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Perceived effects of climate change on household water resourses in Benue State, Nigeria.

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The study assessed the effects of climate change on household water resources in Benue State, Nigeria. Multistage sampling technique was used to select 160 respondents. Data were collected using interview schedule. Descriptive statistics were used in data analysis. Perceived effects of climate change on water resources include: decrease in the quantity of fish in water bodies (M=3.93), increased conflict over water resources (M=3.72), increased energy and time spent on water collection (M=3.63), increase in the amount of money spent on water (M=3.43), decrease in the quality of surface water (M=3.39), decrease in groundwater level (M=3.32), shrinking of surface water (M=3.18), among others. Strategies for ameliorating the impacts of climate change on water resources include: integrated water resources management (M=3.91), participatory risk assessment involving the local people and all other stakeholders (M=3.90), encouraging local watershed management (M=3.88), and mainstreaming gender in community water management (M=3.79) among others. It was recommended that development agencies should adopt integrated water resources management in helping people adapt to the effects of climate change on water resources. This can be achieved by ensuring that water provision intervention considers provision of water in terms of its development, use and protection and also considering all sectors and institutions which use and affect water resources.

Keywords: effects, climate change, household, water resources

INTRODUCTION

Climate change now presents the most serious environmental challenge facing mankind in the 21st century; manifesting in extremes of weather events such as flooding, drought, heat waves, changes in rainfall intensity and pattern, sea level rise, drying up of rivers, streams, among others (Development Partnership in Higher Education (DelPHE), 2010). The unprecedented catastrophe that is presented by climate change now threatens to put the already achieved humankind development into recession while posing a very big challenge to the achievement of the Millennium Development Goals (MDGs) by nations.

The characteristics of the components of the hydroclimatogical systems of different ecological zones would be altered as a result of climate change with their consequences on the availability of water resources. (The Ministry of Environment of the Federal Republic of Nigeria, 2003). Because much of the solar energy received by the earth is used to drive the hydrological cycle, higher levels of solar energy trapped in the atmosphere will lead to an intensification of this cycle, resulting in changes in precipitation patterns (WaterAid, 2007).

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Already, 1.1 billion people worldwide do not have access to safe drinking water while 2.4 billion are without access to adequate sanitation (World Health Organization (WHO) and United Nations International Children's Emergency Fund (UNICEF), 2000). According to the impacts of climate change including sea level rise, drought, heat waves, floods and rainfall variation could by 2080 push another 600 million people into malnutrition and increase the number of people facing water scarcity by 1.8 million. Water stress conditions (for instance the disappearance of Lake Chad) according to forecasts, will worsen by 2025, and further increasing women and girl's burden of collecting and transporting water over long distances (International Water and Sanitation Centre (IRC), 2004). In Daudu community in Guma Local Government area of Benue State for instance, households now suffer from acute water scarcity due to a shorter rainy season, which has resulted in the drying out of streams and lowering of the water table. During dry season, women and children spend about three hours daily in search of water (http://www.nigeriaclimatechange.org/docs/). The relevant questions now are: what are the major sources of water for households in the area? What is the seasonality of water resources in the area? What are the effects of climate change on household water resources in the area? What are the strategies for ameliorating the effects of climate change on household water resources in the area?

Objectives of the study

The overall purpose of the study was to assess the effects of climate change on household water resources in Benue State, Nigeria. The specific objectives were to:

(i) identify the major sources of water for households in the area;

(ii) determine the seasonality of water resources in the area;

(iii) ascertain the effects of climate change on household water resources; and

(iv) ascertain the strategies for ameliorating the effects of climate change on water resources in the area.

MATERIALS AND METHODS

The study was carried out in Benue state. The State is located between longitude 7°44'E and 9°55'E and between latitude 6°29'N and 8°7'N. All the households in the State constituted the population for the study. Multistage sampling technique was used in sample selection. Benue State has 3 agricultural zones (Northern, Central and Eastern Zone). Northern and Eastern zones were randomly selecte. Two blocks (Kastina-Ala and Konshisha) were randomly selected from Eastern zone and two blocks (Gboko and Gwer-west) were randomly selected from the Northern zone too; giving a total of four blocks. In each block, two circles were randomly selected. Twenty households were randomly selected from the list of households in each circle; giving a total of one hundred and sixty (160) households. However, only 156 copies of the interview schedule were well filled and used in data analysis. Data on sex (i.e male or female), age (years), marital status (i.e single, married, divorced or widowed) were collected at the nominal level. Household size and number of years spent in the community were collected at ordinal level. Data on major source of water for households were collected by asking respondents to tick against the source of water for their households from a list provided and to indicate which source they used for each month of the year (in order to determine the seasonality of water resources in the area). Information on the effects and strategies for ameliorating the effects of climate change on water resources were collected using Lykert-type scale. Data were analyzed using percentage, mean scores and standard deviation.

RESULTS AND DISCUSSION

Table 1 shows that majority (61.5%) of the respondents were male. This shows that there were more male than female-headed households in the area. The mean age of the respondents was 46.1 years. This implies that the respondents were old enough to make rational decisions/contributions in issues regarding water provision. The results also show that majority (72.4%) of the respondents were married with a mean household size of 13 persons. This shows that households in the area are quite large implying that they could be finding the problem of water scarcity quite difficult to manage at the household level since increasing demand for water has been reported to be directly related to population growth (http://www.unfpa.org/rh/ planning/mediakit /docs /sheet3 .pdf). Majority (72.4%) of the respondents had farming as their major occupation. The finding is in line with Hilhorst, Marti, Adiya and Korrie (nd) who stated that farming is the key livelihood activity in Benue State, with yam and cassava being the main crops. The implication of this is that since agriculture in developing countries has been reported to suffer the worse negative impacts of climate change (IPCC, 2001), the livelihood of households in this area is put in serious danger by this climate change. The mean number of years spent in the community by the respondents was 29.5 years. This shows that majority of the respondents had stayed for almost three decades in the community. Since climate change occurs over timescales ranging from decades to millions of years (FAO, 2007), the implication of this finding is that they have should have had some experience with regards to the effects of climate change on water resources in the area.

Table 1. Percentage distribution of respondents according to socio-economic characteristics

Socio-Economic Characteristics	Frequency	Percentage (%)	Mean M
Sex:			
Male	96	61.5	
Female	50	38.5	
Age			
1-20	11	7.0	
21-40	64	41.3	
41-60	44	28.4	46.1
61-80	26	16.8	
81 and above	10	6.5	
Marital status			
Single	26	16.7	
Married	113	72.4	
Widowed	15	9.6	
Divorced	2	1.3	
Major occupation			
Farming	113	72.4	
Trading	11	7.1	
Civil/public service	16	10.5	
Artisanship	6	3.8	
Unemployed	2	1.2	
Native medicine	2	1.3	
Studentship	6	3.8	
Estimated monthly household income(₦)			
≤ 5000	68	43.6	
5001-10,000	28	17.9	
10,0001-15,000	8	5.1	31703.7
15,001-20,000	16	10.3	
20,001 and above	36	23.1	
Awareness of climate change			
Aware	153	98.7	
Not aware	2	1.3	
Do you think climate change effects water resources			
Yes	156	100	

Entries in Table 1 also shows that majority (98.7%) of the respondents indicated they were aware of climate change. This finding agrees with Ozor, Madukwe, Onokala, Enete et al., (2010) who asserted that most farmers in southern Nigeria are aware of climate change issues. This awareness will invariably make people in this area very responsive to actions designed to tackle the impacts of climate change on water resources in the area. From the Table, all (100%) of the respondents indicated that climate change affects water resources. This finding implies that all the people in the area are experiencing the impacts of climate change on water resources.

Major sources of water for households

Table 2 shows the distribution of respondents according to major sources of water for households. From the Table, a large proportion (45.4%) of the respondents sourced water from well within their homes, 37.4% sourced from rivers/streams/springs, 20.5% sourced from public well, 12.1% sourced from rain water, 8.6% sourced from borehole, 4.6% sourced from packaged water, 2.9% sourced from water tanker/vendors, another 2.9% sourced from ponds, 1.7% sourced from tap within their homes and 0.6% sourced from public tap.

Table 2. Percentage distribution of respondents according to major sources of water for households

Major sources of water for households	Frequency	Percentage (%)
Well within home	79	45.4
Public well	35	20.5
Tap within home	3	1.7
Public tap	1	0.6
Borehole	15	8.6
Rivers/streams/springs	65	37.4
Rain water	21	12.1
Tanker/water vendors	5	2.9
Packaged	8	4.6
Ponds	5	2.9

*multiple response

Table 4. Percentage distribution of respondents according to seasonality of water resources

Water Resources	January %	February %	March %	April %	May %	June %	July %	August %	September %	October %	November %	December %
Well	58.3	60.0	59.5	58.3	64.1	64.1	64.8	64.8	64.1	55.0	54.4	54.4
Streams/ Rivers	37.1	33.9	39.1	35.8	30.1	31.9	29.4	29.4	30.1	39.1	39.1	39.1
Rain	0.6	0.6	0.6	12.2	82.1	89.6	89.7	89.7	88.4	21.1	1.9	1.3
Pond	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.9	1.9
Tanker/Water vendor	2.6	2.6	3.1	2.6	1.9	-	-	-	-	2.6	3.1	3.1
Borehole	4.4	4.7	4.4	3.8	3.1	2.6	1.9	1.9	1.9	3.8	5.7	5.7
Satchet Water	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	1.3
Pipe-borne water	0.6	0.6	0.6	0.6	-	-	-	-	-	-	0.6	0.6

***multiple response**

The study is in line with UNEP (1999) which noted that, due to inter-annual variability of rainfall in Africa, many are becoming dependent on groundwater. Also, with De Wit (2006) who noted that in Africa, much of the population relies on surface water supplies. The implication is that people in the area are very much dependent on natural water sources which are much threatened by climate change and thus could suffer most of the impacts of climate change on water resources.

Seasonality of water resources

Data in Table 4 show the distribution of respondents according to seasonality of water resources. From the table, majority of the respondents sourced water from the well during the months of January (58.3%), February (60.0%), March (59.5%), April (58.3%), May (64.1%), June (64.1%), July (64.8%), August (64.8%), September (64.1%), October (55.0%), November (54.4%) and December (54.4%). A good proportion of the respondents sourced water from the streams/rivers during the months of January (37.1%), February (33.9%), March (39.1%), April (35.5%), May (30.1%), June (31.9%), July (29.4%), August (29.4%), September (30.1%), October (39.1%), November (39.1%), and December (39.1%). From the table also, majority of the respondents sourced water from rain during the months of May (82.1%), June (89.6%), July (89.7%), August (89.7%) and September (88.4%).

This shows that well and streams/rivers were all-year-round water sources in the area while rain is a water source for the period of May-September. Personal

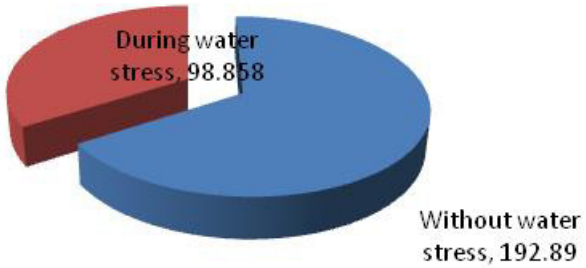

Figure 1. Mean distribution respondents according to quantity of water used by their household per day during water stress and when there is no water stress

observation showed that many people in the study area live in mud houses with thatched roofs. They therefore could not collect good quality and quantity of water during rains. Also, they are poor and many do not have large containers to conserve rain water against scarce periods. A report indicates that the changes in temperature and precipitation (as a result of climate change) have major impacts on lakes, streams, groundwater and wetlands (http://www.wicci.wisc.edu/report/WICCI-Chapter-3.pdf).
This result therefore implies that households in the area are much vulnerable to the effects of climate change on water resources since well (groundwater) and streams were the all-year-round water sources in the area.

Quantity of water used by households per day during water stress and when there is no water stress

Figure 1 shows the mean distribution of respondents according to quantity of water used during water stress and when there is no water stress. From the figure, each household could comfortably use about 192.89 litres of water if water is in abundance but because of the water scarcity, each used 98.858 litres of water per day. This shows that people in the area were using less than half the quantity of water they would ordinarily use because of the increased scarcity of water in the area.

Effects of climate change on water resources

The result of the respondents' perceived effects of climate change on water resources are shown in Table 6. The result revealed that fifteen (15) out of the thirty two (32) variables were perceived by the respondents as effects of climate change on water resources in the area. The variables include: decrease in the quantity of fish in water bodies (M=3.93), increased conflict over water resources (M=3.72), increased energy and time spent on water collection (M=3.63), increased wilting of crops in the field due to moisture stress (M=3.57), increase in the amount of money spent on water (M=3.43), decrease in the quality of surface water (M=3.39), loss of some fish species (M=3.33), decrease in groundwater level (M=3.32), decrease in groundwater quality (M=3.29), increase in water borne disease (M=3.29), shrinking of surface water (M=3.18), drying up of rivers and lakes (M=3.16), increased spread of water related diseases (M=3.04), increase in frequency of drought (M=2.67) and low rainfall intensity (M=2.59).

These findings are in line with United Nations Framework Convention on Climate Change (UNFCCC, 2006) assertion that presently, water availability is decreasing in Africa with disparities between the location of and need for water resources. UNFCCC (2001) also stated that reduction in water quantity will lead to reduction in water quality and associated impacts on health and biodiversity. On the other hand, Ozor (2008), noted that there is a widespread drying up of streams and rivers in many communities in Nigeria due to climate change ultimately leading to their search for water in neighbouring communities with the attendant man hour losses, propensity to trigger conflicts and hardship on the people.

However, three of these variables including loss of some fish species (M=3.33; 1.153), increase in water-borne diseases (M=3.29; 1.019) and increased spread of water related diseases (M=3.04; 1.102) had high standard deviation implying that the respondents' perceptions on these variables were quite diverse.

Table 6. Mean distribution of respondents according to perceived effects of climate change on water resources

Effects of climate change on water resources	M	SD
Improvement in the quality of surface water	1.93	0.595
Decrease in the quantity of surface water	3.39*	0.924
Improvement in the quality of groundwater quality	2.03	0.656
Decrease in groundwater quality	3.29*	0.974
Increase in groundwater level	2.07	0.686
Decrease in groundwater level	3.32*	0.914
Shrinking of surface water	3.18*	0.949
Drying up of rivers and lakes	3.16*	0.960
Increase in water borne diseases	3.29*	1.019
Increase in the amount of money spent on water	3.43*	0.940
Increased frequency of flooding	1.73*	0.705
Increase in frequency of drought	2.67*	0.776
Decrease in frequency of drought	1.77	0.712
High intensity rainfall	1.80	0.697
Low intensity rainfall	2.59*	0.897
More intense and frequent storms	1.75	0.642
More intense and frequent least waves	2.28	0.909
Increased energy and time spent on water collection	3.63*	0.778
Higher water temperatures	2.07	0.781
Lower water temperatures	2.13	0.811
Salinization of groundwater	1.97	0.761
Increased spread of water related diseases	3.04*	1.102
Increased incidence of wild fire	1.96	0.745
Increased erosion	1.75	0.673
Increased mortality of young fish due to rising water temperature	1.30	0.668
Loss of some fish species	3.33*	1.153
Disruption of safe water supplies through flood damage to infrastructure	1.27	0.639
Loss of crops to floods	1.30	0.618
Loss of lives and property of floods	1.35	0.733
Increased conflict over water resources	3.72*	0.679
Increased wilting of crops in the field due to moisture stress	3.57*	0.706
Decrease in quantity of fish in water bodies	3.93*	0.414

Strategies for ameliorating the impacts of climate change on water resources

Entries in Table 7 show that seventeen (17) out of the eighteen (18) variables were perceived by the respondents as strategies for ameliorating the impacts of climate change on water resources. Some of the variables include: integrated water resources management (M=3.91), clarifying the legal entitlement to water for all users (M=3.91), participatory risk assessment involving the local people and all other stakeholders (M=3.90), provision of water supply infrastructure such as pipe-borne water and boreholes (M=3.89), provision of capacity building opportunities for women to diversify their sources of livelihood (M=3.89). Others include: engaging the beneficiary community for which water provision is planned (M=3.88), encouraging local watershed management (M=3.88), organizing gender specific technical training programmes on water resources management (M=3.88), modification of irrigation techniques (M=3.88), provision of new irrigation schemes and dams (M=3.86), proper enforcement of laws on watershed protection (M=3.84), modification of cropping calendars (M=3..82), mainstreaming gender in community water management (M=3.79) and avoiding gender bias in household water provision (M=3.77).

The findings agree with IRC (1995) suggestions, that projects to supply drinking water, improve sanitation and

Table 7. Mean distribution of respondents according to perceived strategies for ameliorating the impacts of climate change on water resources

Strategies for ameliorating the impacts of climate change on water resources	Mean	SD
Provision of water supply infrastructure such as pipe borne water	3.89*	0.448
Provision of new irrigation scheme and dams	3.86*	0.471
Engaging the beneficiary community for which water provision is planned	3.88*	0.484
Integrated water resources management	3.91*	0.383
Creating awareness to the people as to the impacts or impending impacts of climate change on water resources	3.87*	0.441
Encouraging local watershed management	3.88*	0.415
Clarifying the legal entitlement to water resources for all users	3.91*	0.352
Participatory risk assessment involving the local people and all other stakeholders	3.90*	0.414
Mainstreaming gender in community water management	3.79*	0.672
Traditional breeding of crops, forage and livestock and fishery specie	3.85*	0.429
Implementation of seasonal climate forecasting.	1.74	1.241
Modification of cropping calendars	3.82*	0.514
Organizing gender specific technical training programmes in water	3.88*	0.487
Modification of irrigation techniques	3.88*	0.381
Provision of capacity building opportunities for women to diversify their income	3.89*	0.478
Avoiding gender bias in household water provision	3.77*	0.699
Afforestation initiatives	3.83*	0.441
Proper enforcement of laws on watershed protection	3.84*	0.527

protect drinking water resources should have more fundamental and developmental aims. They should not only improve local conditions and practices, but by the way they work with the people they also strengthen the latter's capabilities to bring about and preserve these changes, improve their living conditions and stimulate the undertaking of new development activities in their homes and communities. The results also show that respondents agree to the fact that gender mainstreaming in community water management can improve adaptation to the impacts of climate change on water resources; and just as IRC (2004a) noted that involving men and women in influential roles at all levels can hasten the achievement of sustainability in the management of scarce water resources. The only variable that the respondents did not perceive as a strategy for ameliorating the impacts of climate change on water resources which is implementation of seasonal climate forecasting (M =1.74; 1.241) had a high standard deviation This shows that the respondents actually had divergent views as to the potentials of this strategy in helping them cope with the impacts of climate change on water resources.

RECOMMENDATIONS

Based on the findings of the study, is was recommended that local watershed management should be encouraged. The local people should be sensitized on the need to preserve their indigenous knowledge on watershed management. They should be sensitized on the need to plant trees within their communities and especially around watersheds. Government should also embark on some afforestation initiatives to help moderate the impacts of excessive heat on the environment. There should be proper enforcement of laws on watershed protection. There is also a need for provision of water supply infrastructure such as pipe-borne water and boreholes for the communities. New irrigation schemes and dams should be provided. This can be done by adopting some cost effective locally made irrigation techniques that could be affordable by the local people

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