Perception of climate change effects on forest-dependent rural livelihoods in Ondo State, Nigeria

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ABSTRACT

Rural population is the highest in developing countries with pathetic living condition and lack of resources to cope with ecological perturbations apart from not having social opportunities to cushion the impacts of extreme events. This paper reports the impacts of climate change on the livelihoods of forest dependent rural populations in Ondo State, a forest rich southwestern part of Nigeria, with the view to identifying possible adaptation strategies. Stratified multistage simple random sampling was used in selecting respondents for the study. The state was stratified into Local Government Areas (LGAs) and Four (4). Odigbo, Akure North, Owo and Idanre were randomly selected. In each of the LGAs selected, one forest reserve each (Oluwa, Ala, Owo and Idanre, respectively) was selected. Three rural communities surrounding each of the forest reserve were then selected as study site while 30 households were randomly selected for interview. Primary data were collected from the selected households in the selected communities using a set of structured and open-ended questionnaire. Data were analysed using descriptive and inferential statistics at $\alpha_{0.05}$. Generally, more (62.2%) respondents noticed changes in rainfall pattern, which led to flooding in 2014, while 37.2% noticed increase temperature, which led to the drought of 2007. On availability of forest resources, majority (78.6%) of the respondents noticed changes in the availability of Mansonia, while 12.0%, 8.0%, 5.5% and 4.7% attested to changes in the availability of *Terminalia superba, Gmelina, Tectona grandis* (Teak) and *Obeche*, respectively. Similarly, 78.0% of the respondents noticed changes in availability of firewood, while changes in the availability of seeds, fruits and mushrooms were attested to by 15.0%, 4.7%, and 1.4% of the respondents, respectively. Identified impacts of climate change by the respondents included among others reduction in agricultural production, flooding, increased livestock death and shortage of food. Suggested mechanisms for coping with climate change adversities included changing of the planting date, practice of agroforestry, planting of trees and early harvesting regime. Climate change was found to impact agricultural and rural land use in the study area. Therefore, the adoption of agroforestry practices as rural land use is recommended in Ondo State as an adaptation measure against climate change.

Keywords: Climate change impact, Forest-based livelihood, Rural income, Adaptation to climate change

INTRODUCTION

Climate change is used to describe a systematic change in the key dimensions of climate –including average temperature, wind and rainfall patterns over a longer period of time (Paavola, 2008). Climate can change over a period of time ranging from months to thousands or millions of years, however, the classical time period was put at 30 years by Paavola (2008). Climate change was observed by Chomitz *et. al.* (2006) as an important threat to global environmental, social and economic activities. The Intergovernmental Panel on Climate Change (IPCC, 2007a) considered climate change to be one of the major threats to sustainable development because of its effects on health, infrastructure, agriculture and food security, and forest ecosystem. Parmesan and Yohe (2003), Parmesan (2007) and Somorin (2010) reposed climate change has having significant impacts on the forests provision of vital ecosystem services and on the well-being of people living in forest areas. About 60 million local communities around the globe are estimated to depend on forests (World Bank, 2008).

Livelihoods are the sum of ways in which people make a living. In most communities in low- income countries, poor families balance a set of food and income earning activities using forest products (Carney, 1998). Thus, rural poor people tend to suffer more than others when extreme events like floods, tropical storms and land slides occur. This happens for three reasons: first, the rural poor live in areas and shelters that are more susceptible to these extreme events; second, they do not have the resources to cope with these events; and third, the poor in developing countries cannot depend on social opportunities like safety nets to cushion the impacts of extreme events (Sen, 1999).

Therefore, the forest is vital to man's existence because of the many ecological and economic

functions it performs. It assists in the global cycling of water, oxygen, carbon and nitrogen and lend stability to hydrological system. It ensures a regular supply of fresh water, prevents flood, soil erosion and siltation of river beds down stream. It also assists in improving air quality, stabilizes global climate condition and protects the soil (Sharma *et al*.1992). It supplies many products in form of wood (basic material for construction, furniture, paper etc.) and non wood items (extractions, bark, dye, fibre, gum, incense, latexes, oils, resins, waxes, shellac, tanning compounds), food, bush meat, flowers, fruits, honey, nuts, leaves, seeds, spices etc. as well as decorative, ceremonial and medicinal items.

The forest plays vital roles as raw material provider for furniture, paper, food and health industries (Sharma *et. al.* 1992). According to the World Bank (2001) globally more than 1.6 billion people depend on forest for their livelihoods at varying degrees. About 60 million indigenous people are almost wholly dependent on forest. Some 350 million people who live within or adjacent to dense forests depend on them to a higher degree for subsistence and income. Many rural communities in Africa depend on medicinal plants from the forest for their primary health care delivery.

Understanding the impacts of climate change on forest-dependent rural livelihood will inform sustainable forest management planning.There is need to understand climate change impacts and the implications on forest dependent rural livelihoods. This paper aims at investigating the impacts of climate change on livelihoods of the respondents with the view to identifying possible adaptation strategies.

METHODOLOGY

Study area

This study were carried out in Ondo State, Nigeria. The State is located in southwestern part and lies within latitude $7^{o}18'$N and longitude $5^{o}02'$E. It covers an area of over 15,595 square kilometers. The climate of the state is tropical with two distinct seasons viz: the dry and rainy seasons. The rainy season commences in March and ends in October with a peak in July/ August while the dry season occurs between October and March. Up to 2000mm of rainfall may be experienced in the coastal areas of the south, which diminishing to 1500mm in the hinterland. The temperature varies from 21^{o}C to 29^{o}C throughout the year with an average value of 25^{o}C. The State has 17 Forest Reserves covering over 3,07566km^2 stratified into: 2,834.68 high forests, 194.76Km^2 savannah and 46.22Km^2 mangrove/fresh water swamp.

Sampling procedure

Stratified, multistage random sampling procedure was used for this study. Ondo State was stratified into Local Government Areas (LGAs). Four LGAs were first randomly selected viz: Odigbo, Akure North, Owo and Idanre. In each of the LGAs, one Forest Reserve was then selected for this study. In Odigbo LGA, Oluwa Forest Reserve was selected. In Akure North, Ala Forest Reserve was selected. In Owo LGA, Owo Forest Reserve was selected while Idanre, Forest Reserve was selected in Idanre LGA. From each Forest Reserve, three rural communities surrounding the Forest Reserve were randomly selected for the study, thus, twelve communities were used for this study from which thirty households each were randomly selected. Finally, thirty (30) respondents were randomly selected for interviews from the selected households in each community. Ninety respondents' were randomly selected for sampling in each LGA making a total of three hundred and sixty (360) respondents.

Primary data were collected from the households in the rural community in the study locations using socioeconomic survey. This was done through personal interviews guided by a set of structured questionnaire for each respondent. Also, a 7 man Focus Group Discussions (FGD) involving opinion leaders was held in each community to further collect relevant qualitative information on the subject matter. The socioeconomic data generated were subjected to descriptive statistical analysis.

RESULTS AND DISCUSSION

Awareness of respondents about climate change

The study (Table 1) found that found that more of the respondents identified with flood (62.2%) compared to drought (37.2%) as offshoots of climate change in the study area. However, flood was perceived to be more noticed in Idanre (74.4%) than in any other sites while Akure North was perceived to be the most hit by drought (45.6%) compared to other parts of the study area. On the sources awareness about the climate change phenomenon, majority of the respondents' was informed about climate change through radio (Fig. 1). Adekunle *et al*. (2011) had earlier reported the use of radio as the first external sources of awareness about climate change in his study area. The study of Azeez and Okafor (2013) in rural southeastern Nigeria also reposed this finding. Also, more (62.2%) respondents noticed the changes

in rainfall pattern, which led to the 2004 flooding while only 37.2% noticed the temperature increase which culminated in the 2007 drought (Table 1). This showed that though indices of climate change were available in their communities, not all respondents were aware or noticed them. Somorin (2010) reported similar climatic scenario in the Republic of Congo, particularly in coaster regions, which he affirmed implied a change in the structure and functioning of the forest ecosystems. According to Nyong (2005) droughts and floods are already common occurrences, with some countries experiencing both within a year. In her third assessment report, IPCC (2001) also reported Africa as the most vulnerable region to climate change, due to the extreme poverty of many Africans, frequent disasters such as droughts and floods and her agricultural systems heavily dependent on rainfall.

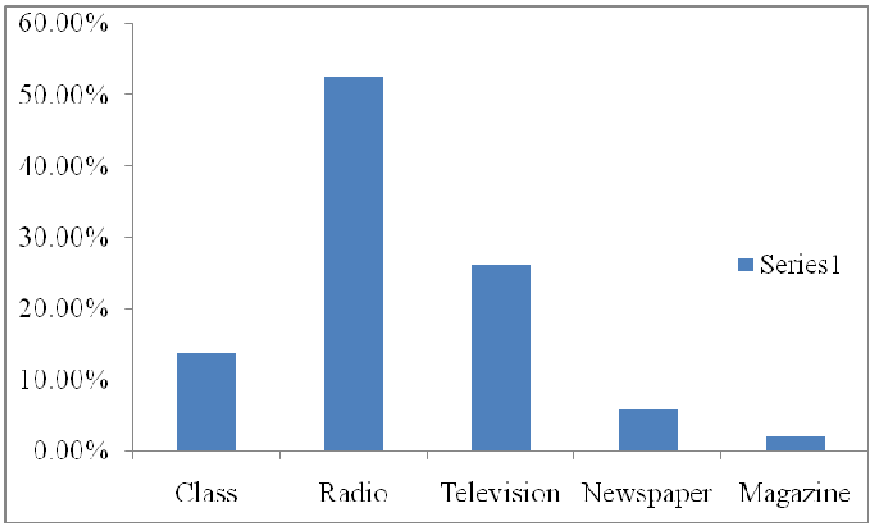

Figure 1: Distribution of Respondents' Sources of Awareness about Climate Change

Table 1: Frequency distribution of respondents' identification with notable climate change events

Identified Events	Odigbo		Akure North		Owo		Idanre		Mean	Mode
	Freq	%	Freq	%	Freq	%	Freq	%	%	
Drought (2007)	39	43.3	41	45.6	13	34.4	23	25.6	37.2	Akure
Flood (2014)	51	56.7	49	54.4	59	65.6	67	74.4	62.2	Idanre
Total	**90**	**100**	**90**	**100**	**90**	**100**	**90**	**100**	**100**	

Income generating activities of respondents'

Results from the study ranked farming as most popular income generating activity in the study sites (Figure 2). This is followed by trading, processing of produce, transport business, hired labourer, livestock rearing, gathering of NTFPs, artisan works and hunting. This result showed that farming is the major occupation in all the communities and that most of the communities depended on forest resources for their livelihoods.

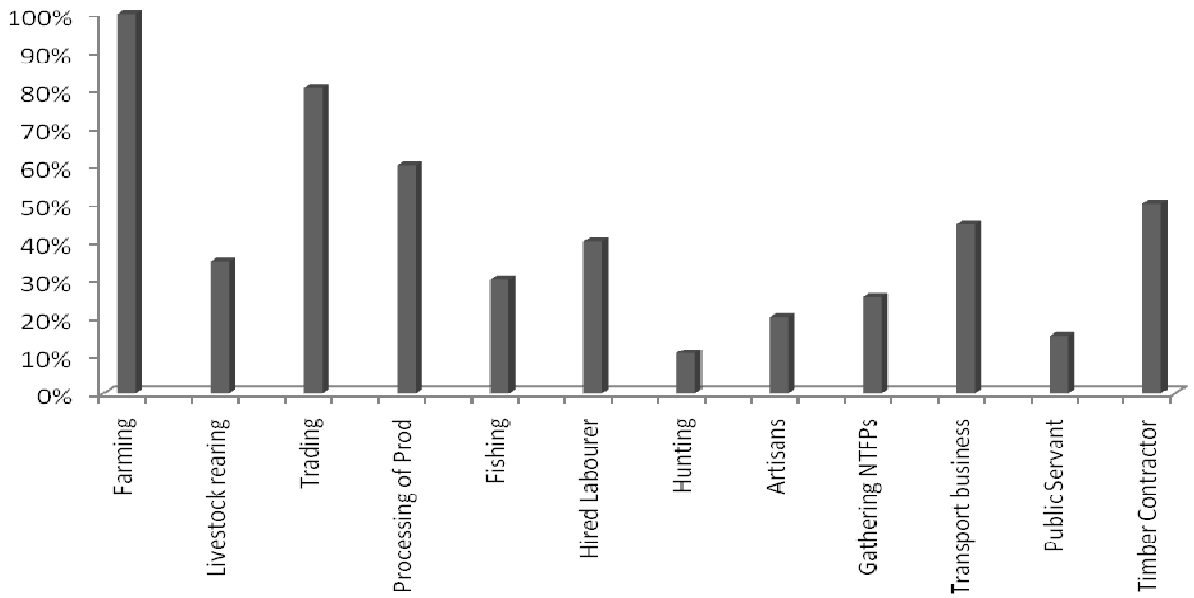

Figure 2: Frequency distribution of respondents' livelihood activities

Hunting was the least income generating activity in all the communities; this may be adduced to prevalence of Ebola outbreak news as at the time of carrying out this study, which compel most people to avoid eating bush meat or associating with related activities. Even the hunters could not eat bush meat because of the Ebola outbreak. This may be why the result was not in agreement with Adekunle *et al*. (2011) findings, which did not rate hunting as the least income generating activity in the same study area.

Impacts of climate change on respondents' income, health and food intake

Idanre recorded the highest number of respondents (13.3%) with the lowest annual income of between ₦12000.0 and ₦60000.0 from their primary livelihood sources (Table 2). The highest annual income of between ₦36000.0 and ₦420000.0 was recorded among respondents from Akure North (2.2%) and those in Owo (2.2%). Majority of the respondents' in all the studied sites (Odigbo, Idanre and Owo LGAs) had annual income of between ₦18 1,000 - ₦240,000 from their primary sources of livelihood. This is in agreement with Adekunle *et al*. (2011) who reported an average annual income of ₦378,758.83 in their study area is. He further reported that they are still within the ambit of poverty line which has a lot of implication on their standard of living with the increasing problem of climate change. From FGDs in this study, it was gathered that climate change has caused land degradation and by extension reduction in farm outputs, which also reduced their income. This was reposed by the findings of Paudel *et. al*. (2011) that decreases in land productivity can be attributed to climate vagaries in their study area. Invariably, many of the respondents' in this study are living below poverty line, since poor land productivity will negatively impact livelihoods output.

According to World Bank (2001) poverty is a colossal challenge to 2.8 billion of the worlds' population and 6 billion people are living on less than $2 a day. Some of the respondents were not able to meet their basic food and non-food needs because of low income. Skoufias *et. al*. (2011 and 2011a) also expressed concern about climate change slowing down or possibly reversing the progress on poverty reduction.

Table 2: Frequency distribution of respondents' annual income from primary occupation

Income (₦ '000)	Odigbo		Akure North		Owo		Idanre		Mode
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
12 – 60	4	4.4	3	3.3	2	2.2	12	13.3	Idanre
>60 – 120	27	30.0	15	16.7	13	14.4	18	20.0	Odigbo

Income (₦ '000)	Odigbo Freq.	%	Akure North Freq.	%	Owo Freq.	%	Idanre Freq.	%	Mode
>120 – 180	6	6.7	10	11.1	4	4.4	22	24.4	Idanre
>180 – 240	29	32.2	18	20.0	33	36.7	22	24.4	Owo
>240 – 300	8	8.9	15	16.7	11	12.2	15	16.7	Akure/Owo
>300 – 360	16	17.8	25	27.8	22	24.4	0	0.0	Akure
>360 – 420	0	0.0	2	2.2	2	2.2	0	0.0	Akure/Owo
Nill	0	0.0	1	1.1	3	3.3	1	1.1	Owo
Total	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	

Data on respondents' annual income from other sources (Table 3), shows that majority of those making more than ₦120000.0 were from Owo (38.9%) while Akure North house majority of those earning between ₦12000 and ₦60000/annum (91.1%) in the study area. Thus, annual income of respondents' from other sources was between ₦12000 and ₦60000 from this study. Implicitly, most of this annual income is from the sales of Non Timber Forest Products, which is in agreement with the submission of Vedeld *et al*. (2004) that a higher proportion of the total income of forest dependent respondents' comes from forest resources. Most rural poor people maintain diversified livelihood strategies because they cannot obtain sufficient income from any single strategy to survive and also to reduce risks. This is why most farmers include forest products in their livelihood systems. And this had exposed them to climate risks. Reports from FGDs revealed that respondents use to earn more from their land before the advent of climate change. In their study, Paudel *et. al*. (2011) also linked decrease in forest products availability over time to climate change and over exploitation.

Table 3: Distribution of respondents by annual income from other sources

Income (₦'000)	Odigbo Freq.	%	Akure North Freq.	%	Owo Freq.	%	Idanre Freq.	%	Mode
12 – 60	73	81.1	82	91.1	36	40	66	73.3	Akure
>60 – 120	15	16.7	7	7.8	13	14.4	24	26.7	Idanre
>120 – 180	0	0	0	0	35	38.9	0	0	Owo
Nill	2	2.2	1	1.1	6	6.7	0	0	Owo
Total	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	

Respondents' annual income spent on house health

Spending of respondents on household health was analysed and the results (Table 4) reveal that modal spending on health was from Idanre respondents who spent more than ₦120000 but not more than ₦180000 annually in this direction. The lowest spending in the area of household health was recorded in Owo (31.1%), which was between ₦12000 and ₦60000. Also, Akure North was observed to record the modal spending of between >₦60000 and ₦120000 on household health. In summary, annual income spent on household health in the study area was between ₦61,000- ₦120,000.

By implication, more than half of the respondents' annual income from their major occupation was spent on household health. Basu and Ostro (2009) were of the opinion that the rural poor are the most reliant on environmental goods and services and therefore the most vulnerable to climate change health risks. The least spending on household was recorded in Owo LGA. This might be adduced to the less severe impact of climate change in the LGA.

Table 4: Frequency distribution of respondents by annual spending on household health

Spending (₦'000)	Odigbo		Akure North		Owo		Idanre		Mode
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
12 – 60	41	45.6	30	33.3	60	66.7	28	31.1	Owo
>60 – 120	46	51.1	57	63.3	22	24.1	56	62.2	Akure
>120 – 180	3	3.3	3	3.3	8	8.9	6	6.7	Idanre
Total	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	

Respondents' annual income spent on children education

Modal spending on children education was observed by this study (Table 5) to be between ₦360000 and ₦420000 by 10.0% of the respondents' in Akure North. Respondents from Idanre recorded the modal lowest spending (₦12000 – ₦120000) on children education in the study area. Owo was observed to record the modal spending (42.2%) in the range of ₦120000 and ₦180000. Respondents from Odigbo also recorded the modal spending of between ₦180000 and ₦360000 on children education (Table 5). The study revealed the spending of between ₦301,000- ₦360,000 on children education in Odigbo and Akure North LGAs. This is more than the annual income of most respondents' from their primary occupation. Excerpts from FGDs revealed that they supplement their income with the income from the sales of forest products.

Income from the sales of forest products, such as woods, medicinal herbs, gums, latex, resins and spices was observed by Byron and Arnold (1999) as providing financial capital, which can be used either as working capital for trading activities or to educate children. These forest resources was however reported to have reduced due to climate change and by extension less is spent by the farmers on their children education with majority resulting to borrowing money to pay for their children education.

Climate change has both direct and indirect negative impacts on the general well-being of people. Livelihoods of rural communities are likely to suffer most as they are highly exposed to climate extremes such as severe droughts and floods and their consequences on the one hand, and have limited capacity to respond to such impacts on the other (Dahal *et al.* 2009). Dube and Phiri (2013) also reposed this from their study, which reported 98% of their respondents affirming the negative effect of climate change on their crop yield. The report submitted that crops wilted due to inadequate rainfall and rising temperatures. Decline in food production they observed will lead to increased malnutrition and severe consequences, particularly for children (Dube and Phiri, 2013). Ninan *et. a*l. (2012) was of the opinion that the climate sensitivity of an agriculture practice will likely affect food production, which in turn will impact on poverty and livelihoods. This was also the view of Nhemachena *et al*. (2010) who observed that climate change has economic impacts on crop and livestock farming system. Lecocq and Shalizi (2007) also stated that the ultimate damages of climate change may significantly affect economic growth. Haminton *et al.* (2005) also highlighted a number of other illustrative impacts that climate variability and change have on livelihoods and food access, many of which also impact on food availability and nutrient access aspects of food security. These impacts affect food security through altering or restraining livelihood strategies, while also affecting the variety of food available and nutritional intake.

According to Muller-Kuckelber (2013), one of the most pertinent issues of climate change in regards to human development is reduced agricultural productivity. This reduction in agricultural production is the consequences of increase in the infestation of pests and diseases. A change in climate may bring about the introduction of new crop pests and diseases. Crop pests and diseases are greatly influenced in their incidence, spread and distribution by climate especially temperature, moisture and relative humidity. They often damage the health of forests and crops in a relatively short period, which requires a high level of preparedness to cope.

Table 5: Frequency distribution of respondents' annual spending on children education

Spending (₦ '000)	Odigbo		Akure North		Owo		Idanre		Mode
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	
12 – 60	1	1.1	1	1.1	3	3.3	46	51.1	Idanre
>60 – 120	0	0.0	6	6.6	46	51.1	38	42.2	Idanre
>120 – 180	13	14.4	16	17.8	38	42.2	2	2.2	Owo
>180 – 240	24	26.7	16	17.8	3	3.3	0	0.0	Odigbo

Spending (₦ '000)	Odigbo Freq.	%	Akure North Freq.	%	Owo Freq.	%	Idanre Freq.	%	Mode
>240 – 300	15	16.7	8	8.9	0	0.0	0	0.0	Odigbo
>300 – 360	24	26.7	17	18.9	0	0.0	0	0.0	Odigbo
>360 – 420	5	5.6	9	10.0	0	0.0	0	0.0	Akure
Nill	8	8.9	17	18.9	3	3.3	4	4.4	Akure
Total	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	**90**	**100.0**	

Perception of effects of climate change on the availability of forest resources

Assessment of respondents' perception of forest products availability in the study area (Table 6) revealed that among the identified tree resources, *Mansonia altisima* was the commonest (78.6%) while on NTFPs, firewood rated highest (78.9%). Also worthy of note is that forest tree resources are more abundant in Idanre and Odigbo while the NTFPs are more prevalent in Owo and Odigbo. Invariably, Odigbo holds the highest retinue of forest resources in the study area.

Generally, 78.6% of the respondents noticed changes in the availability of *Mansonia altisima*, 12.0% noticed changes in availability of *Terminalia superb,* 8.0% noticed changes in the availability of *Gmelina arborea*, 5.5% noticed changes in the availability of *Tectona grandis* while 4.7% observed changes in availability of Obeche (Table 4). The respondents were of the opinion that climate change reduced availability of timbers in the forest. This confirms Dube and Phiri (2013) findings that big trees were disappearing due to deforestation. Discussions with opinion leaders also reveal that increase in temperature may dehydrate some timbers and by extension limit their usefulness even though they may not go into extinction. This agrees with Sacramento *et. al*. (2013) findings in Chicualacuala District, Gaza Province, in Mozambique, where high temperature and changing rainfall patterns were observed to likely affect tree growth and their availability. Specifically, they found that fruit trees like Massala (*Strychns spinosa*) and Macuacua (*Strychnos madagasearienses*) got dry due to extreme heat in the District. Also, Majule (2010) reported that timber is likely to remain relatively unchanging except where there is decrease in rainfall. From this study, 78.9% of the respondents noticed changes in availability of firewood while 15.0%, 4.7% and 1.4% observed changes in availability of seeds, fruits and mushroom, respectively (Table 1). This is not too far from a similar study by Majule (2010) who reported fuel wood decrease as a result of reduced rainfall and predicted likely fuel wood increase when rain increases. Majule (2010) further stated that availability of natural resources is commensurable with climate change, over use, land transformation and population growth. The decrease of these forest products had created a negative impact on the livelihood of the forest dependent communities.

Perception of the effects of climate change on forest dependents rural livelihoods

Examining respondents' perception of the impact of climate change on their livelihood, the study (Table 7) found that shortage of food (44.7%) was the most popular impact and was more rampant among Odigbo respondents (57.8%). Closely following food shortage impact was perceived low income (26.6%), which was more noticed by Akure North respondents' (35.5%). Identified perceived effects of climate change on forest fringe livelihoods (Table 7) were ascribed mainly to changes in rainfall patterns and increase in temperature as garnered from focus group discussions with some respondents. This ascription agrees with Dube and Phiri (2013) findings in Zimbabwe where farming was observed to be largely dependent on rainfall patterns. Any negative changes in the rainfall patterns are therefore likely to negatively impact rural livelihoods. Armah *et al*. (2010) reposed this when they reported flood as simultaneously triggering reduction in food production and by extension a reduction in household income, which ranked second among identified effect of climate change on livelihoods in the study area (Table 7).

Armah *et al*. (*Op. cit.*) further reported that floods may affect seed supply either through affecting crop production (on farms) or by destroying seed stores (in homes). Either way, the lack of seeds for subsequent planting could have a negative multiplier effect on food production. Increase temperature could reduce global food supplies and contribute to higher food prices (IPCC, 2007). This further confirms Iglesias *et al.* (2009) who reported that when the optimal range of temperature values for a crop in a particular region is exceeded, crops tend to respond negatively, resulting in a drop in yield.

The shortage of food might also be due to shortage of water, which the respondents (7.5%) ranked as the third impact of climate change on their livelihoods.

The respondents mentioned that due to decreased rainfall; the water table has been lowered resulting in water scarcity for irrigation. This agrees with Acharya (2011) findings from Nepal's agriculture sector, which was seriously affected by climate change. The study reported an abysmal low income for farmers who are the most affected by the severe water stresses linked to decreased supply and increased demand of water from irrigation channels.

The shortage of food might also be due to flooding, another important impact of climate change on respondents livelihoods (Table 7). Floods are likely to have dramatic impact on food production system. Increasing rainfall patterns can lead to floods erosion and also increased weed infestation. Floods and changes in rainfall pattern had drastically decreased yield and production. This is similar to the statement of Armah *et al*. (2010) during the months of August and early September 2007, heavy rainfall led to severe flooding in Northern Ghana resulting in the loss of lives, displacement of vulnerable persons and the destruction of key infrastructure, food stocks and livestock throughout the region.

Flood was also observed to damage road and causes soil erosion by the same study. This observation was in line with the work of Shrestha *et al*. (2014), which reported floods as often destroying the local village roads and bridges every year thereby making transportation difficult during the whole monsoon season. Walthall *et al* (2012) also reposed heavy rainfall as causing flooding in their study area as warmer temperatures speed up the water cycle. This eventually will lead to increase in transportation cost as observed in Ondo State (Table 7). Platteau (2000) was of the opinion that availability and access to transport infrastructure influences access to markets.

Increase temperature is expected to aggravate drought and by extension the death of livestock (Table 7), which as observed by the respondents also impacts forest fringe livelihood. Somorin (2010) was of the same opinion when he submitted that climate variability and extreme events like drought will affect the grazing of natural rangelands, resulting in stock mortalities. He further reported that climate change will also have impacts on livestock in Africa; higher temperatures are good for small farm animals like goat and sheep because they are heat tolerant, but by contrast, large farm animals like cattle are not heat tolerant. Heat stress and drought have a negative impact on animal health, dairy and meat production as well as livestock production. This also confirms Walthall *et al* (2012) findings that an animal's ability to adjust its metabolic rate to cope with temperature extremes can lead to reduced productivity and in extreme cases death. Prolonged exposure to extreme temperatures will also further increase production costs and productivity losses associated with all animal products, e.g. meat, eggs and milk.

Table 7: Frequency distribution of respondents' perception of climate change impacts on their livelihoods

Identified Impacts	Odigbo		Akure North		Owo		Idanre			
	Freq	%	Freq	%	Freq	%	Freq	%	**Mean**	**Mode**
Flooding	5	5.6	1	1.1	4	4.4	6	6.7	4.5	Idanre
Death of livestock	1	1.1	6	6.7	7	7.8	10	11.1	6.7	Owo
Shortage of food	52	57.8	40	44.4	39	43.4	30	33.3	44.7	Odigbo
Increased transportation cost	6	6.7	2	2.2	2	2.2	9	10.0	5.3	Idanre
Shortage of water	2	2.2	7	7.8	11	12.2	7	7.8	7.5	Owo
Bad road	3	3.3	2	2.2	5	5.6	7	7.8	4.7	Idanre
Low income	21	23.3	32	35.5	22	24.4	21	23.3	26.6	Akure
Total	90	100	90	100	90	100	90	100	100	

Identified adaptation measures to negative impact of climate change

On identified measures for adapting to climate change impact among respondents (Figure 3), the study found that planting of trees was the most popular suggestion, most especially in Owo site (50.1%). This agrees with Ofuoku (2011) findings in Delta State, Nigeria where rural farmers adopted planting of trees as climate change adaptation measure.

Also, worthy of note is the suggested change in planting dates to meet the climate change agenda, which was mostly aired by respondents from Odigbo followed closely by those from Akure North site. The study of Adekunle *et al*. (2011) made similar findings in their study area where respondents choose different planting date as adaptive measures. In their own study Agwu *et al*. (2011) found that 38% of farmers in West Africa change their planting dates in response to changes in rainfall patterns due to climate change. Akure North had the highest respondents

(25.6%) that adopted agro forestry practice as the adaptation measures.

This was the adaptation measure that stood out in the study of Onyekuru *et al*. (2014) as farmers' adaptation choice to climate change menace. Idanre had the highest respondents (23.3%) that adopted harvesting early as the adaptation measures; a measure not considered at all by respondents from Owo.

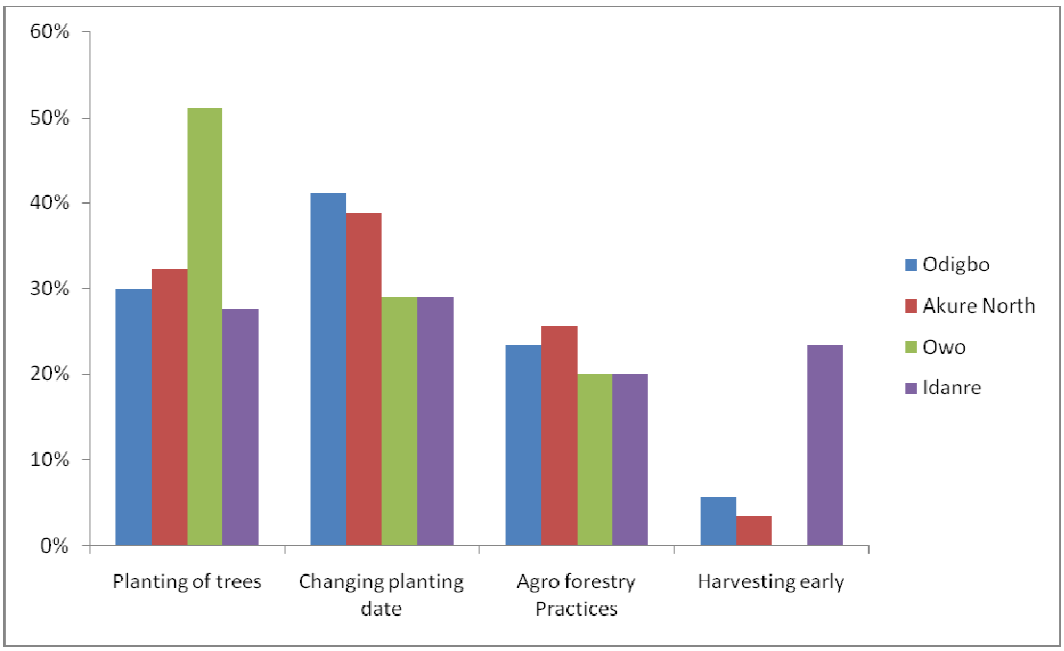

Figure 3: Distribution of measures adopted by respondents in adapting to climate change

CONCLUSION AND RECOMMENDATIONS

Majority of the respondents were aware of the climate change and the adverse impacts of climate change on their livelihoods. Climate change not only affects forest resources availability, it also negatively impact the mainstay of the rural forest fringe communities livelihood, which is mostly farming.

By extension it affects the livelihood outcomes of respondents and puts their lives at risk. Adaptation measures have been identified by the communities for sustaining their production systems, which is expected to be taken serious by policy makers in the state concerned and the Nigeria state as a whole. Among the adaptation measures adopted by the respondents, choosing different planting date is the dominant. This goes beyond relying on indigenous ways of doing things, which is likely to take time. The practice of agroforestry, planting of trees on farmlands and harvesting early are other identified mitigating measures.

It is therefore suggested and recommended that agro forestry practices should be adopted by all farmers in Ondo State as an adaptation measure against climate change. It ensures socioeconomic development and boosts food security and eradicates poverty. It is also imperative that government step up awareness program on climate change with the view to better informing respondents' about the implications of some of their innocent farming activities, which negatively impact the forest ecology and by extension their livelihoods. In the interim, government is expected to invest in meteorological gadgets, which will aid the prediction of weather. This is with the view to better inform rural farmers on appropriate planting periods using well organised extension organisations and or media most appropriate to deserving communities.

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