International Scholars Journals

Advances in Aquaculture and Fisheries Management ISSN 2756-3278 Vol. 12 (6), pp. 001-009, June, 2024. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Adaptation Strategies for Fish Farmers Facing Climate Change in Southwestern Nigeria

Grace Modupe Adebo[1]* and Tolu Anthony Ayelari[2]

[1]Department of Agricultural Economics and Extension Services, University of Ado-Ekiti, P. M. B. 5363, Ado-Ekiti, Nigeria.

[2]Department of Forestry, Wildlife and Fisheries management, University of Ado-Ekiti, P. M. B. 5363, Ado-Ekiti, Nigeria.

Accepted 21 January, 2024

Production systems and livelihoods in South Western Nigeria are at risk of climate variability and change; the fisheries sectors are no exception. The study examined the vulnerability of fish farmers in Ondo and Ekiti States of Nigeria to Climate change. A total of 120 respondents were purposively selected, interviewed and used for data analysis. Result indicated that the fish farmers in Ondo and Ekiti States witnessed unprecedented change in weather conditions as reflected in unusual excessive downpour of rain thus affecting their productivity through flooding. Most of these fish producers were young, mainly males, literates, and experienced fish farmers but relied mainly on personal savings and money borrowed from friends and relatives for fish farming. They practiced the extensive system of fish culture, utilizing local feeds and depended mainly on streams, rivers and rainfall. Fish production is concentrated in wet season. Most farm sizes were below 1 ha, and utilized earthen pond. About 65% experienced flooding with about 61.6% loosing within 3501 to 5000 fishes at a time. All categories of fishes were flooded. Majority of the fish farms were not insured by any insurance company while the few that were insured experienced untimely and inadequate compensation, also very few received compensation from the Government. Climate change resulted in low productivity, low income, starvation, poor health as well as poor standard of living of the respondents.

Key words: Fish production, climate change, vulnerability, fish farmers.

INTRODUCTION

Millions of people including many in developing countries derive their livelihoods from fishing while about 2.6 billion people get their protein from seafood. Fishing provide employment for up to ten million people in Africa and provide a vital source of protein to 200 million people. About 30% (29.5 Mt) of the world fish catch is used for non-human consumption, including the production of fishmeal and fish oils that are employed in agriculture, in aquaculture, and for industrial purposes. Fishmeal and fish oils are key diet components for aquaculture production; depending on the species being cultured, they may constitute more than 50% of the feed.

Despite the importance of fish to the World economy, reports around the World indicate vulnerability of fish production to climate change. According to Inter-governmental Panel on Climate Change (2001), climate change could have dramatic impacts on fish production, which would affect the supply of fishmeal and fish oils and that future aquaculture production could be limited by the supply of fishmeal or fish oils if stocks of species used in the production of fishmeal are negatively affected by climate change and live-fish production

Climate change according to Allison et al. (2005) can affect the productivity or distribution of fishery resources of both marine and inland waters in a variety of ways:

1. Changes in water temperature and precipitation affect the dynamics of ocean currents, the flow of rivers and the area covered by wetlands. This will have effects on ecosystem structure and function and on the distribution and production of fish stocks. In 2007 the United States National Academy of Sciences reported that increased temperature coupled with loss of snow pack, and lower

*Corresponding author. E-mail: Modupedebo@yahoo.com. Tel: +234-803-4356-524.

spawning flows are likely to lead to increased mortality among juvenile salmon, particularly Chinook, in the Snohomish River Basin and hydrological similar watersheds Many species, such as salmon, cannot live in water over 21°C. In addition to direct effects of temperature, increased volume and changed timing of stream flows are likely to cause many river-spawned eggs to wash downstream.

On February 22 2008, the United Nations Environment Programme (UNEP), issued a report titled "In Dead Water: Merging of climate change with pollution, over-harvest, and infestations in the world's fishing grounds, warning that three quarters of the world's key fishing grounds are at risk of being seriously impacted by rising temperatures. They reported potential consequences as changes in oceanic circulation patterns, currents that bring nutrients and remove waste from fisheries, rising surface temperatures that are expected to bleach and kill as much as 80% of the world's coral reefs, a major tourist attractions and nurseries for many juvenile fish, and, the possible acidification of the ocean's waters as warmer water absorbs more atmospheric carbon emissions. Increased acidity would impact organisms that utilize calcium for shell-production.

2. Increased incidence of extreme events such as floods, droughts and storms will affect fishing operations and increase damage and disruption to coastal and riparian homes, services and infrastructure.

3. Sea level rise, melting of glaciers at the headwaters of major rivers and other large-scale environmental changes will have unpredictable effects on coastal and wetland environments and livelihoods.

4. Complex links between climate change, fisheries and other sectors will have indirect effects on fisheries ranging from fisheries being affected by changing water demands from agriculture to diversion of government and international financial resources away from fisheries management and into emergency relief after extreme weather events.

In the short-term, climate change is anticipated to impact freshwater fisheries through incremental changes in water temperature, nutrient levels and lower dry season water levels. In the longer-term, larger changes in river flows are anticipated as glaciers melt, reducing their capacity to sustain regular and controlled water flows. There is a particular concern for river fisheries in downstream impacts from adaptations within other sectors. In particular, conflicts exist between agricultural irrigation needs and fish productivity in river systems.

The loss of coastal habitats and resources is likely through sea level rise, warming sea temperatures, extremes of nutrient enrichment and invasive species. Coastal fishing communities face a double exposure of reduced fisheries resources and increased risks of coastal flooding and storm surges.

Fifty million people could be at risk by 2080 because of climate change and increasing coastal population densities. Projections suggest that these combined pressures will result in reef loss and a decline in fish availability for per capita consumption of approximately 15% by 2015 (U.N, 2008).

A recent study on the vulnerability of national economies and food systems to climate impacts on fisheries has revealed that African countries are most at risk. This according to the United Nations as reported by Defend Humans Right (2008) is because many African countries are semi-arid with significant coastal or inland fisheries. This gives them high exposure to future increases in temperature and linked changes in rainfall, hydrology and coastal currents. Also, these countries depend greatly on fish for protein, and have low capacity to adapt to change due to their comparatively small or weak economies and low human development indices. Countries in this category include Angola, Congo, Mauritania, Mali, Niger, Senegal and Sierra Leone. Other vulnerable African nations include Rift Valley countries such as Malawi, Mozambique and Uganda. (Defend Humans Right, 2008) Beyond Africa it is the Asian river dependent fishery nations including Bangladesh, Cambodia and Pakistan that are most at risk. The often overlooked links between fisheries and agriculture also make the semi-arid areas of Africa vulnerable. In these areas, the higher-potential agricultural zones are around lakes, swamps and river-floodplains. Here fisheries often provide both safety nets and capital to invest in agricultural inputs and livestock. If the fishery system is under stress, the potential of the other components of the ‘tri-economy’ is reduced. The system as a whole is resilient to local-scale perturbation, but with reduced rainfall stressing both fisheries and crop agriculture, that resilience could be threatened by climate change.

According to FAO (2008), the world is likely to see significant changes in fisheries production in the seas and oceans. For communities who heavily rely on fisheries, any decreases in the local availability or quality of fish for food or increases in their livelihoods’ instability will pose even more serious problems. Fishing communities located in the high latitudes and those that rely on climate change-susceptible systems, such as upwelling or coral reef systems, will have the greatest exposure to climate-related impacts. In addition, fisheries communities located in deltas, coral atolls and ice dominated coasts will be particularly vulnerable to sea level rise and associated risks of flooding, saline intrusion and coastal erosion. But countries with limited ability to adapt to the changes, even if located in low risk areas, are also vulnerable. FAO also noted however that the impacts of climate-related physical and biological changes in fisheries on the communities that depend on them will be as varied as the changes themselves. Both negative and positive impacts are likely, depending on local circumstances and the vulnerability and adaptive capacity of the affected communities’ Environmental

change, particularly climate change, will have a disproportionate impact on poor people in rural areas where livelihoods of the majority depend directly on natural resources. Depletion of soil fertility and degradation of forest resources, water resources, pastures, and fisheries is already aggravating poverty in many developing countries. Global warming will affect the agro-ecological suitability of crops. The increasing atmospheric concentration of carbon dioxide will enhance plant photosynthesis and may contribute to improved water-use efficiency. It may also lead to increased pest and disease infestations.

Responses to climate change can be of two broad types. The first employs adaptive measures to reduce the impacts and risks, and maximize the benefits and opportunities, of climate change, whatever its cause. The second involves mitigation measures to reduce human contributions to climate change. Both adaptive measures and mitigation measures are necessary elements of a coherent and integrated response to climate change. If future emissions are higher, the impact will be stronger, and vice versa. At the same time, no matter how aggressively emissions are reduced, climate change is a reality for the 21st century, since existing emissions in the atmosphere will remain for decades to come. Thus adaptation to climate change is inevitable.

In the absence of mitigation and response capacities, losses from damage to the infrastructure and the economy, as well as social turmoil and loss of life, will escalate and be substantial. And this burden will fall on the poorest and in the poorest countries. It is only in poor countries that drought turns to famine, often resulting in population displacement, suffering, and loss of life. The social and economic costs of such occurrences may undo, in just a day or a month, the achievements of years of development efforts. Global environmental change is expected to have a significant impact on food systems worldwide. The nature and gravity of vulnerabilities of food systems are of utmost importance and the design of adaptive policies to cope with environmental changes is critical. Global environmental changes pose the following challenges to agricultural research: Changes in the flow and storage of materials, ecology of pests and diseases, dynamics of rainfall regimes and water accumulation, plant responses to temperature and CO_2 concentration, reduction of greenhouse-effect gases, plant salt tolerance affected by intrusion of saltwater due to sea-level rise, conservation of biodiversity, and adaptation of food production systems to extreme weather events..

Three major vulnerabilities were identified in relation to climate change. These are social economic and environmental vulnerability

Many factors contribute to social vulnerability, including rapid population growth, poverty and hunger, poor health, low levels of education, gender inequality, fragile and hazardous location, and lack of access to resources and services, including knowledge and technological means.

And when people are socially disadvantaged or lack political voice, their vulnerability is exacerbated further. The economic vulnerability of agriculture is related to a number of interacting elements, including its importance in the overall national economy, trade and foreign-exchange earnings, aid and investments, international prices of agricultural commodities and inputs, and production and consumption patterns. All of these factors intensify economic vulnerability, particularly in countries that are poor and have agriculture-based economies.

Agriculture is at the core of environmental vulnerability and concerns the management of natural resources, such as land degradation, water scarcity, deforestation, and the threat to biodiversity. Climate change could cause irreversible damage to land and water ecosystems, and lead to loss of production potential. A lot climate change in Nigeria, according to Nnimmo Bassey as reported by Paehler (2007) is a ticking time bomb and it exists little or even nothing to mitigate its effects.

Several literatures on climate change in developing countries and particularly in Africa do not make any reference to Nigeria. Does it mean that climate change have no significant effect on Nigeria? Nigerian is an Agrarian country whereby over 70% of the inhabitants depend on Agriculture for their sustenance. There is a growing awareness of aquaculture in Nigeria with more than 100 private commercial fish farms currently in production. A lot of small scale fish farms are springing up everyday Fish farm in Nigeria presently covers an estimated 60,000 ha of the country and produces some 25,000 to 30,000 mt of fish per year (Moehl, 2003). In recent times, there is the incidence of sudden and unprecedented change in weather condition all over the south Western Nigeria with the attendant problems of abnormal rainfall and flooding, excessive harsh sunlight and heat when not raining. A lot of houses, properties and farms were adversely affected. It is noted that a large percentage of the fish producers in Nigeria utilized earthen ponds usually cited at river banks, valleys and wet lands. This prompts investigating if the fish farmers in the area are also vulnerable to the unusual weather changes and if yes to what extent were they affected? What their features/characteristics are as relates to fish production? Are they experienced fish farmers? Do they insure their business in case of disaster? Do they receive any incentive from the government? What are their coping strategies?

It is on this note that this study is embarked on mainly to examine the vulnerability of fish farmers in Ekiti and Ondo States of Nigeria to climate change. Specifically, it aimed at examining: the socio-economic characteristics of fish farmers in the study area, the features and fish production practices as well as the effect of climate on fish production.

METHODOLOGY

The study was carried out in Ondo and Ekiti States of Nigeria. Ondo

Table 1. Socio-economic characteristics of the respondents.

Variable	Frequency	Percentage
Age (years)		
< 25	14	11.7
26-35	12	10.0
36-45	28	23.3
46–55	40	33.3
> 55	26	21.7
Sex		
Male	96	80.0
Female	24	20.0
Marital status		
Single	17	14.2
Married	85	70.8
Widowed	08	6.7
Divorced	10	8.3
Highest educational level		
No formal education	08	6.7
Primary education	28	23.3
Junior secondary education	26	21.7
Senior secondary education	22	18.3
Tertiary education	46	38.3
Years of experience		
1 – 5	10	8.3
6–10	38	31.7
11–15	64	53.3
> 15	08	6.7
Source of fund for fish farming		
Personal savings	112	93.3
Friends and relatives	60	50.0
Bank loan	28	23.3
Co-operative loan	50	41.7
Micro credit schemes	12	10.0

Source: Field survey, 2008.

state shares boundary with Ekiti in the west, Edo in the South, Ogun in the East and Osun in the North while Ekiti shares boundary with kwara in the North, Kogi in the West, Osun in the East, and Ondo in the South. Ondo state falls between the mangrove and the rain forest zones. The area has a mean annual rainfall ranging from 3000 to 2000 mm and a temperature range of 17.5 to 27°C. The relative humidity of the state is above 60%. Ekiti State falls within the rain forest Zone. The mean annual rainfall of Ekiti state is 2400 to 2000 mm while the temperature ranges from 20 to 27°C.

Four local government areas (Ado-Ekiti, Ayedire/Gboyin, Akoko South west and Akure South LGAs) were randomly selected from Ekiti and Ondo States. Efforts were made to find out the areas where fish production is concentrated in the selected LGAs, thus three villages/communities were selected from each LGA. These are: Mugbagba, Oke-bola, Atikantan, Ode, Egbe, Aisegba, Oka, Akungba, Ikun, Aule, Oba-ile and Alagbaka. Due to the few Fish farms in the areas, “a purposive sampling technique” was adopted to select 120 respondents utilized in this study. A structured interview schedule was used in eliciting information from them. Data collected were analyzed using frequency counts and percentages. Pie chart was involved in data presentation.

RESULTS AND DISCUSSION

Socio-economic characteristics of the respondents

Table 1 show that majority of the respondents were young with about 66.6% fallen within the age of 26 to 55

Table 2. Fish production practices.

Variable	Frequency	Percentage
Cultural practices		
Extensive	88	73.3
Semi-intensive	32	26.7
Intensive system	0	0.00
Size of fish farm (hectares)		
< 1	88	73.3
1 - 5	30	25.0
6-10	02	1.7
> 10	0	0.00
Type of ponds		
Earthen pond only	77	64.2
Concrete pond only	12	10.0
Tanks only	08	6.7
Earthen and concrete pond	13	10.8
All A, B and C	10	8.3
Features of earthen ponds		
Marshy	12	15.3
Near stream/rivers	41	52.6
Far from streams and rivers	0	0.00
Contours	25	32.1
Sources of water for fish		
Rivers	60	50.0
Streams	12	10.0
Wells	08	6.7
Spring	10	8.3
Boreholes	04	3.3
Rainfall	80	66.7
Tap water	0	0.00
Type of food utilized for feeding fishes		
Locally formulated feed	45	48.8
Imported commercial feed	38	37.5
Kitchen waste	55	31.4
Poultry dung	32	26.7

Source: Field survey, 2008.

years, 80% were males, 70.8% were married, 14.2% were single, 8.3% were divorced while 6.7% were widowed. Majority of the respondents were literate with 38.3% having tertiary education, while 18.3% had secondary education. About 58.3% were full time farmers, 21.7% were retired civil servants, 11.7% civil servants, while 8.3% were politicians. About 93.3% derived the fund utilized for fish farming from personal savings, 50.0% borrowed from friends and relatives, 41.7% utilized co-operative loan, 23.3% obtained bank loan, while 10.0% borrowed from the Government initiated micro-credit scheme. Majority (91.2%) have engaged in fish farming for more than six years.

It could be deduced from the aforementioned that fish farmers in the study area were young, mostly males, literate, and experienced farmers who utilized personal savings and money borrowed from friends and relatives for fish production.

Fish production practices of the respondents

Data in Table 2 shows that majority (73.3%) of the respondents practiced extensive system of fish culture; 26.7% practiced the semi-intensive system, while none of them practiced the intensive system. This might be due to

the fact that personal savings and money borrowed from friends and relatives were their major source of fund, this invariably might be very small, hence their inability to embark on the intensive system of fish rearing, which is capital intensive.

Majority (73.3%) had less than 1 ha of fish farm, 25.0% had 1 to 5 ha, while only 1.7% had between 6 and 10 ha (Table 2). Majority (64.2%) utilized earthen ponds for fish rearing; 10.8% utilized both earthen and concrete tanks, 10.0% utilized concrete pond only, 8.3% made use of earthen pond, concrete pond and tanks together, while 6.7% made use of tanks only. 33.3% of the earthen ponds were established near streams and rivers, 20.8% were established in contours, while 10.0% were on marshy ground. Rivers, streams and rainfall were the major sources of water for fish production. When considering their feeding, 48.8% of the respondents utilized locally formulated feeds for feeding their fishes, 37.5% used imported fish feeds, 31.7% relied on kitchen wastes while 26.7% utilized poultry dung, pawpaw and other locally available feed stuffs that can be consumed by fishes.

It can be inferred from the findings that fish farmers in Ekiti and Ondo States of Nigeria engaged in extensive system of fish production with the use of earthen ponds being predominant, relied mainly on rainfall, streams and rivers as water sources and utilized local food and feed stuffs for fish production. The system aforementioned practiced cannot be divorced from the poor financial status of the fish farmers. They could not obtain credit for fish farming because most financial institutions view fish production as being relatively risky when compared to other farm enterprises such as poultry. They have the believe that fishes cannot be seen or assessed physically at any point in time, more also due to high interest rate of banks, bureaucratic bottlenecks and lack of collateral security, the fish farmers consider banks as the last resort for loan. This makes fish production in the environment to remain low.

Climate change and fish production

There are two major seasons in the study area- wet and dry seasons. Depending on climate change, wet season may last for eight months while dry season covers four months. Due to total reliance on rainfall which also influences streams and rivers, fish farming in the study area is concentrated in wet seasons. According to Table 3, majority (80%), of the farmers indicated that fish production is not carried out in dry seasons due to insufficient rainfall or water, harsh sun dries off rivers and streams as well as pilfering.

Table 3 shows that majority (65.0%) of the respondents have experienced flooding in their farm in 2008. About 61.6% indicated 3500 to 5000 fishes were flooded from their farm, while 12.8% indicated that 501 to 2000 fishes, 2000 to 3500 fishes well as above 5000 fishes respectively were flooded from their farm.

Efforts were made to find out the average weight of fish loss. Figure 1 show that 48.7% of the respondent had less than 200 g fishes flooded, 25.6% had between 200 to 600 g flooded, 15.4% had above 2 kg of fishes flooded, and 2.6% had about 2 kg of fishes flooded. Figure 2 indicates that 59.0% experienced flooding periodically; 25.6% experienced flooding occasionally, while 15.4% experienced it frequently. Table 3 also shows that only 15.4% were able to find control measures against flood.

Efforts were made to find out if the fish farms were insured, only 8.3% of the fish farms were insured. Out of the few insured, only 33.5% were compensated by insurance company after the flood incidence and the compensation was delayed. Only 12.8% received financial aids from the government after the flood. It should be noted that only 15.3% of the fish farmers consulted Agricultural Extension Agents for Counseling. Effect of climate change on the respondents include: Low productivity, low income, starvation, poor health and poor standard of living (Figure 3).

CONCLUSION AND RECOMMENDATION

The study examined the vulnerability of fish farmers in Ekiti and Ondo State to climate change. A total of 120 respondents were purposively selected, interviewed and used for data analysis. Result indicated that the fish producers in Ondo and Ekiti States were young, mainly males, literates, experienced but relied mainly on personal savings and money borrowed from friends and relatives for fish farming. They practiced the extensive system of fish culture, utilizing local feeds and depended mainly streams, rivers and rainfall as their main source of water for fish farming. Fish production is concentrated in wet season. Dry season production was not popular due to water shortage, high mortality as well as pilfering. Most of the farm sizes were below 1 ha, and utilized earthen pond. Majority experienced flooding resulting into great loss with about 61.6% of the respondents loosing within 3501 to 5000 fishes at a time. All categories of fishes were flooded .most of them did not embark on any control measures. Majority of the fish farms were not insured by any insurance company while the few that were insured only 33.3% were compensated after the flood and such compensation was delayed, also very few received compensation from the Government. Climate change resulted in low productivity, low income, starvation, poor health as well as poor standard of living of the respondents.

Based on the aforementioned findings, there is urgent need for policy intervention to safeguard the situation. The following recommendations were made:

1. Government should encourage fish farmers in Ondo

Table 3. Climate change and fish production.

Variable	Frequency N= (120)	Percentage
Production season		
Wet season	96	80
Dry season	06	05
Both wet and dry season	18	15
Reasons for not producing in both season		
Water shortage	100	83.3
High mortality rate	96	80.0
Pilfering	88	73.3
Number of respondents affected by flood		
Yes	78	65.0
No	42	35.0
Average no of fish flooded		
< 500	0	0.00
501 - 2000	10	12.8
2001 - 3500	10	12.8
3501 - 5000	48	61.6
> 5000	10	12.8
Average size of fishes flooded		
< 200 g	38	48.7
200 - 600 g	20	25.6
601 – 1 kg	06	7.7
2 kg	02	2.6
> 2 kg	12	15.4
Control measures against flood		
Yes	12	15.4
No	66	84.6
Farm insurance		
Yes	10	8.3
No	110	91.7
Incentives from insurance company		
Yes	06	60.0
No	04	40.0
Incentives from government		
Yes	10	12.8
No	68	87.2

Source: Field survey, 2008.

and Ekiti State to obtain loan from banks and micro-credit institutions. This can be done by reducing interest rate on loans for fish production as well as removing the stringent conditions attached to loans.

2. Fish farmers should engage in preventive measures such as building of strong barriers around their farms to prevent flooding.
3. Use of concrete ponds and tanks. This can be

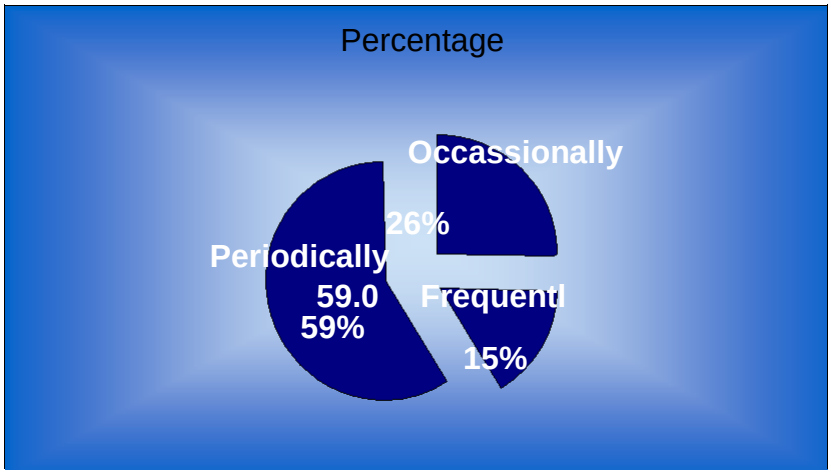

Figure 1. Frequency of flooding.

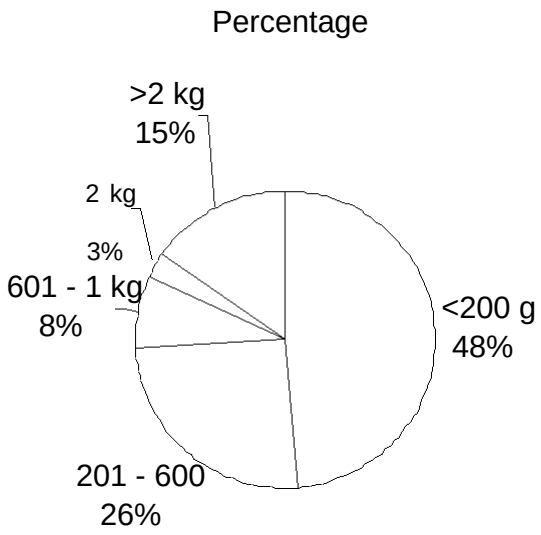

Figure 2. Average sizes of fish flooded.

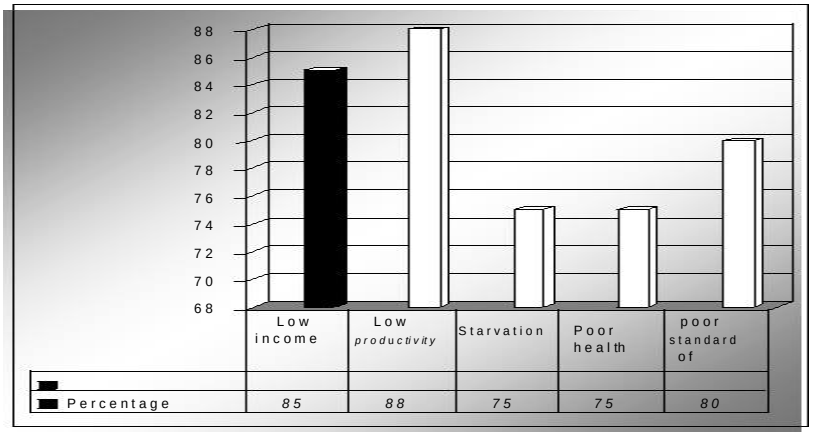

Figure 3. Effect of climate change on fish producers.

stimulated through fund invested in fish farm.

4. Intensive system of fish rearing is a good way of escape from flood and losses.

5. Fish farmers should be encouraged to insure their farms with reputable insurance company to prevent future occurrences

6. Government should come early to the aids of fish farmers when cases of flood are reported; thorough investigation should be carried out after which such farmer should be bailed out of the problem.

7. Policies on food production in the country should pay special attention to fish farming and should evolve policies that will investment in fish production and improve farmer's welfare

REFERENCES

Allison EH, Adger WN, Badjeck MC, Brown K, Conway D, Dulvy NK, Halls A, Perry A, Reynolds, JD (2005). Effects of climate change on the sustainability of capture and enhancement fisheries important to the poor: analysis of the vulnerability and adaptability of fisherfolk living in poverty. Project No. R4778J. Final Technical Report, Fisheries Management Science Programme, MRAG/DFID, London 164 pp. www.fmsp.

Defend Humans Right (2008). African Climate change affecting fish stocks. wd.american.edu/gender/wlp

Food and Agriculture Organization of the United Nations (2008). Report of the FAO Expert Workshop on Climate Change Implications for Fisheries and Aquaculture: Rome, Italy, 7–9 April 2008. FAO Fisheries Report no. 870 (Food and Agriculture Organization of the United Nations, 2008);http://tiny.cc/fisheries7

Food and Agriculture Organization of the United Nations (2008). Post-harvest losses in small-scale fisheries Case studies in five sub-Saharan African countries FAO Fisheries and Aquaculture Technical Paper http://www.fao.org/docrep/013/i1798e/i1798e.pdf

Intergovernmental Panel on Climate Change (2001). An Assessment of the Intergovernmental Panel on Climate Change Synthesis report. Summary for policy makers www.ipcc.ch/pdf/climate-changes-2001/...spm/synthesis-spm-en.pdf -

Moehl John (2003). Gender and aquaculture, Development in the Africa Region FAO Aquaculture Newsletter, July, No 29, Espanol.

Paehler HK (2007). Nigeria in the dilemma of climate change. Konrad-Adenauer-Stiftung 3, Rudolf Close, off Katsina Alla Crescent Maitama Abuja http://www.kas.de/nigeria/en/publications/11468/

United Nations Environment Programme, UNEP (2008). In Dead Water: Merging of Climate Change with pollution, over-harvest, and infestations in the World's fishing grounds GRID-Arendal, Norway, www.grida.no http://www.unep.org/pdf/InDeadWater_LR.pdf Climate Change Network http://climatechange.unep.net.