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Adoption of Fish Production Improved Measures for Climate Change Adaptation by Farmers in Ekeremor Area of Bayelsa State, Nigeria

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Abstract
Fish production which provides employment opportunity, income and food security in developing African countries is currently affected by climate variability. This study therefore examine fish production improved strategies adopted by farmers for climate change adaptation in Ekeremor Local Government Area of Bayelsa State, Southern Nigeria. A total of sixty fish farmers randomly selected from six major Ekeremor communities participated in the study using interview schedule. Data from the respondents were analyzed by the use of percentage and mean scores derived from Likert types scales. The study found flooding; change in strength of storm and flooding; change in strength of storm, precipitation pattern and flooding; increased temperature, change in wind direction and strength of flooding; sea level rise and flooding as major climate change features in the area. Farmers' perceived climate change effects in the area included low fish production, high cost of fish production, low growth rate, reproduction inefficiency, high fish mortality and susceptibility of fish to diseases and toxicants. The study further revealed that culturing high disease resistant fish species, aquaculture diversification, and aquaculture zoning and monitoring were the major fish production improved measures adopted by the farmers. The farmers' ineffectiveness in adopting the improved adaptive measures were caused by illiteracy (m=2.50), inadequate finance (m=3.5), lack of insurance cover (m = 2.90), lack of competent fishery extension agents (m = 3.36), poor access to capital (m = 2.85), lack of government assistance (m = 2.93) and high cost of energy (m = 2.60). The study concludes that measures such as qualified fishery extension personnel, appropriate insurance policy and government soft loan should be available to encourage the farmers improve and sustained their fish production.
Keywords: Improved Adaptive Measures, Fish Production, Climate Change.

Introduction

A major source of animal protein in many countries of the world is fish. Fish provides about 20% of protein intake in over 127 developing countries and even reach 90% in small Island developing states or coastal areas (FAO, 2005). Beside source of protein to human diet, fish production activities provide employment opportunities and generate income to people to promote their livelihood. Ekeremor (2012) observed that in addition to those directly employed in fishing, there are forward linkages to other economic activities generated by the supply of fish (trade, processing, transport, retail) and backward linkages to support activities (boat building, net making, engine manufacturing and repair, supply of services to fishermen and fuel to fishing boat, etc). Omobepade et al (2014) assert that although coastal fisheries provide opportunities for investment, production, nutrition and trade, the vulnerability of the coastal ecosystem to climate change indices such as storms, cyclones, widespread flooding, coastal erosion, sea level rise, changing rainfall pattern, drought, salinization of water and soil, and coral bleaching may reduce its efficiency. Albert and Isife (2014) noted that in recent time fish production in southern Nigeria has been hindered by climate change effects such as low fish catch, increase in boat mishap, reduced fish production and low growth rate of fishes, etc.

According to IPCC (2007), climate change represents any change in climate over time whether due to natural variability or as a result of human activities. Secretan et al (2007) itemized climate change indices to include: increasing acidification of the oceans, increasing sea level and related change in winds, strength of storms, precipitation patterns, among others. In separate studies by Albert and Isife (2014) in Andoni, Rivers State and Ekeremor (2012) in Ekeremor, Bayelsa State, southern Nigeria, it was established that climate change fishing experiences recorded rise of sea level, rise in temperature, high wind, change in tidal pattern and frequent storms and high flooding. Climate change therefore posses serious threat to agricultural production, hence food security. This scenario calls for concerted efforts of individuals, government and private agencies for mitigative measures.

In a bid to provide solutions to the havoc caused by climate change, especially in fishing settlements, various measures are developed for adaptation to the changing situation. Although, the fisher folk may have indigeneous measures to mitigate climate change in fish production, improved strategies have been developed and recommended for adoption such as aquaculture insurance, aquaculture diversification, building adaptive structures, ecosystem aquaculture approach, aquaculture zoning and monitoring, culturing high disease resistant

species, institutional policy and planning, among other measures. According to De Siloa and Soto (2009), the application of the afore-stated adaptive measures are viewed primarily from a technical perspective and have been found plausible for combating or mitigating the impact of climate change on fish production.

Inasmuch as fish farmers in the study area experience climate change and its effects on their fish production, it is necessary therefore to ascertain the adoption status of the fish farmers to the improved adaptive strategies. The study also seeks to obtain answers to the following research questions. What are the specific climate change features in the fishing area? What are the effects of these changes on fish production in the area? What improved mitigative measures are available to the fish farmers? To what extent have the farmers adopted the improved adaptive measures, and what factors hinder the farmers from adopting the measures to improve fish production in the study area?

Purpose of the Study

The main aim of the study was to ascertain farmers' adoption status of fish production improved measures for climate change adaptation in Ekeremor Local Government Area of Bayelsa State. The study specifically sought to:

1. identify climate change features in the fishing area;
2. examine the effects of climate change on fish production in Ekeremor;
3. ascertain fish production improved measures and extent of farmers' adoption of the strategies for climate change adaptation in the area; and
4. identify farmers' constraints to adoption of the improved measures for climate change adaptation in the study area.

Methodology

The study was undertaken in Ekeremor Local Government Area of Bayelsa State, southern Nigeria. Six major Ekeremor settlements which include: Ekeremor, Ojobo (Ozobo), Amabilo, Ndoro, Igbena – Angalabiri and Isampou were studied. The population of the area is predominantly fish farmers, who rely heavily on fishing for their livelihood. Ten (10) fish farmers were randomly selected from each community/settlement that made up Ekeremor LGA. This gave a total of sixty (60) respondents from the six fish settlements. An interview schedule was designed and used to elicit information from the fish farmers concerning their knowledge of climate change and its effect on fish production activities in their communities. The instrument also sought farmers' levels in adopting improved strategies to mitigate climate variability. Percentage and mean scores were applied for data analysis. The mean scores were derived from a four point Likert type scale of very serious (4), serious (3), less serious (2) and not serious (1) used to test the magnitude of the effect of climate change on fish production in the study area. The cut-off mean point was 2.50. Also, another four point Likert type scale of very great extent (4), great extent (3), little extent (2) and very little extent (1) was used to verify the extent of farmers' adoption of improved measures to cope with climate change. Similarly, the same four point Likert type scale was developed to ascertain the magnitude to which certain factors impeded farmers' adoption of the measures for climate change adaptation in the study area. A cut-off mean point of 2.50 was also assigned for both cases.

Results and Discussion

Climate change features in Ekeremor

The fish farmers were asked to indicate the climate variations they experience in their settlements. Table 1 shows their reactions to the various climate change features which include: sea level rise only (6.67%), increased temperature only (3.33%), flooding only (25%), change in strength of storm, precipitation pattern and flooding (93.33%), increase in temperature, change in wind direction and strength of flooding (100%), change in strength of storm and flooding (80%) and sea level rise and flooding (56.67%). The figures indicate that the noticeable climate change experiences in the study area were combination of some of these features which include sea level rise and flooding; change in strength of storms, precipitation pattern and flooding; change in strength of storm and flooding; increase in temperature, change in wind direction and strength of flooding. The findings corroborate George (2010) who noted that farmers perceived climate change effects from sustained changes overtime in environmental temperatures, rainfall intensity and pattern and also wind variability. In 2012, many riverine communities in Nigeria witnessed great flooding that resulted in loss of properties, fish farms, crops, livestock and aquatic animals.

Table 1: Farmers' observed climate change features in Ekeremor

Features	Frequency (n=60)
Sea level rise only	4(6.67)
Increased temperature only	2(3.33)
Change in wind direction and strength only	-
Change in strength of storm only	-
Change in precipitation pattern only	
Increased flooding only	15(25)
Change in strength of storm, precipitation pattern and flooding	56(93.33)
Increase in temperature, change in wind direction and strength of flooding	60(100)
Change in strength of storm and flooding	48(80)
Sea level rise and flooding	34(56.67)

Figures in parentheses are in percentage

Effects of Climate Change in Ekeremor Fishing Communities

The effects of climate change in Ekeremor communities as perceived by the fish farmers are described in table 2. From the table, the farmers indicated that low fish production (2.52), high cost of production (3.45), low fish growth rate (2.90), fish mortality (2.86), combination of low-fish production, low growth rate and susceptibility of fish diseases and toxicants (2.94) were the major effects of climate change in their fishing settlements. The farmers, however, indicated that high cost of fish meal (2.20), susceptibility of fish to diseases and toxicants only (2.31), stunted growth only (2.30), reproduction inefficiency and high cost of fish meals (2.00) were minor effects of climate change in their communities.

The effect of climate change in southern part of Nigeria is enormous. According to Nwalieji et al (2014), climate change has drastically reduced fish farming activities in Anambra State, resulting mainly from increased fl ooding; variation in rainfall pattern and intensity. Albert and Isife (2014) found that in Andoni, Rivers State, low fish catch, reduced fish production, low growth rate and increase in boat mishap were common climate change effects on fishing. The authors assert that constant boat mishap prevents fishermen from moving off-shore for higher fish harvest resulting to low fish catch and high price of fish. The result also supports the observation of De Siloa and Soto (2009) that the direct impact of climate change on aquaculture are fluctuations of fish catch and unavailability of fish meal and oil.

Table 2: Fish Farmers' Perceived Climate Change Effects in Ekeremor

Effects	Mean score	Ranking
High cost of production only	3.45	1st
Low fish production, low growth rate and susceptibility of fish to diseases and toxicants	2.94	2nd
Low fish growth rate only	2.90	3rd
Fish mortality only	2.86	4th
Low fish production only	2.52	5th
Susceptibility of fish to diseases and toxicants only	2.31	6th
Fish mortality and stunted growth	2.30	7th
Stunted growth only	2.30	7th
High cost of fish meal only	2.20	8th
High cost of fish production, fish reproduction inefficiency and fish mortality	2.10	9th
Reproduction inefficiency only	2.00	10th
Reproduction inefficiency and high cost of fish meals	2.00	10th

Mean scores $\geq$ 2.50 = serious effect; < 2.50 = less effect

Farmers' Adoption Levels of Fish Production Improved Measures for Climate Change

The extent to which the fish farmers in Ekeremor have adopted the improved measures for fish production is described in table 3. The table indicates that culturing high disease resistant fishes (3.40), aquaculture diversification (2.85) and aquaculture zoning and monitoring (2.72) were the adaptive measures adopted high by the fish farmers. The other measures such as aquaculture insurance (1.50), research and technology transfer (2.31), building adaptive capacity and resilience in fishes (1.74), prioritization and enhancement of non-fed aquaculture (1.60) and Ecosystem Approach to Aquaculture (1.65) recorded low adoption by the farmers.

From the result, aquaculture insurance had the lowest adoption score by the farmers. Secretan et al (2007) remarked that aquaculture insurance measure helps to limit bankruptcy in agricultural business losses caused by climate change events. Such insurance takes measure against damage to stock and property, and will

at least ensure that finance is available for business operation. Research and technology transfer also recorded low adoption. This is where the technical assistance of trained fishery extension workers is needed to bring latest fishing technology knowledge to the farmers. A research conducted in Orazi region of Rivers State by Albert et al (2014) reveals that most fish farmers in the area lacked needed capacity for easier and improved fish production. Inadequate fishery extension programme could be a reason for the low adoption status of the farmers.

Table 3: Farmers' Adoption Levels of Improved Fish Production Measures for Climate Change Adaptation

Measures	Mean score	Ranking
Aquaculture Insurance	1.50	Less adopted
Research And Technology Transfer	2.31	Less adopted
Culturing high disease resistant fishes	3.40	1st adopted
Aquaculture diversification	2.85	2nd adopted
Aquaculture zoning and monitoring	2.72	3rd adopted
Building adaptive capacity and resilience in fishes	1.74	Less adopted
Prioritization and enhancement of Mari-culture (non-fed aquaculture)	1.60	Less adopted
Ecosystem Approach to Aquaculture	1.65	Less adopted

Mean scores > 2.50 = High Adoption; < 2.50 = Low Adoption

Constraints to Farmers' Adoption of Fish Production Improved Measures for Climate Change Adaptation

Table 4 shows the factors limiting farmers' effectiveness in adopting strategies for fish production adaptation to climate change in the study area. The major impediments of the fish farmers were inadequate finance (3.40), lack of appropriate insurance cover (3.47), lack of competent fishery extension agents (3.52), lack of access to capital (2.80), lack of government assistance (2.95), high cost of energy (2.61), and poor education status of the farmers (2.55). The minor challenges facing the fish farmers include: poor transport facilities (2.32), lack of advertisement in TV/radio (2.31), poor access to market (2.00), lack of ICTs and networking (1.90), insufficient seedlings for production (2.40), and lack of proper stocking density (2.06).

A similar study by Ekeremor (2012) recorded that most farmers in the study area were financially poor and lacked insurance cover for their fishing businesses. Inadequate finance is a serious constraint that could affect operations of agricultural activities, especially the fishing business. If farmers are financially handicapped, they cannot purchase stock seedlings, feeds, pay for labour, equipment and other fishing materials. Lack of competent fishery extension personnel has been identified by Isife et al (2010) as one of the limiting factors to effective transfer and adoption of agricultural technologies in Rivers State. Most extension workers lack necessary training and competence knowledge to educate the farmers on latest technology to improve their farming, work. Modern information and communication technologies (ICTs) which serve as bridge between researchers, extension advisers and farmers are either lacking or inadequately utilized for fishery extension service delivery in the study area. According to Umunakwe et al (2014), ICTs help to ensure the quality, accuracy and relevance of information on climate change, and assist extension workers to translate and mediate technical or scientific information to suit local content. The authors further stated that extension workers, through the use of ICTs, offer farmers a broader set of options and information needed for climate change adaptation and by this deepening the thrust for them.

Table 4: Constraints to Farmers' Adoption of Fish Production Improved Measures for Climate Change Adaptation

Constraints	Mean score
Illiteracy	2.55
Inadequate finance	3.40
Lack of appropriate insurance cover	3.47
Lack of competent fishery extension agents	3.52
Transportation problem	2.32
Lack of access to capital	2.80
Lack of advertisement in TV/radio	2.31
Lack of government assistance	2.95
Poor access to market	2.00
Increase rising in energy cost	2.61
Lack of ICTs and Networking	1.90
Insufficient seedlings for production	2.40
Poor stocking density	2.06
Ignorance of the improved measures	2.20

Mean scores ≥ 2.50 = major constraint; < 2.50 = minor constraint

Conclusion and Recommendations

The study established that fish farmers experienced climate variations such as change in strength of storm, precipitation pattern, flooding, change in wind direction, increase in temperature and sea level rise. These affected their fishing operations leading to low fish production, mortality, low and stunted fish growth, and susceptibility of fish to diseases and toxicants. To mitigate against these effects, the fish farmers adopted culturing of high disease resistant fishes, aquaculture diversification and aquaculture zoning and monitoring as improved adaptive measures for climate change. However, the farmers' adoption capacity was hindered by inadequate funds, lack of insurance agencies (arranged insurance cover), lack of competent fishery extension agents, lack of government assistance (both materials and finance), poor educational levels of the farmers, among others. The study advanced that to encourage fish farmers adopt the adaptive measures for increased fish production, appropriate aquaculture insurance policy is important. Competent fishery extension personnel, who will provide technical guide, knowledge and right information should always be available. Government's soft loans and strong institutional policy on aquaculture planning and management should also be considered as veritable measures for increased fish production.

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