Combating Climate Change In Nigeria: An Evaluation Of Farmers' Adoption Of Climate Change Adaptation Technologies - A Case Study Of Obudu Agricultural Zone Of Cross- River State, Nigeria

Agbarevo, M.N.Benjamin

Abstract: Climate change and its effects have become a major developmental challenge of Africa in the millennium. The problem of environmental degradation and decreased agricultural production are some of its major effects. The study was , therefore ,conducted to evaluate the extent of adoption of climate change adaptation technologies by farmers in Obudu Agricultural zone of Cross River State. In conducting the study, 136 farmers participating in the Agricultural Development Programme (ADP) in Obudu were randomly selected. The data for the study was collected by means of a structured questionnaire to which the farmers responded. The data collected was analyzed using both descriptive and inferential statistics. The t-test was used for testing the significance of difference between the population and sample means. The study found that few of the climate change adaptation technologies recorded very high adoption levels. It also found no significant difference between the sample and population means. The null hypothesis that there is no significant difference between the sample and population means was accepted at 0.05 level of significance, while the alternative hypothesis was rejected. Some recommendations were made to increase the number of farmers participating in the ADP programs as well as improve adoption of climate change adaptation and natural conservation technologies.

Key words*:* Evaluation, farmers, adoption, climate, change, adaptation, technologies.

1. Introduction

The threat to plant and animal life, including man, among other detrimental effects of climate change call for concerted efforts in combating climate change and mitigating its effects. Environmental degradation and the concomitant effects on crops, farm animals and man, unequivocally constitute one of the greatest challenges of man in the new millennium. The ever increasing world population, earth detrimental technology based activities of man, in form of oil exploration, nuclear and greenhouse gas emissions, deforestation, among others make the development of strategies and technologies to combat, mitigate and adapt to climatic change very imperative. The effects of climate change such as desert encroachment, severe drought, erosion, floods, high temperatures arising from depletion of the ozone layer by greenhouse gases, etc., have tended to reduce agricultural production, among other effects. Thus impoverishing the farmers. In this regard, Akinyemi et al*.* (2004) observed that many rural communities in Nigeria are threatened by problems associated with climate change. Farmers appear to suffer most from effects of climatic change as their very means of livelihood is devastated in addition to other debilitating effects of climate change.

- *Dr. Agbarevo, M.N. Benjamin is currently a Senior Lecturer, Department of Rural Sociology and Agricultural Extension, Michael Okpara University of Agriculture, Umudike, Umuahia, Nigeria,*
- *Email: machibenevo@gmail.com (+2348053362707)*

Due to deforestation, the forest land area of Nigeria has been reduced from more than 60 million hectares in 1890s to the current area of about 9.6 million hectares with a current annual estimated loss of about 300,000 hectares (NEST, 2004). The attainment of the goal on food security is one of the Millennium Development Goals (MDGs). The achievement of the this goal is seriously threatened by climatic change, largely due to environmental degradation caused by wanton destruction of forest, bush burning, overgrazing, emission of greenhouse gases, much use of fuel wood for cooking, among others. Deforestation is a major cause of climate change. In the last 8000 years, world forest cover has declined by more than 40 per cent, from 62 to 33 million square kilometers (Bryant et al*.,* 1997). Current concerns about deforestation focus more on developing countries because that is where most of the deforestation occurs as greater measure of control has been achieved in most developed countries of the world with the temperate regions recording an increase in forested areas (Kaimowitz, Bryon & Sunderlin; 1999). It has, however, been observed(Serageldin, 1992) that the rate of forest loss is considerably worse than previously estimated as the annual tropical forest loss is over 20 million hectares, which gives an incredible 55,000 hectares per day. On the other hand, between 1980 and 1990 an estimated 137.3 million hectares of tropical forest were cleared, that is, 7.2 per cent of the total area that existed in 1980. Deforestation is undertaken for a number of reasons. According to Sharma and Rowe (1992), the tropical countries hardest hit are Nigeria, Ghana, Cote d'Ivoire, Costa Rica, Honduras, India, Nepal, Thailand and the Philippines. The reasons for deforestation include: farming, which accounts for 60-70 percent of annual clearing of tropical forest; fuel wood gathering, which accounts for the greatest proportion of the wood used in developing countries; commercial logging, which accounts for 10-20 percent of deforestation in sub-Saharan Africa, cattle grazing and

urbanization. Hence, the reasons for deforestation are anchored on population pressure, economic, agricultural and social factors, while lack of political will, exemplified by policy failures, has led to poor implementation of environmental control measures. To achieve the Millennium Development Goal on food security, farmers need to be mainstreamed into practices and activities designed to combat climate change, while adapting to it. This is important because famers not only contribute substantially to deforestation and other causes of climate change but are most threatened vis-à-vis their means of livelihood. To mainstream farmers into climate change adaptation and environmental protection efforts, the role of agricultural extension in reaching out to farmers and getting them to adopt environmental protection technologies within the contextual framework of participatory extension cannot be over emphasized (Agbarevo, 2007). Some of the adverse effects of climate change and environmental degradation which could be mitigated through good sustainable agricultural and environmental friendly practices include: loss of human, animal and plants life;

- global warming;
- drying up of rivers and lakes;
- excessive drought;
- floods/rain storms;
- loss of biodiversity;
- death/loss of fishes when ponds, rivers and lakes dry up;
- extinction of some animal and plant species;
- loss of soil microbes due to soil pollution;
- decline of forest and their products;
- crop failure, and
- change in rainfall pattern/distribution.

Sustainable climate change adaptation and agricultural technologies packaged by extension for adoption by farmers have to be affordable, socially and culturally acceptable,, environmentally friendly, and must be able to serve in the long term for it be sustainable otherwise their adoption would be low. Although climate adaptation and control technologies are included in the Extension delivery package of recommendations for adoption by farmers, the level of adoption is apparently unknown. It is in this regard that the study was conceived.

2. Materials Studied

The materials studied are climate change technologies packaged by the Agricultural Development Programme (ADP) as well as the level of adoption of such technologies by farmers in Obudu Agricultural Zone of Cross River State.

3. Area Descriptions

Obudu, which is the area of study, is in northern Cross- River State of Nigeria. The state is in the South- South geo-political zone of Nigeria. It is bounded to the south by the Atlantic Ocean, to the east by the Republic of Cameroon, to the south-west by Akwa-Ibom State, to the west by Abia and Ebonyi States, and to the north by Benue State. It lies between the co-ordinates of latitudes 6°N and 8°E of the Equator. There are three main cities in the state: Calabar (the state capital) in the south, Ikom in the central zone and Ogoja in the northern zone. The inhabitants of the state are mainly farmers. Most of the local governments have several rivers, which encourage fishing activities. The farmers are mainly resource-poor. Farmers in the south and central zones are predominantly arable crop farmers. Crops produced include maize, yam, cassava, plantain, banana, cocoa yam, etc. However, Ikom in the central zone is noted for production of cocoa in addition to the other crops. Boki Local Government, which is also in the central zone is noted for the production of cocoa and palm oil in commercial quantities. Farmers in the north produce cassava, yam and maize but to a less extent. They, however, produce rice and groundnuts in greater quantities than the other zones. Generally, cassava, yam and maize are the major crops grown in the state. The state has a population of about 3million and a land mass of 22156 square kilometers with wide expanse of arable lands, which encourage arable and plantation farming. As typical of areas in Nigeria with many rivers, the state has a multiplicity of languages with more than one language spoken in some local governments. Cross River State is adapted to the production of a wide range of crops because of variation in the soil and climatic conditions. The south of Cross River and its environs are essentially mangrove forest, swamp and tropical rainforest. Cross River central is essentially a rainforest belt, while Cross River North is essentially guinea savanna belt.

4. Methods

In conducting the study, 136 farmers participating in ADP activities were randomly selected from Obudu Agricultural Zone of Cross River State. The data for the study were collected through the use of a structured questionnaire containing climate change adaptation or environmental protection/sustainable agricultural technologies as items to which the farmers responded. The questionnaire which was a 5 point graphic rating scale, had five options to each item/technology, thus: always, often, seldom, rarely, never, to which numerical values 5, 4,3,2,1, were assigned respectively. This was to determine the level of adoption or how regularly the adopted technology was practiced by the farmers. In collecting the data, copies of the questionnaire were administered to the farmers who were literate, while the illiterate farmers were interviewed using the questionnaire as an interview schedule. The researcher was assisted by the staff of ADP in collecting the data.

5. Techniques

The data collected were analyzed with the use both descriptive and inferential statistical techniques. The mean was used to determined level of adoption or how regularly the farmer practiced the technology or extension recommendation. in doing this, the 5 point rating scale was modified thus: a five point rating scale of 5, 4, 3, 2, 1 add up to 15, which gives a mean of 3 when divided by 5. The scale was modified thus:>4.50 (very high), 4.00–4.5(high) 3.50–3.99(low) < 3.50(very low). The significance of difference between the sample and the population means was determined with the use of t-test at 95% confidence level (p≤.0.5) using the formula:

$$t = \frac{x - u}{s} \sqrt{n-1}$$

Where:

$\overline{X}$ = sample mean

U = population mean

S = standard deviation of sample

N = sample size

6. Results

Table one shows the mean adoption score of each of the twenty seven climate change adaptation and environment friendly technologies packaged by the Agricultural Development Programme (ADP) in Cross-River State and delivered to farmers in Obudu Agricultural Zone of the State. Only four out of the 27 technologies recorded very high adoption, they included: planting of fruit trees at home, erosion control, establishing fires breaks and crop rotation. However, most of the technologies recorded high adoption (mean: 4.00-4.5.0); they included avoidance of bush burning, tree planting, cover cropping, alley cropping, less use of fuel wood for cooking, avoidance of crop removal during harvesting, mulching, irrigation, soil mulching, forest regeneration/fallowing with legumes, planting of wind breaks, agrisilviculture, homestead garden, hedge planting, establishment of zoological and botanical gardens. The technologies that recorded low adoption included: controlled/selective felling of trees or timber, taungya system of agro forestry, plantation farming, agrisilvipastoral farming, in-situ wild flora conservation. Very low adoption was observed for organic manuring only.

7. Discussion

Very high adoption level was observed for planting of fruits trees at home (which provided food and income for the home), control of forest fires, erosion control and crop rotation (which safeguarded the farm investment). This agrees with the findings of kernga (2003) who observed that economic consideration was of primary importance in determining which technologies farmers adopted. Planting of Fruits trees provided a source of income for the family; while establishment of fire breaks, crop rotation and erosion control were equally very high in adoption for economic reasons as forest fire and erosion lead to crops loss. Crop rotation safe guards against pest/disease attacks in addition to other benefits. Hence, farmers regard these technologies as important safeguard for their investments. In other words, the accruable benefits from these technologies accounted for their very high adoption levels. This is equally supported by Adebayo (1997) and Lee (1990) who reported that expected economic benefits or returns accruing from the use of technology highly influenced adoption. The technologies that did not record very high adoption levels have no direct economic benefits even though they contribute to the overall success of agricultural production (for example, planting of cover crops does not directly but indirectly contributes to improve production). Hence, farmers did not consider them foremost priority to adopt. This finding is supported by shroff-mehta (2003) who observed that farmers are only willing to adopt innovative practices/technologies only when the benefits are well demonstrated directly, and in the short term. He further noted that innovative practice that is product-oriented with the products well established in the market will be more readily adopted. In spite of the benefits of organic manure which outweigh inorganic manure, organic manuring recorded the lowest adoption level. This implies that extension delivery viz-a -vis the ADP in the area of study has not sufficiently sensitized the farmers on the benefits of organic manure (which is environment friendly) as against inorganic fertilizer that pollutes the soil with other attendant side effects. Farmers have been made to depend heavily on inorganic fertilizer as against organic fertilizers. This practice by ADP is against sustainable agricultural practice and preservation of ecosystem because inorganic fertilizer kills soil fauna and flora; increases the acidity of the soil among other demerits. This finding is again in consonance with the finding of Agbarevo (2008) that revealed farmers preference to inorganic fertilizer. Table 2 shows the t-test analysis of significance of difference between the sample mean and population mean. The result of the analysis shows that there is no significant difference at 0.05 level of significance. This means that the results and findings made from the sample used for the study are a true reflection of the population from which the sample was drawn. The hypothesis that there is no significant difference between the sample and population means is hereby accepted while the alternative hypothesis is rejected.

TABLE 1: MEAN RESPONSES OF FARMERS TO ADOPTION OF CLIMATE CHANGE ADAPTATION AND NATURAL RESOURCE CONSERVATION TECHNOLOGIES

Technology adopted	mean	rating
1. Avoidance of bush burning	4.28	2
2. Controlled felling of trees	3.65	3
3. Tree planting.	4.46	1
4. Cover cropping	4.34	2
5. Taungya system	3.93	3
6. Alley cropping	4.36	2
7. Less use of fuel wood	4.04	2
8. Non- removal of crop residue	4.23	2
9. Mulching	4.42	2
10. Irrigation	4.22	2
11. Inorganic/soil mulching	4.30	1
12. Planting of fruits trees	4.28	3
13. Forest regeneration/fallowing	4.47	1
14. Plantation farming	3.98	2
15. Establishment of fire breaks	4.72	3
16. Planting of wind breaks	4.26	3
17. Silvipastoral (folders/trees/livestock)	3.79	2
18. Agrisilvipastoral (crops/tree/animals	3.98	2
19. Agrisilviculture (crops and trees)	4.27	2
20. Homestead garden	4.40	2
21. Hedge planting	4.29	3
22. Organic manuring	3.35	1
23. Erosion control	4.80	3
24. In-situ wild flora conservation	3.88	2
25. Zoology gardens	4.13	2
26. Establishment of botanical gardens	4.08	2
27. Crop rotation	4.59	1

KEY:

1. Very high level adoption
2. High level adoption
3. Low adoption level.

TABLE 2: t -TEST ANALYSIS OF SIGNIFICANCE OF DIFFERENCE BETWEEN SAMPLE AND POPULATION MEANS

Groups	$\bar{x}$	sd	n	p-value	table-t	t-cal	result
Sample	4.23	0.34	180	0.05	1.96	0.68	not sig.
Population	4.25	0.33					

***Decision:** Ho accepted.

8. Conclusion

The need to place emphasis on packaging environment friendly technologies to farmers for adaption in our collective effort to **preserve our ecosystem, adapt to climate change as well as combat** climate change to ensure sustainability of our natural resource base and agricultural production cannot be overemphasized. The study has shown that athough environmentally friendly and climate change adaptation and control technologies are embodied in extension packages of recommendations for adoption by farmers, farmers consider them of secondary importance because they do not contribute directly to increasing farm income, or safeguarding their investments. This scenario shows that farmers have not well appreciated the need to combat climate change as well as preserve the ecosystem. This further implies that extension delivery has not sufficiently educated the farmers and rural dwellers to understand that efforts geared towards climate change adaptation are of primary importance in conserving their natural resource base, biodiversity and guaranteeing sustainability of production and improvement in their livelihoods. The paper recommends the provision of incentives to farmers and other rural dwellers for adoption of climate change and natural resource conservation technologies. The ADP should vigorously pursue an enlightenment campaign to sensitize farmers and other rural dwellers on the need to combat climate change and conserve their natural resource base for sustainability of agricultural production in an environment, devoid of degradation and pollution.

REFRENCES

[1]. K. Adebayo. Communication in Agriculture. Abeokuta,1997. (Intergrity Prints).

[2]. M.N. Agbarevo Enhancing Adoption of Agricultural Extension Technological Packages Within the Contextual Frame Work of Participation, Group Extension and Farming Systems Research. Journal of Research in Agriculture 2 vol.4, no.4, pp.1-6, 2007.

[3]. M. N. Agbarevo the Influence of Gender on Adoption of Agricultural Extension Recommendations by Resource Poor Men and Women Farmers Cross River State. Journal of Social Policy and Society, vol.3 no. 1, pp.67-71.

[4]. G.O. Akinyemi, C.A. Adebayo, O.S. Tayo, I.G. Akinyemi and P.O. Ige. Effective Environmental Management: Recipe for Sustainable Food Production in Nigeria. In A.O. Olejede et al. Global Food Crisis in Nigeria Agriculture. Proceedings of the 43rd Annual Conference of the Agricultural Society of Nigeria, held at Abuja, 20-23 October, 2009.

[5]. I.O. Asinwa, A.F. Adio, G.O. Akinyemi, and A.A. Jayeole, Agro forestry: An imperative to Achieve Food Security and Sustainabile Environment in Nigeria. In A.O Olejede et al. Global Food Crisis and Nigeria Agriculture. 43rd Annual Conference Proceedings of Agricultural Society of Nigeria, 20-23rd October, pp.757-759. 2009

[6]. D.M Brown. Considering the Role of Landscape Farming and the Farmer in the Adoption of the Tree Planting in Calveria Masamis Oriental Province, Philippines. Unpublished MS Thesis, University of London.

[7]. D. Brayant, Nieksen, and Tingely. The Last Frontier Forests: Ecosystems and Economies on the Edge. Washington, D.C. 1997 [World Resource Institute].

[8]. D. Kaimowitz, N. Bryon, and Sunderlin. Public Policies to Reduce the Destruction of Environment. Washington, D.C. 1999. [World Bank]

[9]. A. Kernga. Report on Adoption Study, J.Ext. vol.38,no.1, pp.1-11.

[10]. J.W. Lee. More than Accountability: Evaluation Agricultural Extension Programmes. TRDC Publications. University of England Rural Development Centre 172:2, 1990.

[11]. NEST. Nigeria Climate Change, Extensive Summary of Five Multi-Sector Surveys on Nigeria Vulnerability and Adaptation to Climate Change: Nigeria Climate Change Project. 2004.

[12]. I. Serageldin. Saving Africa's Rainforests. In K. Cleaver, M. Munasinghe, M. Dyson, N. Egli, A. Penker and F. Vencelius (Eds.). Conservation of West and Central African Forests: 1992 (The World Bank, Washington, D.C.)

[13]. N. Sharma, and R. Rowe,. Managing the World's Forests. Finance and Development 29(2):31-33, 1992.

[14]. P. Shroff-Mehta. Institutional Constraints in Promoting Indigenous Knowledge. Indigenous Knowledge Notes 60:1-4, 2003.