomera.

Adapting to Climate Change by Small Scale Farmers in Nigeria's Niger Delta Region: Challenges and Opportunities

Introduction

One of the regions in Nigeria that is being negatively affected by climate change is the Niger Delta region. The Niger Delta is a complex and fragile environment. Almost all the oil production activities in Nigeria take place in the region, which spans through the uplands to the deep sea. Oil explorations in the region bring with them environmental degradation of monumental dimensions. Of particular concern has been enormous and consistent gas flaring which has taken place in the Niger Delta since the inception of oil production in the region. Traditionally, agriculture (crop farming and livestock rearing) and fishing are important livelihoods in the Niger Delta. Both the uplands (dry land) as well as wetlands are cultivated. Farmers in Niger Delta, particularly wetland farmers, operate between two extreme conditions-flooding and drought, conditions that are associated with changes in climate in the region. An examination of the available literature shows that in the context of the Niger Delta region, and indeed other parts of Nigeria, the understanding of vulnerability to climate change and the strategies and pathways for adaptation are currently enveloped in high uncertainties because of inadequate information and data (Akpofure, 2012; Awosika et al, 1992; CPED, 2005).

This study identifies the major methods used by households to adapt to climate change in the various ecological zones of Delta State, the factors that affect their choice of method, and the barriers to adaptation. A variety of adaptation measures have been adopted by small scale farmers in the communities of the various ecological zones in Niger Delta to mitigate the impact of climate change. These adaptation measures are influenced by the geographical location of the communities and the common climate events. Overall, strategies such as late planting, economic diversification, planting on mounds, agricultural diversification and mixed cropping among others are used by respondents (Downing, T, et al, 1997). The use of land management adaptation techniques is also common to respondents in the three ecological zones. Planting on terraces is employed by a small proportion of the respondents. Farmers also plant flood-resistant or flood-tolerant varieties of crops like sugar cane and swamp rice (Odjugo, P.A. 2010).

Methodology

Data collection entailed:

(i) Field surveys were carried out in ten LGAs sampled from the three ecological zones as follows:

  (a) Mangrove Swamp (Warri South, Isoko South, Burutu and Patani);

  (b) Freshwater Swamp (Ethiope East, Ughelli South, and Sapele) and

  (c) Lowland Forest (Ika South, Aniocha North and Ndokwa East)

(ii) Administratively, the LGAs targeted in Mangrove Swamp ecological zone are in Delta South Senatorial District. Those in Freshwater Swamp are in Delta Central Senatorial District. Finally, those in Lowland Forest zone are in Delta North Senatorial District.

(iii) Quantitative data collection entailed the administration of between 400 and 450 household questionnaires in each selected LGA;

(iv) A total of about 4000 successfully completed household questionnaires were retrieved cleaned up and used for the quantitative data analysis;

(v) An average of between 1,250 and 1,500 household questionnaires were used in the analysis in each of the three ecological zones;

(vi) Qualitative data collection entailed the conduct of key informant interviews and focused group discussions amongst mainly community-based stakeholders;

(vii) A total of 107 key informants, with at least ten identified in each LGA were interviewed in the three ecological zones;

Also three categories of focus group discussions were organised in each target LGA comprising "all males", "all females" and a mix of "males and females", respectively.

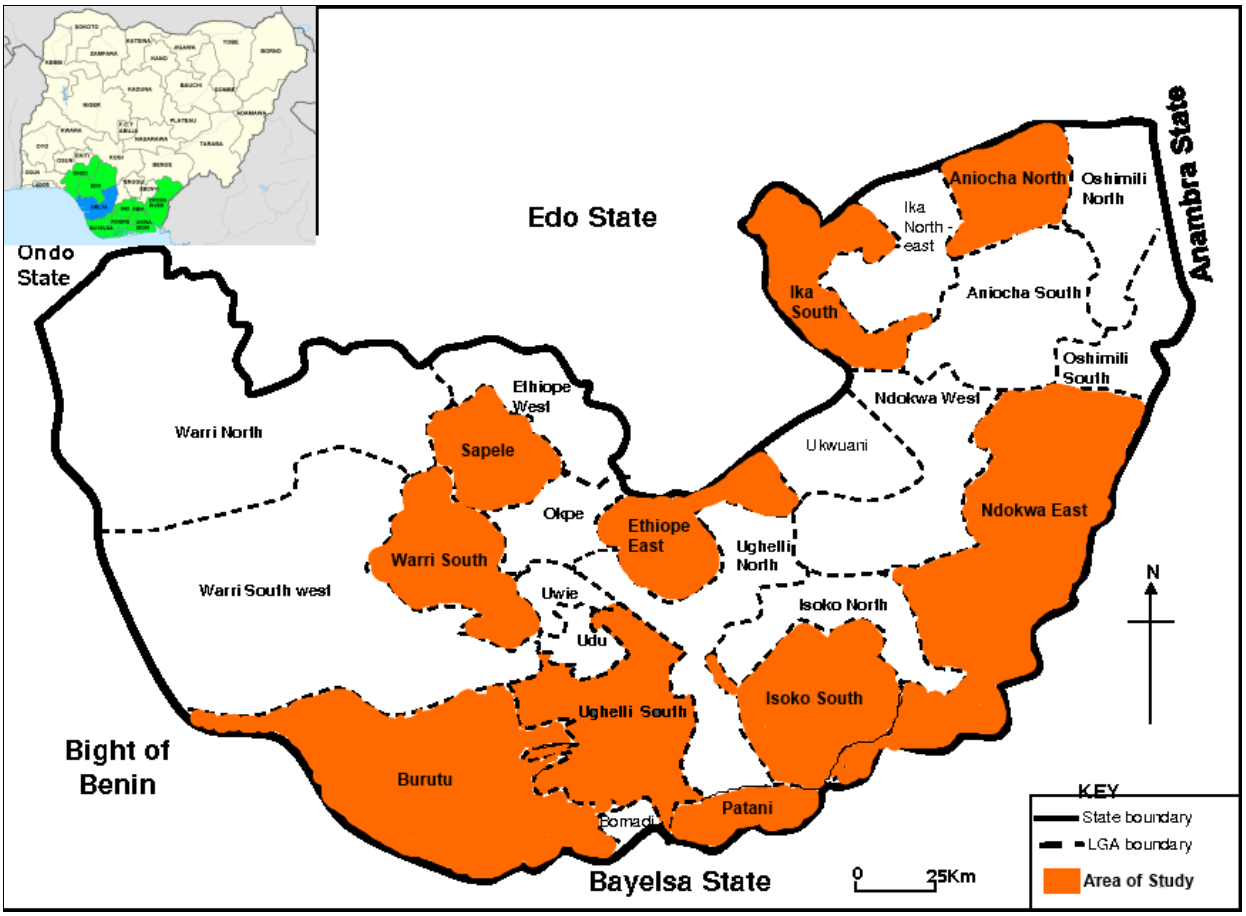

Fig. 1: Map of Delta State showing Local Government Areas of Project Implementation

Data quality assurance and processing are crucial components of any data collection activity and hence the usefulness of the output generated from the input data. After the data has been entered onto the tablet, it was exported to Statistical Package for the Social Sciences (SPSS) version 20. The data generated were analysed in terms of frequencies, percentages, and central tendencies (mean, mode, median), as well as grouping the data into class intervals. The sampling procedure and the questionnaire format allow derivation of inferential statistics, where necessary. Qualitative data from interviews, focus group discussions and observations were transcribed and used to elaborate on the statistical results.

Economic and crop production diversification strategies

As an adaptive strategy, respondents in the three ecological zones have diversified their economic activities; for instance, they also altered their lifestyle and switched to other income generating activities such as: Establishing of commercial motorcycles driving business, selling of oil and petrol, saloon, petty shops and business, small scale poultry keeping, selling food items across the roads and shops as new income generating activities (Abotutu, 2012). As shown in Table 2 the respondents indicated that one of the strategies they adopted to increase agricultural production is to increase the size of cultivated land whenever available. When additional farmland is inadequate or unavailable respondents were not in a position to adopt this strategy.

Table 1: Percentage Distribution of Respondents' report on livelihood/income diversification used in response to climate change disasters

Ecological Zones	Livelihood diversification	Out migration	Share cropping	Obtain loans	Use of alternative strategy	Pre-mature harvest	Relocation of livestock	Combination of all the above
Mangrove Swamp	19.5	8.2	1.2	4.6	3.5	27.4	2.5	33.0
Freshwater Swamp	17.0	2.9	5.0	5.8	4.2	38.2	1.2	25.7
Lowland Rainforest	22.1	2.3	4.3	3.0	2.0	8.2	0.3	57.4

Table 2 shows that about half of the respondents in the Mangrove Swamp and Freshwater Swamp ecological zone where land for farming is generally inadequate indicated that they increase the size of their cultivated land while the remaining half said they were not able to do so because they had no additional land to put into farming. On the other hand, in the Lowland Rainforest ecological zone where more land appears available, over 71 per cent of the respondents indicated that they were able to put more land into cultivation. Table 2 further shows that most of the respondents that increased the size of their cultivated land reported that the strategy was effective in increasing their income in the phase of climate change.

Table 2: Percentage Distribution of Respondents' experience on adopting increasing the size of cultivated land as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	49.9	50.1	47.4	2.7	49.9
Freshwater Swamp	52.0	48.0	46.0	6.0	48.0
Lowland Rainforest	71.3	28.7	68.6	3.0	28.4

The rural non-farm sector in the Niger Delta region not only contributes directly to rural households' income that creates employment opportunities, but also it provides avenues for input supplies to the farming sector and value-adding opportunities for the farm production. A well-off and non-farm sector should be able to provide employment to marginal farmers who leave agriculture because they could no longer survive in farming. A growing interest in the rural non-farm sector reflects the increasing realization that rural peoples' livelihoods are derived from diverse sources and are not as overwhelmingly dependent on agriculture (African Development Bank 2006). Table 3 shows that the majority of the respondents (58.8 per cent) in the Lowland Rainforest reported diversification from farm to non-farm activities which can be explained largely by the availability of non-farm activities in the communities of the upland part of Delta State compared with the situation in the Mangrove Swamp and Freshwater Swamp ecological zones where such opportunities are limited. Table 3 further shows that most of the respondents who adopted this strategy described their strategy as effective.

Table 3: Percentage Distribution of Respondents' experience on adopting diversification from farm to non-farm activities as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	37.3	63.7	32.6	4.9	62.5
Freshwater Swamp	40.7	59.3	34.0	6.8	59.2
Lowland Rainforest	58.8	41.2	54.3	4.7	41.0

New agricultural technologies, such as high-yielding crop varieties, offer the promise of improving productivity in Niger Delta region and hence the welfare of farmers in the context of the negative effects of the prevailing climatic change. Table 4 indicated that the vast majority of the respondents in the three ecological zones reported that they adopted planting different crop varieties as a strategy of adaptation to climate change. Table 4 further shows that the vast proportion of the respondents described their strategy as effective in terms of improving their incomes (NEST, 2004 and 2011).

Table 4: Percentage Distribution of Respondents' experience on adopting planting different crop varieties as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	61.9	38.1	58.5	3.8	37.8
Freshwater Swamp	69.2	30.8	60.3	9.1	30.7
Lowland Rainforest	92.3	7.8	89.0	3.3	7.7

Farming communities in Niger Delta region have survived a long series of climate fluctuations in the past by adapting to widely varying weather conditions. One of which has been planting of their crops at different times within the year. Table 5 indicates that the vast proportion of the respondents in the three ecological zones reported that have been adopting different planting times for their crops as response to the effects of climate change and most of the respondents also described this approach as effective in improving their agricultural productivity.

Table 5: Percentage Distribution of Respondents' experience on adopting different planting times as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	54.1	45.9	49.2	5.3	45.5
Freshwater Swamp	72.7	27.3	64.3	8.5	27.3
Lowland Rainforest	71.7	28.3	64.3	7.6	28.1

Crop diversification features prominently in Niger Delta region's farming household climate change adaptation strategies. Through crop diversification, farming households can spread production and income risk over a wider range of crops, thus reducing livelihood vulnerability to weather or market shocks. A few farmers have indicated that they use new type of maize seeds that produce maize within a short time (three months) and do not require a lot of rain. Therefore, farmers are trying to adapt to the changing climate by changing the type of seeds they use. This change has been noted by farmers in some communities indicating that there is a change in the type of bananas they plant now compared to what was obtainable some few decades ago. As the rainfall duration is getting reduced, the farmers tend to plant the type of bananas that can resist drought (shifting from the tall to the dwarf species). Majority of respondents showed that they are gradually shifting from the production of 12 months to 6-8 months cassava species.

Table 6: Percentage Distribution of Respondents' experience on adopting planting of early maturing crops as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	60.6	39.4	57.7	3.0	39.3
Freshwater Swamp	68.3	31.8	59.6	8.5	31.9
Lowland Rainforest	79.9	20.1	78.3	1.9	19.8

Table 6 shows that a greater proportion of the respondents in the three ecological zones reported that they have at various times adopted early maturing crops particularly maize as a strategy for adapting to climate change which they described as effective.

However, the planting of flood tolerant crops appears not to be popular as a strategy for adapting to the impact of climate change in the three ecological zones (Table 7). Similarly, the planting of drought tolerant crops as a strategy for adapting to the impact of climate change in the three ecological zones is not popular among the respondents (Table 8). Furthermore, Tables 9 and 10 also indicates that respondents in the three ecological zones show that the vast proportion of the respondents reported that they do not adopt the planting of salt tolerant crops and pest resistant varieties largely because opportunities for the adoption of such strategies are not available.

Table 7: Percentage Distribution of Respondents' experience on adopting flood tolerant crop as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	31.3	68.8	24.6	7.1	68.3
Freshwater Swamp	25.0	75.0	19.3	5.7	75.1
Lowland Rainforest	8.5	91.5	7.8	0.9	91.3

Table 8: Percentage Distribution of Respondents' experience on adopting drought tolerant crop as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	26.8	73.2	19.8	7.3	73.0
Freshwater Swamp	19.9	80.1	12.3	7.5	80.2
Lowland Rainforest	6.3	93.7	5.9	0.7	93.4

Table 9: Percentage Distribution of Respondents' experience on adopting salt tolerant crops as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	10.1	89.9	8.0	2.4	89.6
Freshwater Swamp	11.2	88.8	5.5	5.7	88.8
Lowland Rainforest	3.1	96.9	2.9	0.6	96.5

Table 10: Percentage Distribution of Respondents' experience on adopting pest resistant varieties as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	13.9	86.1	9.3	5.0	85.8
Freshwater Swamp	29.6	70.4	24.9	4.8	70.4
Lowland Rainforest	21.8	78.2	19.7	2.5	77.8

Finally, it can be stated that the lowland forest area picked economic diversification, dry season farming and late planting as the best options. While the freshwater swamp forest practised more of economic diversification, mixed cropping and agricultural diversification, the mangrove swamp forest zone used more of economic diversification, netting of fishing ponds and planting on mounds and ridges. This implies that as the impacts vary from ecological zone to the other so also is the adaptation strategies. What is common in the three ecological zones is economic

diversification. All the adaptation options are autonomous which will fail with increasing severity of climate change impacts, except planned adaptation measures are put in place.

Adaptive strategies for livestock keeping

In order to adapt to the effects of climate change at household level, some respondents in the three ecological zones of Delta State diversify their economic activities by doing both crop production and animal keeping. Respondents usually move with their animals from one place to another in search of water and pastures especially during the dry season. These movements in most cases are not planned and not coordinated to negotiate resource use which sometimes results into conflicts between groups. Other measures include change of new breed of animals that resist diseases and climate change impacts, construction of ponds and reservoirs for water storage. Some livestock keepers said that they have abandoned the traditional cows that could not resist new diseases and also practise zero grazing that need more grass cutting along the river banks. Table 11 shows that the vast majority of the respondents reported that they are not adopting early maturing livestock as a strategy for adapting to climate change largely because such varieties are not viable in the various ecological zones. The situation with regard to the adoption of different breeds of livestock is largely similar as the vast majority of the respondents do not adopt that strategy. This could be explained by the limited opportunities for doing so as different varieties of livestock are not readily available (Table 12).

Table 11: Percentage Distribution of Respondents' experience on adopting early maturing livestock as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	24.4	75.6	21.6	3.2	75.2
Freshwater Swamp	14.3	85.8	10.3	4.1	85.6
Lowland Rainforest	18.5	81.5	18.1	0.8	81.2

Table 12: Percentage Distribution of Respondents' experience on adopting rearing different breeds of livestock as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	24.4	75.6	20.9	4.1	75.0
Freshwater Swamp	13.7	86.3	10.3	3.6	86.2
Lowland Rainforest	20.9	79.1	18.6	2.5	78.9

Soil Conservation

Since the rainfall intensity is getting higher by the day in the Niger Delta region, erosion is also increasing thereby reducing soil fertility. In order to preserve soil fertility, farmers use various ways such as the use of terraces, mulching, grass strips and other traditional methods. However, some farmers still do not use any methods to preserve soil fertility. Although the proportion of those who do not practice any conservation methods seems small, there is need to encourage this group to at least use one of any means to preserve their soil for its fertility. Bush fallowing is one of the soil conservation practised by most farmers. Farmers indicated that, they normally leave some farms empty for sometime before using them again (bush fallowing), so that the land can recover its fertility. Crop rotation is another method mentioned by farmers as one of the means they use to preserve soil fertility and ensure soil conservation. Some respondents indicated that, they use crop mixing as a method to ensure soil fertility. They mostly mix beans and maize or groundnut and yam or cassava (Delta State Government, 2013).

Mulching which is a process of covering the soil surface around the plants in order to create favourable conditions for the crop growth is practiced by some farmers in the Niger Delta region. This includes moisture and soil conservation, temperature moderation, salinity and weed control etc. Ideally, mulching has a significant effect on earliness, yield and quality of the crop. Types of mulching materials used may be organic plant residues, insert material like pebble etc. or and synthetic materials like plastics.

Table 13: Percentage Distribution of Respondents' experience on adopting mulching as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	35.2	64.8	26.9	8.8	64.4
Freshwater Swamp	40.8	59.2	34.6	6.5	58.9
Lowland Rainforest	38.6	61.4	35.6	3.0	61.4

Table 13 shows that a significant proportion of the respondents indicated that they are adopting mulching as a strategy for adapting to climate change, although the vast majority of them do not. A significant proportion of those adopting mulching reported that it was effective. Some respondents also reported that they use plastic mulch, in a similar fashion to mulch, to suppress weeds and conserve water in crop production and landscaping. Table 14 however indicates the vast majority of the respondents do not use plastic culture as a strategy for adapting to climate change.

Table 14: Percentage Distribution of Respondents' experience on adopting plastic culture as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	24.1	75.9	17.6	6.9	75.4
Freshwater Swamp	24.5	75.5	20.3	4.7	75.1
Lowland Rainforest	51.3	48.7	49.8	1.7	48.5

In view of the generally lowland nature of the Niger Delta region, terrace and contour farming as a strategy of adaptation to climate change is not popular. Tables 15 and 16 show that the vast majority of the respondents (over 77 per cent) do not adopt terrace and contour farming strategies because the environment in most of the ecological zone do not make such farming approaches necessary.

Table 15: Percentage Distribution of Respondents' experience on adopting terracing as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	23.6	76.4	16.8	7.5	75.7
Freshwater Swamp	23.3	76.7	17.0	6.5	76.5
Lowland Rainforest	11.3	88.8	10.9	0.4	88.7

Table 16: Percentage Distribution of Respondents' experience on adopting contour farming as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	21.6	78.4	16.6	5.5	77.9
Freshwater Swamp	22.3	77.7	15.8	6.9	77.3
Lowland Rainforest	8.7	91.3	8.0	1.0	91.0

Dry land farming in most of the communities in the three ecological zones of the Niger Delta region is made possible mainly by the fallow system of farming, a practice dating from ancient times. The system is necessary because in the process

of field fallow the soil replenish with nutrients. Crop rotation is closely associated with the fallow system. Crop rotation helps to battle against the forces of erosion. Rotating crops helps to improve soil stability by alternating between crops with deep roots and those with shallow roots. Pests are also deterred by eliminating their food source on a regular basis. Tables 17 and 18 show that these systems of farming which the respondents use to combact the impacts of climate change on their livelihood are practised by the vast majority of the respondents in the Lowland Rainforest and to some extent in the two other zones (Nhemachena, C and Hassan R., 2007).

Table 17: Percentage Distribution of Respondents' experience on adopting bush fallowing as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	39.6	60.4	34.6	4.8	60.6
Freshwater Swamp	48.1	51.9	41.2	6.9	51.9
Lowland Rainforest	81.3	18.8	76.8	4.5	18.8

Table 18: Percentage Distribution of Respondents' experience on adopting crop rotation as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	56.6	43.4	53.7	3.2	43.1
Freshwater Swamp	61.9	38.1	55.9	6.1	38.0
Lowland Rainforest	83.4	16.6	82.1	1.3	16.6

Use of Fertilizers

The major reason for bush fallowing as revealed by the respondents was to restore soil fertility that is normally lost from excessive farming and soil erosion. In addition, farmers use different ways to manage their farms. Some of them use local manure from livestock. Apart from this, very few of the respondents use industrial fertiliser, pesticides and certified seeds. Although the chemicals applied in these crops, are said to have positive impact to crop production; the challenge is how to minimize their associated negative effects and cope with environmental management aspects. However, as stated above, few farmers do apply modern methods for soil conservations; there is a need to sensitize farmers on the need for soil conservation. Some farmers indicated that, they would have also liked to use fertilisers but they cannot afford to buy. So they normally just plant the seeds and hope for the best which does not work in most cases. Most farmers in the target communities rarely use modern farm management practices such as organic manure, pesticides, traditional and certified seeds, or chemical fertiliser. There is the need to find ways to assist farmers to apply modern methods for agriculture inputs as this is a major way their adaptive capacity can be enhanced in the face of climate change. Although such application of modern agricultural inputs requires huge investments in terms of agricultural inputs subsidies, extension services and capacity development among others. The government needs to focus on these areas so as to improve the adaptive capability of the people.

Table 19: Percentage Distribution of Respondents' experience on adopting use of fertilisers as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	32.9	67.1	24.2	9.1	66.8
Freshwater Swamp	52.5	47.5	46.3	6.8	47.0
Lowland Rainforest	64.4	35.6	58.8	5.8	35.5

Irrigation farming

Food production in the Niger Delta region still relies almost exclusively on rain-fed agriculture, leaving farmers and rural communities vulnerable to increasingly erratic rainfall patterns and extreme climate conditions. Yet there is vast potential to scale up irrigation to increase crop yields and improve resilience to climate shocks. Although irrigation in the communities of the Niger Delta region has the potential to boost agricultural productivities by at least 50 percent, food production on the region is almost entirely rain fed. The area equipped for irrigation, currently slightly more than 13 million hectares, makes up just 6 percent of the total cultivated area. Irrigation farming is being used in some communities. There are various forms of irrigation that are being used by farmers, but this is done in a very small scale when compared to the demand for irrigation. Many small scale farmers do not have financial means to install an irrigation system in their small farms. As a result, many tend to farm near the rivers using the flood water for dry season farming. Others resulted to the use of buckets while very few employ the use of pumping machines for dry season farming (UNDP, 2006).

Variations in ecological adaptation strategies are noticed in the communities of the different ecological zones. Table 20 shows that a significant proportion of the respondents in the Mangrove Swamp and Freshwater Swamp reported that they adopt irrigation as a strategy for adapting to climate change with limited effect. On the other hand, only an insignificant proportion of the respondents in the Lowland Rain forest ecological zone have adopted irrigation as a strategy for adapting to climate change. This can be explained by the financial challenges of developing an irrigation system in the upland area of the Niger Delta region where access to river and water basins are quite far. This places the Mangrove Swamp and Freshwater Swamp at an advantage in carrying out small scale irrigation farming system because of the accessibility of rivers and water basins.

Table 20: Percentage Distribution of Respondents' experience on adopting irrigation as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	24.6	72.0	14.3	10.6	75.0
Freshwater Swamp	38.2	61.8	28.2	10.1	61.8
Lowland Rainforest	11.5	88.5	9.7	2.0	88.3

Planting early enables farmers to capitalize on initial rains to grow a full complement of crops. The farmers know they risk replanting if rain break for more than two weeks damaging the planted crops.

Table 21: Percentage Distribution of Respondents' experience on adopting early planting as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	66.2	33.8	62.9	3.5	33.6
Freshwater Swamp	84.3	15.8	76.5	7.9	15.6
Lowland Rainforest	95.1	4.9	92.3	2.9	4.8

Crop rotation which is the practice of growing a series of dissimilar or different types of crops in the same area in sequenced seasons is practiced by many small scale farmers in the Niger Delta region. It is done so that the soil of farms is not used for only one set of nutrients. In general, crop sequences that take advantage of multiple opportunities to suppress and remove weeds from the field are expected to

improve weed management on the farm. Table 22 shows that the vast majority of the respondents in the three ecological zones indicated that they are adopting seasonal rotation as a strategy for adapting to climate change in their communities and most of them equally reported that the strategy has been effective (CPED, 2014).

Table 22: Percentage Distribution of Respondents' experience on adopting seasonal rotation as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	56.6	43.4	53.3	4.0	42.8
Freshwater Swamp	65.3	34.7	55.8	9.6	34.6
Lowland Rainforest	73.1	26.9	67.7	5.4	26.9

Another key component of adaptation strategy used by respondents relates to switching from one agricultural activity to another in response to the peculiarities of the locality. Table 23 shows that switching from fishing to farming is only significantly practiced by respondents in the Mangrove Swamp ecological zone while in the other two zones it is basically not practiced. It shows that the opportunities for farming are being used by those involved in small scale fishing in view of the impact of climate change. It appears that virtually all the respondents in the Freshwater Swamp and Lowland Rainforests do not have the opportunities of switching from fishing to crop farming because most of them are crop farmers rather than being involved in fishing. Again Table 24 shows that a significant proportion of the respondents (26.8 per cent) in the Mangrove Swamp zone indicated that they have changed from fishing to non-farm activities as a strategy for adapting to climate change compared with the respondents in the Freshwater Swamp and Lowland Rainforest ecological zones where less than 10 per cent reported switching to non-farm activities. This shows that there is more pressure on farmers and those fishing in the Mangrove Swamp ecological zone compare to those in the two other ecological zones (CPED, 2014).

Table 23: Percentage Distribution of Respondents' experience on adopting changing from fishing to crop farming as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	26.8	73.2	24.3	3.2	72.6
Freshwater Swamp	5.4	94.6	3.6	1.8	94.6
Lowland Rainforest	7.1	92.9	6.3	0.8	92.9

Table 24: Percentage Distribution of Respondents' experience on adopting changing from fishing to non-farm activities as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	28.6	71.4	25.2	4.3	70.6
Freshwater Swamp	4.1	95.9	2.8	1.3	95.9
Lowland Rainforest	4.7	95.3	3.9	0.9	95.2

Table 25 shows that few respondents reported that they changed from fishing to livestock farming in the three ecological zones which suggests that livestock farming is not a significant agricultural activity which can provide a sustainable livelihood to households except some support is provided to improve the situation. Table 26 again differentiates the Mangrove Swamp ecological zone from the other two zones in terms of respondents' adopting hunting for different types of fish as a strategy for adapting to climate change. While over 40 per cent of the respondents in the

Mangrove Swamp ecological zone reported that they have adopted hunting for different types of fish as a strategy for adapting to climate change, less than 5 per cent of those in the Freshwater Swamp and Lowland Rainforest ecological zones reported adopting hunting for different types of fish as their response to climate change (NEST, 2004).

Table 25: Percentage Distribution of Respondents' experience on adopting changing from fishing to livestock farming as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	17.9	82.1	14.1	4.3	81.6
Freshwater Swamp	1.7	98.3	1.0	0.7	98.3
Lowland Rainforest	4.1	95.9	4.0	0.2	95.8

Table 26: Percentage Distribution of Respondents' experience on adopting hunting for different types of fish as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	40.6	59.4	38.3	2.7	59.1
Freshwater Swamp	4.9	95.1	3.2	1.8	95.0
Lowland Rainforest	11.7	88.3	11.2	0.5	88.3

With climate change and oil exploration having considerable impact on fishing in the rivers and ocean shores of the Niger Deltas region, those involved primarily in fishing have adjusted to the challenges by fishing further ashore as a strategy for adapting to climate change. Table 27 shows that this strategy is only relevant in the Mangrove Swamp ecological zone where about 35 per cent of the respondents indicated that they practised fishing further ashore in response to the challenges of climate change compared with less than 5 per cent of the respondents in the other two ecological zones. Again, this situation can be explained by the fact that fishing is the dominant activity in the Mangrove Swamp ecological zone compared with those of the Freshwater Swamp and Lowland Rainforest zones where a greater proportion of the households are crop farmers. Furthermore, Table 28 shows that adopting relocation to a different fishing ground as a strategy for adaptation to climate change is significant mainly in the Mangrove Swamp ecological zone where about 40 per cent reported as such compared with the two other ecological zones where less than 10 per cent of the respondents are so involved in that strategy.

Table 27: Percentage Distribution of Respondents' experience on fishing further ashore as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	34.6	65.4	29.9	4.9	65.2
Freshwater Swamp	3.4	96.6	2.1	1.4	96.5
Lowland Rainforest	4.5	95.5	4.3	0.3	95.4

Table 28: Percentage Distribution of Respondents' experience on adopting relocation to a different fishing ground as a strategy for adapting to climate change disasters and its effectiveness

Ecological Zones	Yes	No	Effective	Not effective	Not applicable
Mangrove Swamp	39.7	60.3	37.4	2.7	59.9
Freshwater Swamp	4.3	95.7	2.7	1.8	95.6
Lowland Rainforest	6.5	93.5	5.3	1.3	93.4

Small scale farmers combining fishing with crop farming is a common strategy of adaptation to climate change in the Niger Delta region. The findings of the survey shows that a higher proportion of the respondents that indicated combining fishing with crop farming are in the Mangrove Swamp ecological zone compared with the situation in the Freshwater Swamp and Lowland Rainforest ecological zones where less than 5 per cent of the respondents are involved. This can again be explained by the fact that it is easier for households in the Mangrove Swamp ecological zone to practice both fishing and farming compared with those in the two other ecological zones because climate change has resulted in most of the rivers and waters in them receding making it difficult for fishing to take place without some support.

Constraints to adaptation

Considering the magnitude of the impacts of climate change in Delta State, adaptation is expected to be fraught with myriads of challenges. The results of this study identified factors which respondents considered as constraints to the adoption of the various adaptation options identified. Fifteen of these were rated as critical from the perception of the respondents. The most critical was the governments' unresponsiveness to climate risk management. This is not surprising as the Niger delta communities expect governments at all levels to drive the process of adaptation to climate change impacts. The next most critical constraints, in descending order, were: limited availability of land for farming, lack of access to credit facilities, limited income and lack of Government presence among others (Uyigue, E. and Agho, M. 2007).

Conclusion

Farmers and fisher folks in the communities of Delta State are already feeling the effects of climate change. Exposure to floods, droughts and rainfall variability are only predicted to get worse as the impacts of climate change increase. The consequences of these hazards on the well-being of the primary producers are severe, inducing intense episodes of food insecurity, which will force them to engage in erosive and unsustainable coping strategies. Substantial improvements in the resilience of rural farmers and fisher folks are needed to address the current and increasing vulnerabilities of subsistence farmers and fisher folks in the communities of the region. The most effective way of reducing the vulnerability of farmers and fisher folks is through general adaptation strategies that focus on improving their overall well-being. Despite the promise of some specific adaptation measures, farmers and fisher folks emphasized their desire to remain autonomous in deciding what type of specific adaptation measures they choose to employ. They are looking for support in improving their general well-being so as to be in a better position to use their own resources to adapt to future changes. Although it is important to recognize the autonomy of farmers and fisher folks in their adaptation choices, it was also clear from discussion with them that they will need and are interested in receiving information and advice on potential adaptation strategies. Future action research is needed to find effective advising strategies that can help farmers and fisher folk access information on, and capital to invest in, specific adaptation strategies.

References

Abotutu A. A. (2012). Vulnerability and Adaptation to Climate Change in the Niger Delta: The case of the Urban Poor in Warri and Environs, Nigeria. *American Journal of Agricultural Economics* 71(5), 1272-1279.

African Development Bank (ADB) (2006) *Poverty and Climate Change: Reducing the Vulnerability of the Poor through Adaptation*, Addis Ababa: ADB

Akpofure, R. (2012). Assessing Security Implications of Climate Change in the Niger Delta, Nigeria

Awosika, L.F. (1995) "Impacts of global climate change and sea level rise on coastal regions and energy development in Nigeria", in Umolu, J.C. (ed.) *Global Climate Change: Impact on Energy Development*, Lagos: DAMTECH Nigeria Limited

Awosika, L.F., French, G.T, Nicholls, R.J. and Ibe, C.E. (1992) "The impact of Sea Level Rise on the Coastline of Nigeria", in *Proceedings of IPPC Symposium on the Rising Challenges of the Sea*, Magaritta, Venezuela

Centre for Population and Environmental Development (CPED) (2005), *Baseline Line Survey of Niger Delta region*; Port Harcourt: Niger Delta Master Plan Report.

Centre for Population and Environmental Development (CPED) (2014) Climate change impact, vulnerability and adaptation in the Lowland and Wetland Areas of Delta State, Nigeria Benin City, A CPED Research Report.

Centre for Population and Environmental Development (CPED) (2020) "Empowering women as key leaders in promoting community-based climate change adaptation and disaster risks reduction initiatives in Niger Delta region" Technical Report submitted to IDRC.

Delta State Government (2013) Draft Climate Change Policy, Asaba: Government of Delta State

Downing, T. Ringius, L., Hulme, M., and Waughray, D. (1997) " Adapting to Climate Change in Africa" *Mitigation and Adaptation Strategies for Global Change,* Vol. 2, pp.19-44

Downing, T.E. et al (2001) *Climate Change Vulnerability: Linking Impacts and Adaptation,* Nairobi: UNEP.

Intergovernmental Panel on Climate Change IPCC (2014); *Climate Change 2014: Impacts, Adaptation, and Vulnerability* WGII AR5 Summary for Policymakers. https://ipcc wg2.gov/AR5/images/uploads/IPCC_WG2AR5_SPM_Approved.pdf.

Nigerian Environmental Study/Action Team (NEST) (2004). *Regional Climate Modeling and Climate Scenarios Development in Support of Vulnerability and Adaptation Studies: Outcome of Regional Climate Modeling Efforts over Nigeria,* Nigerian Environmental Study/Action Team, Ibadan.

Nigerian Environmental Study/Action Team (NEST) (2011) *Reports on Research Projects on Impacts and Adaptation – Climate Change in Nigeria: A Compendium of Reports Commissioned by Building Nigeria's Response to Climate Change (BNRCC) Project* Ibadan, Nigeria

Nhemachena, C. & Hassan, R. (2007), Micro-level Analysis of farmers' Adaptation to climate change in South Africa. International food policy research institute, Discussion paper No. 00714.

Odjugo, P. A. O.(2010). Shift in crops production as a means of adaptation to climate change in the Semi-arid region of Nigeria *Journal of Meteorology and Climate Science*, *Vol. 8 (1):1-6*

Onokerhoraye, A.G. and Omuta, G.E.D. (2014) "Knowledge Transfer and Knowledge Brokerage for Policy Making on Health Care in Nigeria: The Example of the Primary Health Care Project in Delta State" CPED Policy Paper Series No. 1, 2014.

United Nations Framework Convention on Climate Change (2007) *Climate Change: Impacts, Vulnerabilities and Adaptation in Developing Countries*, Bonn: UNFCC Secretariat

United Nations Development Programme (UNDP), (2006) *Niger Delta Human Development Report*, Abuja: UNDP

Uyigue, E. and Agho, M. (2007) *Copping with Climate Change and Environmental Degradation in Niger Delta of Southern Nigeria*, Benin City: Community and Development Centre

World Food Program (1999), *An overview of vulnerability analysis and mapping*, Rome: World Food Program.