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VULNERABILITY AND ADAPTATION CAPABILITIES OF THE RURAL POOR TO CLIMATE CHANGE EFFECTS IN KWARA STATE, NIGERIA

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Abstract

Climate change is expected to worsen the condition of the poor because they are less capable to respond to its adverse effects. This study examines the vulnerability and the capability of the rural poor to adapt to the adverse effects of climate change in Ilorin South Local Government Area, Kwara State. Data for the study were obtained through focus group discussions and the use of structured questionnaire. Purposive random sampling technique was used to select five rural settlements, from which a representative sample of 30% of households in each settlement was then selected using equal probability systematic sampling technique. A relative poverty line was derived for the area whereby, all those who earn less than 50% of the mean income were regarded as poor. Vulnerability indices were also constructed using the integrated approach to vulnerability analysis. It was discovered that, while the level of poverty is relatively low (39%) a close positive relationship was observed between poverty and level of vulnerability. It was also observed that no adaptation measure was carried out alone but, in combination with other adaptation techniques. Major adaptation measures employed by the poor are planting different types of crops, planting different varieties of the same crop, changing types of crops planted and soil conservation techniques. The study recommends that, policies aimed at improving adaptive capabilities should be pursued. Some of the strategies suggested include improving access to credit, investment in irrigation facilities and improving rural roads to facilitate access to input and output markets.

Keywords: *Vulnerability, Adaptation, Rural poor, Integrated approach, Vulnerability analysis.*

Introduction

Global warming is being associated with increasing frequency and intensity of drought and floods in many parts of the world. Extreme weather has adverse effects on agriculture which is the main source of livelihood in the rural areas. In Africa, as in other developing parts of the world there is high dependence on natural resources and low capacity to adapt to changing climate in rural areas (African Development Bank et al, 2003). The rural poor are however, more vulnerable to degradation of the environment because they depend more on resources of the ecosystem (for food, animal fodder, fuel and building materials). On the other hand local socio-economic conditions often push the poor into marginal areas highly vulnerable to natural disasters (International Panel on Climate Change (IPCC), 2001).

Climate change is expected to worsen the vulnerability of the poor through its impact on their livelihoods, water supply situations, health conditions, food security and economic opportunities especially in Africa and other developing parts of the world (African Development Bank et al, 2003). Poverty related impacts of climate change include reduction in crop yield that may result from variation in temperature, flooding, decrease in water availability, new/changed insect pest incidence and adverse effects on food security, employment and income and exposure of people to new health risks (IPCC, 2001). Widespread poverty in Africa has made the continent the most vulnerable to the impacts of projected changes from climate change because poverty seriously reduces adaptation capabilities on the continent (Watson, Zinyoera and Moss, 1998).

Capacity to cope with environmental changes depends on some physical and socio-economic factors. For instance, The Energy Resources Institute (TERI), India (2003), identified cropping patterns and crop diversification, ownership of assets, access to services (banks, health and educational institutions etc) and available infrastructure like irrigation facilities, markets and transport facilities as determining adaptation capacity.

The challenge posed by poverty in Nigeria is enormous though, despite the fact that the country is richly endowed by nature. With a Human Poverty Index for developing countries (HPI-1) of 37.3, Nigeria was ranked 80th among 108 countries considered (UNDP, 2008). However in terms of depth and severity of poverty, the rural areas are worse off compared to the urban areas (Thomas and Canagarajah, 2002). According to the Federal Office of Statistics (FOS) (1999a) and (1999b) by 1980, 38 percent of rural dwellers in Nigeria were poor while the figure was 17

percent for the urban population. By 1996 however, rural poverty had increased to 69 percent compared to 58.2 percent for urban areas. Against this background, this study aims to examine the vulnerability and adaptation capabilities of the rural poor to the effects of climate change in Ilorin South local Government Area of Kwara State.

Conceptual Issues

Vulnerability: Definition and Approaches to Vulnerability Analysis

Vulnerability has been conceptualized by various scholars from the perspectives of their individual disciplines. Thus, it has been very difficult to agree on a universally accepted definition or even adopt a universal methodological approach for assessing vulnerability (Deressa, Hassan and Ringler, 2008). The most comprehensive definition of vulnerability was given by the Intergovernmental Panel on Climate Change (IPCC) which viewed vulnerability as the degree of susceptibility or inability of a system to cope with adverse effects of climatic variability and extremes. Vulnerability depends on the nature, level and rate of change as well as the sensitivity and adaptive capacity of the system (IPCC, 2001). This implies that a system which is both highly sensitive to changes in climate and with little ability to adapt will be highly vulnerable. As regards vulnerability analysis, vulnerability is seen to depend on the adaptation that has occurred and also viewed in terms of capacity to respond to changes in climate. The level of vulnerability is thus, determined by a combination of adaptive capacity, sensitivity and exposure (Olmos, 2001).

Three major approaches have been adopted for the analysis of vulnerability to climate change. These are the socio-economic approach, the biophysical or impact assessment approach and the integrated assessment approach (Deressa, Hassan and Ringler, 2008). The socio-economic approach is concerned with determining the adaptive capacities of individuals or communities using their internal characteristics. Vulnerability is analyzed using information on socio-economic characteristics of individuals and social groups. This approach has however been criticized for its limited focus on variations or differences in society. Variations exist in intensities, frequencies and probability of environmental hazards and distribution of natural resource endowment which can lead to different levels of vulnerability (Deressa, Hassan and Ringler, 2008). The biophysical approach focuses on the magnitude of damage on the social and biological systems resulting from an environmental stress. This approach has however been criticized for focusing mainly on physical damages like reduction in yields. Also, while

reduction in yields resulting from stimulated changes in climatic variables can be seen, the impact on individual farmers can not be determined. The integrated approach is a combination of the socio-economic and biophysical approaches. While the integrated approach is an improvement over the other two approaches, it lacks a standard basis for combining the socio-economic and biophysical approaches (Deressa, Hassan and Ringler, 2008).

Adaptation

In simple terms, adaptation is any human action that minimizes the adverse effects of climate change while maximizing the advantages. According to Smit, Klein and Wandel (2000), adaptation refers to all adjustments in behaviour or economic structure that leads to reduction in vulnerability by society to climate change. The ability of a socio-economic system to adapt is dependent on some system characteristics known as the "determinants of adaptation." These include sensitivity, vulnerability, resilience and adaptive capacity (Olmos, 2001). Sensitivity is the "degree to which a system is affected by, or responsive to climate stimuli," while resilience is the "degree to which a system rebounds, recoups or recovers from a stimulus." Adaptive capacity is the "potential or capability of a system to adapt to (to alter to better suit) climate stimuli" (Olmos, 2001: 6). Adaptation could be planned or spontaneous, passive, anticipatory or reactive. As opposed to spontaneous adaptation, the planned anticipatory adaptations are mainly carried out by governments and other organized agencies (Olmos, 2001).

African farmers' adaptation options have been classified into two main types of modification in the production system. These are increased diversification and protection of sensitive growth stages of crops. The latter ensures that critical growth stages never coincide with periods of very harsh climatic conditions. Some of the adaptation strategies available to African farmers include crop diversification, planting different varieties of the same crop, varying planting and harvesting dates, irrigation, using soil and water conservation methods, shading and shelter and diversifying to non-farming occupations (Hassan and Nhemachena, 2008).

Review of Literature

Rural Poverty profile in Nigeria.

In Nigeria, majority of the people in poverty are found in the rural areas. For instance, according to the National Bureau of Statistics (NBS) (2007) by 2004, 63.8 percent of rural dwellers were living in poverty

compared to 43.1 percent recorded for urban areas. Poverty is more of rural problem in Nigeria (Omonona, 2009).

Subsistence agriculture still constitutes the main source of livelihood in the rural areas of the country. The poverty situation is worsened by the problem of inadequate infrastructure like roads and other basic facilities (Oyebanji, 1981 and Aderamo and Magaji, 2010). The result is that majority of people lack adequate access to productive inputs, output markets and other basic facilities. The rural production system is therefore characterized by small farm size, application of traditional farming inputs and high level of food insecurity immediately before harvest (Omonona, 2009).

According to Omonona (2009), some household characteristics are useful for determining poverty profile in Nigeria. These include demographic factors like age, gender, household size, marital status and number of wives. Locational factors include relief, soil type vegetation, precipitation and distance to urban centres. Human capital consists of educational level, occupation, access to credit and social network. Farm factors include the use of modern inputs, sale of farm produce, land tenure, diversity of income sources and types of crops planted. He also identified community factors and assets as consisting of source of drinking water, pattern of refuse disposal, health consultations, number of persons per room and nature of toilet facilities.

Vulnerability of the rural poor in Nigeria

Generally, the poor are more vulnerable to risk because of their characteristics. Such characteristics according to Omonona (2009) include low level of assets, less access to credit, and insurance, less access to input and output markets and low level of public protection and empowerment. In a participatory poverty appraisal, Ayoola et al (1999) noted that the rural poor in Nigeria identified some factors as contributing to their poverty and vulnerability. These include climatic extremes like drought, flooding and erosion. Other factors are low or declining soil fertility, pests, erosion, poor access to inputs, inadequate storage facilities and poor transport infrastructure among other things.

Various studies have examined the demographic and other characteristics which are determinants of poverty and vulnerability among rural households in Nigeria. For instance, Oni and Yusuf (2007) noted that male headed households have higher level of consumption than female headed households. They further concluded that poverty is more common among female headed households in rural Nigeria. Welfare of members of

household is known to rise with increase in the age of head of household up to a certain level before it starts to fall. On the other hand, welfare level of households decline with increase in the size of household in Nigeria (Oni and Yusuf, 2007 and Okunmadewa, Yusuf and Omonona 2005).

Large number of the elderly and children in household further increases the likelihood of the household falling into poverty. Higher poverty levels are associated with households with high dependency ratio (Oni and Yusuf, 2005). Higher level of educational attainment of heads of household has been associated with lower level of poverty (Olaniyan, 2000). High social capital and greater diversity of income sources have also been associated with lower poverty levels. Heterogeneity of membership of local level institutions and high rate of attendance at meetings are associated with lower poverty and vulnerability (Okunmadewa, Yusuf and Omonona 2005). Social capital improves agricultural productivity, facilitate the management of common resources and have positive impact on the income and welfare of the people (Omonona, 2009).

Materials and Methods

The study area is Ilorin South Local Government Area of Kwara State. It covers a total area of about 174 square kilometers. Fufu the LGA headquarter is located about 30 kilometers from Ilorin the State capital. The topography consists of relatively flat and undulating landscape interspersed with valleys. The drainage of the area is dominated by rivers Asa and Oyun and their tributaries. This area lies within the Tropical wet and dry climate. The wet season begins towards the end of March and ends in October while the dry season lasts from November to February. In Kwara State, the total annual rainfall ranges from about 1,000 to 1500mm (Kwara State Government, 1998) while the mean temperature ranges from 30⁰ to 35⁰ Celsius (Oyebanji, 2000).

According to the 2006 census, Ilorin South local Government Area has a population of 209,251 (Federal Republic of Nigeria, Official gazette, 2009). The major occupation of the people in the rural part of the LGA is farming. However many Fulani cattle herders are also found within the area. Agricultural products of the area include melon, pepper, groundnuts, sorghum, beans, cassava, rice, soyabean, maize, yams, locust bean, shea nuts, cashew and fresh milk (Raw Material Research and Development Council, 2009). The close proximity of villages like Aduagba, Agbabiaka, Agbede and Abelu to Ilorin ensures ready market for their agricultural products.

The major data used for the study include information on the vulnerability profile of the people. This covered physical, social and economic vulnerability which was used as vulnerability indices from which vulnerability profiles were developed. Primary data required for the study was collected through various surveys. These include focus group discussions and the use of structured questionnaire. Focus group discussions were held with community leaders and other people chosen at random. As expected, this helped to create people's interest in the study and provided some background information on the people's understanding about climate change and its implications.

Further information was derived through the application of structured questionnaire. A purposive random sampling technique was adopted to select five rural settlements in Ilorin South LGA for the study. Due to the fact that the result of the 2006 census are not yet available on settlement basis, the sample size was determined based on the population figures of the 1991 census projected to 2010. The projection is based on 3% annual growth rate for Kwara State (Federal Republic of Nigeria, 2007). The average size of rural households in Nigeria is 5 persons (NPC, 2009). This was used to estimate the number of households in each settlement. Based on this, a representative sample, 30% of households in each settlement were selected using equal probability systematic sampling method. The heads of household were targeted in the survey. A total of 235 copies of the questionnaire were applied. The settlements selected and the numbers of households chosen for questionnaire administration are as follows: Ilota (110), Omode (35), Aduagba (30), Fufu (30) and Magaji (30).

Vulnerability Index

The choice of indices for this study was based on review of literature and the nature of data available. The direction of relationship among the vulnerability indicators is such that positive value is attached to adaptive capacity while negative value is attached to both exposure and sensitivity. This is based on the assumption that greater exposure to negative effects of climate is more sensitive to damages. It is further believed that areas that have higher frequencies of climate extremes like floods and drought are liable to losses in livelihood (Deressa, Hassan and Ringler, 2008). In this study, exposure is represented by future risk of being affected by erosion. The variables selected for this study are shown in Table 1. As adopted by Deressa, Hassan and Ringler (2008) and based

on the procedure used by Moss, Brenkert and Malone (2001), vulnerability is calculated as:

$$\text{Vulnerability} = (\text{adaptive capacity}) - (\text{sensitivity} + \text{exposure})$$

Thus, higher net values means lesser vulnerability while, lower net values indicate higher vulnerability. The scale of analysis for this study was the village level. This is believed to be the most appropriate for a study of this nature.

Table 1: Selected Vulnerability Indicators in Ilorin South LGA

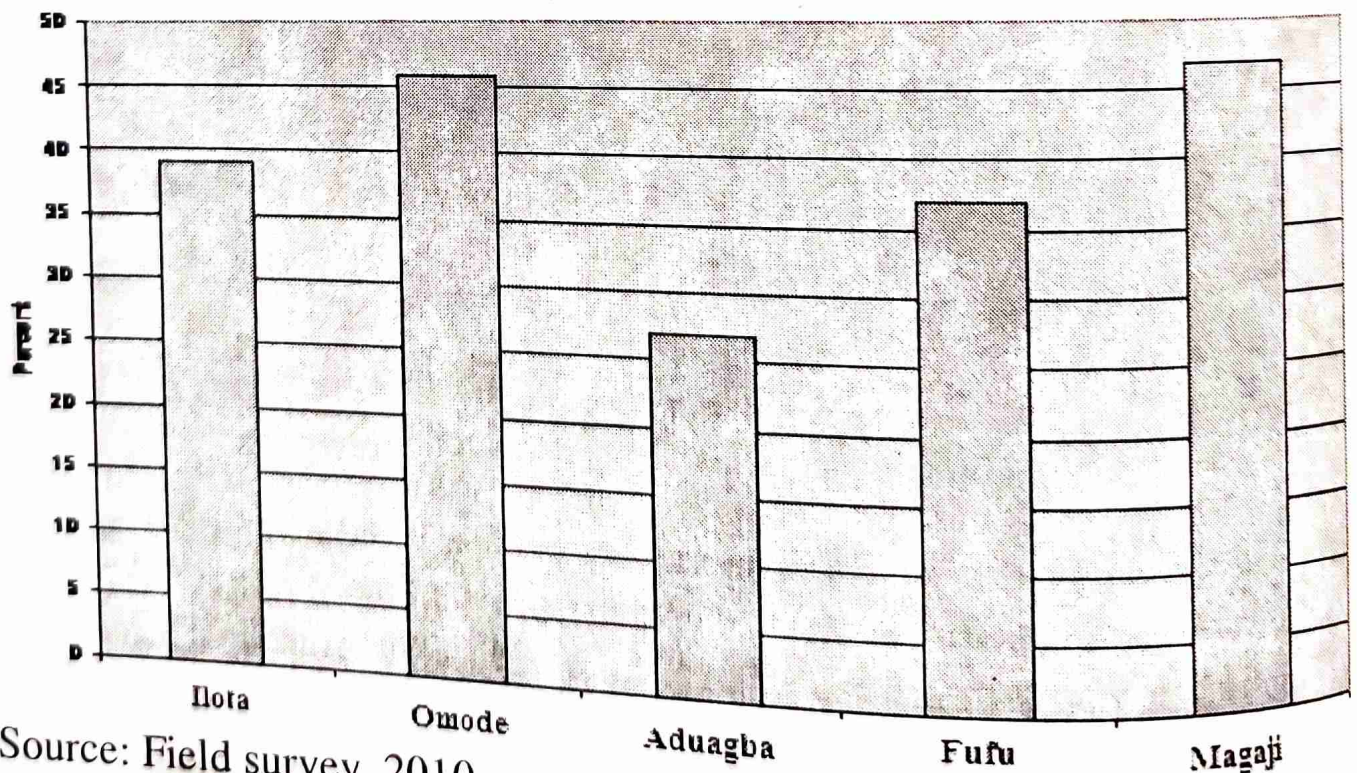
Determinants of Vulnerability	Vulnerability Indicators	Description of Indicators	Unit of Measurement	Expected functional relationship between Indicator and Vulnerability
Adaptive Capacity	Wealth	(a) Alternative source(s) of income (b) Ownership of household assets (c) Membership of cooperative society (d) Access to remittance (e) Ownership of personal means of transport. (f) Literacy.	(a) % of people with alternative source of income (b) % with at least one household asset. (c) % belonging to cooperative. (d) % with access to remittance. (e) % with personal transport. (f) % with at least primary education.	The higher the % of people with assets, with social safety-net and higher % with education the lower the vulnerability.
Sensitivity	Extreme Climate	Experience of extreme climate event (Drought, Flood and destructive wind) in the	% affected by extreme climate event in the last 10 years.	The higher the % of people affected the greater the vulnerability.

Exposure	Exposure to Climate effects	area. Experience of erosion on home of farm.	(a) % experiencing erosion. (b) % likely to experience erosion in the future.	The higher the % of affected people the greater the vulnerability.
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Source: Adapted from Deressa, Hassan and Ringler, 2008

Results and Discussion

A relative poverty line was derived for this study by first computing the mean income of the respondents which gave a figure of N104, 553 per annum. All those who earned less than 50% of the mean income (N52, 277 per annum) were regarded as poor. This shows that out of the total number of 235 respondents, the income of 92 falls below the poverty line. Thus, the headcount ratio is 39%, meaning that 39 percent of the respondents were poor. This is by far lower than the figure of 63.8% recorded for rural Nigeria by NBS (2007). In terms of spatial manifestation of poverty, Magaji village has the highest incidence of poverty with 47% of sampled population living in poverty. Omode is next with 46% poverty incidence. The lowest poverty incidence (27%) was recorded in Aduagba (Figure 2).



Source: Field survey, 2010

Figure 2: Poverty Incidence in sampled settlements.

The poverty gap which refers to the mean distance of the income of the poor from the poverty line was 31.2%. In monetary terms, this gives N16, 310 below the poverty line.

Climate change effects in the study area.

The people in the study area are mainly exposed to gradual climate change effects as against extreme climate events. There are no recorded cases of drought and large-scale flooding in the study area. Some respondents however, reported that they had experienced destruction from localized flooding and strong winds either on their homes or on their farms. This has resulted in damages to their houses and crops. On the other hand many people also reported experiencing serious erosion in either their homes or on their farms.

In terms of the effect of climate variability on farming activities, a total of 189 people or 80.4% reported that adverse climate has negatively affected their farm output. Falling within this group are all those who engage in farming as their main occupation and some others who farm to support their main occupation. Among the farming population in the area, increasing temperatures and unpredictable nature of the rainy season are believed to have the greatest effect on farming activities.

Various group discussions organized in the area confirmed that despite their low literacy levels, the rural dwellers have a lot of understanding about their natural environment. The people closely observe activities around them. For example, they use their knowledge about mating periods of various animals and flowering of some plants to determine changes in conditions and seasons. The group discussions exposed the fact that, the local people are aware of climate change. For instance, most of the participants in the discussions noted that the rains are no longer predictable and when they come they fall in torrents. Some observed that the month of June is no more characterized by heavy rainfall as in the past. Also, the "August break" never occurs in the month of August anymore. Specifically, in Magaji village, a resident explained that the excessive heat experienced these days, is the result of disappearance of what he referred to as the "Baaru" rain (in Yoruba language) that falls in December. According to their belief these rains are expected to usher in the harmattan season every year.

Vulnerability Profile in Ilorin South LGA

As stated earlier, the integrated approach has been adopted for this study. Both socio-economic data of the people and information on the effects of extreme climatic events are used for the study. The adaptive capacity in the study area is dependent on some chosen indicators as summarized in Table 2. Tables 3 and 4 show the indicators of sensitivity while, Tables 5 and 6 represents the indicators of exposure.

Table 2: Characteristics of the poor according to the indicators of adaptive capacity in the sampled settlements.

Settlements	% with Alternative income	% with household assets	% in Coop. society	% Receiving remittance	% with Personal transport	% with Formal education
Iloja	34.0 (37.27*)	46.5 (55.5)	14.0 (35.5)	53.5 (72.7)	27.9 (48)	32.6 (43)
Omode	37.5 (42.86)	56.2 (71.4)	12.5 (31.4)	43.8 (62.9)	25.0 (37.1)	12.5 (13)
Aduagba	37.5 (70.0)	100 (100)	0.0 (10.0)	75.0 (70.0)	10.0 (53.3)	37.5 (53.3)
Fufu	45.5 (56.66)	63.6 (76.7)	9.0 (30.0)	36.4 (53.3)	10.0 (50.0)	27.2 (46.7)
Magaji	28.6 (40.0)	50.0 (70.0)	0.0 (6.7)	43.0 (80.0)	6.7 (26.7)	0.0 (26.7)
Average	40.2 (45.1)	55.4 (68.0)	9.8 (27.2)	50.0 (69.4)	27.2 (43.3)	23.9 (40.0)

(*) All respondents (poor and non poor)

Source: Field survey, 2010

The proportion of the people with alternative source of income in the area is 45.1% (Table 2). Only 40.2% of the poor have other source(s) of income. Across the sampled settlements, Fufu have 45.5% of the poor with alternative source of income. The lowest figure is found in Magaji with just 28.6% of those in poverty with other source of income. Having an alternative source of income is expected to raise the adaptive capacity of an individual. Diversity of income sources allow people to be in a better position to cope, when exposed to shocks with negative consequences.

Table 2 further indicates that ownership of household assets is highest in Aduagba, with 100% of the respondents possessing at least one household asset. The assets considered include radio, television set,

generating set, electric fan and electric iron. All those designated as being poor in Aduagba also possess at least one of these assets. As indicated in Table 5, the lowest proportion of the poor with household assets (46.5%) is found in Ilota.

Cooperative society which is as a form of social capital is known to have great impact on individual's welfare. Membership is however very low in the area. As indicated in the table, only 64 respondents constituting 27.2% belong to cooperative societies. Considering the poor in the area, only 9.7% said they belong to cooperative societies. The highest figure for the poor is recorded in Ilota (14%) while, in Aduagba and magaji none of the poor belong to any cooperative society.

Access to remittance is very high in the study area. A total 163 or 69.4% of the respondents receive some money regularly from children and other relatives residing in other areas. Even among the poor, access to remittance can be said to be high at 50%. For instance, in Aduagba as high as 75% of the poor receive regular remittance from relatives. However, only 36% of those designated as being poor have access to remittance in Fufu.

Considering the ownership of personal means of transport in the study area, a total of 102 or 43.3% of the respondents own at least one means of transport. For the poor (those who earn less than 50% of the mean income level) only 27.2% own a means of transport. This low level of ownership of means of transport among the poor is understandable because of their very low income level. In terms of distribution among the settlements, Ilota has 27.9% of the poor respondents possessing at least a means of transportation. This is followed by Omode with 25% while, Magaji has only 6.7% of its poor population owing personal means of transport.

The proportion of sampled population in the area with formal education is 40%. Aduagba also has 37.2% of those below the poverty line having some formal education. However, none of those designated as being poor in Magaji village has any formal education. In terms of level of educational attainment 63 or 67% of those with formal education had only primary education.

A total of 33 respondents (14%) noted that they had experienced flooding within the last ten years. However, when only the poor are considered Table 3 shows that, 23.9% of them have experienced flooding in the past. Omode has 37.5% of those categorized as poor affected by flooding in the past. Magaji has the lowest proportion with 14.2% of the poor experiencing serious flooding within the last ten years.

Table 3: Respondents affected by flooding.

Both Poor and Non-poor

Poor only

Settlements	People affected by flooding	% of sample		Poor affected by flooding	% of poor
Ilota	13	11.8%		10	23.2
Omode	9	25.7%		6	37.5
Aduagba	3	10%		2	25.0
Fufu	6	20%		2	18.1
Magaji	2	6.7%		2	14.2
Total	33	14%		22	23.9

Source: Field survey, 2010.

A total of 46 respondents (19.6%) reported having personal experience of destruction from strong winds within the last decade (Table 4). Table 4 further shows that 20.6% of the poor respondents have been affected by strong winds in the past. Aduagba also recorded the highest figure with 37.5% of the poor experiencing damage to property from strong winds within the last ten years.

Table 4: Respondents affected by strong winds

Both Poor and Non-poor

Poor only

Settlements	People affected by strong winds	% of sample		Poor affected by strong winds	% of poor
Ilota	23	20.9		8	18.6
Omode	6	17.1		3	18.8
Aduaga	8	26.7		3	37.5
Fufu	6	20.0		2	18.1
Magaji	3	10.0		3	21.4
Total	46	19.6		19	20.6

Source: Field survey, 2010

It was also discovered that 151 people constituting 64.3% of the respondents are experiencing erosion on their farms or in their homes (Table 5). Considering only the poor, a total of 63 respondents or 68.5% are experiencing erosion on their landed property. The highest figure (72%) is found in Ilota where 31 of those below the poverty line are affected. On the other hand 62.5% of the poor in Aduagba are affected by erosion.

Table 5: Respondents affected by Erosion
Both Poor and Non-poor Poor only

Settlements	People affected by erosion	% of sample	Poor affected by erosion	% of poor
Ilota	72	65.4	31	72.0
Omode	21	60.0	10	62.5
Aduagba	19	63.3	5	62.5
Fufu	21	70.0	7	63.6
Magaji	18	60.0	10	71.4
Total	151	64.3	63	68.5

Source: Field survey, 2010

When asked if they believe they could be affected by erosion in the future, a total of 174 (74%) of the respondents agreed that they are at risk from erosion (Table 6). This implies that a great number of people will continue to be at risk from erosion. This can be attributed to the continuous destruction of the natural vegetation for farming activities and for gathering firewood in the study area. In terms of future exposure to erosion 79.3% of the poor believe that they are at risk from erosion in the future. This could be as a result of the fact that the poor are more likely to occupy the marginal areas within their communities (Omonona, 2009 and Gbadegesin, Olorunfemi and Raheem, 2010).

Table 6: People at risk from erosion
Both Poor and non-poor Poor only

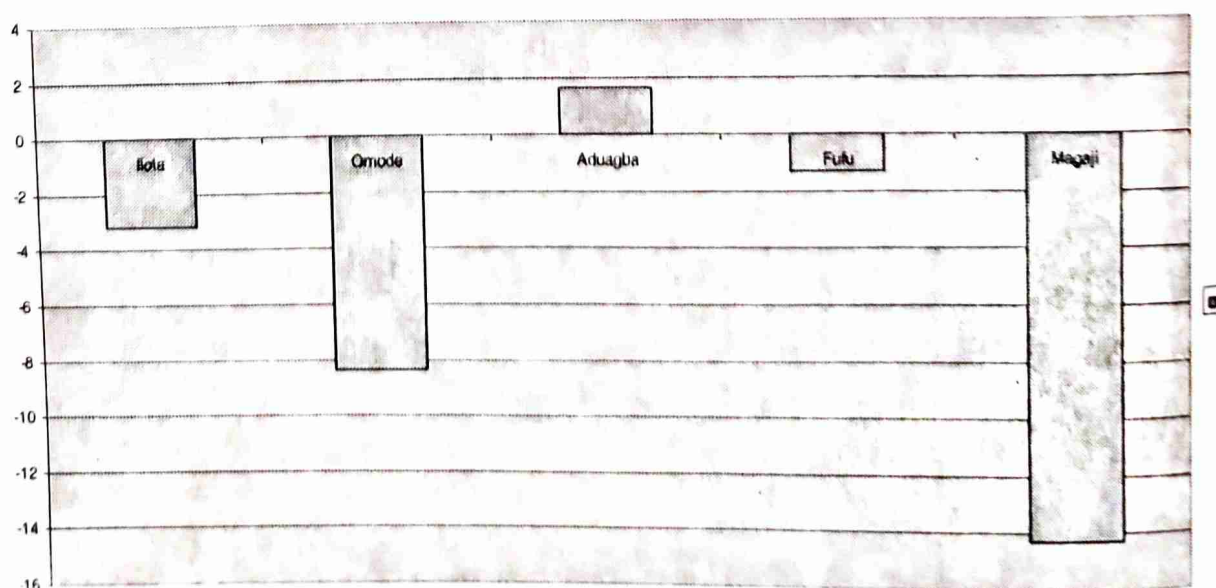
Settlements	Respondents at risk from erosion	% of all respondents	Poor at risk from erosion	% of poor
Ilota	79	71.8	34	79.0
Omode	24	68.6	13	81.3
Aduagba	22	73.3	6	75.0
Fufu	26	96.7	9	81.8
Magaji	23	76.7	11	78.6
Total	174	74.0	73	79.3

Source: Field survey, 2010

The data contained in tables 2 to 6 was used to construct vulnerability index for the area. For example, the vulnerability index for Ilota is calculated as follows;

$$\frac{34 + 46.5 + 14 + 53.5 + 27.9 + 32.6}{6} - \frac{23.2 + 18.6 + 72}{3} = -3.8$$

The same procedure was used to compute vulnerability indices of the poor for all the other sampled settlements. Figure 3 shows the vulnerability index of the poor for each of the sampled settlements. It could be seen that the net effect of adaptation, exposure and sensitivity is negative for Ilota, Omode, Fufu and Magaji but, it is positive for Aduagba. This indicates that while the poor in Aduagba are relatively vulnerable, those designated as being poor in the other settlements are highly vulnerable to the effects of climate change. Figure 5 further shows that, the poor residents of Magaji are the most vulnerable. The high vulnerability of the poor in Magaji is because; none of the poor have any formal education nor belong to any cooperative society. Furthermore, while the ownership of personal transport is very low, many of the poor in Magaji also experience erosion. Most of the poor in Ilota, Omode and Fufu also experience erosion, while a larger proportion of them face the risk of erosion in the future. Very high proportion of the poor in Ilota, Omode and Fufu are also uneducated and do not belong to cooperative societies. The relatively lower vulnerability in Aduagba is the result of very high level of asset ownership and high proportion of the poor receiving remittance from relatives. Aduagba also has a relatively higher proportion of people with formal education. This is in line with the findings of Olaniyan (2000) higher level of education attainment is associated with lower level of rural poverty in Nigeria.



Source: Field survey, 2010

Figure 3: Vulnerability indices of the poor in sampled villages in Ilorin South LGA
Adaptation strategies of the poor in Ilorin South LGA.

The analysis of adaptation in this study focuses on the adaptive response of the poor to climate change in the area. All the 92 respondents whose income fall below the relative poverty line (N52, 277/annum) agreed to have adopted one or more adaptation measures. The adaptation measures considered are grouped into those carried out at home and those used by the farmers. The adaptation strategies applied by the respondents at home include rainwater harvesting which is a traditional way of collecting water in barrels and pots placed under the roofs. Other measures include rationing of water, plastering the base of their mud buildings with cement, sand filling and opening up of drainage channels around their homes. For instance, according to table 7 all the poor respondents agreed that they harvest rainwater during the rainy season. A total of 71 or 77.2% of the poor also engage in rationing of water in order to reduce the water use in their households, especially during the dry season. Furthermore, 38% of the poor agreed that they have plastered the base of their buildings with cement in the past to prevent collapse from erosion. Sand filling around the buildings to prevent the foundations from being exposed is also common in the area. 57.6% of the poor use sand filling or placing of sand bags to control or reduce the effects of erosion. Clearing drainage channels to control flooding is a practice which 84 or 91.3 % of the respondents carry out, especially during periods of heavy rainfall.

The adaptation strategies employed on the farms are those that help the people guard against losses resulting from rising temperatures and unpredictable precipitation. Table 7 indicates that these poor farmers use a combination of various adaptation techniques. For instance, the farmers among the poor respondents plant different varieties of crops. This helps to reduce the risk of complete failure because climatic events have different effects on different crops. This supports the finding of Hassan and Nhemachena (2008) that African farmers employ adaptation strategies that help reduce losses from climatic variability. A total of 68 or 95.78% also plant different varieties of the same crop as security against failure of some varieties. While none of the respondents have changed completely from crop to livestock production, 32 or 45% combine cultivation with rearing of livestock. Livestock provide source of income during off season period and at times of crop failure. Most of the respondents (86%) also agreed that they use soil conservation techniques. Irrigation farming and shading and shelter are not very common among the poor in the study area.

Furthermore, none of the respondents has ever completely abandoned a piece of land and moved to a different site in the past. 7% of the farmers agreed that they had at one time or the other abandoned farming for other occupations in the past but, later returned to farming.

Table 7: Adaptation strategies used by poor farmers in Ilorin South LGA

Adaptation Measures	Frequency	%
Planting different crops	71	100
Planting different varieties of crop	68	95.78
Changing type of crop planted	62	87.3
Planting crop with short growing period	24	33.8
Combining crop with livestock	32	45
Changing from crop to livestock	0	0
Increase use of fertilizers, pesticides or Other chemicals	14	19.7
Use irrigation	6	8.5
Soil conservation	61	86.0
Shading and shelter	11	15.5
Change amount of land cultivated	26	36.6
Moved to different site	0	0
Farming to non-farming occupation	5	7.0
Prayer	71	100

Source: Field survey, 2010

Conclusion and Recommendations

This study examined the vulnerability and adaptive capabilities of the rural poor to climate change in Ilorin South LGA, Kwara State. Poverty profile and vulnerability indices were constructed and results compared among the five settlements selected for the study. The poverty profile for the area shows that poverty level in the area is low compared to the level of rural poverty in the country.

The integrated approach using both socio-economic and environmental factors was used to develop vulnerability indices for the poor in the area. The vulnerability was computed as the net effect of both sensitivity and exposure of the people on their adaptive capacity. It was discovered that the poor in Magaji are most vulnerable. The poor in Ilota, Omode and Fufu are also highly vulnerable, while those in Aduagba are relatively less vulnerable. The high vulnerability of the poor in Ilota,

Omode, Fufu and Magaji was attributed to the low level of education, high exposure to erosion and less access to social safety nets. The relatively less vulnerability of Aduagba resulted from high level of asset ownership, high level of access to remittance and relatively higher level of education.

It was further observed that no adaptation measure was carried out alone but, in combination with other adaptation techniques. The major adaptation measures employed by the poor are planting different types of crops, planting different varieties of the same crop, changing types of crops planted and soil conservation techniques.

Based on the findings of the study, it could be seen that vulnerability to climate change in the study area is closely related to poverty. Therefore, policies aimed at reducing vulnerability while increasing adaptive capacity needs to be pursued. Integrated rural development programmes focused at reducing poverty can be very useful for reducing vulnerability and promoting adaptive capabilities to climate change.

Improving access to credit, investment in irrigation facilities and provision of other infrastructural facilities are also very important. For example, improved rural road provision will ensure access to markets and enhance adoption of farm level adaptation techniques. Better rural roads will allow rural dwellers to easily obtain new crop varieties and other necessary inputs required to adapt to climate change.

There is also the need to embark on enlightenment programmes to educate the people on climate change in order to improve understanding of its impacts. This will help to build people's confidence to acquire new knowledge and skills to improve their ability to adapt to climate change.

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