Analysis of upland farm households' vulnerability to climate variability in the Niger Delta, Nigeria

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ABSTRACT

The study analysed the vulnerability of upland farm households to climate variability in the Niger Delta. Three states - Akwa Ibom, Ondo and Rivers were selected from the nine states that make up the Niger Delta region. A total of 120 respondents from upland communities of the Niger delta were used for analysis. Household questionnaire and vulnerability questionnaire using Cost Route method were the instruments used for data collection and analysed using Vulnerability Profile and Vulnerability / Risk Framework. The results of the analysis show that both male and female headed households in all the upland communities were vulnerable to flooding, windstorm, erosion and drying up of streams. Important factors that made households vulnerable to climate hazards were low agricultural output and income, non-availability of irrigation facilities, insufficient farm labour and lack of storage facilities. Technical capacities of household members were assessed using both science-based knowledge as well as indigenous knowledge of climate change as indicators to adaptation to climate variability. It was assumed that the adaptive capacity of households could be enhanced by the number of persons with either science-based knowledge or indigenous knowledge across the region. Expenditure on carbohydrate was higher across the region during disaster time, followed by expenditure in protein, vitamin/minerals and fat and oil and other classes of food, implying that more carbohydrate food is consumed during disaster period than any other class of food. Certain geographical factors such as distance to coastline and population have direct impact on climate variability in the Niger Delta Region. Recommendations include establishment of emergency evacuation systems, income opportunities and support programmes as well as capacity building on climate change knowledge, enterprise development and management.

Key words: Farm households, Nigeria, poverty, rural areas, smallholder farmers

INTRODUCTION

Vulnerability is central in climate change discussions and has been described by the. Intergovernmental Panel on Climate Change (IPCC 2001a) as the degree to which a system is susceptible to, or unable to cope with adverse effects of climate change, including climate variability and extremes. It includes susceptibility as well as the ability to adapt. The level of vulnerability determines whether an ecosystem or society can be resilient in the face of climate change. Similarly, vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity. As documented by IPCC (2001b), vulnerable populations to climate change include small holder agriculturalists with inadequate resources, pastoralists, rural landless labourers, and urban poor. Reduced food supplies and high prices immediately affect landless labourers who have little savings. The effect on agriculturalists and pastoralists depends on how much surplus they produce and the relative terms of trade. Ecological dimension has also featured in vulnerability studies. According to Watson *et al*. (1998), people who live on arid or semi-arid lands, in low-lying coastal areas, in water-limited or flood-prone areas, or on small islands are particularly vulnerable to climate change. In the same vein, IPCC, (2001b) stated

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that climate change will, in many parts of the world, adversely affect socio-economic sectors, including water resources, agriculture, forestry, fisheries and human settlements, ecological systems, and human health, with developing countries being the most vulnerable. Developing countries have lesser capacity to adapt and are more vulnerable to climate change damages, just as they are to other stresses. This condition is most extreme among the poorest people (IPCC, 2001c). According to the IPCC report on the regional impacts of climate change cited by Watson *et al* (1998), Africa is the continent most vulnerable to the impacts of projected changes because widespread poverty limits adaptation capabilities. According to the report, the importance of agricultural activities for the economies of most African countries, combined with the farming sector's reliance on the quality of rains during the rainy season, make countries in the region particularly vulnerable to climate change. Thus, from the point of view of food security, the increasing incidence of drought represents a very serious threat. It has been argued that, in Africa, drought hazard and vulnerability "are likely to be the most damaging locus of impacts of climate change" (Downing, *et al* 2001).

Despite the Vulnerability of Nigeria's Niger Delta region to the impact of climate change, there is limited comprehensive studies aimed at analysing farm households' vulnerability to climate variability in the region. The natural terrain and hydrology of the Niger Delta have always caused certain environmental problems, especially flooding, siltation, occlusion, erosion and the shortage of land for agriculture and development. Communities, roads and farmlands are partially or totally submerged from channels or by water flowing over the levees. In the mangrove swamp forest areas, diurnal tidal movements result in floods exacerbated by rising sea levels, coastal erosion and land subsidence. The floods also cause continual modification of river courses in the area, rendering the rivers useless as modes of transportation. This also has significant impacts on the pattern of human life and on the economy. Communities have been displaced and forced to relocate as a result of it. Public facilities, houses and other economic assets have been lost. These problems which the local people (who are mainly farmers and fisher folks) have lived with for many years are being exacerbated by climate change impact. Table 1 shows clearly the

Table 1: Impact of Sea Level Rise (SLR) in the Niger Delta Region

Type of Impact	Unit of Measure	Present	1m SLR	2m SLR
Erosion rate	m/year	10-15	16-19	20-25
Area lost to erosion	Km^2	26-45	55-120	130-230
Inundation and erosion	Km^2	3,000	7,000	15,000
Per cent of area lost	%	15	35	75
Villages impacted	No	50	200	350
People displaced	Million	0.15	1-2	2-3

Note: Total area of Niger Delta is about 2 million hectares
Source: Awosika et al., 1992

There is therefore a need to close the knowledge gap in the subject matter of vulnerability to climate variability on agriculture in the region. It is a strongly held opinion that any assessment at the national level must take account of regional patterns of vulnerability within the country and the distribution of vulnerability within the national community (Adger, *et al*, 2004). This study addresses this concern. Moreover, it has been asserted that it is less meaningful to aggregate vulnerability across scales since the processes that cause vulnerability are different at each scale (Adger, *et al*, 2004). We share in this opinion and extend the argument to include sectors of the economy. For instance, it is obvious that the activities and operations taking place in the industrial sector are not exactly the same as those in agriculture

or mining. And the intense petroleum exploration and production in the Niger Delta region of Nigeria which have resulted in gas flaring with adverse effects on the environment, (Ibeanu, 2000) is also peculiar to the region. Therefore, it is important to develop our understanding of vulnerability and adaptation to climate variability by examining each sector and region separately. And, several authorities (IPCC, 2001c, Nwosu, 2008 and Speranza, 2010) have reported that agriculture is the most vulnerable of all sectors, particularly in developing countries and regions like Nigeria's Niger Delta. In spite of the global concern and the obvious vulnerability of the Niger Delta region to climate variability given its coastal nature and industrial activities, empirical investigation of climate variability and long term change, particularly, households' vulnerability are yet to be given sufficient attention. This study therefore analyses households' vulnerability to climate variability in the region and fills this gap.

2. MATERIALS AND METHODS

2.1 The Study Area

The Niger delta was chosen for this study because it is particularly vulnerable to climate change being a low-lying coastal area, with flood-prone communities lying 96m above sea level and approximately 50m below the sea level. It is also of immense value to the economic survival of Nigeria because of the abundance of petroleum and natural gas in the region.The Niger Delta is located between latitude 5.3261° N and longitude 6.4708° E. It is found along the Atlantic Coast of Southern Nigeria. The Niger Delta is an area of over 70,000 square kilometres and among the three largest wetlands in the world and the largest mangrove swamp in Africa. About 2,370 square kilometres of the Niger Delta area consist of rivers, creeks and estuaries while stagnant swamp covers about 8600 km^2. (Constitutional Rights Project, 1999). The mangrove swamp spans about 1900 square kilometres and has a coastline spanning about 450 kilometres terminating at the Imo River entrance (Uyigue, and Agbo 2009). The Niger Delta is characterized by two seasons- the dry and rainy seasons. The rainy season stretches from March to October and could be as high as 3800mm to 4500mm. Relative humidity is above 60% on the average. High and long rainfall cause flooding leading to loss of valuable properties including crops and livestock. Loss of lives has also been recorded in some flood incidences. The dry season is only experienced for a few months in some coastal sections of the region.

The Niger Delta is richly endowed with mineral-rich sedimentary formations which yield minerals such as petroleum, clay, glass sands, marble and limestone. The exploitation of petroleum accounts for over 90% of the Federal government export revenue (Ibeanu, 2000). The soils support a variety of food and cash crop production. Aquatic resources such as fish, shrimps, crabs, etc. are in abundance in the region. The region has been adjudged the largest shrimp ground in West Africa. Crop farming, livestock rearing, fishing and petty trading are important livelihoods of the people of the Niger Delta. Food crops such as cassava, yam, cocoyam, rice, plantain and vegetables are cultivated because of the rich loamy soil type found in the region. Important cash crops grown include oil palm, *raphia* palm, coconut, cocoa and rubber.

2.2 Sample Size and Sampling Procedure

The Niger Delta is made up of nine States namely: Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Rivers and Ondo. Multistage sampling procedure was employed in the study. Three States of the Niger Delta –Akwa Ibom, Ondo and Rivers States were purposively selected for the study in the first stage. In the second stage, two upland communities were selected from each State. Information on the total number of households was obtained from official census figures of 2006. Also, the knowledge of the researchers and officials of the Agricultural Development Project (ADP) and State Ministries of Agriculture in each of the selected States was relied upon to select communities with high concentration of farming activities. Emphasis was placed on selecting communities with intense farming activities by majority of the population. Thus, the six communities were selected purposively. The third and last stage of sampling was the selection of farming households for a detailed study. Again, none availability of household listing in the communities was a serious challenge to the study. The principle of disproportionate sampling was employed to validate the selection of households in the communities used for the study. However, investigation revealed disproportionate distribution of male and female households, roughly in the ratio of 4:1. Under this circumstance, more male headed households could be expected. The estimated number of households from the three states is about 3,141,367 this was derived by dividing the

total population as per each state by the average household sizes. In line with the skewed distribution of households, the proportion of households sampled was adjusted to 15 male headed and 5 female headed per community. A total of 40 upland households were selected from each State to give a total of 120 respondents.

2.3 Data Collection

A combination of quantitative and qualitative data collection techniques were employed in the study. These were administration of a set of open ended household questionnaires (quantitative data collection) to collect cross sectional data, and administration of Vulnerability questionnaire using Cost Route Method. The open ended questionnaire was pretested and modified before administering it across the three States selected for the study. The response rate was normally distributed across the region. Data used for the study were collected from a panel of five households from each of the study community on a fortnightly basis for six months. In addition, two Focus Group Discussions (FGD) and two In-depth-interviews (IDI) were conducted in each community. The FGD groups were male group and female group. One male and one female key informant were also interviewed in each community in the States selected for the study.

2.4 Methods and Data Analysis

Two broad approaches were adopted for the analysis of farm households' vulnerability to climate variability. These were (i) Vulnerability profile and (ii) Vulnerability/risk Framework. These frameworks make for a quick assessment of household strength and weaknesses. These assessments allow for understanding of where to concentrate efforts in vulnerability reduction and capacity building.

2.4.1 Vulnerability profile: Separate indicators representing different elements of household vulnerability to climate variability were constructed. In all, nine (9) indicators - economic factors, health and nutrition, education, empowerment, ecology, poverty, physical infrastructure, conflict and social capital, and geographical factors were constructed. Since vulnerability is geographically and socially differentiated (Adger, *et al* 2004), we adopt inductive approach to characterize the indicators. This is in agreement with the work of Ramachandran and Eastman, (1997).

2.4.2 Vulnerability/Risk Assessment Framework: We adopted the vulnerability/risk framework of Downing *et al*, (2001) and the Vulnerability Assessment Framework of Jones (2001). This framework focuses on current vulnerability, risk of present and future climatic variations, and responses to reduce present vulnerability and improve resilience to future risks. This framework places the stakeholder at the center of the research. We consider this very important since we assume that the people in the Niger Delta region have developed indigenous knowledge system that have enabled them to cope so far with climate variability. We examined factors that predispose households to being vulnerable. These factors include irrigation water availability, precipitation, drought, agricultural productivity and production, labour availability and land tenure, food storage and processing, transportation and distribution, population factors, income and conflicts. These factors were scored on a scale ranging from 1 to 3 (where 1 indicates that the factor does not appear to be a key determinant of vulnerability, 2 suggests that it is important and 3 that it is very important). The mean score of the respondents on the importance of each factor was computed and compared with the maximum expected score (5). The value of the mean score was then used to ascertain the importance of a given factor in pre-disposing households to the impact of climate change.

3. RESULTS AND DISCUSSION

3.1 Vulnerability Profile

3.1.1 Food Supply and Expenditure: Extant literature reveals that one aspect of household life that is usually adversely affected by any shock from adverse event is food consumption. Consumption expenditure on major food items was estimated during normal period as well as period of climate event/disaster (Table 1). The results show that for Akwa Ibom State, climate disaster time expenditure on all the food items considered was lower than normal time expenditure. For instance, on the average, normal time expenditure on carbohydrate by households is NGN9924.49 while mean disaster time expenditure is NGN5711.76. This amount is lower than the normal time expenditure by NGN4211.73. This is also the case for other important food items. Figure 1 below present total expenditure on food during periods of extreme climate conditions across the three states in the region. About NGN 35959.56 was spent on carbohydrates, NGN23049.06 on protein, NGN10137.07 on tamins/minerals, NGN5567.71 on fat/oil while

vitamins/minerals, NGN5567.71 on fat/oil while NGN2923.44 was spent on other food items. The situation reveals inadequate food to purchase during climate disaster. Akwa Ibom State depends on states such as Cross River, Benue, among others for most of its food supply. Occurrence of disaster may restrict the movement of traders, thus reducing the food supply to the disaster communities. The situation could lead to hunger and starvation by households thereby making them more vulnerable to other adverse conditions. The situation in Ondo State is similar to Akwa Ibom. However, the amounts expended on these food items are lower in Ondo State than Akwa Ibom State. During periods of extreme weather conditions, expenditure on protein food is NGN2639.66 while that of normal time is NGN2132.42. In Rivers State (adverse weather conditions such as flooding or drought) food expenditure is higher than normal time expenditure. The general pattern observable from this result is that across the State, more money is spent by households on carbohydrates followed by protein, vitamins/minerals and fat and oil in that order. This means that more carbohydrate foods are consumed by households than any other type of food in the Niger Delta region.

Table 2: Mean monthly expenditure on basic/important food components

Food component	Akwa Ibom		Ondo		Rivers	
	Normal Time expenditure (NGN)	Disaster Time (or extreme weather conditions) expenditure (NGN)	Normal Time expenditure (NGN)	Disaster Time expenditure (NGN)	Normal Time expenditure (NGN)	Disaster Time expenditure (NGN)
Carbohydrate	9924.49	5711.76	3844.44	4000	5373.24	7105.63
Protein	5295.81	2639.66	3636.11	2132.42	4274.64	5070.42
Vitamin/mineral	2757.88	1589.33	765.44	434.98	2109.86	2479.58
Fat & oil	1793.18	153.63	598.33	677.50	1098.59	1246.48
Others	766.20	175	278	267.62	535.21	901.41

Source: Field data, 2011

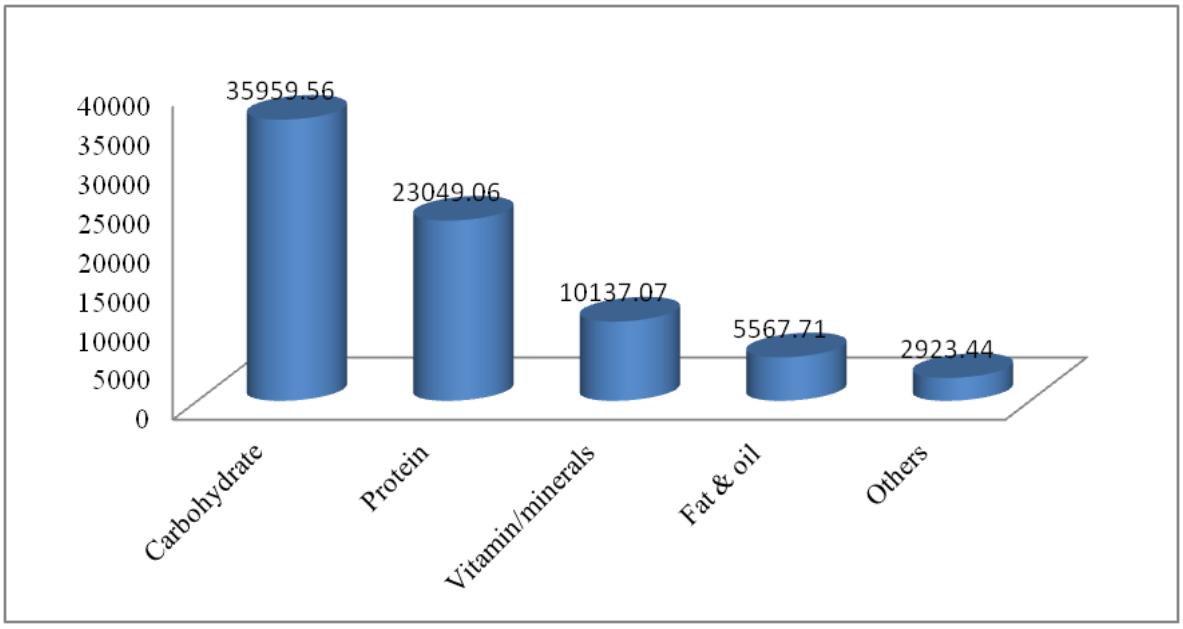

Figure 1: Expenditure Profile on Food

3.1.2 Technical Capacity: The number of household members with science-based knowledge as well as indigenous knowledge of climate change has been used as indicator of the technical capacity of households to adapt to the impact of climate variability and long-term change (Adger *et al*, 2004). In this study, we used the number of male and female household members enrolled in science-based courses in tertiary institutions or who have graduated from science-based disciplines. In addition, the number of male and female household members with indigenous knowledge of climate issues was also considered. The assumption is that the adaptive capacity of households could be enhanced by the number of persons with either science or indigenous knowledge. Result presented in Table 3 shows that the number of male and female household members who graduated in science-based courses is higher in Rivers State followed by Akwa Ibom and Ondo States. The general pattern across the State and community type is that a large percentage of the households do not have many of their household members either enrolled in science-based courses or having graduated from science based courses. The result is presented in Table 3.

Table 3: Percentage distribution of respondents by their household's technical capacity

Technical capacity	Respondent	Akwa Ibom				Ondo				Rivers			
		Number of Household members				Number of household members				Number of household members			
		Nil	1- 3	>3	Total	Nil	1- 3	>3	Total	Nil	1-3	>3	Total
Science-based Knowledge													
Male household members in Science based courses	Male	90.4	7.9	1.6	100	95.4	4.6	0	100	71.4	28.6	0	100
	Female	93.8	6.3	0	100	98.2	2.8	0	100	33.3	66.7	0	100
Female household members in Science based courses	M ale	95.2	4.8	0	100	96.9	3.1	0	100	71.4	28.6	0	100
	Female	87.5	12.5	0	100	94.3	5.7	0	100	33.3	66.7	0	100
Male graduate household members in Science based courses	Male	95.2	4.8	0	100	95.5	3.1	1.5	100	64.3	35.7	0	100
	Female	100	0	0	100	95.4	5.6	0	100	33.3	66.7	0	100
Female graduate household members in Science course	Male	93.7	4.3	0	100	95.9	3.1	0	100	78.6	21.4	0	100
	Female	87.5	12.5	0	100	92.2	7.8	0	100	33.3	66.7	0	100
Indigenous Knowledge													
Male household members with indigenous knowledge	Male	82.5	11.1	6.3	100	93.8	4.6	1.6	100	64.3	35.7	0	100
	Female	75	25	0	100	100	0	0	100	0	100	0	100
Female household members with indigenous knowledge	Male	50.8	49.2	0	100	95.4	4.6	0	100	71.4	28.6	0	100
	Female	56.3	37.5	6.3	100	100	0	0	100	0	33	67	100

Source: Field data, 2011

In none of the female households has their member any indigenous knowledge of climate change. The result on the indigenous knowledge should be interpreted with some caution. The attitude of discussants at the FGD shows that the current was that persons with local/indigenous knowledge are looked upon as possessing weird knowledge capable of harming people. For this reason, people do not want to admit they have this knowledge although they use such skills on occasions e.g. in rain-making. Adaptation intervention may target legitimizing and popularizing this knowledge to reduce the vulnerability of farming communities to the impacts of climate change. In upland communities of Rivers State, some households have 1 to 3 male and female member either enrolled or have graduated from science-based courses. The same pattern is obvious on non-science based courses. The fact that very few households have members with science-based and tertiary level knowledge has serious implications for adaptation to climate change knowledge and the use of it are what the households need to, first, reduce human induced climate hazards and, second take informed actions to mitigate the impact of climate change. When this is lacking, adoption of adaptation measures may be hindered. Technical capacity of households need to be built if Nigeria will respond effectively to the impact of climate variability and long-term climate change. Result further indicates that some households have 1-3 members with indigenous knowledge of climate change. The result also reflects the submissions of participants in FGDs in some of the communities. In each community, members have a way of ascertaining if rain will fall or not. Sometimes, the direction of the rain forming-clouds or appearances of certain insects or birds are used as indicators of how the weather will look like in the near future.

3.1.3 Geographical factors: Geographical factors such as distance from coastline, population within 100km of coastline have been identified as capable of making households vulnerable to climate change impact (Heger, and Paddison, 2008). The proposition is that the nearer households and communities are to climate hazard prone sites such as the coast, ravine and erosion sites, the more vulnerable they are to climate change impact. The distribution of the respondents in the three States studied according to the location of their homes from the coast, ravine and erosion sites is presented in Table 3.

Table 4: Percentage distribution of respondents by the distance of their homes to the coast, ravine and erosion sites

Community Type	Distance	Coast		Ravine		Erosion Site	
	(Km)	Male	Female	Male	Female	Male	Female
		%	%	%	%	%	%
Akwa Ibom	≤ 1	33.9	26.7	1.6	80.0	56.9	33.3
	2 – 3	40.0	13.3	21.5	20.0	24.6	46.7
	≥ 3	26.1	60.0	76.9	0.0	18.5	20.0
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Ondo	≤ 1	23.1	6.7	7.7	6.7	26.1	66.7
	2 – 3	30.8	26.7	53.8	33.3	58.5	13.3
	≥ 3	46.1	66.6	38.5	60.0	15.4	20.0
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Rivers	≤ 1	7.1	0.0	7.3	0.0	22.9	10.5
	2 – 3	0.0	0.0	0.0	0.00	27.1	19.5
	≥ 3	92.9	100.0	92.7	100.0	50.0	70.0
	Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: Field data, 2011

What seems to be common to both male and female households is their nearness to erosion sites. The houses of more than a half of the male respondents and 33.3% of the female were found to be located less than 1 kilometer from erosion sites. With these features, it can be inferred that these communities may be easily affected in event of climate hazards/events. The location of the male and female respondents in the upland communities of Ondo State according to the distance of their homes from the coast, ravine and erosion sites respectively is presented in Table 4. The results show that the upland households are closer to ravine and erosion sites than they are to the coast. More than 60% of the female headed households live within a distance of less than 1kilometer from erosion site. The results tend to indicate that most households in the Niger Delta region are close to hazard sites or the other. The implications of the findings are that households in the Niger Delta are vulnerable to climate change impact.

The distribution of the households in Rivers State according to the location of their homes from the coast, ravine sites as well as erosion sites is also presented in Table 4. All the female respondents (100%) in the upland communities live more than 3 kilometers away from the coast. However, a smaller percentage of the respondents live close to ravines as well as erosion sites. Although, the percentage of respondents living close to ravine and erosion site is less than those living close to the coast, it is high enough to give attention, particularly in the face of "increasing climate variability"(IPCC, 2001c).

3.1.4 Economic: Many studies report that agriculture is one sector that is very vulnerable to climate variability. For this reason, the economic factor that can make households vulnerable to climate change impact considered is the extent of households' dependence on agriculture. Extent of dependence is measured by number of household members in agriculture as well as offering services as hired agricultural labour. The result is presented in Table 5.

Table 5: Percentage distribution of households by proportion of members in agriculture and as hired labour

Community Type	Proportion of household members	Household Members in Agriculture		Household members as Hired labour	
		Male	Female	Male	Female
		%	%	%	%
Akwa Ibom	None	7.9	0.0	55.6	50.0
	½	6.4	0.0	34.9	50.0
	More than ½	85.7	100.0	9.5	0.0
	Total	**100.0**	**100.0**	**100.0**	**100.0**
Ondo	None	36.9	33.3	92.3	80.0
	½	63.1	66.7	7.7	6.7
	More than ½	0.0	0.0	0.0	13.3
	Total	**100.0**	**100.0**	**100.0**	**100.0**
Rivers	None	57.1	100.0	100.0	100.0
	½	14.3	0.0	0.0	0.0
	More than ½	28.6	0.0	0.0	0.0
	Total	**100.0**	**100.0**	**100.0**	**100.0**

Source: Field data, 2011

Findings from the study show that a high percentage of male and female households in upland communities of Akwa Ibom State have more than half of their members in agriculture as well as hired agricultural labour. In the upland communities, 85.7% of the male respondents said more than ½ of their household members are in agriculture. All the female headed households (100%) have more than half of their members in agriculture. This implies agriculture is more of an occupation of women headed households. Discussants were quick to point out that due to rural- urban migration, there is scarcity of hired agricultural labour in the rural communities. They submitted that farmers rely more on exchange labour, though this is insufficient and thus limit the size of land cultivated. The implication of this situation is that income of the household from this livelihood will be low leading to poverty and reduction in adaptive capacity of farming households. In Ondo State, most households-male and female, have at least half of their members in agriculture. In the upland communities, 63.1% of the male respondents and 66.7% respondents report that a half of their household members are in agriculture. It can be inferred from this result that agriculture is the primary occupation in the communities studied. Because agriculture is highly vulnerable to the impact of climate change, it can be deduced that these farming households are prone to the impacts of climate change.

The distribution of respondents in Rivers State by the proportion of their household members in agriculture or being agricultural labourer is also presented in Table 4. Findings show that 28.6% of the male respondents in upland communities have more than a half of their household members in agriculture.

4. Current Vulnerability: Rating of Factors that make Households in the study area Vulnerable to Climate Variability. The result on the farmers' rating of factors that make them vulnerable to the impact of climate change is presented in Tables 6, 7 and 8.

4.1 Rating of factors that make households in Akwa Ibom State vulnerable to climate variability and climate change hazards

Table 6: Percentage distribution of respondents by their rating of factors that make their households vulnerable to the impacts of climate variability in Akwa Ibom State

Factor	Sex	Rating				m= ranking by Males m= ranking by Females
		Not Important (1)	Important (2)	Very Important(3)	Mean	
Non availability of irrigation facilities	Male	75.00	71.43	49	2.72	m 2
	Female	25.00	28.57	15.52	2.69	f 4
	All	**100.00**	**100.00**	**100.00**	2.71	
Non availability of water for livestock	Male	84.62	80.95	80.00	2.07	m 8
	Female	15.38	19.05	20.00	2.19	f 10
	All	**100.00**	**100.00**	**100.00**	2.11	
Low agricultural output	Male	90.00	90.91	75.00	2.45	m3
	Female	10.00	9.09	25.00	2.85	f 1
	All	**100.00**	**100.00**	**100.00**	2.59	
Insufficient farm labour	Male	88.24	72.73	80.77	2.45	m3
	Female	11.76	27.27	19.23	2.74	f 3
	All	**100.00**	**100.00**	**100.00**	2.55	
Non availability of agricultural land	Male	82.35	80.00	81.40	2.32	m5
	Female	17.65	20.00	18.60	2.63	f 6
	All	**100.00**	**100.00**	**100.00**	**2.43**	
Insufficient food storage facilities	Male	80.95	80.00	83.33	2.06	m9
	Female	19.05	20.00	16.67	2.22	f 9
	All	100.00	100.00	100.00	2.11	

Inadequate processing facilities	Male	96.30	70.00	78.26	1.89	m11
	Female	3.70	30.00	21.74	2.22	f 9
	All	**100.00**	**100.00**	**100.00**	2	
Inadequate means of transportation and distribution	Male	95.24	84.38	66.67	1.96	m 10
	Female	4.76	15.63	33.33	2.41	f 8
	All	**100.00**	**100.00**	**100.00**	2.11	
Increased population	Male	76.92	82.61	80.95	2.09	m7
	Female	23.08	17.39	19.05	2.07	f 11
	All	**100.00**	**100.00**	**100.00**	2.09	
Low income	Male	90.91	88.00	75.00	2.4	m4
	Female	9.09	12.00	25.00	2.63	f 6
	All	100.00	100.00	100.00	2.44	
Conflict	Male	87.50	66.67	81.82	2.14	m6
	Female	12.50	33.33	18.18	2.65	f 5
	All	**100.00**	**100.00**	**100.00**	2.32	

Source: Field data, 2011

Female farmers in Akwa ibom state rated low agricultural output as number one factor that can make their households vulnerable to the impacts of climate variability and long term climate change as shown in Table 6. This was followed by insufficient farm labour, conflict and non-availability of water for irrigation facilities, in that order. For the men, inadequate storage facilities were rated as number one factor that can expose their households to the impacts of climate variability and change. Following closely in their rating were non-availability of irrigation facilities and insufficient farm labour. While non-availability of water for livestock was rated as important by women, rainfall, low-agricultural output, insufficient farm labour, insufficient food storage facilities, inadequate means of transportation, distribution and increased population were considered as factors that can predisposed households to the impact of climate change. Most of the other factors listed were rated as not important.

4.2 Rating of factors that make households in Ondo State vulnerable to climate variability and climate change hazards

For Ondo state, insufficient farm labour and non-availability of agricultural land were rated as important. Inadequate food storage facilities and conflict were rated as unimportant in exposing households to the impact of climate (Table 7). On the basis of the percentage of the respondents reporting on a given factor, it can be seen that the females paid more attention to non-availability of agricultural land, insufficient food storage facilities, and inadequate means of transportation and distribution. No female mentioned these factors as being not important whereas men rated land as not important. This finding may be attributable to the land tenure system whereby land ownership is mainly through inheritance, and male children are primarily the heir to family land. This probably makes female respondents more vulnerable to land related climate change impact. In the Niger Delta region, as in most parts of Nigeria, making food available to the household is primarily the responsibility of women. This could inform why food storage and processing facilities are rated as important by women than men. However, in any intervention directed at reducing the vulnerability of upland farming households in Ondo State to climate variability, those rated as unimportant in predisposing households to impact of climate change need to be the focus. These include rainfall, farm labour, land, food storage and processing facilities, transportation, population and income.

Table 7: Percentage distribution of upland respondents by their rating of factors that make households vulnerable to the impact of climate vulnerability on Ondo State

		Not Important	Important	Very Important	Mean	Rank
						m= ranking by males, f= ranking by females
Non availability of irrigation facilities	Male	82.1	66.7	91.7	1.46	M= 11
	Female	17.9	33.3	8.3	1.4	f =10
	All	100	100	100	1.45	
Non availability of water for livestock	Male	79.4	70.6	89.7	1.98	m =8
	Female	20.6	29.4	10.3	1.73	f =9
	All	100	100	100	1.94	
Rainfall	Male	80	66.7	85	2.72	m =1
	Female	20	33.3	15	2.53	f =4
	All	100	100	100	2.69	
`Drought	Male	88.9	65.2	83.3	1.54	m =10
	Female	11.1	34.8	16.7	1.8	f =8
	All	100	100	100	1.59	
Low agricultural output	Male	81.5	77.8	84.6	2	m =7
	Female	18.5	22.2	15.4	1.93	f =7
	All	100	100	100	1.99	
Insufficient farm labour	Male	82.6	61.1	89.7	2.25	m =6
	Female	17.4	38.9	10.3	2	f =6
	All	100	100	100	2.2	
Non availability of agricultural land	Male	100	81.8	75	2.2	m =5
	Female	0	18.2	25	2.73	f =3
	All	100	100	100	2.56	
Insufficient food storage facilities	Male	0	81.8	79.4	2.68	m =3
	Female	0	27.2	20.6.	2.8	f =1
	All	0	100	100	2.71	
Inadequate food processing facilities	Male	100	72.7	81	2.71	m =2
	Female	0	27.3	19	2.8	f =1
	All	100	100	100	2.71	
Inadequate means of transportation &distribution	Male	0	69.2	82.3	2.71	m =2
	Female	0	30.8	17.7	2.73	f =2
	All	0	100	100	2.71	
Increased population	Male	100	73.3	81.7	2.68	m =4
	Female	0	26.7	18.3	2.73	f =2
	All	100	100	100	2.69	
Low income	Male	82.9	85.7	77.4	1.92	m =9
	Female	17.1	14.3	22.6	2.07	f =5
	All	100	100	100	2.07	
Conflict	Male	80.6	85.7	100	1.12	m =12
	Female	19.4	14.3	0	1.07	f =12
	All	100	100	100	1.11	

4.3 Rating of factors that make households in Rivers State vulnerable to variability and climate change hazards

Seven factors were rated as predisposing households to the impact of climate change by both male and female upland farmers in Rivers State (Table 8). Similar factors were considered by both sexes as important except that while females did not consider lack of storage facilities, non-availability of agricultural land, as important, the male farmers rated these alongside other factors as being important. On the other hand, the females considered low agricultural output, drought, among other factors as those that can make them vulnerable to impact of climate change, whereas male respondents rated those as not important. The common factors that can expose both male and female farmers in Rivers state to the impact of climate change are rainfall, non-availability of farm labour, increased population, low income and conflict. The result is in conformity with the situation in Rivers State. The state experiences heavy rainfall almost all year round. This, in extreme cases may affect farming adversely. Similarly, because of better pay in the oil related industry, there is migration of labour from agriculture to the oil industry. This adversely affects agricultural production, thus making farming households vulnerable to the impact of climate change.

Table 8: Percentage distribution of respondents by their rating of factors that make upland farming households in Rivers State vulnerable to impacts to climate variability

	Sex	Not Important	Important	Very Important	Mean	Ranking M = ranking by males f = ranking by females
Non availability of irrigation facilities	Male	84.4	50	60	1.94	M 6
	Female	15.6	50	40	1.33	f 6
	All	100	100	100	1.35	
Non availability of water for livestock	Male	100	75	50	1.79	m 9
	Female	0	25	50	1	f 8
	All	100	100	100	1.82	
Low agricultural output	Male	50	87.5	75	1.94	m 6
	Female	50	12.5	25	2.67	f 1
	All	100	100	100	2.41	
Insufficient farm labour	Male	60	80	80	2	m 5
	Female	40	20	20	2.33	f 3
	All	100	100	100	2.06	
Non availability of agricultural land	Male	71.6	60	87.5	2.21	m 4
	Female	28.4	40	12.5	1	f 8
	All	100	100	100	2.12	
Insufficient food storage facilities	Male	50	81.2	71.4	2.21	m 4
	Female	50	18.8	28.6	1.67	f 5
	All	100	100	100	2.12	
Inadequate food processing facilities	Male	50	91.7	50	2.36	m 3
	Female	50	8.3	50	2	f 4
	All	100	100	100	2.12	
Inadequate means of transportation &distribution	Male	50	80	75	2.4	m 2
	Female	50	20	25	1.3	f 7
	All	100	100	100	2.2	
Increased population	Male	100	72.3	66.7	2	m 5
	Female	0	27.7	33.3	2	f 4
	All	100	100	100	2	
Low income	Male	100	72.3	71.4	2.2	m 4
	Female	0	27.7	28.6	2.6	f 2
	All	100	100	100	2.3	
Conflict	Male	75	75	75	2	m 4
	Female	25	25	25	2	f 4
	All	100	100	100	2	

Source: Field data, 2011

5. CONCLUSIONS, POLICY IMPLICATIONS AND RECOMMENDATIONS

The study concludes that both male and female headed households in the upland communities of the Niger delta are vulnerable to flooding, windstorm, erosion and drying up of streams. This result concurs with earlier studies by Zabbey, (2007) that due to its characteristic lowlands, the Delta region is potentially vulnerable to any rise in sea level. Those factors that are considered very important to household vulnerability to climate hazards are: low agricultural output and income, non-availability of irrigation facilities, insufficient farm labour and lack of storage facilities. Except in Rivers State, farming households tend to spend less on food during disaster. This presupposes lack of income to buy food. Most households lack technical capacity to adapt to climate variability and change. There is a high level of dependence on agriculture, and households are located close to areas susceptible to the impact of climate hazards thus, are vulnerable to climate change impact. Communities in the Niger Delta have limited adaptation measures to climate change related events and extremes. Some of these measures may not be sufficient given their vulnerability to climate variability.

The result of the study indicates that farming households are vulnerable to flooding, windstorms, and drying up of streams and other water bodies, and erosion. Several factors are rated as "very important" in exposing the farmers to the impacts of climate hazards. These are low agricultural output, non-availability of irrigation facilities, insufficient farm labour, and lack of agricultural commodities/food storage facilities, low income and inadequate means of transportation. Besides the current climate related hazards, farmers believe they are likely to have mud and landslides in their communities. From the fore goings, it can be safely concluded that farming communities in the Niger Delta are affected by and can be exposed to more climate related hazards. To assist the communities adapt to these hazards, it is recommended that early warning system on extreme climatic events be established. Without this warning, such events could destroy crops or kill livestock that farmers rely on for livelihood. Emergency evacuation systems should also be established. This is to evacuate farmers in the event of extreme climatic event. Of particular importance is the need for the creation of climate information agency to regularly disseminate climate information to the farmers.

Climate variability has impacted on the communities in many ways. Chief among these are loss of income, poor crop yield, loss of properties and health problems (skin rashes, etc). These affect men and women alike. Therefore, programmes that will reduce the vulnerability of farmers' livelihoods to climate change impact will be useful. Income opportunities and income support programmes and capacity building on climate change knowledge, enterprise development and management are recommended. Income support and capacity building on enterprise will enable the farmers diversify their income sources in order to reduce their vulnerability to climate variability and change.

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