Journal of Agriculture and Environment for International Development - JAEID 2014, 108 (2):153 - 166
DOI: 10.12895/jaeid.20142.217

Rural perception to the effects of climate change in Otukpo, Nigeria

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Submitted on 2014, 25 March, accepted on 2014, 5 November. Section: Research Paper

Abstract: The study has further examined rural perception to the effects of climate change. The study used rural settlements in Otukpo, Nigeria as a case study. Primary and secondary data were utilised for the study. Data collection was done through the use of a questionnaire with open-ended questions and questions with multiple answers. A total of 100 questionnaires were randomly distributed among household heads in 10 settlements selected from 58 rural settlements for the study. Spatial distribution of the rural settlements were analysed using the nearest neighbour statistical analysis while descriptive statistics such as graphs and tables were used to present data. Rural settlements in Otukpo are randomly distributed and may be tending towards clustering. This is indicated by an Rn index value of 0.96 from the nearest neighbour analysis. Most of the settlements (59 %) have a distance of two to three kilometres between them. There is an inadequacy of functional facilities and poor access to services in the rural settlements in Otukpo. Respondents in rural settlements in Otukpo are faced with the risk of agricultural occupational loss (22 %), water shortages (42 %), flooding (29 %), land based conflicts (16 %), health hazards (12 %), erosion (26 %), and migration (57 %). With evidence of climate change ascertained globally including Nigeria, the study concludes that rural settlements in Otukpo and elsewhere are vulnerable to the effects of climate change which is evident in literature. Government should plan appropriately to optimize standard of living and provide basic functional facilities and services for rural settlements.

Keywords: rural settlements, climate change, developing countries, Nigeria.

Introduction

Nigeria has a long history of changing weather and environmental conditions because of its many climatic zones, ranging from the long coastal zone in the south and large arid area in the north. Historical climatic records between 1971 and 2000

show a trend in rising temperature in Nigeria. The positive trend, which is statistically significant at 95 % confidence level, is approximately 0.014 °C per year for maximum temperature and 0.025 °C per year for minimum temperature. In total, over the thirty year period studied, the maximum and minimum temperatures have increased by 0.4 °C and 0.8 °C respectively. In addition, the incidence of heat waves has increased by more than 20 days over the period (Abiodun *et al.*, 2011).

Climate change research scholars usually assess human socio-economic processes alongside biophysical process (Smit and Skinner, 2002; Leichenko and O'Brien, 2002; Fraser *et al.*, 2003). This is because climate change studies recognize that vulnerabilities are usually associated with specific types of climatic risks and particular locations and time periods. The vulnerability of settlements is assessed based on exposure to extreme climate conditions and adaptive capacity to reoccurring extreme conditions (McCarthy *et al.*, 2001). The functional relationship between exposure and adaptive capacity is simply a result of settlement occurrence in areas where climatic changes are being observed overtime (Robards and Alessa, 2004). Therefore, settlements (whether urban or rural) in areas of adverse climatic changes are vulnerable to climatic extremes such as droughts, floods, extreme heat waves, extreme cold, storms, security issues, disease outbreaks, and migration. Vulnerability to climate change can however be intensified by climate hazards, poverty and unequal access to resources, food insecurity, trends in economic globalisation, conflict and incidence of diseases such as HIV/AIDS (Intergovernmental Panel on Climate Change [IPCC], 2007).

Climate change adaptation is especially important in developing countries since those countries are predicted to bear the brunt of the effects of climate change (Cole, 2008). Adaptive capacity which is the capacity and potential for humans to adapt to climate change is unevenly distributed across different regions and populations, and developing countries generally have less capacity to adapt (Schneider *et al.*, 2007). It therefore means that governments and communities should embrace the concept of adaption and mainstream it into planning and the development process. This is also presented in other studies such as in Obekpa (2011).

Climate change is evident in Nigeria (Abiodun *et al.*, 2011; Odjugo, 2011) and Otukpo (Abu, 2008; Hula, 2010; Abu *et al.*, 2011; Akinnagbe *et al.*, 2012). This study therefore examines rural perception to effects of climate change in Otukpo by understudying the level of infrastructural development and rural respondent opinion. The objective is to assess the current livelihood situation of rural dwellers in Otukpo, and the level of infrastructural development, as these have significant implications for adaptation to the effects of climate change. The study further draws its relevance from its addition to exiting literature on the effects of climate change in rural areas, and the recommendations proffered to policy makers on the importance of rural infrastructural development.

Study area

Otukpo Local Government Area (LGA) is one of the oldest LGAs in Benue State, but also the traditional headquarters of Idoma people where its paramount Chief the Och'Idoma has his palace. The LGA came into existence in 1923, with its headquarters at Otukpo. In addition to metropolitan Otukpo town, other prominent settlements in the local government area include Ogobia, Upu, Otukpoicho, Otobi, Adoka, Oyagede and Akpa-Igede (Odoh and Jidauna, 2013). Otukpo Local Government Area (LGA) of Benue State is located between latitude 7° and 7°45' North and longitude 7°35' and 8°30' East.

The population of the LGA is 261, 666 persons as presented in the 2006 national census results. The population figure is made of up 133, 347 males and 128, 319 females (Federal Government of Nigeria [FGN], 2007). The predominant housing types are zinc and thatch roofed houses with earth brick walls. Well over half of the population of the area is engaged in farming activities at varying degrees. Plants mostly cultivated are yams, cassava, rice and beniseed. Most of the markets are periodic with at least a 5-day interval between market days. Otukpo LGA is faced with underdevelopment as functional amenities are inadequate. A Trunk 'A' federal road and the Port Harcourt-Kaduna railway line traverses the town.

The land is generally low lying and gently undulating with occasional inselbergs, lateritic mesas, butes, knolls and low ridges breaking the monotony of interfluves which alternate with shallow open valleys (Nyagba, 1995).

Surface drainage is generally good except near the banks of the major rivers where swampy floodplains have developed. The main rivers include Okoloko and Otobi. The smaller streams include Ukplo, Mmaba, Idikwu and Okpa Eupi. These smaller streams dry up completely during the dry season. According to Nyagba (1995), the water table in the area may drop below 20 metres and create serious water shortages as most wells dry up. These resultant water shortages lead to seasonal outbreaks of cholera in parts of Otukpo LGA as many residents lack access to water and engage in poor hygienic and domestic practices due to water scarcity.

Soils in Otukpo LGA are deeply weathered red and yellowish brown soils developed essentially on sedimentary rock. The soils are easy to cultivate but prone to excessive internal drainage and intense leaching leaving plants in the area to obviate the adverse effects of the rapid internal drainage of the soil by drawing water from the subsoil (Nyagba, 1995).

The climate is tropical in Otukpo. The average annual temperature in Otukpo is 27.2 °C. In August, the average temperature is 25.5 °C. It is the lowest average temperature of the whole year. The warmest month of the year is March with an average temperature of 29.3 °C. About 1723 mm of precipitation falls annually. The driest month is December with 9 mm. Most precipitation falls in September, with an average of 282 mm (Climate-data, 2013).

The Study area lies within the Southern Guinea Savannah with its characteristic coarse grasses and numerous species of scattered trees. However, persistent clearance of the vegetation for arable agriculture plus the practice of bush fallowing system has led to the development of regrowth vegetation at various levels. The vegetation is sparsely distributed except in open shallow valleys where the vegetation is denser. Vegetation of economic value includes locust bean, shea tree, mahogany, Isoberlina Doka, and fruit trees such as mango.

Methodology

The geographical scope of the study includes all the rural settlements in Otukpo LGA. Investigation was carried out on a sample of 58 rural settlements. The study utilized both primary and secondary data. Primary data collection was done through the use of a questionnaire with open-ended questions and questions with multiple answers. The questionnaire covered relevant issues relating to the scope of the study including demographic attributes, occupation, households and housing types, and livelihood and social practices. From a list of 56 rural settlements, 10 rural settlements with at least 100 inhabitants and each within 5 kilometres of the other were randomly selected. A total of 100 questionnaires were randomly distributed among 10 household heads in each of the selected rural settlements. The household heads where randomly selected from independent houses and compounds without bias for age, gender or occupational type. Field observation was carried out using a rapid rural appraisal tool during field visits to all the selected settlements. The nearest neighbour statistical analysis was used to assess spatial distribution. Distances between settlements were calculated from relevant maps of the study area. The nearest neighbour analysis technique was used to measure the spatial distribution of 56 rural settlements in Otukpo mathematically. The formula used is $Rn = 2d\sqrt{n}/A$. 'A' is the size of the area concerned; 'd' is the mean distance between settlements (taken as an average of the distance between them) and n is the number of villages. Rn represents the nearest neighbour index. Indices can range from zero to 2.15 (when settlements have the maximum spacing and are regularly distributed). The nearest neighbour analytical technique was used to study spatial distribution of rural settlements in Ngah and Ismael (2011), and organisation of settlements in Khan and Ahmad (2014). Recent literature on the topic was sourced from the internet and descriptive statistics such as graphs and tables were used in the presentation of data.

Results and discussion

Availability of facilities in rural settlements in Otukpo LGA is similar to what is obtainable in most rural areas in Nigeria. Rural areas in Nigeria are generally

characterized by poor social amenities, both in quality and quantity and rural communities are disproportionately more disadvantaged than urban centres due to governmental neglect (Nwokocha, 2008). The poorest regions are most likely to suffer because they are least able to adjust to new conditions owing to an inadequacy of livelihood support infrastructure (Hunter, 2007). Information on available infrastructure in Otukpo and relationship of household respondents with proximity and social interaction are presented in Tables 1, 2 and 3. Most of the respondents (67 %) in this study are from settlements which contained more than 500 inhabitants and have close spatial interaction. Table 1 show the result of the nearest neighbour analysis (Rn-Index) and suggest that rural settlements in Otukpo are randomly distributed but may be tending towards clustering (Table 1). This is

Table 1 - Rural settlements in Otukpo and distances between them.

Settlements	Distance (Km)	Settlements	Distance (Km)
Iwili	2	Unwaba-Aokwu	1
Unmogidi	3	Unwaba-Eokpa	1
Upu-Adoka	3	Abache	2
Olakpoga	3	Uga	2
Ojanowa	3	Okpiligwu	1
Ukplago	4.5	Olahimu-Icho	7
Oloke	2.5	Ojakpama	3
Ojinebe	3	Olahimu-Ehaje	2
Ogodumu II	2	Ogowu	1
Ogodumu I	4	Oplegba-Icho	2
Okpaflo	3	Oduda Ehaje	3
Ipole	2	Ekant Ili	1
Otada	2	Omlonye-Ehaje	2
Ofiloko	6	Onaje	2
Adoka Centre	4	Okakele	4
Ukwaba	5	Ifete-Ai-Enejo	1
Udabi	4	Ai-Ochemoche	2
Aukpa	3	Ipom-icho	2
Obena	4	Ipom-Ehaje	3
Onipi	2	Igblagidi	4
Aune	2	Ipolo-icho	5
Ai-Eya	2	Ipolo-Ehaje	4
Opa	3	Unwaba-Oju	2
Okpeje	3	Effeyi	3
Emichi	6	Okoto	2
Igaruwa	3	Jericho	2
Ilaba	4	Odaubi	6
Ibaji	2	Ogobia	4

Rn – Index (0.96)

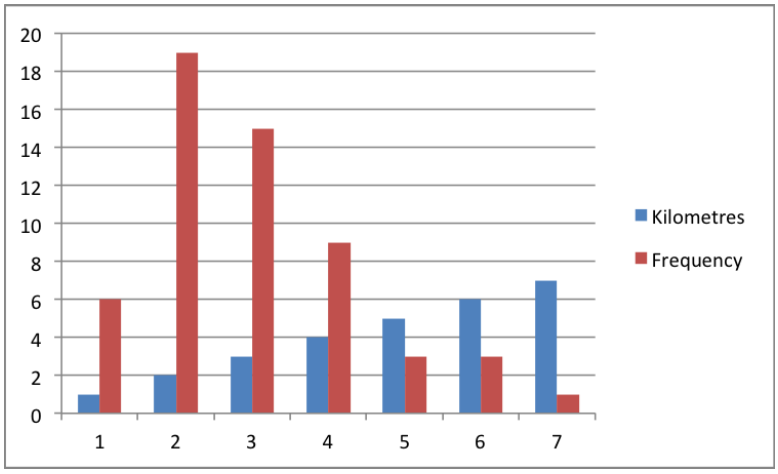

Figure 1 - Distribution of rural settlements in Otukpo according to distances between them.

because an Rn Index of 0.96 was obtained and according to the nearest neighbour Rn - Index Scale (0-2.15), 2.15=Perfect dispersal; 1.00=Random Distribution; and 0=Perfect Clustering. Most of the rural settlements in Otukpo have a distance of two to three kilometres between them (Figure 1).

The distribution of rural settlements in Otukpo gives the area a structure that has potential to adapt well to the impacts of climate change. This is because the settlement distribution type has the potential to promote social interaction and sharing of information on life lessons such as new knowledge on agricultural practices and food storage. The structure as described has the potential for shared access to available community infrastructure and resources. However, the lack of infrastructural development is a major disadvantage. A settlement with sufficient infrastructural development will be better equipped to deal with new conditions which might result from climate change as suggested by Hunter (2007). According to Hunter (2007), government policies for climate change should not be climate-specific, but aim to enhance families' livelihood options and make them more resilient should their resource-base change. This way, development efforts and programs to reduce poverty will lessen livelihood vulnerability. Respondents reported that they are beginning to experience agricultural occupational loss, water shortages, flooding, land based conflicts, health problems, erosion, and migration and fear that these may intensify with climate change (Figure 2).

A high percentage of respondents reported houses dominated with zinc and thatched roofed houses. Zinc roofed houses are considered modern even though more than half of these zinc roofed have walls made of mud bricks. These housing types are built to regulate room temperature in times of hot or cold weather. A typical family

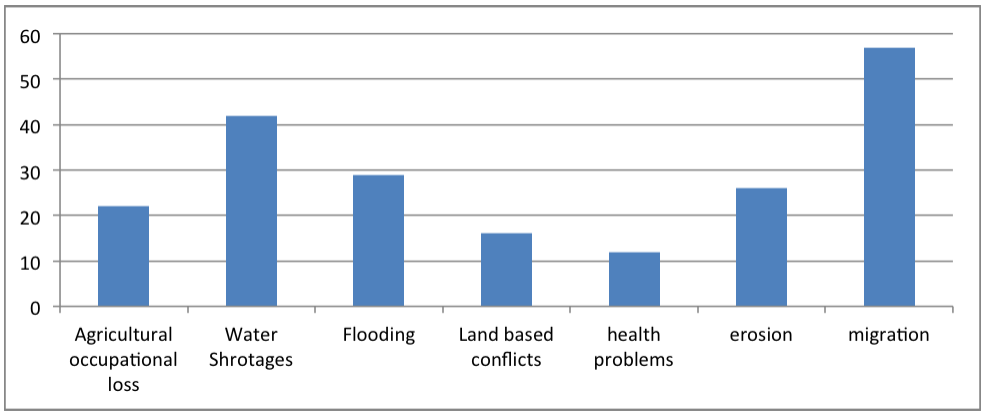

Figure 2 - Percentage of respondent indicators to environmental problems.

has an average of two buildings of two rooms each in a compound with external kitchen and toilets. The number of buildings is usually higher for large families with more than eight members. These housing types are renovated often due to effects from severe weather conditions and may not be sustainable in the event of reoccurring extreme climatic conditions such as flooding and erosion. The most reported reason for these housing types is inadequate funds.

In keeping with typical rural economies, the structure of occupation tilted heavily towards agriculture. More than half of the respondents reported farming as their main occupation. This means they are mostly vulnerable to declining agricultural yield and livelihood loss since issues of climate change such as rising temperature, flooding and water shortages are already evident in Nigeria (Odjugo, 2011; Abah, 2012). Davies *et al.* (2009) mentioned that poorer countries are especially vulnerable to climate change because of their geographic exposure, low incomes and greater reliance on climate sensitive sectors, particularly agriculture.

Agriculture in Otukpo is mostly rainfed as no respondent reported the practice of irrigation. Most of the streams in Otukpo are seasonal and some of them are likely to dry up permanently in future as evidence exists to suggest prolonged dry seasons due to early cessation of rainfall (Odjugo, 2011; Anuforom, 2013). Stream water is the predominant source of domestic water supply as reported by respondents (Table 2). Ogwuche (2012) observed that water is an important development factor in rural areas. This means that the observed trend of water shortage in Otukpo and other surrounding areas (Aper and Agbehi, 2011) will adversely affect development and livelihood activities.

In developing countries, water and food shortages caused by climate change will result in a more rapid spread of disease, infections and opportunistic infections (Action against AIDS Germany [AAAG], 2013). Cholera claimed the lives of 12

persons and led to the hospitalisation of over 80 persons in Otukpo in 2013 (Duru, 2013). More than half of the respondents reported an experience of a water-related illness. The absence of available health care in close proximity to rural dwellers is significant to vulnerability. This limits access to essential preventive and treatment services and may have contributed to the high prevalence rate of HIV/AIDS in Otukpo LGA which is one of the highest in the country at 9.1% (Federal Ministry of Health [FMOH], 2010). HIV and climate change are perceived as profoundly linked, a perception shared by a range of United Nations bodies, including Joint Programme on HIV/AIDS (UNAIDS) and the United Nations Environment Programme (UNEP) (UNAIDS, 2009). Adverse conditions as a result of climate change can exacerbate the HIV burden of any government. HIV/AIDS has been linked to decline in agricultural activities (Nzeh *et al.,* 2008; Enete and Amusa, 2010) and migration (Habib and Jumare, 2008). Increasing temperature due to climate change can potentially raise the incidence of Malaria which is of concern for health authorities in Benue state. According to Brody *et al.* (2008), a high risk from climate-change related health impacts exist in rural areas where access to healthcare is limited as they are often unable to travel long distances to the nearest health facility.

Odjugo (2011) assessed climate change and global warming in Nigeria over two climatic periods 1901 - 1938 and 1971- 2008. Odjugo (2011) found that temperature in Nigeria increased by 1.78 ^{o}C between the two climatic periods. This is above the global temperature average rise of 0.74 ^{o}C for 100 years (IPCC, 2007). Rainfall decreased by 91 millimetres in Nigeria between the two climatic periods with major shifts in double and single rainfall peaks. The climate trend may continue and alter seasonal dependent livelihood activities. The effects of climate change in Otukpo is seemingly documented in existing literature (Abu, 2008; Hula, 2010; Abu *et al.*, 2011; Akinnagbe *et al.*, 2012).

With the evidence of climate change in Otukpo, recent disputes and migration over land (Akor, 2012) suggest land for agricultural purposes may be becoming scarce. The findings in Okpe and Ikongbeh (2012) revealed that rural-urban migration has a significant negative effect on agricultural output in Otukpo. According to Okpe and Ikongbeh (2012), rural labour force migrates for economic and non-economic reasons leading to the decline in agricultural labour supply and agricultural output. Availability of adequate policing may help douse tensions over scarcity of resources and prevent conflicts and deaths. However, most of the respondents indicated that a police station was more than 2 kilometres from their home (Table 2).

The road networks in the area are a mix of earth and tarred roads (Table 2). Earth roads are more predominant as reported by respondents and link rural settlements to markets and urban centres. However, heavy rainfall which seems to be intensifying annually has continued to adversely affect these earth roads making it difficult to transport goods and farm produce from settlements to markets. Limited capacity to

Table 2 - Available facilities in rural areas in Otukpo.

AVAILABLE FACILITIES	% OF RESPONDENTS
TYPES OF HOUSES	
Zinc	79
Thatched	21
TYPES OF OCCUPATION	
Farming	56
Government Services	16
Commerce	17
Transportation	2
Others	9
WATER SUPPLY	
Hand dug wells	40
Stream	55
Tap Water	5
ELECTRICITY AVAILABILITY	
With Electricity	80
Without Electricity	20
MARKET TYPES	
Daily	62
Periodic	38
ROAD TYPES	
Tarred roads	40
Earth roads	57
Others	3

Source: Researcher's field survey

transport agricultural produce to markets and reliance on middlemen contribute to weak bargaining power and market relations among many rural households (Eriksen and Silva, 2003). It is anticipated that an increase in rainfall intensity will worsen the transportation situation in Otukpo with adverse effects on agricultural produce and social interaction if the roads do not receive adequate attention.

The level of social interaction among residents in Otukpo is quite frequent. Social interaction is important to share ideas about relevant issues. Issues here could range from new farming methods to happenings in other places. Adapting to the effects of climate change can be enhanced through active social interaction. Adaptation activities can be effective through market exchanges (Smit *et al.*, 2000), through extension of social networks (Adger, 2003), or through the actions of individuals and organisations

Table 3 - Distance of Respondents from available facilities.

	% RESPONDENTS				
DISTANCE IN KILOMETRES	CLINICS	PRIMARY SCHOOLS	POST OFFICE	POLICE STATION	TARRED ROADS
0 – 1 km	17	65	15	6	34
1 – 2 km	19	28	13	23	27
2 – 3 km	31	7	28	33	26
3 – 4 km	28	0	15	33	12
> 4km	5	0	29	5	1

Source: Researcher's field survey

to meet individual or collective goals. Social interaction among residents in the study area is characterised by strong family and clan ties. Frequency of visits among respondents decreased with reduction in settlement sizes and over 50 % of respondents indicated that they visit other settlements at least once every two weeks.

Implication of findings for Climate Change Adaptation and Development

The inadequacy of basic functional facilities in rural settlements in Otukpo can be explained by improper attention from responsible authorities. If the current situation persists, migration may become the preferred adaptation strategy to climate change in a bid to avoid coping with crisis situations and poor infrastructure as found elsewhere in literature (Scot, 2008; Davies *et al*., 2009; Obepka, 2011). Future planning should consider the mainstreaming of climate change adaptation in the location and nature of facilities and services to be provided by government. The provision of basic functional facilities in adequate numbers will hasten effective development and strengthen the adaptive capacity of rural settlements in Otukpo. The study therefore makes the following suggestions and recommendations:

i. Relevant authorities should recognise the need to support rural settlements to adapt to climate change and hasten investments in infrastructural development and provision of services.
ii. The provision of facilities in larger rural settlements will attract or pull people from smaller settlements encouraging urbanisation. This will help strengthen communities mitigate the effects of climate change.
iii. Construction of motorable and tarred roads in rural areas will encourage clustering, more interaction, improve communication, flow of ideas and enhance accessibility.

iv. The political desire to raise the standard of living of rural dwellers can be hastened with the provision of basic functional amenities and can be sustained with consideration for climate change adaptation.

Conclusion

The study from Otukpo reveals that rural settlements face agricultural occupational loss, water shortages, flooding, land based conflicts, health hazards, erosion, and migration if climate change trends intensifies. In order to prevent adverse impacts of climate change, the need to initiate settlement adaptation strategies has become necessary for rural populations especially in developing nations. This is because these settlements lack the basic infrastructure and amenities to optimize standard of living and adapt to emerging conditions due to climate change as observed. Climate change adaptation activities should be mainstreamed into development planning in developing nations. When this is done, rural settlements in Otukpo and elsewhere will be better prepared and capable to adapt to the changes that are expected to manifest from climate change.

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