



Determinants of Access and Utilization of Climate Services among Vulnerable Communities: A Case Study of Isoko Communities in Delta State, Nigeria

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Changes in climate have caused impacts on natural and human systems. These impacts affect poor people's lives through impacts on livelihoods and destruction of homes. In Delta State, the impacts of climate change are real. Adaptation has been identified as the key to reducing the impacts of climate change. However, successful adaptation depends on use of climate services. While climate services are essential to adaptation, the services do not always reach the users who need it most. This paper analyses factors influencing access and utilization of climate services in Delta state, Nigeria. The paper utilized the survey research while data were analyzed using both descriptive and inferential statistics. Findings show low utilization of climate service. The determinants of access and utilization of climate services include income, educational attainments, access to ICT facilities, extension agents and the level of local climate variability. The paper calls for awareness creation on the importance of climate services.

INTRODUCTION

Globally, climate change has constituted a serious threat to development gains in the last decades. It has negatively impacted on both human and natural systems generating adverse consequences for living organisms especially human beings (IPCC, 2014). The impacts on human beings are both direct through loss of lives and property and indirectly through destruction of livelihoods, decrease in agricultural production leading to increase in food prices and food insecurity. These impacts also exacerbate other stressors in the environment with negative implications for livelihoods especially those that rely on natural resources such as agriculture. According to Nigerian Meteorological Agency [NIMET] (2008), which is the agency charged with the responsibility of providing climate information; climate change is already a reality in Nigeria based on the report of climate assessment for the period 1941 to 2000. The report noted the following changes in climatic condition of Nigeria over the period:

Rainfall

The report demonstrated that the combination of late onset and early cessation of rain in Nigeria shortened the length of the rainy season in most parts of the country for the year under assessment. There was also reduction of annual rainfall by between 2-8mm in many regions of Nigeria while slight increase of between 2-4mm was observed in few locations such as Port Harcourt (NIMET, 2008).

Temperature

The assessment also reveals that that in the long term, there was temperature increase in several parts of the country with the exception of areas around the Jos Plateau while the largest increase in temperature were observed in areas around Maiduguri, Sokoto and Ibadan in the South West Nigeria. The mean temperature increase in these areas is in the range of between 1.4-1.9°C (NIMET, 2008). Also, the report from future climate projection for Nigeria suggests that indicates general trend of rising temperature from 2.0 – 2.2°C from south to north for the period 2046 – 2065, with a much more rapid increase in the range of 3.5 – 4.5°C. The above clearly demonstrates the gravity of climate change challenges both now and in the future and calls for concerted effort on the part of national government to set up relevant institutional frameworks for addressing the challenges.

In view of the projected climate disruption precipitated by high levels of Greenhouse Gases (GHG) emissions, adaptation is seen as a necessary strategy at all scales to mitigate the impacts of climate change. Hallegatte et al., (2015) notes that, between now and 2030, good climate-informed development will give the best chance for warding off increases in poverty due to climate change. This clearly demonstrates the importance of climate services in climate change adaptation. Climate services are scientifically based information and products that enhance users' knowledge and understanding about the impacts of climate on their decisions and actions (American Meteorological Society (2015). Climate services deliver data, statistical analyses, tools, and other information resources about historical weather patterns and expected future climate conditions including temperature and precipitation scenarios, sea-level changes and their potential impacts on agriculture, infrastructure, health, and other sectors (USAID, 2013). It has been shown to be useful in planning various activities that depend

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on climate information. In the agriculture sector, farmers are able to select more effective planting times, and choose the most appropriate crops for the coming season. In the health sector, it is used in designing early warning systems to improve surveillance on diseases affected by climate conditions (such as Malaria, Dengue Fever, and so on) and help mitigate against the suffering resulting from weather extremes such as heat waves and winter cold, and urban smog events (Nyenzi and Malone, 2005; Ayubu, Malongo, Siza and Respickius, 2012). In the construction industry, planners and engineers use long-term climate forecasts to decide where buildings should be sited as floodplains move, or how to design bridges to ensure they can withstand increasingly heavy storms (McMichael *et al.*, 2003, Patz, 2002).

While climate information services are essential to help address extremes climatic events in a changing climate, the information does not always reach the users who need it most (WMO, 2006; Suarez, 2009; Onwumele, 2013). Tall *et al.* (2012) noted that climate services had been previously underutilized for several reasons. These include the existence of information gap between critical stakeholders in the use of climate services, cultural barriers reinforced by difficulties in changing from a mindset of disaster response to preparedness and early action, lack of sufficient funding from donor agencies, too much technicality attached to provided climate services which limits ability of final users to properly decode them, and non-salience and reliability of provided information. The above issues emphasize the fact that in many instances, despite some previously relayed climatic services, preparedness of people to ensure mitigation of any welfare losses as a result of climatic hazards is often limited (Suarez, 2009; Tall *et al.*, 2012).

As noted previously, the Nigerian Meteorological Agency (NMET) has the mandate to provide climate services, Apart from NMET, academic institutions such as universities, non-governmental organizations and research institutions are other main sources of climate services in Nigeria (Onwumele, 2013). Despite the availability of these institutions and their services, the devastating impacts emanating from climate related hazards such as flooding in the last decade cast doubts in the accessibility and utilization of climate services by vulnerable communities in the study area.

One region in Nigeria that is vulnerable to climate change is Isoko land in the Niger-Delta. Isoko communities are noted for high agricultural activities but highly vulnerable to climate change impacts especially flooding and suffered severe impacts during the 2012 flood disaster in Nigeria (Onwumele, 2013). The factors determining the level of access and utilization of climate services among vulnerable communities in Isoko land have not been fully investigated. It is on this premise that this study aims at identifying the factors influencing access and utilization of climate services among vulnerable communities in Isoko land in Delta state, Nigeria.

Goal and Objectives of the Study

The goal of this paper is to identify the factors influencing access and utilization of climate services among vulnerable communities in Isoko land of Delta State, Nigeria. The specific objectives are to:

1. Identify the socio-economic characteristics of the respondents in the study area
2. Determine the awareness level of climate services among the respondents and their sources of information
3. Ascertain the extent of utilization of climate services among the respondents
4. Determine the socio-economic variables influencing access to climate services among vulnerable communities in the study area

5. Proffer policy recommendation to improve access to climate services

Hypothesis of the study

There is no significant relationship between the socio-economic characteristics of respondents and their accessibility and utilization of climate service in Isoko land Delta State, Nigeria.

CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

A climate service is a decision aide derived from climate information that assists individuals and organizations in society to make improved ex-ante decision-making (Tall, 2013). A climate service requires appropriate and iterative engagement to produce a timely advisory that end-users can comprehend and which can aid their decision-making and enable early action and preparedness. Climate services need to be provided to users in a seamless manner and, most of all, need to respond to user requirements (Hellmuth *et al.*, 2011). Climate services are essential for adaptation to climate variability and change. In 2009, the World Climate Conference-3, attended by more than 2,500 participants from more than 150 countries, including 13 Heads of State and Government and 81 Ministers, decided to establish a Global Framework for Climate Services (GFCS) to strengthen the production, availability, delivery, and application of science-based climate prediction and services. This only attests to the importance of climate services to successful climate change adaptation and sustainable development. Climate services include the use of simple information like historical climate data sets as well as more complex products such as predictions of weather elements on monthly, seasonal or decadal timescales, also making use of climate projections according to different greenhouse gas emission scenarios (World Meteorological Organization, 2011). Various applications of climate services have been identified to include helping farmers to determine which crops to plant or whether to reduce livestock numbers if a drought is forecast, helping engineers to make decisions on where to invest in disaster mitigation measures such as dams, where to locate buildings, which construction methods to use and how much heating and cooling is needed for critical infrastructure, helping in the health sectors when and where disease outbreaks are likely to occur, helping water engineers to guide major investment decisions relating to long-term water management such as whether and where to build new reservoirs, among others (World Meteorological Organization, 2011).

The framework of analyses of determinants of access and utilization of climate services is based on the Ziervogel, (2004) framework for assessing how forecast information is integrated into decisions. It begins with the premise that people are not always optimizing and rational and so idealized decision-making models will never be achieved (Clark and Marshall 2002). By implication, households in vulnerable communities will not all make the same decisions in the same way and in isolation (Weber and Sonka 1994). It therefore builds on the notion of 'bounded rationality'. It holds that the decisions people make are shaped by limited knowledge, cognitive capacity, resources and the structure of the environment in which decisions occur (Simon, 1957). These factors are seen as filters in determining what the response to new information will be. Fischhoff (1994) identified four steps for addressing the problem of forecast integration into household decision making. The first step is the delivery or dissemination of the forecast. If the household receives the forecast, the second step occurs where filters are applied that either encourages or discourages further consideration of the forecast. The filters may include the importance placed on the forecast by households, household's available resources, seasonal forecast conflicts or alignment

with household's traditional climate forecasts and local environmental indicators. Other filters might be a function of the perceived options that exist for responding to the forecast that are based on the history of decision making, the perceived riskiness of using the information and the success or failure of past decisions (Weber and Sonka 1994). If the filters allow for the forecast to be adopted, then in Step 3 decisions need to be made on how to use the information. Finally, in Step 4 the impact of the decisions made in response to the forecast are assessed. These can be positive, negative or no impact. The results from Step 4 (the impacts) become one of the filters for future years. The numerous constraints associated with accessing and utilization of the forecast can be broadly separated into problems of forecast delivery and problems with using the forecast. The first problems are those of dissemination; include the mechanisms for delivery, the timing, and the message that is conveyed. The credibility of the forecast, built on the accuracy of past forecasts and the forecast communicators' reputation, can also restrict uptake (Patt, 2000; Patt and Gwata, 2002). Thus, socio-economic and physical environments are underlying filters that affect how households will access and utilize new information about the climate.

Currently, the primary source of climate data is observation by ground-based weather stations across the continent. The main strength of these station observations is that they give the true measurements of the climate variable of interest. However, in many parts of Africa stations are sparse, declining in number, and unevenly distributed. For example, while the World Meteorological Organization (WMO) recommends a minimum of one rainfall station for every 15 to 25 km depending on geography, the current station coverage in Africa is a small and declining fraction of this requirement. Compounding this problem, the distribution of existing stations is uneven, with most located in cities and towns along major roads. As a result, coverage tends to be worse in rural areas, exactly where livelihoods may be most vulnerable to climate variability and climate change (International Research Institute for Climate and Society, 2016).

Several scholars have over the years examined the applications and impacts of climate services in diverse sectors. One of the most widely reported application of climate services was the October 18, 2013, Cyclone Phailin, which tore through the Indian states of Odisha and Andhra Pradesh. It was the equivalent of a category 5 hurricane as strong as Hurricane Katrina, which devastated the US Gulf Coast in 2005 with a death toll of 1, 836 (Federal Emergency Management Agency, 2005). Thanks to climate services utilization by the Indian Government which led to the evacuation of more than 800,000 people from coastal areas and hence the casualties figures were as low as 21 but that number was far fewer than the 10,000 people who died in a storm in the same area in 1999 (United Methodist Committee on Relief (UMCOR), 2013). In his study, Ritchie et al. (2004) found that the use of stream flow forecasts significantly increases the amount of water available for in stream flows/environmental purposes in the Murray-Darling River Basin in Australia, while maintaining the amount of water needed by irrigators. Similarly, Steinemann (2006) examined the use of seasonal precipitation forecasts by water resource managers in Georgia to decide whether to pay farmers to suspend irrigation in forecasted drought years. Results indicate that the economic benefits associated with the use of these forecasts included \$100–350 million in mitigated agricultural losses in state-declared drought years and \$5–30 million in savings to the state in non-drought years.

In the energy sector, studies have demonstrated the value of short-term and seasonal forecasts. For instance, Hamlet et al. (2002) found that the use of stream flow forecasts increases energy production from

major Columbia River hydropower dams by 5.5millionMWh/year, resulting in an average increase in annual revenue of approximately \$153million per year. Also, Block (2011) study shows that the use of forecasts to manage hydropower operations in Ethiopia produces cumulative decadal benefits ranging from \$1 to \$6.5 billion, compared to a climatological (no forecast) approach. In the transportation sector, the use of climate services also results in increased revenues and voided costs for transportation industries and/or public agencies. Frei et al. (2012) found that the use of meteorological information by the road transportation sector in Switzerland generates an economic benefit of \$56.1 to \$60.1 million per year in reduced government spending, and an additional \$14.2 to \$25.3 million per year in value added. Stewart et al. (2004) found that improved short-term precipitation forecasts can help road supervisors improve their allocation of resources and their efficiency in snow removal activities on the New York Thruway. In disaster risk management, studies show that climate services help lower the social and economic costs of extreme events, including floods and hurricanes, Hallegatte (2012) estimated that in Europe, hydro-meteorological information and early warning systems save several hundreds of lives per year, and avoid between \$596 million and \$3.5 billion of disaster asset losses per year.

In the above review, there is increasing recognition that climate service has a central role in attaining sustainable development of nations. Summarily, while several scholars have examined the benefits of the utilization of climate services, there are little or no studies examining the determinants of access to climate services which is one of the preconditions for application and utilization of climate services especially in a developing country such as Nigeria. This is the *raison d'être* of the present study.

MATERIALS AND METHOD

Description of the study Area

Location: The Isoko land of Delta State in the Niger-Delta is defined as the geographical unit situated between Latitudes 5° 13' 05'' and 5° 37' 55'' north of the equator, and between Longitudes 6° 03' 20'' and 6° 26' 45'' east of the Greenwich Meridian (Figure 1). The area is bounded in the west by Ughelli North and Ughelli South Local Government Areas of Delta State, in the north by Ndokwa West Local Government Area and in the east by Ukwani Local Government Area. It is bounded in the south by Patani Local Government Area and in the Southeast by River Focados. Politically, the Isoko area of Delta State is made up of two Local Government Areas, namely: Isoko North and Isoko South.

Based on the 2006 censuses, Isoko land had a total population of 371, 867 made up of 186, 211 males and 185, 656 females (NPC, 2007). Primary economic activities include farming, fishing, oil mining, sand mining and lumbering. Secondary activities include modern manufacturing and oil refining. Tertiary activities include services such as banking, communication, marketing and transportation services.

The Physical Background

a) Relief and Drainage: Isoko land is located on a flood plain with a network of rivers. The area is made up of two distinct relief zones. They are the River Flood Plain zone, which comprises the upper riverine plain that extends from the lower River Niger towards upper Bomadi axis and the poorly drained transitional lower riverine plain. This zone is characterised by a swampy terrain with some small rivers forming tributaries of the River Niger. The second zone is the higher well-drained plain in the north. This zone extends to the River Ase, which

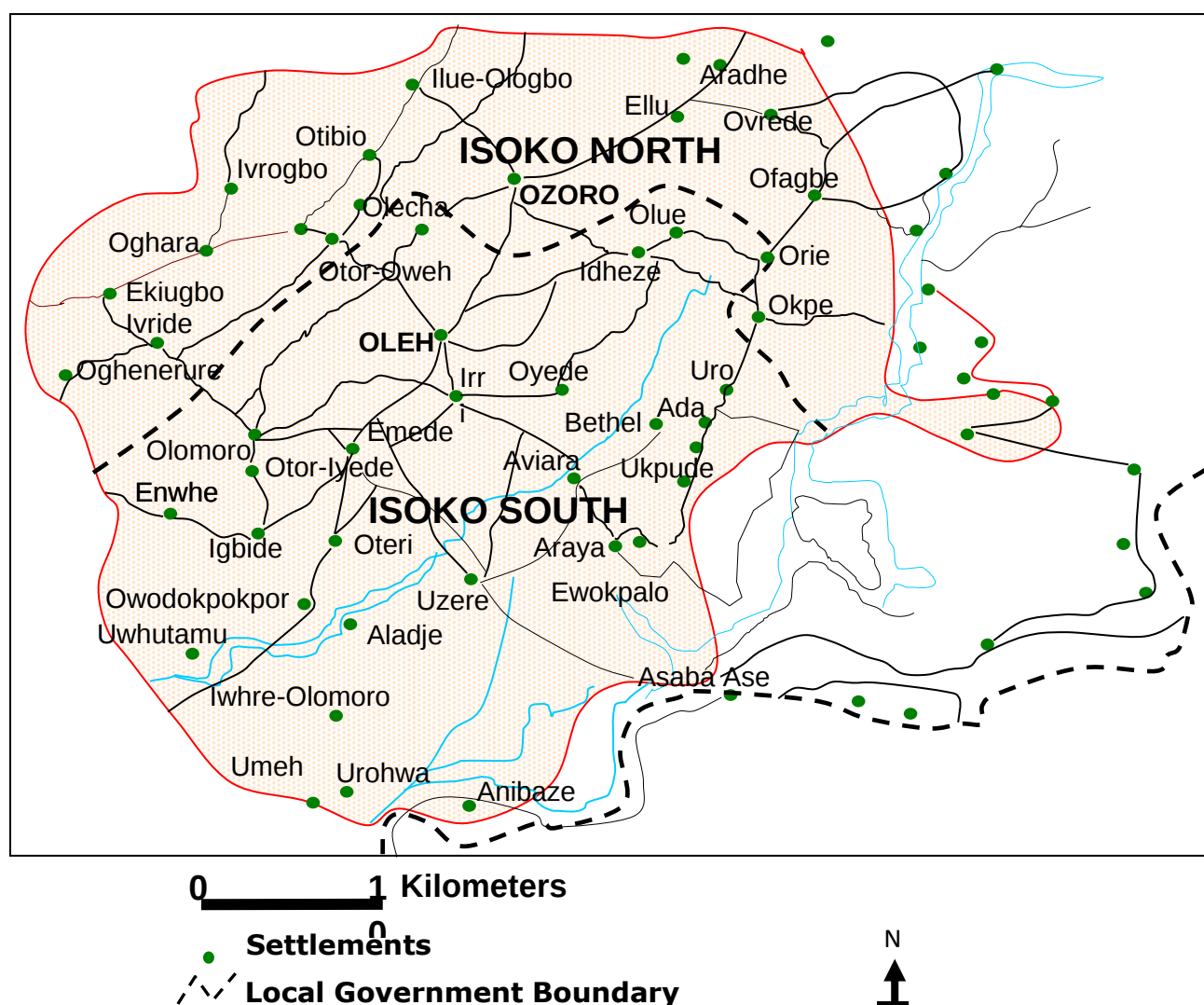


Figure 1 MAP OF ISOKO LAND (Source: Author, 2009)

drains into the Forcados River. This zone covers the northern part of the region.

b) Climate: The region experiences high rainfall and high relative humidity most of the year. Isoko land has an average annual rainfall of about 1200-4500mm. The climate is humid equatorial and is marked by two distinct seasons, the Dry and Rainy seasons which is influenced by two air masses, namely, the South Monsoon Trade Wind associated with moisture and which blows across the Southern Atlantic Ocean. The other wind is the Northeast Trade Wind from the Sahara Desert associated with Harmattan. The Dry season lasts from about November to April and is significantly marked by the cool "harmattan" dusty haze from the north-east winds. The Rainy season spans from May to October with a brief dry spell in August. Temperature increases from the south to the north. Average daily temperature is about 30°C.

The cross-sectional survey design was adopted for the study. The population of the study consists of household heads in Isoko communities in Delta State. Eight communities (Uzere, Umeh/Erohwa, Olomoro, Irri, Otibio, Orie, Ofagbe, Ovrede) were randomly selected from a list of communities in Isoko land. Thirty (30) copies of structured questionnaire were randomly administered to each of the selected

community. A total of two hundred and forty (240) copies were administered in all. Data for the study were obtained through the questionnaire administration. In addition, content analysis was carried out on key official documents of NMET which is the officially recognized climate services agency in Nigeria. Both descriptive and inferential statistics were employed in the analysis of the data that were collected. Objectives 1, 2, 3 and 5 were achieved using mean, frequency distribution and percentages, while logistic regression was employed to analyse the relationship between the socio-economic characteristics of farmers and their accessibility to climate services (objective 4). Both the descriptive and inferential statistics were performed by the use of Statistical Packages of the Social Sciences (SPSS).

Model Specification

Binary choice models are commonly used when outcomes are divided into two categories. For this study, the logit model, which is one type of binary choice model, was adopted which produced the t-ratios that were compared with t-critical values to test the hypothesis of the study, which states that there is no significant relationship between the socio-economic characteristics of farmers and their accessibility to climate

services. Logit regression analysis is a unit/multivariate technique that allows for estimating the probability that an event occurs or not, by predicting a binary dependent outcome of a set of independent variables. For instance, if a linear probability model is given as:

$$P_i = E(Y = 1|X_i) = \beta_1 + \beta_2 X_i \quad (1)$$

Where X is the explanatory variable and $Y = 1$ means that the outcome is positive, while 0 imply otherwise. A representation of equation (1) given as in equation (2) below is the (cumulative) logistic distribution function, where the value of Z_i ranges from $-\infty$ to $+\infty$; and P_i ranged between 0 and 1; P_i is non-linearly related to Z_i (i.e. X_i).

$$P_i = E(Y = 1|X_i) = \frac{1}{1 + \exp[-(\beta_1 + \beta_2 X_i)]} = \frac{1}{1 + \exp(-Z_i)} \quad (2)$$

Where $Z_i = \beta_1 + \beta_2 X_i$

The logistic distribution in equation (2) satisfied the two conditions required for a probability model. The two conditions are (i) as X increases, $P_i = E(Y = 1|X_i)$ increases but never steps outside the 0-1 interval and (ii) the relationship between P_i and X_i is non-linear, that is, it approaches zero at slower rates as X_i get small and approaches one at slower rates as X get very large.

Rearranging and taking natural log of equation (3) will result in:

$$L_i = \ln[P_i/(1 - P_i)] = Z_i = \beta_1 + \beta_2 X_i \quad (3)$$

L in equation (3) is called the logit, it is the log of odds ratio that is linear in X and also in the parameters.

The dependent variable for this study is the access to climate services from the Nigerian metrological Servicers (NMET). The dependent variable, access to climate services, is a dummy variable which takes the value of 1 if respondents have access or 0 if otherwise. The independent explanatory variables include:

X_1 = Age (measured in years)

X_2 = sex (dummy variable, 1 for male, 0 for female)

X_3 = Marital status (dummy variable, married=1, single =0)

X_4 = Education level (Number of years spent in school)

X_5 = Income (Naira)

X_6 = household size (Number of people in household)

X_7 = Access to electricity (yes=1; No=0)

X_8 = location of respondents whether urban or rural (Urban=1; Rural 0)

X_9 = membership of cooperatives (membership of association=1; not a member=0)

X_{10} = access to extension agents (having access =1 no access=0)

X_{11} = access to ICT (having access to ICT=1; no access=0)

X_{12} = Participation in workshops and conferences (participation=1; no participation =0)

X_{13} = level of local climate variability (Highly variable =1; little variability)

RESULTS AND DISCUSSION

The result shows that the majority (66.3%) of the respondents were males while average age of the respondents is 46 years of age. Result further shows that 76.5 per cent of the respondents are married with an average household size of 5.8. Results also indicate that respondents are fairly literate as about 44.4 per cent of the respondents had primary education, 16.8 per cent had secondary educational qualification and 22.4 per cent of the respondents had tertiary educational qualification while 16.3 per cent of the respondents had no formal educational qualification. Income is generally low as 16.3 per cent of the respondents earned about N10,000 (\$27.7) per month. The mean income of households in the sampled population is N25, 561 per month. If poverty is defined globally as living below the equivalent of \$1.00 per capita / day, then given an average household size of 5.8 at an exchange rate of N360 to a dollar, the average family will need to earn about N62, 640 (\$174) to live above the poverty line. The implication of this is that the people in the study area are living below the poverty line which is one of the major factors contributing to low adaptation and vulnerability to climate change impacts.

Awareness, Access and Utilization of Climate Services

Adequate knowledge and awareness of the existence of climate services is one of the preconditions for accessing and utilization of climate services for climate change adaptation practices. Hence, the paper attempt to determine the extent of awareness of climate services among vulnerable households in the study area. Figure 2 shows that the majority (60.0%) of the respondents are not aware of the existence of climate services in the study area. Only 30 per cent of the respondents are aware of the existence of climate services. Climate services awareness is much needed for public access and utilization of climate services in planning for adaptation to climate change impacts among vulnerable communities. In this regard, public education is critical in raising levels of awareness of the existence and importance of climate services among vulnerable population.

Despite the importance of climate services in climate change adaptation among vulnerable communities, only 31.2% of the respondents in the study area are using climate services in planning for adaptation while the majority noted that they are not using climate services (Figure 3). The above findings not only confirm the fact that there is poor access to climate services, but it also indicates that there is poor utilization of climate services in the study area. This finding is supported by Tall *et al.* (2012) who indicate that there is gross underutilization of climate services particularly in the developing countries including Nigeria. Among the reasons advanced are the absence of sustained dialogue between climate services providers and end users and the information provided by climate services providers was largely incomprehensible to decision maker/disaster manager (Onwumele, 2013; Onwumele, 2014).

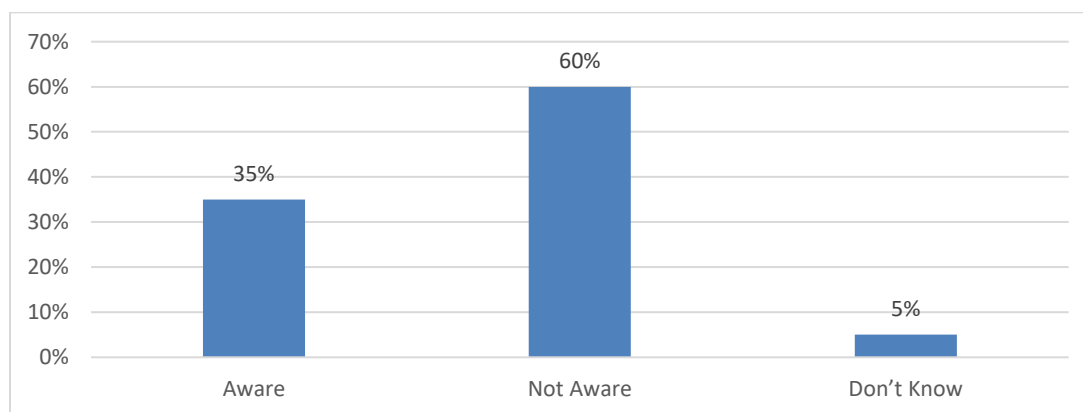
Sources of Climate Information in Nigeria

Results indicate that the Nigerian Meteorological Agency (NIMET) has the mandate to monitor weather and climate in Nigeria and provide meteorological information for sustainable development and safety of life and property in the country. In response to this mandate therefore, the Agency produces the rainfall prediction annually and presents it as the Seasonal Rainfall Prediction (SRP) in the first quarter of every year. Apart from NIMET, academic institutions such as universities, non-governmental organizations and research institutions are other main sources of climate information in Nigeria. Some institutions created by

Table 1 Socioeconomic characteristics of Respondents

Variables	No. of Respondents	Percentage
Sex:		
Male	130	66.3
Female	66	33.7
Age in Years:		
21-30	19	9.7
31-40	49	25.0
41-50	40	20.4
51-60	51	26.0
61-70		
Mean =46.07 Years	37	18.9
Marital Status:		
Married	150	76.5
Single	20	10.2
Divorced	12	6.1
Separated	1	0.5
Widowed	13	6.6
Household Size (No. of Persons):		
1-3	32	16.3
4-6	97	49.6
7-9	36	18.5
10 -12		
Mean =5.8 persons	31	15.6
Education Level (No. of years spent in School):		
0(No formal education)	32	16.3
1-6	87	44.4
7-12	33	16.8
13-18		
Mean =9.6 Years	44	22.4
Income of Respondents Per Month Per Household:		
1000- 10, 000	33	16.9
11, 000-20, 000	54	27.4
21, 000-30, 000	52	26.4
31, 000-40, 000	15	7.8
41, 000-50, 000	10	5.2
51, 000-60,000		
Mean Income = ₦25, 561	32	16.3

Source: Field Survey, 2017

**Figure 2** Awareness of the Existence of Climate Services

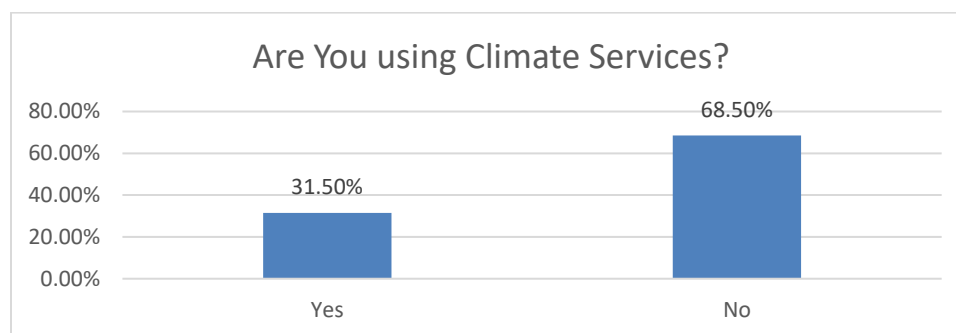


Figure 3 Usage of Climate Services by Respondents

Table 2 Channels of Climate Change Communication in Nigeria

Channels of Climate Change Communication	Media
Mass Media	TV, Radio
Print media	Pamphlets, newspapers, brochures, posters
Electronic media	Internet, sms support services

Table 3 Logistic Regression Results of Factors Influencing Farmer's perception of Climate Change

	B	S.E.	Sig.	Exp(B)
Step 1 ^a				
Age (X ₁)	-.524	.683	.443	.592
Sex (X ₂)	.026	.368	.944	1.026
Marital Status (X ₃)	-.073	.539	.892	.930
Education (X ₄)	.549	.465	.03**	1.732
Income (X ₅)	.231	.083	.016**	.729
Household size (X ₆)	-16.364	4397.976	.997	.000
Access to electricity (X ₇)	.316	.239	.048**	.729
Location of respondents (X ₈)	-.386	.457	.398	.680
Membership of cooperatives (X ₉)	-19.082	3753.700	.996	.000
Access to extension agents (X ₁₀)	1.545	.790	.020**	4.689
Access to ICT (X ₁₁)	0.373	1.125	.051**	1.452
Participation in workshops (X ₁₂)	-17.112	3123.611	.896	.0123
Level of local climate variability (X ₁₃)	0.639	.817	.019**	0.528
Constant	42.500	5782.081	.994	2.863

Source: Authors compilation, 2017

the government such as Special Climate Change Unit (SCCU) within the Federal Ministry, Building the Nigerian Response to Climate Change (BNRCC), Nigerian Environmental Study/Action Team, among others also help in the dissemination of climate information. Some academic institutions have special centres dedicated to the provision of climate information such as the Centre for Climate Change and Fresh Water Resources at Federal University of Technology Minna and Centre for Energy, Research and Development at Obafemi Awolowo University Ile-Ife; and Abubakar Tafawa Balewa University, Bauchi respectively.

The study further examines the formats for the dissemination of climate information in Nigeria. It is crucial to note that the format is a major factor that influences end-users' ability to comprehend any information. Results indicate that the main formats are text, audio and digital or images. The text format is in English language while the audio is usually sound produce from speakers. While English language is the official text format in Nigeria, however, the literacy level of the local communities is a major determinant of their ability to interpret the text. Table 3 shows the main channels of climate change communication in Nigeria.

Table 2 indicates three main channels of climate change communication including mass media comprising television and radio. The second channel is the print media which includes newspapers, brochures, posters and pamphlets. The last channel is the electronic media including internet and short message services (sms) support services. As noted by Lwoga et al, (2010), the use of ICT including internet, mobile phones, emails, community radio, TV, telecenters, computers are not fully utilized by community. What is obvious from the above table is the fact that the present channels of climate change communication lack indigenous or traditional content and thus at variance with the information sharing and communication strategies of households in the region as noted in Table 2. The implication of this is that local community in the study area will lack access to climate information since climate services are not disseminated through community channels.

It is instructive to note that in 2013, Nigeria's National Framework for Application of Climate Services (NFACS) was produced in line with World Metrological Organizations (WMO)'s Global Framework for Climate Services (GFCS) which aims at increasing access to weather

and climate services especially by the most vulnerable communities who need it the most, while also improving their understanding to ensure more effective application of the information. The above finding only shows that there is need for more effort on the part of government in promoting access and utilization of climate services in Nigeria.

Determinants of Access and Utilization of Climate Services

Climate services, which provide timely, tailored information and knowledge to decision makers are seen as an important part of improving our capacity to manage climate-related risk. The aim of climate services is to provide people and organizations with timely, tailored climate-related knowledge and information that they can use to reduce climate-related losses and enhance benefits, including the protection of lives, livelihoods, and property. Amongst the challenges faced by vulnerable communities in Isoko land is inaccessibility to climate services. This section sought to identify the determinants and constraints to access to climate services among vulnerable households in Isoko land in Delta State. The result of the logit regression is presented in Table 3. The estimated values of education level (X_4), income (X_5) access to electricity (X_8), access to extension agents (X_{10}) access to ICT facilities (X_{11}) and level of local climate variability (X_{13}) significantly contributed to the probability of having access and utilization of climate services. It is of interest to note that age (X_1), gender (X_2), marital status (X_3) household size (X_6) membership of cooperative (X_9), participation in workshops and conferences (X_{12}), do not significantly contribute to the likelihood of having access and utilization of climate services in the study area.

The estimated coefficient of educational level (0.549) was significant at 0.05 level of significance and its exp(b) value of 1.732 suggests that as number of years of school of the respondents increases, the odds of having access to climate service and utilization of climate services by respondents also increases. The estimated coefficient of income (0.438) was at 0.05 level of significance and its exp(b) value of 1.549 implies that as people get more income, the odds of having access to climate service and utilization of climate services by respondents increase (Table 3). The estimated coefficient of access to electricity (0.316) was also significant at 0.05 level of significance and its exp(b) value of 0.729 implies that as access to electricity increases, the odds of accessing climate service and utilization of climate services by respondents increase. The estimated coefficient of access to extension facilities (1.545) was significant at 0.05 level of significance and its exp(b) value of 4.689 implies that those that have access to extension facilities stand a better chance of about 4.7 times odd of having access to climate services and utilization of climate services than those that do not have access to extension facilities. The estimated coefficient of access to ICT facilities (0.373) was significant at 0.05 level of significance and its exp(b) value of 1.452 implies that the more ICT facilities at the disposal of the respondents, the more likely the increase in odd of having access to climate services and utilization of climate services. The estimated coefficient of level of local climate variability (0.639) was significant at 0.05 level of significance and its exp(b) value of 0.528 implies that as the variability of local climate increases, the odd of having access to climate services and utilization of climate services increases. The above finding is supported by Oyekale (2015) study which reveals that the probabilities of having access to weather forecasts significantly increased with access to formal education, farm income and previous exposure to climatic shocks. It is also glaring from the

result that the predictors included in the model could only account for between 24 per cent and 37.3 per cent of the variance in determining the access to climate services and utilization of climate services as suggested by Hosmer and Lemeshow (0.24), Cox and Snell (0.276) and Nagelkerke (0.373).

CONCLUSION

While the impact of climate change on local community such as the study area is well acknowledged by scholars and vulnerable communities themselves, adaptation has been identified as the key to reducing the impacts of climate change on vulnerable populations. Adaptation is a process by which strategies to moderate, cope with, and take advantage of, the consequences of climate events are enhanced, developed and implemented. However, successful adaptation depends on the intelligent use of climate information services. While climate information services are essential to help address extremes climatic events in a changing climate, the information does not always reach the users who need it most. Ensuring the availability of, and access to, high-quality climate services tailored to address the vulnerability of local communities is a necessity in the study area. This paper identified the factors that determine access and utilization of climate information services in a vulnerable population. In the light of the findings, the paper made the following recommendation.

1. There is the need for the local authority to implement more awareness and campaign programme to raise awareness on the importance of climate services for success climate change adaptation at the community level.
2. It is also important for local authority to increase community access to electricity, extension facilities and ICT facilities to enhance their access and utilization of climate services.

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