Climate Change Impact and Adaptation Strategies of Farmers and Fishermen in Bayelsa State, Nigeria

Odele Muyiwa[1] Idris Nasiru Medugu[1] *Babalola Ayo[2] Modibbo M.[3]

[1]Department of Geography, Faculty of Social Sciences,
Nasarawa State University, Keffi, Nasarawa State, Nigeria

[2] Department of Surveying and Geoinformatics, Faculty of Environmental Sciences,
University of Ilorin, Ilorin, Kwara State.

[3] Department of Surveying & Geoinformatics, Faculty of Environmental Technology,
Abubakar Tafawa Balewa University, Bauchi State.

*Corresponding Author: babalola.ayo@unilorin.edu.ng

Abstract

The fishing and farming are the mainstays of the people of the Niger-delta livelihoods and activities. Unfortunately, these livelihoods have been impacted by the activities of climate change. This study seeks to examine the impact of climate change on farmers and fishermen as well as adaptation strategies in Bayelsa State, Nigeria. The study employed a cross sectional household survey to interview a total of 200 farmers and 200 fishermen from twelve communities in three Local Government Areas of Bayelsa State. A checklist was used to guide the semi-structured interview. Findings of the study showed that 92.75% of the participants had good perception of climate change and its impact on farming and fishing activities in the area. Also, decreased quantity and quality of crop yield with mean values of 3.75 was the most devastating effect of climate change according to the farmers while decreasing fish resources and increasing distance to fishing ground with increasing mean values of 3.72 was the most devastating impact of climate change on fishermen. The most favoured on-farm adaptation strategy by farmers was changing of planting time (92.5%) and livelihood diversification for off-farm livelihood diversification (95%) while fishers also preferred to diversify their livelihood sources to non-fishery activities (93.5%). Both farming and fishing livelihood were found to be moderately vulnerable to climate change impact with overall livelihood vulnerability index of 0.392 and 0.390 as well as -0.086 and -0.089 for the approach index respectively. From this study it is evident that farmers and fishers observed elements of climate change in the study area and refers to the change in climate currently experienced as, "bad" compared to what was experienced in the past. It is recommended that the farming communities should assess their vulnerabilities due to climate change particularly as it affects post-harvest so as to engage relevant authorities to help initiate adaptive capacity. Secondly, the fishing communities should be assisted and provided with the needed support by way of fishing boats and technical skills needed to be effective water navigators.

Keywords: *Greenhouse emission, Global warming, livelihood, Climate change, Farmers.*

Introduction

Climate change is defined as a change in the pattern of weather, and related changes in oceans, land surfaces and ice sheets, occurring over time scales of decades of longer (Australian Academy of Science, 2021). Evidently, climate change is a global phenomenon, and its impacts, are felt more by the developing countries especially those in Africa due to their low level of coping capabilities (Mshelia, 2005; Nwafor, 2007; Jagtap, 2007).

As has been proven, Africa is one of the most vulnerable regions to climate change in the world. Previous assessments (Hulme, 1996; IPCC, 2007a) concluded that Africa is particularly vulnerable to the impacts of climate change because of factors such as widespread poverty, recurrent droughts/flooding, inequitable land distribution and over dependence on rain-fed agriculture (Hulme, 1996, IPCC, 2007a).

Nigeria is one of such developing countries and researchers have shown that Nigeria is already being plagued with diverse ecological problems, which have been directly linked to the on-going climate change (Medugu et. al. 2014a). The unimpeded increase in greenhouse gas emissions is raising the earth's temperature. The consequences include melting glaciers, more precipitation, more and more extreme weather events, and shifting seasons. The accelerating pace of climate change, combined with increase in global population, threaten food security everywhere. Populations in the developing world, which are already vulnerable and food insecure, are likely to be the most seriously affected. In 2005, nearly half of the economically active population in developing countries of about 2.5 billion people relied on agriculture for their livelihood.

According to Regmi and Adhikari (2007), climate change is recognized as a threat to communities which depend more on natural resources such as soil, water and biodiversity. As it is, Nigeria remains vulnerable to the economic, ecological and social impacts of climate change since this phenomenon adversely affects various climate-sensitive sectors such as agriculture and water resources.

Agriculture remains the backbone of the Nigerian economy providing livelihoods for over 80% of the population, and owing to dependence on nature, the livelihood security of farmers should be in consideration. Also, water resources are

linked to livelihoods and development through drought and flood disasters. Dinar et al (2006) opined that, many African countries, which have their economies largely based on weather-sensitive primary productions systems like Nigeria, are particularly vulnerable to climate change. And this vulnerability has been demonstrated by the devastating effects of recent flooding in the northern and Niger Delta regions of the country.

However, climate change may not be the only factor contributing to the vulnerability but a combination with other factors that are not climatic in nature. Thus knowing and exploring the impact of climate change and vulnerability level in Bayelsa is important. For instance very little is known about how the farmers and fishermen are impacted by the activities of climate change.

Niger Delta is recognized as being vulnerable to climate change due to it low-lying area. The salinization of underground water leads to shortage of underground fresh water which the inhabitants of the region (mostly farmers) depend on as their main source of water for drinking and for other domestic use (Medugu et al, 2014b). Another impact of sea-level rise on the region is the emergence of health-related hazards for the farmer and his family. Rise in temperature and humidity increases pest and disease and the risk of invasion as well as other natural disasters like floods, ocean and storm surges, which not only damage sources of livelihood but also causes harm to farmland, post-harvest activities, life and property (Idowu et al, 2011).

The resultant natural disasters such as flood, bush fires, ocean surges and landslides cause economic losses, population displacements, communal crises, forced migrations (promoting ecological refugees), and widespread soil erosion effects. Extreme storm events are likely to increase failure of floodplain protection as well as damage urban drainage and sewage system (Apata, 2010). The farming community may also experience discomfort arising from the increase in heat waves and power outage (Boko et al, 2007).

Climate change is increasingly stressing coastal communities in the region, worsening the existing strains of development and pollution. Though some farming families in the region are still engaged in farming, they work more with little in return. Because of the degradation of the environment, the local farmer can no longer engage in sustainable agriculture,

leading to risen poverty level in the region.

Many people in the Niger Delta whose source of livelihood once depended on natural sectors such as, farming are now changing their means of livelihood. Change in occupation will have adverse impacts on the agricultural sector. Continued degradation of land and water as a result of climate change will affect the major agricultural produce, thus increasing hardship for the farmer and his family. Settlements in the coastal region have been uprooted by coastal erosion (Uyigue & Agho, 2007).

Coastal erosion poses serious problem for the economic activities especially natural sectors such as crop farming and fisheries. Apart from coastal erosion, flood in general has impacted negatively the livelihood of many communities in the region. The Nigerian National Emergency Management Agency (NEMA) described the 2012 flood incident as the worst flooding to hit the country in over 50 years.

From the coastal areas of Bayelsa, Cross Rivers, Delta and Rivers states to the hinterlands in Oguta in Imo State, the unprecedented flood left in its wake a national disaster that has rendered millions homeless with several deaths recorded (Tarfa et al, 2019, Idris et al, 2016). The flood which was at a level over seven feet (7ft) submerged most farmlands and houses with only their roofs visible. Most of those affected were indigent and had occupations ranging from crop and animal farming to fishing of which River Niger was their major source of fishing livelihood. The costs of cultivation have also increased with changing environmental trends. More physical labour is needed to prepare the farmland for good yield and all these are occurring as a result of climate alteration in the region.

Study Area

The study area is Bayelsa State which is located in the Niger Delta Region of Nigeria. It is situated between latitude 4º 15'N and 5º 23'N of the Equator and longitude 5º 22' E and 6º 45' E of the Meridian (Fig 1). Covering a land area of 9,415.76 Square Kilometres, Bayelsa shares boundaries with Delta State on the North, River State on the East and the Atlantic Ocean on the West and South (NPC, 2006).

The climate of Bayelsa State is tropical that is, wet and the dry season. Rainfall in Bayelsa State varies in quantity from one area to another. The state experiences

equatorial type of climate in the southern part and tropical rain towards the northern parts. Rain occurs generally every month of the year with heavy down pour. The state experiences m high rainfall which decreases from south to north. The amount of rainfall is adequate for all-year-round for crop production. The wet season is not less than 340 days annually (Ayansanwo 2003). The mean monthly temperature is in the range of 25˚C to 31˚C. Mean maximum monthly temperatures range from 26˚C to 31˚C. The mean annual temperature is uniform for the entire State and the hottest months are December to April. The difference between the wet season and dry season on temperatures is about 2˚C at the most. Relative humidity is high in the state throughout the year and decreases slightly in the dry season (Ayansanwo, 2003). The major soil types in the state are young, shallow, poorly drained soils (inceptisol Aquepts) and acid sulphate soils (Sulphaquepts).

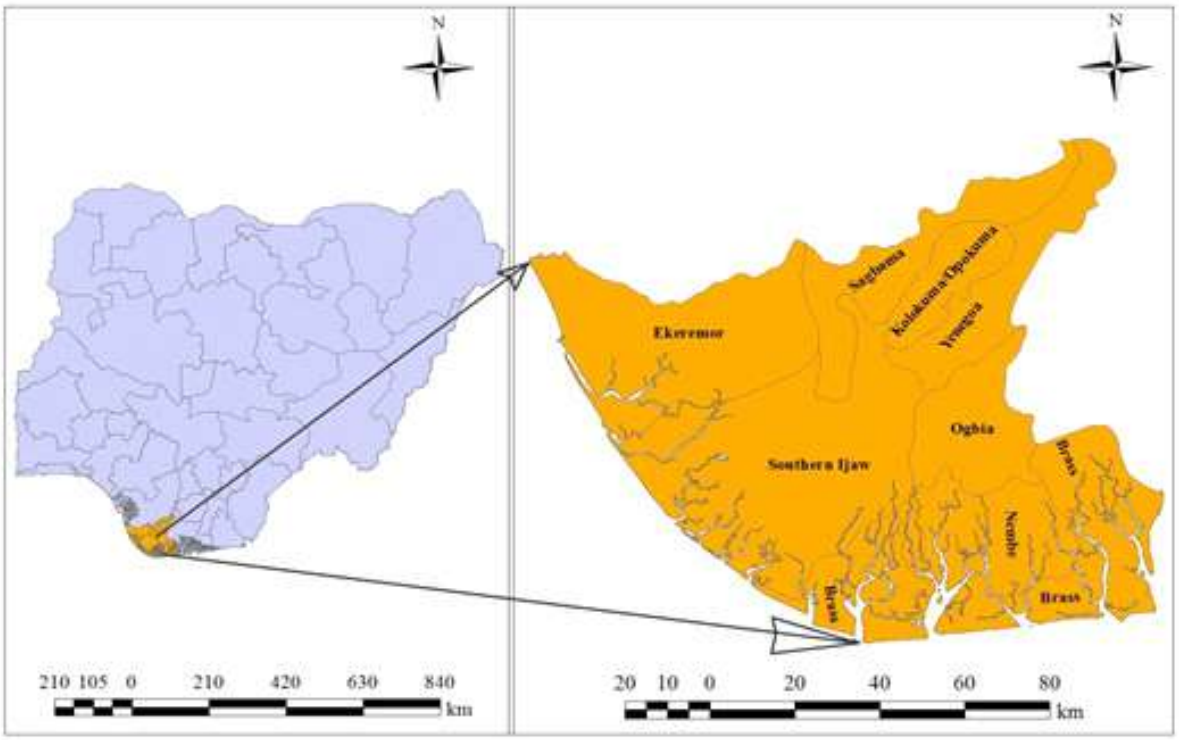

Fig 1. Map of Nigeria Showing Bayelsa State the Study Area

Research Methods

The study employed a cross-sectional household survey design. It employed the use of both quantitative and qualitative modes of inquiries to seek opinions and knowledge on how climate change impacts livelihoods within different occupations.

Three local governments namely Nembe, Ogbia, and Yenagoa were purposively sampled for this study based on the understanding that climate change poses high negative impact on livelihood of the densely populated areas. The population of the Nembe, Ogbia, and Yenagoa local government areas are 130,966, 179,606, and 352,285 respectively, hence provided a good testing ground for this study. Sample frame for this study is the sum total of the population of the three LGAs which is given as 662,857 persons.

The sample size for the study was determined from the sampling frame using the mathematical model expressed as: $n = N / 1 + N (e^2)$ (Gomez and Jones, 2010). The "n" signifies the sample size; the "N" signifies the sampling frame and the "e" signifies the margin of error. 5% margin of error with 95% confidence level was used in determining the sample size for the study.

$n = 662,857 / 1 + 662,857 (0.05)^2$

$n = 662,857 / 1 + 662,857 (0.0025)$

$n = 662,857 / 1 + 1657.14$

$n = 662,857 / 1658.14$

$n = 399.76$

n = approximately 400 respondents (farmers and fishermen)

The equivalent sample size in the study communities was then determined using the principle of proportionality. This is shown in Table 1 with the respective percentages of selection:

Table 1: Equivalent Sample Size per Local Government

LGA	LGA Population (N)	Percentage (%) [No./Total*100]	Proportionate Sample Percentage/100*Total Sample Size
Nembe	130,966	130966/662857*100 = 19.76	19.76/100*400 = 79
Ogbia	179,606	179606/662857*100 = 27.09	27.09/100*400 = 108
Yenegoa	352,285	352285/662857*100 = 53.15	53.15/100*400 = 213
Total	**8409**	**100**	**382**

Structured questionnaire and structure interview were used to collect data for the study. Data on the perceived impact of climate change on farming and fishing livelihoods were analysed using real limit of numbers or values of the mean and standard deviation

Results and Discussion

Perceived Impact of Climate Change on Farming Livelihood in Bayelsa State

Table 2 presents the mean values of the rating of degrees of climate change impact on various aspects of crops and animal farming in the study area. It revealed that decreased quantity and quality of crop yield, increased cost of crop/livestock production, increased crop/livestock Pest infestation and spread of diseases and flooding of farmland were among the major indicators of climate change impact on crop and animal production in the study area with mean rankings of 3.75, 3.72, 3.71 and 3.60. Hence, they were considered areas of high climate change effect (HE) impacting the livelihood of crop and animal farmers in Nembe, Yenagoa and Ogbia LGAs of Bayelsa State.

Conversely, the indicators of climate change impact on agricultural productivity with low effect (LE) according to respondents rating in the study area were: late seed germination (2.13), decreased numbers of livestock (2.04), increased animal mortality rate (1.88) and types of livestock raised (1.52), while it was found that climate change had no effect (NE) on the disappearance of grassland for grazing, with a mean value (1.14).

All other indicators of climate change impact on agricultural livelihood in the study area were found to be moderately affected (ME) as well as the overall climate change impact which had a mean value of 2.84. The standard deviation of all the items ranged from ±0.58 – ±1.41 with an average standard deviation of ±0.84; indicating that the respondents were not far from the mean and from one another in their responses.

Farming livelihood in the study area is associated with these climate change impacts given its location in the Niger-Delta region of Nigeria where excessive rainfall often results in erosion and flooding, thereby washing away to soil nutrients and causing farmers to spend more in improving the top soil nutrient in the area. Extended rainfall in the area also results in post-harvest destruction of crops and flooding of farmlands affects the quality and quantity of

crops produced. In a similar study conducted in the United States of America collaborated this finding that excessive rainfall can affect crop yield as much as excessive heat and drought (Science Daily, 2019)

Table 2: Mean Ratings of Climate Change Impact on Crop/Animal Farming

Perception	Mean	SD	Decision
Decrease quantity and quality of crop yield	3.75	±0.827	HE
Change in the choice of crops (specie) grown	3.04	±0.582	ME
Decreased numbers of livestock	2.04	±1.092	LE
Late seed germination	2.13	±1.045	LE
Damage/breaking of plants, due to windstorm	3.11	±0.784	ME
Post-harvest losses	3.06	±0.723	ME
Increased crop/livestock pest infestation and spread of diseases	3.71	±0.888	HE
Death of young livestock/still birth	3.16	±0.819	ME
Disappearance of grassland for grazing	1.14	±0.636	NE
Increased animal mortality rate	1.88	±0.722	LE
Poor (quality and quantity) Livestock yield	2.78	±0.807	ME
Type of livestock raised	1.52	±1.406	LE
The duration for pregnancy (Gestation period)	3.16	±0.860	ME
Increased cost of crop/livestock production	3.72	±0.880	HE
Changes in crop harvesting time/period	3.13	±0.740	ME
Flooding of farmland	3.60	±0.906	HE
Weed growth	2.78	±0.641	ME
Cluster Response	**2.80**	**±0.844**	**ME**

Note: SD = Standard Deviation, High Extent (HE=3.50 – 4.00) Moderate Extent (ME=2.50 – 3.49) Low Extent (LE=1.50 – 2.49) No Extent (NE=0.50 – 1.49).

Perceived Impact of Climate Change on Fishing in Bayelsa State

Table 3 presents the results of the analysis on the respondents perceived indicators of climate change impact on fishing and fish farming livelihood in Nembe, Yenagoa and Ogbia LGAs of Bayelsa State. It was found that: changes in the distribution of fish species, increasing access/distance to fishing ground and declining fish density in a given area were the three major indicators of climate change impact on fishing and fish farming livelihood in the study area.

The three indicators had a mean rating value of 3.78, 3.72 and 3.72. Hence, they were regarded as aspects of fishing and fish farming activities that are highly impacted by climate change in the study area. According to Ikehi (2014), with the changing conditions of water bodies in the Niger Delta region such as temperature, salinity and invasion of aggressive water species, the fish dominated region seems to be affected causing the fishes to move to different part of the water body thus forcing the fishing farmers travel a great distance to make a good catch. Capsizing of fishing boat due to excessive wave/storms during fishing with a mean rating value of 1.19 was a low indicator and least affected of climate change.

This finding is in agreement with that of Uyigue and Agho (2007), and Ikehi and Zimoghen (2015). The increased water wave in the region seems to have caused little or no capsizing of fishing boat. The low capsizing of boats could be attributed to the experience of the fisher men in the region as most of them are good water navigators and fisher men/women.

Table 3: Mean Ratings of Climate Change Impact on Fishing/Fish Farming

Indicators	Mean	SD	Decision
Stocking rate of fingerlings	2.70	0.716	ME
Stocking time and method for the fingerlings	2.22	1.219	LE
Type of fish raised	3.13	0.831	ME
Breeding cycle and Egg hatchability	3.00	0.883	ME
Quality and Size of fries/fingerlings	2.53	1.533	ME
Growth rate of the fishes	3.16	0.710	ME
Feed consumption	2.73	0.760	ME
Feeding period/time	2.82	0.671	ME
Disease infestation of the fishes	2.84	1.350	ME
Death rate in the pond	3.38	0.922	ME
Quantity/Yield of fish	3.00	0.693	ME
Pond temperature	2.70	0.902	ME
Availability of water for ponds	2.02	0.767	LE
Access/distance to fishing ground	3.72	0.954	HE
Fish density in an area	3.71	0.982	HE
Loss of fishing gear	2.14	0.945	LE
Capsizing of fishing boat due to wave	1.19	0.936	NE
Sizes of fish caught	3.02	0.644	ME
Number of fish caught	2.97	0.676	ME
Distribution of fish species in an area	3.78	0.837	HE
Cluster Response	**2.84**	**0.896**	**ME**

Farmers Adaptation and Coping Strategies to Climate Change Impact

Table 4 presents the result of both the on-farm and off-farm adaptation strategies that were used by crop and animal farmers in the study area. Among the identified on-farm strategies, almost all (92.5%) were found to be changing their planting and animal stocking times as an adaptation strategy to the impacts of climate change. Interview responses revealed that the changing of planting/stocking times was in response to the fluctuating weather pattern.

The changing of planting/stocking time was closely followed by responses on planting flood-tolerant crops (90%). Interview responses proved that this strategy is highly used in the area considering its coastal location. This finding is expected given the

high effect rating of farmland flooding as an indicator of climate change impact by the farmers in the study area.

A soil conservation practice was another climate change adaptation strategy pursued by farmers in the study area. Accordingly, 85.5% of sampled respondents claimed that they used soil conservation techniques (Raising walls with sand bags and/or blocks to divert flood water, tied ridging and ridging) as adaptation strategy to reduce the adverse effect of climate change on farm productivity. This is because land degradation (due to flooding of farms and erosion) as a result of climate change is declining production and productivity of farmers in the study area.

Table 4: On-farm and Off-farm and Coping Strategies to Climate Change

Strategy	Frequency	Percentage (%)**
On-Farm Adaptation and Coping Strategy	***n =200***	
Changing the timing of planting	185	92.50
Planting early maturing varieties	149	74.50
Crop/livestock diversification and increased intercropping	158	79.00
Agro-forestry practices	91	45.50
Crop rotation	144	72.00
Mulching	166	83.00
Planting/rearing drought-tolerant crops/animals	31	15.50
Planting flood-tolerant crops	180	90.00
Use of chemical fertilizers, manure and pesticides	146	73.00
Raising walls with sand bags and/or blocks to divert flood water	171	85.50
Use of Irrigation Facilities	14	7.00
Off-Farm Adaptation and Coping Strategy		
Rely on friends and relatives	113	56.50
Selling of livestock/livestock products (e.g. egg)	143	71.50
Changing diets	94	47.00
Livelihood diversification	191	95.00
Governmental and NGOs assistance	103	51.50
Changing profession entirely	30	15.00

** Respondents provided multiple responses

Also, 79% of the respondents claimed to have used each of the crop diversification/increased intercropping/interbreeding and mulching as adaption strategies to reduce the adverse effects of climate change on farming livelihood in the study area. Interviewed farmers claimed that the increasing unpredictable weather pattern during farming seasons has added another dimension to the need to diversify crops and/or animal.

In areas where rainfall variability is a perennial feature, growing two or more crops on the same piece of land acts as a type of insurance against total crop failure. These results are similar to other studies that have been conducted elsewhere in Sub-Saharan Africa (Bryan et al., 2013), suggesting that farmers are increasingly diversifying their crops/livestock to cope with climate variability.

In addition, planting/rearing early maturing varieties of crops/animals has been one of the main adaptation strategies used by farmers to reduce their vulnerability to adverse effect of climate change/variability. About 74.5% reported using this adaptation strategy. According to them, by the time seasonal flood or drought sets in, these flood/drought-escaping varieties would have passed the most critical stages of their development such as flowering and tasseling, which can withstand excessive water/temperature and/or require an appreciable amount of those to produce a good harvest. By maturing earlier, these varieties reduce the risk associated with climate variability.

Changing cropping patterns has also been used by farmers to cope with the effects of climate change. This was reported by 73% of the sampled respondents. Interactions with the farmers during transect walks and reconnaissance surveys revealed that most farmers in the study area have been changing their cropping pattern in response to the increasing unpredictability of weather pattern.

Also, one of the major problems that farmers are facing is the increase of crop–livestock pests and diseases. Hence a high proportion (72%) of the respondents reported the use of chemical fertilizers, manure, pesticides and vaccination as a means of averting adverse effect of climate change. Furthermore, about 45.5% of the sampled respondents were adopting agro-forestry practices as a measure to the adverse effects of climate change in the study area. Key informant

interviews suggested that growing trees was not part of the farming system in the early days. However, due to increasing change in weather pattern in the area, many farmers have adopted the system given that, trees alongside crops helps to regulate/control surface runoffs (flood) and also serve as wind break.

Planting of drought-tolerant crops and use of irrigation in response to the impacts of climate change were the least favoured adaptation and coping strategies among farmers. Only 15.5% and 7% respectively, reported the used of these strategies. This could be attributed to the study area being located within the coastal region of Nigeria and hence, records high occasion of rainfall during each planting cycle or even throughout the year. This is likely the reason why most crop farmers in the area practiced rain-fed agriculture.

In crop production systems of Sub-Saharan Africa that are characterized by inherently high weather fluctuation, diversification has been used as a key off-farm adaptation strategy to reduce the production risk associated with climate change (Dinar et al., 2008; Ellis 1998). This was confirmed by 95% of sampled respondents who reported practicing livelihood diversification as an adaptation strategy to the impact of climate change. Interview with the respondents revealed that farmers in the study area were engaging in multiple non-arable farming livelihood activities in response to weather fluctuations. They claimed that they were diversifying livelihood activities more today compared with the 1970s. A study by Ikehi (2014) suggests that most of the farmers were mainly crop farmers in the 1960s through the early 1980s.

In rural agriculture-dependent communities, households usually depend to a greater extent on social networks. This explains why a good proportion (56.5%) of the respondents relied on friends and relatives to cope with the impact of climate change on their farming livelihood.

Interview with the respondents revealed that farmers in the study area had relied on friends and families at least once in the last five years (i.e. 2015–2019) to cope with the impacts imposed by the changing weather patterns on their livelihood activities. Households rely on social networks including farmer-based associations and faith-based organizations that offer assistance in the form of food in times of crisis and also assist members to secure loans.

Temporary migration has long been part of the history of southern Nigerians, however, the increasing weather fluctuations which is greatly affecting farming livelihood has added greater dimension to the importance of temporary migration as a climate adaptation strategy more widely in Sub-Saharan Africa.

About 67% of sampled respondents in the study area indicated that at least, they had migrated within the last 5 years as a strategy to cope with climate change/variability. These results confirm several studies that indicate that people migrate in response to harsh climate conditions as a coping mechanism (McLeman and Smit, 2006; Gemenne, 2011).

Government and non-governmental assistance have also been very useful in helping farmers to cope with shortfalls in agricultural production triggered by extreme climatic events such as droughts and floods. Out of the 200 sampled farmers, 103 (representing 51.5%) indicated receiving some form of assistance from the government and NGOs in the past years. Transact walk and interaction with the respondents revealed that subsidies on fertilizers and food items were among the kind of assistance received. Key informants claimed that during the 2012 floods that destroyed several farms and houses in the study area, the government through the National and State Emergency Management Agencies provided relief items including food and mattresses to cope with (albeit over a short period) with the flood.

Changing diets have also become an important coping mechanism for crop and livestock farmers in the study area. The results also showed that 47% of the sampled respondents have changed their diets as a coping strategy in response to flood induced food insecurity. Farmers reported that they have often relied on food supplies from NGOs and governmental agencies during extreme events and therefore do not have an influence on the choice of food.

Changing profession entirely was unfamiliar among Bayelsa farmers as a measure to coping with climate change impact of farming livelihood. This was confirmed by a few proportions (15%) of the respondents who claimed to have adopted the strategy. Interviewed farmers revealed that “farming is all they know and for the elderly, it's already late to change profession”.

Fishers Adaptation and Coping Strategies to Climate Change Impact

Table 5 presents the adaptation and coping strategies employed by fishers/fish farmers in response to the impact of climate change on their livelihood in the study area.

Table 5: Adaptation Strategies employed by fishers in the Study area

Strategy	Frequency	Percentage (%)**
	n =200	
Diversification to non-fishery activities	187	93.50
Increased time on fishing ground	163	81.50
Changed fishing ground	155	77.50
Changed Target species	132	66.00
Changed fishing gear	112	56.00
Used more gear	103	51.50
Increased fishing days	72	36.00
Change stocking time	103	51.00
Exited fishery	33	16.50
Decreased fishing days	171	85.50
Use of Irrigation Facilities	81	40.50
Decreased time on fishing ground	11	5.50
Built fish ponds with temperature adaptive materials	77	38.50

** Respondents provided multiple responses

Diversification on non-fishery activities was the most adopted strategy as indicated by 93.5% of the respondents, followed by increased time on fishing ground to ensure adequate catch (81.5%), changing of usual fishing ground to area that have become favourable fish domain due to climate change impact on the rivers and streams (77.5%) and changing of target fish species due to out-migration and extinction of choice species caused by climate change (66%). Other adaptation strategies that were also adopted by more than half of the respondents included: changing of fishing gear with 56% adoption, using of more gears (51.5%) and changing fish pond stocking time to a weather favourable period (51%0. Also, 40.5% of the respondents decreased their fishing days to create time for other means of livelihoods, 38.5% ensured that their fish ponds were built with temperature adaptive materials, 36% increased fishing

days and 16.5% exited the fishery business while the rest 5.5% accounted for those who decreased the time they spent on fishing ground.

Conclusion

The majority of the farmers and fishers in the study area were within the active age bracket that are expected to understand modern adaptive strategies to climate change impact and take actions towards escaping being vulnerable. However, farmers and fishers observed elements of climate change in the study area and refers to the change in climate currently experienced as, "bad" compared to what was experienced in the past. Their perceived extent of impacts of climate change on farming and fishing livelihood was moderate and flooding is a major threat to sustainable livelihood in the region.

As agricultural livelihoods become increasingly vulnerable to climate change impacts and risks, farmers and fishers resort to various strategies to offset the ill impacts on their earnings. Much of their adaptation and coping strategies were aimed at providing more livelihood opportunities to reduce their dependence on one aspect of farming/fishery livelihoods or even the entire aspects, so as to spread their risks and therefore improve capacity to sustain their livelihoods. The fishers' adaptation measures of decreasing fishing days and time on fishing grounds and exiting the fishery could also improve income and food security if time created is diverted to productive non-fishery activities including agriculture. This is most especially when the water level is at the point that endangers their lives and increases difficulty of access to fishing ground.

The vulnerability of farming and fishing livelihood to climate change impact in the study area were moderate, although farming livelihood was slightly more vulnerable. Despite the exposure to natural disaster (flood) and climate variability, social network remained the most important causal factor that explained farming and fishing livelihood vulnerability in the region by impacting negatively on adaptive capacity due to poor interpersonal relationship among the fishers and farmers.

Rural livelihoods need people-centric development to build climate resilience, that is, growth that diminishes poverty and reduces deprivation. Livelihood vulnerability of farmers/fishers can be offset by reducing climate sensitivity and enhancing their adaptive capacity to climate

change impacts. Thus, it is clear that livelihood resilience of farmers and fishers in the region, not only need policy attention for strengthening of both sector, but also facilitation in building social networks among the farmers and fishers. The problems of climate change are already evident with climate-related (extreme) events becoming more severe. Therefore, all these should be done to properly address this issue for self-sufficiency in food production, and for export, thereby enhancing virile economy.

Recommendations

The farming communities should assess their vulnerabilities due to climate change particularly as it affects post-harvest so as to engage relevant authorities to help initiate adaptive capacity. Secondly, the fishing communities should be assisted and provided with the needed support by way of fishing boats and technical skills needed to be effective water navigators.

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