**OSUN GEOGRAPHICAL REVIEW**
Published by the Department of Geography, Osun State University, State of Osun, Nigeria
**ISSN: 2695 - 1959 Volume 3, 2020; 102 – 112**

# EFFECTS OF WATER SUPPLY PROJECTS IN JOS METROPOLIS, NIGERIA

***[1]A.A.Yakubu, [2]E.A.Chukwuma,**
**[3]V.E. Lekwot, [2]W.S. Sophie, [3]M.T. Obasi and [4]G.C. Yakubu**

[1]Department of Environmental Management, Bingham University, Karu, Nigeria
[2]Department of Geography and Planning, University of Jos, Jos, Nigeria
[3]Department of Environmental Management, Kaduna State University, Kafanchan, Nigeria
[4]Department of Geography, College of Education, Zing, Nigeria
**Corresponding author's e-mail: andesikutebali@gmail.com*

**Abstract**
This study examines the costs and benefits of water supply projects such as dams, reservoirs, overhead tanks, underground pipelines and water treatment plants in Jos metropolis to both government and individual water users. It utilized both primary and secondary data sources. The primary data were obtained through questionnaire administration, focus group discussion and field observation while the secondary data were sourced from Plateau State Water Board (PSWB), Central Bank of Nigeria and National Bureau of Statistics. The educational and psychological measurement table was adopted to determine the sample size of 378 from the population of 23,453 (water subscribers) which were administered with structured questionnaire. In this study frequency tables, maps, bar graphs and pie charts were used in presenting the results. The results show adequate water supply projects that are underutilized which were executed for social, political and economic reasons to provide potable water for the people. These water supply projects also bring adverse effects on the communities along the floodplains. The adverse effects on households are in form of loss of farmlands, loss of original settlements and prevalence of water related diseases. The benefits of these water supply projects to households on the other hand include reduced distance to water source, time savings, reduction in diseases rate and boost in government's revenue. The study recommends, among other things, that the government should provide alternative farmlands to displaced persons, and alternative occupations for displaced fishermen.

**Keywords:** Adverse effects, Jos metropolis, project execution, socioeconomic effects, water supply

## Introduction

The adverse effects of water supply projects on the health and productivity of man and animals manifest in areas such as incidences of water-borne diseases like malaria, schistosomiasis, cholera and a potential danger of the failure of the dams due to torrential rains or an earthquake (Ali,2018). The case of Lagdo Dam in Cameroon which led to the flooding that displaced so many states in Nigeria in 2012, brought phenomenal losses to man, the entire ecosystem and high expenditure on government and other stakeholders in water projects is a clear example. Governments all over the world have made several efforts to curtail the problem of water scarcity by building dams of several sizes: small, medium and large-scale to take care of municipal and industrial uses, irrigation and tourism. They invest heavy financial resources running into billions of Naira to boost the health of their people and economies of their nationals. But the more these water supply projects are being executed the faster the population growth outpaces the efforts and thin down water supply (Hutton & Haller, 2004).

Most of the projects undertaken in Jos metropolis such as laying of pipes, building of dams among others interfere with road construction and imposes very heavy burden on the government especially during pipe bursts and their maintenance activities. Also, the proximity of most water dams and reservoirs to communities poses very great perpetual threats to them as these serve as breeding grounds to insects such as mosquitoes and flies which are major

careers to diseases like malaria, typhoid, and cholera among others (Wong, 2013 and Ali, 2018). The sustainability or otherwise of most water supply projects depends on the consideration of environmental effects and the continuous provision of financial resources for the upkeep and maintenance of these projects to avert unforeseen environmental and social impacts of these projects on the people and the ecosystem. Some of these negative consequences are water logging and salinization, water borne and water related diseases, flooding among others.

FAO (2012) also pointed out the socio-economic impacts of water projects to include the disruption of the tenure-ship of the land through the transfer of communal land use rights, impeded and or limited access to use of water by the communities. The most significant issue arising from dam construction is the resettlement of people which would cause unnecessary problems of social dislocation from people's ancestral and agricultural lands and lack of adequate compensation of the affected population will pose some difficulties to people who have been resettled due to this process (Fahim, 1981and Ali, 2018). The aim of this study is to determine the effects of water supply project in Jos metropolis.

## Materials and Methods

### Location, Position and Size

Jos metropolis is located between latitudes $9^0$ 54' N and $10^0$ 10' N and longitudes $8^0$ 48' E and $9^0$ 30' E. The study area comprises Jos South and Jos North local government areas with their headquarters in Bukuru and Jos respectively. The area is situated within the northern senatorial zone of Plateau state, and is bounded by Barkin-Ladi and Jos East to the east, Riyom to the south and Bassa local government areas to the west (see Figure 1). The areal extent of Jos metropolis from north to south is 104km while from east to west is about 80km on an elevation of 1,250m above sea level with Shere hills having the highest peak of 1,777m above sea level with an area of 1002.19 $Km^2$ (Mohammed *et al.*, 2010).


**Figure 1:** Plateau State showing the LGAs and study area
Source: GIS LAB, Department of Geography and Planning, UniJos

**Drainage, Hydrology and Hydrogeology**

Most rivers in northern Nigeria owe their origins to the Jos Plateau due to its height above other regions in the northern Nigeria and is the source of Kaduna, Gongola, Korot, Shimanker,N'gell, Kassa, Delimi, Hadeija-Jama'are, Wase and Tenti rivers. The volumes of these rivers are high during the rainy season and low during dry seasons due to the nature of rainfall and other climatic elements of the area (Bingel, 1978, Jiya and Musa, 2012). The presence of these rivers, streams, dams, hand dug wells, ponds and springs constitute very good water resource base for the area. Some of the rivers that the government has dammed and is harnessing for potable water supply to the metropolis are Nupis, Shen, Gwash, Rafin-Sanyi, Agog rivers and Yelwa pond with Tolle Mache, Yakubu Gowon, Liberty (Laminga), Lamingo (Gwash), Kogin – giri and Yelwa Dams built on them. The intensive rainfall in Jos metropolis presents great potential for rain harvesting to the quantities that will cater for households, industries and other water consuming units' need for water right to dry periods. But the technology and the awareness for the harvesting though cheap and simple is not being embraced by most water users due to long rainy season that guarantee abundant precipitation for nine months. Apart from this, there are a lot of streams, ponds, mine pits, lakes and smaller rivers which compliment other major water sources in their raw forms which if developed along with dams will contribute potable water to the piped water system (Daloeng, 2006).

The Jos Plateau is composed of the crystalline basement complex of both igneous and metamorphic origins with younger granites and basalts as the other major rock types existing in the area. According to Schoeneich (1992), the Jos Plateau is denudational in nature and came into being at about the end of tertiary period when there was tectonic uplift of a small area of about 8,000km$^2$ in the central crystalline shield. The raised Plateau which was followed by volcanism went through denudational activities during the late cretaceous age especially on the ages of the Plateau forming valleys which were filled with basaltic lavas.

Mallo (2007), states that the Jos Plateau comprises of Precambrian basement complex rocks (migmatites, gneiss and older granites) the Jurassic younger granites (mostly biotite – granite) and the tertiary as well as quaternary volcanic rocks (basalt, pumive, lava flows and ash deposits). The Jos Plateau due to these geologic processes has risen to the heights of 1,600m, 1,777m and 1,300m at Ropp, Shere Hills and Dogon-Dutse respectively.

The combination of favourable climate, relief, soils, vegetation and abundance of natural scenic vistas, the city presents very great opportunities and potentialities for agriculture, mining, trade, industrial production and recreation and tourism. Some of these attractions' sites are: Shere hills, Jos Museum and Zoological Gardens, Jos Wild Life Park, Riyom Rock, Solomon Lar Amusement Park. Also, the presence of higher institutions of learning, stadia, Tertiary institutions, good road network, water supply infrastructure, waterfalls, mining ponds, ongoing mining activities in Jos metropolis, though environmentally destructive presents very beautiful tourist attractive sites to every visitor to Jos City (Ali, 2018).

**Climate**

Jos metropolis experiences AW climatic type and falls within the koppens AW climatic sub-region. Generally, weather conditions are warmer during the rainy season (April-October) and much colder during the hammattan period (December-February) (Ariyo, 2000). The mean annual temperature of the city ranges between 20$^0$c and 26$^0$c. These temperature ranges are due to influences of rainfall, relief and cloud cover at different periods and seasons of the year. Relative humidity is lower during the dry season between November to March and is very high during the wet season with the peak values of between 81% and 84% in July and August (Bingel, 1978, Ariyo, 2000, Nyong, et al, 2003, Nyong, et al 2008).

Precipitation on the Jos Metropolis ranges from 70cm to 100cm during the peak period. The study area has wet and dry seasons. The wet season takes about 8 to 9 months between mid-March and end October, while the dry season takes about 3 to 4 months from mid-November to mid-March (Ariyo, 2000). The wet season is influenced by prevalence of the warm moist maritime south westerly monsoon winds which blow from the Atlantic Ocean south westward hinterland while the dry season is linked to the dry tropical continental north easterly winds (Hammattan) a cold dry and dusty mass blowing from the Sahara Desert (Ariyo, 2000).

**People and Population**

Jos metropolis comprises of Jos city and Bukuru town which have fused together due to long years of urbanization and population growth. The metropolis

has two local government areas – Jos South and Jos North local government areas and expanding to cover parts of Bassa, Jos East, Riyom and Barkin-Ladi by the urbanization efforts of the state government through the implementation of the Greater Jos Master Plan. Jos has a heterogeneous population with Berom, Anaguta, Afizere, with few of Jere and Buji in Bassa and Jos North Local Government Areas. The other major ethnic groups of Plateau extraction residing in the city include Ron, Mushere, Ngas, Pan, Geomai, Mwagavhul, Tarok, Irigwe, Mupun, Amo, all numbering up to fifty (50) and above. The city is cosmopolitan in nature as it has nearly all Nigerian ethnic groups residing in it, some of which include Yoruba, Igbos, Hausa-Fulani, Tiv, Kuteb, Jukun, Ibibio, Idoma,Igala among others, attracted partly from all over the country by mining activities and her status as the capital city (Ali, 2018).

The population of Jos city is put at 1,387,795 based on the 2019 population projection (National Population Commission, 2006). It has a density of about 391 persons per square kilometre and is the most densely populated and urbanized place in Plateau State. Due to the presence of so many higher institutions, church institutions, commercial activities, administrative activities which have over the years mobilized and are continuously attracting labour, capital and entrepreneurship, all these have combined to make Jos to assume the status of a cosmopolitan city.

**The Economy of the Area**

The economy of Jos metropolis consists of varied human activities and prominent among these are; farming, civil service, industrialization, mining, trading and cattle rearing. The favourable climatic conditions associated with relief favour the production of crops like Irish potatoes, apples, grapes, wheat, barley and so many varieties of vegetables both for direct consumption and for use by the manufacturing firms. The other farm produce of the area include sorghum, maize, acha, tomatoes, green beans and variety of vegetables which are grown throughout the year through rain-fed at wet season and irrigation using the ponds water and streams during the dry seasons.

The other type of agricultural activity undertaken in the area is animal husbandry and fish farming. Apart from the cattle reared at the Federal college of Land Resources Technology and National Veterinary Research Institute (NVRI) Vom, a lot of individuals rear cattle, goats, and poultry as their main occupations. Fish farming is being undertaken on a small scale in the mine ponds and in many homes as backyard ponds in Jos metropolis. The existence of Grand Cereals Limited in Bukuru which produces feeds for all kinds of livestock coupled with the favourable weather conditions have played significant roles in agricultural development of the area (Ariyo, 2000).

Some of the existing industries in Jos are NASCO, Grand Cereals Ltd, Diamond Paints; Swan Paints Ltd, Nigerian Bottling Company, SWAN PLC and WAMCO. Ariyo (2000) pointed out that over sixty (60) of these firms operate in the metropolis, in different sizes and capacities. Companies such as Jos International Breweries, Zuma Steel West Africa and others have been shut down and pushed all their employees into the labour market due to poor management, economic recession and high costs of doing business in Nigeria. The civil service, out of all these human activities is the dominant sector before agriculture engaging over fifty percent (Ariyo, 2000 and Krause, 2011).

Data for this study were derived from both primary and secondary sources. The primary data were generated from administration of questionnaire, focus group discussion and interview of relevant stakeholders. Data on water supply projects like dams, pipelines and reservoirs and their locations were obtained from field survey, Plateau State Water Board data base, Federal Ministry of Water Resources' reports and these sources were complemented by interviews of stakeholders from Plateau State Water Board, Jos.

The social and economic effects of water supply projects to individuals were obtained through questionnaire administration, focus group discussion and interviews of both water subscribers and Plateau State Water Board staff.

**Sampling Techniques and Procedures**

Jos metropolis has been designated into 21 water supply districts (Bukuru A - D) and (Jos A - O) by Plateau State Water Board. Each district has varied number of residents that are connected to piped water system as shown in Table 1totalling 23,453. The sample size of 378 was determined using the Educational and psychological measurement table of Krejcie and Morgan (1970) at 95% confidence level with a degree of accuracy of 5%. The researcher adopted a systematic sampling approach in the

selection of some districts for questionnaire administration.

This technique was used for selecting the 1st district and every third order district, out of 21 Water Board districts for questionnaire administration. This sampling technique is more convenient than simple random sampling as it ensured that each unit selected has equal probability of being included in the sample. It also ensures that selections are spread more evenly over the population; it ensures nearly evenly distributed spatial spread and achievement of fair representation. The districts were first listed alphabetically and after selecting the first district, each 3rd district was selected and this brought the number to seven districts with a connection population of 8,402.

To arrive at the number of respondents in each of the seven districts, the population of piped connections of each of the districts was divided by total 8,402 and multiplied by 378 as depicted in Table 1. A purposive sampling method was adopted in the administration of questionnaires on household heads from each of these seven selected districts. The choice of the sample type is due to the fact that most houses are not numbered and this approach has enabled the researcher to administer questionnaire to only houses that are connected to piped water system while household heads are selected because they pay and connect households to piped water system and would have more experience than other family members. Completed questionnaire was retrieved from 376 respondents representing 99.4% of the 378 household heads from the seven (7) districts sampled systematically from the 21 Water Board designated districts in Jos metropolis were retrieved (as shown in Table 1).

The sample size is determined using the following formula developed by Krechcie and Morgan (1970):

$$n = \frac{X^2 * N * P(1-P)}{(ME^2 * (N-1)) + (X^2 * P * (1-P)} \quad \text{---------- (1)}$$

Where;

n= sample size

$X^2$= Chi square for the specified confidence level at 1 degree of freedom

N= Population size

P= Population proportion (.50 in the table)

ME= Desired margin of error (Expressed as a proportion)

**Table 1:** Number of piped connections and water supply districts in Jos metropolis

| S/N | Location (Name of District) | Number of Piped Connections | Sampled Size |
|---|---|---|---|
| 1 | Bukuru A (Fire Service) | 1266 | 57 |
| 2 | Bukuru B (Yelwa) | 1089 | |
| 3 | Bukuru C (Rahol Kanang) | 1203 | |
| 4 | Bukuru D (Metred) | 487 | 22 |
| 5 | Jos A (Main) | 1415 | |
| 6 | Jos B | 1116 | |
| 7 | Jos C (Lamingo) | 1521 | 68 |
| 8 | Jos D (Nassarawa) | 2331 | |
| 9 | Jos E (Kabong) | 1049 | |
| 10 | Jos F (Central) | 2334 | 105 |
| 11 | Jos G (U/Rogo) | 1703 | |
| 12 | Jos H (Kufang) | 1636 | |
| 13 | Jos I (Laranto) | 957 | 43 |
| 14 | Jos J (Fudawa) | 853 | |
| 15 | Jos K | 883 | |
| 16 | Jos L (Ali Kazaure) | 597 | 27 |
| 17 | Jos M (Federal Lowcost) | 1299 | |
| 18 | Jos N (Industrial) | 35 | |
| 19 | Jos O (Rikkos) | 1240 | 56 |
| 20 | Jos P (Utan) | 249 | |
| 21 | Jos Q (Rayfield) | 189 | |
| | TOTAL | 23452 | 378 |

**Field Work and Field Survey**

Three methods were used to generate the data used for this research: the use of questionnaires, interviews and focus group discussion. Questionnaire administration is the major instrument for primary data collection for this study. Three hundred and seventy-eight (378) questionnaires were administered to purposively sampled respondents in seven (7) Water Board districts of Jos metropolis, after two weeks 376 of the duly completed instruments were retrieved and analysed.

Interview method was adopted to generate information through personal dialogue with stakeholders of Plateau State Water Board Jos to get the data that will also complement those elicited through the use of questionnaires and documented sources.

To be able to fill the gaps in the questionnaires and achieve fairness in coverage of research matrix for data integrity, the study identified water users in various locations for discussions especially households located near the dams who were not covered in questionnaire administration and interview. This has complemented the data generated through interviews and questionnaire administration. FGD was undertaken in seven sampled districts of Bukuru A (Fire service), Bukuru D (Metred), Jos C (Lamingo), Jos F (Naraguta), Jos I (Laranto), Jos L (Ali Kazaure), Jos O (Rikkos) with fourteen persons comprising of five (5) women, five (5) children, two (2) youths and one (1) adult. The choice and the composition have more women and children than the youths and men because they are the ones that always go to fetch and use water more than youths and men who spend less time at home. This approach was undertaken to obtain responses on time spent by women and children in fetching water, amount spent as transport to and from water points, amount spent to buy water, nature of ailments associated with their closeness to water supply projects and amount spent on curing these ailments, their level of access to these water points for recreation, fishing and swimming.

In this study, mainly descriptive statistical tools were used in data presentation and analysis. The descriptive statistics used for presentation and analysis of data are frequency tables, bar graphs, pie charts, mean and standard deviation.

**Results and Discussion**

These dams and their rivers are shown in Table 2 and Figure 2, the dams were built (constructed) on Rivers Rafin-Sanye, Nupis, Agog , Gwash, Shen River and Yelwa pond for mainly water supply purposes. Plateau State Water Board maintains a number of dams numbering six in Jos metropolis which supply raw water to treatment plants for processing. These dams as shown in Table 2 include Kogingiri, Laminga (Liberty) Lamingo (Gwash), Tolle mache, Yakubu Gowon and Yelwa/Bukuru dams. These dams were constructed at different times and at different sizes with a combined daily capacity of 117,000$m^3$ to provide potable water for the teeming urban population in Jos metropolis. Out of the 23 dams in Plateau State, six are located in Jos metropolis and were built by Plateau State and colonial governments mainly for potable water supply. The remaining dams located outside Jos metropolis were built by NESCO, River Basin Development Authority and the Ministry of Agriculture for hydroelectricity generation, irrigation and water supply (FMWR, 2012). The three largest rivers, the Niger, Benue and Cross River and their tributaries draining the whole country provide ample sites for the construction of dams for all purposes (FMWR, 1991).

**Table 2:** Location of dams and their rivers

| S/No | Name of Dam | Longitude | Latitude | River | Location |
|---|---|---|---|---|---|
| 1 | Yakubu Gowon | 8.97324 | 9.76574 | Shen/Yingi | Ratt B/ladi |
| 2 | Laminga (Liberty) | 8.92374 | 9.8919 | Rafin-Sanye | Jos North |
| 3 | Yelwa | 8.8727 | 9.8 | Yelwa pond | Bukuru |
| 4 | Lamingo (Gwash) | 8.95011 | 9.89514 | Rafin-Sanye | Jos North |
| 5 | Tollemache | 8.96783 | 9.89574 | Nupis | Jos North |
| 6 | Kogingiri | 8.936189 | 9.929282 | Agog | Jos North |

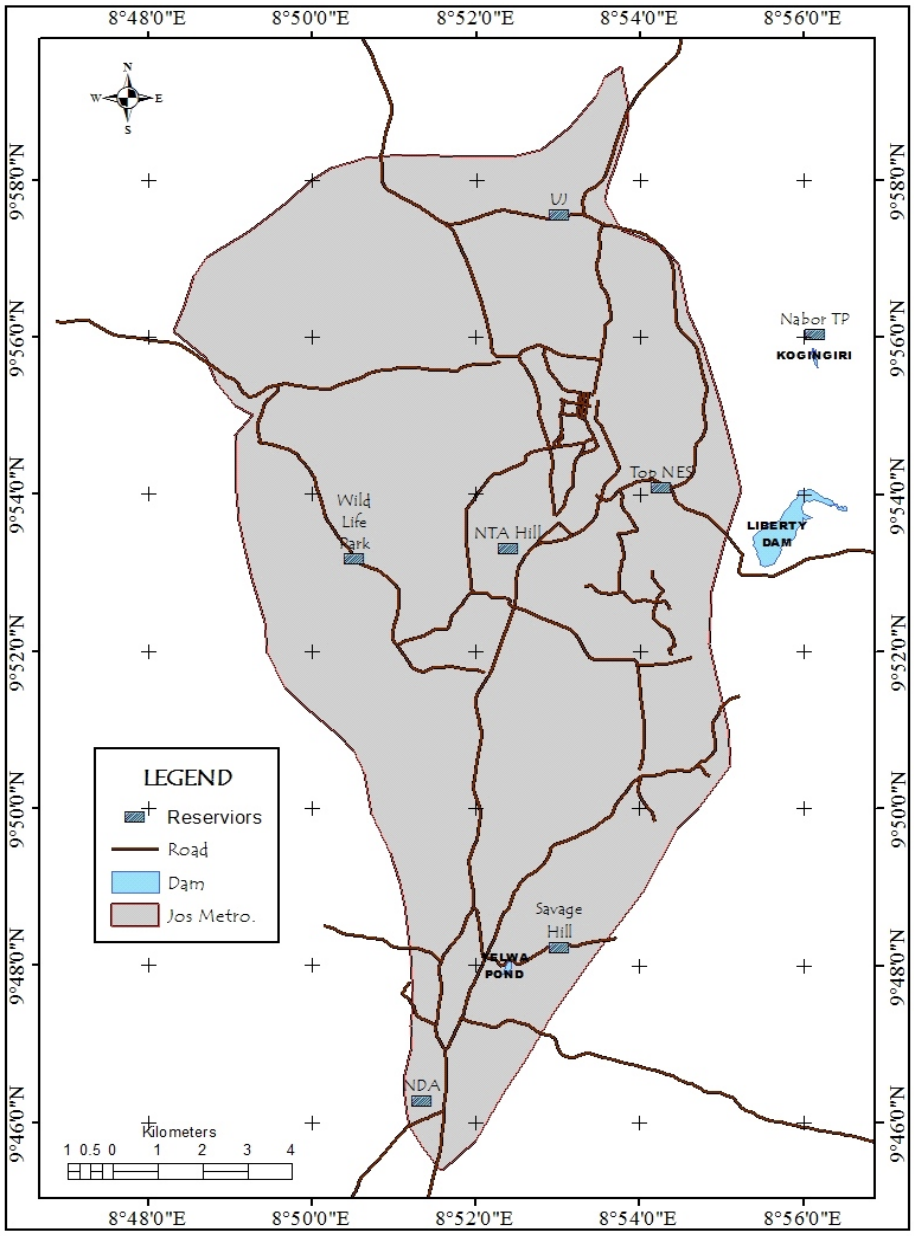


**Figure 2:** Jos Metropolis: Locations of Dams and their Rivers
Source: GIS LAB Department of Geography and Planning University of Jos, 2016

The costs and benefits of water supply projects to users and water supply service providers in Jos metropolis cannot be over stressed as they are also enormous. However, there are adverse socioeconomic and environmental effects of these projects on both government and people of Jos metropolis, Plateau State.

### Adverse Socioeconomic Effects of Water Supply Projects (WSPs) on Water Users

Some of the adverse effects as shown in Table 3 include forceful acquisition of farmlands, long gestation periods, denial of access to source of water, fishing ground and recreation. Nearness to water supply projects according to those surveyed in Table 3 shows that there were resettlement issues, loss of farm lands, loss of water sources, loss of fishing grounds and denial of access to fishing grounds, swimming ground and recreation area. 63.0% of those surveyed suffered forceful eviction from their farmlands.

13.0% on their part said that there were issues of resettlement and lack of compensation which led to denial of their access to sources of water, 15.4% said that they have problems of access to water for fishing purposes, those who use the rivers for recreational activities in which 16.5% and 24.5% of respondents

lost their farmlands and are denied free access to their source of livelihoods. Above 7% of respondents said they lost their natural fishing grounds too to Plateau State Water Board and 7.7% said that they are not allowed to go for swimming and other recreational activities on these rivers any longer. These activities as revealed by an interaction with staff of Plateau State Water Board would bring about high level pollution and a heavy water production cost to the Board if such activities are allowed unchecked.

The remaining 8.2% said they are denied access to these water bodies for recreational activities like swimming. Other negative impacts associated with water supply projects are risk of flooding (30.9%), long gestation of maturity of government investment (33.0%), 5.9% of respondents said that those living along floodplains are affected adversely. Thirty percent (30.3%) of the residents said that all of the above negative effects affect their households.

The interactions with the focus group revealed that their women and children are more affected due to their involvement in sourcing and usage of water and stand to bear serious adverse effects of diseases incidences and prevalence, prevention of access to water resources for their traditional occupations of farming, fishing and recreation. This result agrees with Fahim (1981) on the adverse effects of construction of Aswan high dam in Egypt which included water loss through seepage, water logging, high salinity, problem of disease menace, high risk of flooding and loss of original species of flora and fauna.

Sickness and diseases constitute serious social and economic burdens to mankind as man contracts diseases through water, food and air. Sicknesses such as typhoid, cholera, malaria and schistomasis are water related. Most of water users (residents) around water supply projects interviewed in Lamingo, Shen, Du and Rikkos areas said there is high incidence of water borne diseases around the water supply projects. While 54.0% in Table 4 indicated that the quality of water supply determines the nature of health of residents, 46.0% said water borne diseases are not found to have any linkage with water supply projects in Jos metropolis.

The same Table 4 showed the number of persons in households who took ill due to nearness to water supply projects. In a year, 1 – 3 persons (38.6%) within their households took ill, while 27.4% were of the view that between 4 – 6 members get sick in a year. 16.8% household members were affected by the sicknesses range between 7 and 9 while 65 residents surveyed said their members who took ill are more than 9 in number.

Days of sickness suffered by these persons are said to range between 1 to over 9 days as shown in Table 4, 84.6% of the respondents said that their household members were sick for between 1 – 3 days while 14.6% said that their members were sick for between 4 – 6 days, while only one (1) and two (2) respondents respectively are of the view that theirs that fall ill suffered for 7 – 9 days and above 9 days respectively. These people spent between N1,000 to more than N20,000 for the number of days they live with the sickness as seen in Table 4. 24.2% of these household heads spent between N1,000 –N5,000 on self-medication, non-hospitalized and hospitalized treatments as the 49.7% said they spent between N6,000 – N10,000 on treatment of their sick ones.

**Table 3:** Negative Effects of Water Supply Projects

| S/No | Variables | Classes | Frequency | Percentage |
|---|---|---|---|---|
| **1** | **Negative effects of nearness to WSPs** | | | |
| | | Forceful acquisition of farm lands | 238 | 63.3 |
| | | Denial of access to source of water | 49 | 13.0 |
| | | Denial of access to fishing ground | 58 | 15.4 |
| | | Denial of access to water for swimming and recreation | 31 | 8.2 |
| | | **Total** | **376** | **100.0** |
| **2** | **Other Adverse effects of WSPs** | | | |
| | | Risk of flooding | 116 | 30.9 |
| | | Long gestation period tie down government capital | 124 | 33.0 |
| | | People on flood plains are prone to water related ailments | 22 | 5.9 |
| | | All of the above | 114 | 30.3 |
| | | **Total** | **376** | **100.0** |

Source: Field Survey, 2018

62 respondents in same Table 4 spent amount ranging from N11,000 to N20,000 to treat their sick ones and those who said they treat their loved ones with more than N20, 000 constitute only 9.6% of the total number of residents surveyed. In most areas interviewed, due to lack of coverage of water supply services, water is short in supply and majority of the households have less than 20 litres of water per person per day and this gives rise to poor sanitation and hygiene condition of the people resulting to cases of diseases such as diarrhoea, dysentery, malaria and typhoid.

**Adverse Socioeconomic Effects of Water Supply Projects**

Most of the water supply projects undertaken by government are meant to fulfil social objectives of disease eradication and guaranteeing of the health of the citizenry.

Apart from costs and benefits of water supply projects, there are associated adverse social, economic and environmental issues associated with water supply projects in Jos metropolis. More than 57.0% of the respondents in Table 4 assert that there are negative effects associated with these projects and 42.3% on the other hand said that there is no any impact of water supply projects on them. The nature of the problems according to respondents is such that 26.3% said that the water is not so clean, 33.8% said that the water services are expensive and so resort to raw water, 26.1% viewed the water services as difficult to access and this may be due to their longer distance from pipelines while 13.8% of the respondents said that all the above issues are all associated with water supply projects in Jos metropolis. Majority of respondents (56.1%) view these problems of diseases, lack of access and denial of access to carry out their economic activities associated with water supply projects to be a recurrent decimal, 10.4% are viewing same in opposite direction noting that these problems are not always recurrent, 30.6% said that the problems are non-existent and only 2.9% are undecided about the problem posed by water supply projects in Jos metropolis.

The people that are particularly affected by the adverse effects of these projects are those who live along flood plains and water subscribers. 23.7% as shown in Table 5 said that people living along flood plains are most affected, 51.3% of the respondents are of the view that water supply subscribers are the worse hit while 25.0% were of the view that the two group of people are all affected by these negative effects of nearness to water supply projects. Over Sixty-two (62.2%) of the households experienced and suffered from malaria, typhoid was affected by 12% of households, 4.3% of the respondents suffered from the scourge of cholera while 21.5% were affected by all of the above mentioned ailments due to their nearness to water supply projects in Jos metropolis.

**Table 4:** Adverse Effects of Water Supply on Health of Households

| S/N | Variable | Classes | Frequency | Percentage |
|---|---|---|---|---|
| 1 | Problems with water supply | Yes | 217 | 57.7 |
| | | No | 159 | 42.3 |
| | | **Total** | **376** | **100.0** |
| 2 | Nature of problems with water supply | | | |
| | | Not clean | 99 | 26.3 |
| | | Expensive | 127 | 33.8 |
| | | Difficult to access | 98 | 26.1 |
| | | All of the above | 52 | 13.8 |
| | | **Total** | **376** | **100.0** |
| 3 | Frequency of household's experience of negative experiences with WSPs | | | |
| | | Always | 211 | 56.1 |
| | | Not always | 39 | 10.4 |
| | | Not at all | 115 | 30.6 |
| | | Others | 11 | 2.9 |
| | | **Total** | **376** | **100.0** |

Source: Field Survey, 2018

**Table 5:** People Affected and Health Effects of Nearness to WSPs

| S/No | Variables | Classes | Frequency | Percentage |
|---|---|---|---|---|
| 1 | People prone to the adverse effects of WSPs | People living along flood plains | 89 | 23.7 |
| | | Water subscribers | 193 | 51.3 |
| | | All of the above | 94 | 25.0 |
| | | **Total** | **376** | **100.0** |
| 2 | Health challenges experienced due to proximity to WSPs | | | |
| | | Cholera | 234 | 4.3 |
| | | Typhoid | 45 | 12.0 |
| | | Malaria | 16 | 62.2 |
| | | All of the above | 81 | 21.5 |
| | | **Total** | **376** | **100.0** |

Source: Field Survey, 2018

The interactions with the focus group revealed that their women and children are more affected due to their involvement in sourcing and usage of water and stand to bear serious adverse expects of diseases incidences and prevalence, prevention of access to natural water resources for their traditional occupations of farming, fishing and recreation.

A study by Oruonye (2015) corroborated that water supply projects led to displacements of several communities and creation of resettlement camps in some cases. The study also showed other impacts to include loss of farmlands and historical areas used for local cultural festival and the emergence of some diseases among the people of Jinagbanshin, Lukpo, Shibon Igba and Bariki Lisa as a result of the impoundment of the river Kashimbilla in Taraba State.

## Conclusion

The study has shown that the development of water supply projects in Jos metropolis though to cater for needs of the people for drinking, washing and general economic and health wellbeing of the citizenry come with serious socioeconomic effects. These projects have led to outbreak of cholera, dysentery and other water related diseases among the people living close to these projects.

## Recommendations

1. The Government through the Plateau State Water Board should provide alternate farmlands, fishing grounds, water for irrigation and recreation grounds to those who are denied access to their ancestral lands.
2. People who feel threatened by the risks of flooding and water related ailments associated with WSPs should voluntarily migrate to places that are safe for their habitation and livelihood pursuits.
3. The government should provide partially commercialize and privatize their water supply projects to realize their full or partial costs due to long gestation periods of these projects.
4. People living near water supply projects and do not have access to pipe borne water supply should resort to rudimentary water purification process like the use of alum, boiling and sieving to minimize the burden of sicknesses and diseases.

## REFERENCES


Ali, A.Y. (2018). Cost benefit analysis of water supply projects in Jos metropolis, Nigeria, A PhD thesis submitted to Department of Geography and Planning, University of Jos

Ariyo, J. A (2000). Plateau State in Mamman, A. B et.al (eds) Nigeria: A People united, A Future Assured, Survey of States,Gabumo Publishing Company Ltd, Abuja Vol. II.

Bingel, A.D (1978). Jos: Origins and Growth of the Town 1900 to 1972. University of Jos, Department of Geography Publication No 1, Nigeria 1978

Daleong, H.M (2006). The Sustainability of Rural Water Supply Projects in Districts of Qua'an Pan L.G.A Plateau State. An Unpublished M.Sc Geography Thesis of University of Jos, Nigeria.

Fahim, H.M. (1981). Dams, people and development. The Aswan high dam case, Pergamon Policy Studies,

Pergamon Press, New York, Oxford, Toronto, Sydney, Paris and Frankfurt.

FAO (2012). Coping with water scarcity: An action framework for agriculture and food security. Food and Agricultural Organization of the United Nations, Rome, Italy.www.fao.org,org/asscessd3/3/2014

FMWR (1991). The journey so far (1985-1991) Federal Ministry of Water Resources, Abuja: Old Secretariat, Area 1, Garki.

FMWR (2012). The project for review and update of Nigeria National Water Resources Master Plan, Progress Report 1, JICA, Yachiyo Engineering Company Nigeria Ltd, CTI Engineering International Company Ltd and Sanyu Consultants Inc.

Hutton, G., & Haller, L. (2004). Evaluation of the costs and benefits of water and sanitation improvements at the global level, water, sanitation and health promotion of the human environment, World Health Organization (WHO) Geneva.

Jiya, S. N & Musa, H.D (2013). Impacts of derived Tin Mining Activities on Land use/land cover in Bukuru Plateau State, Nigeria. Journal of Sustainable development.5 (5): 90-96.

Krause, J (2011). A Deadly Cycle: Ethno – Religions Conflicts in Jos, Plateau State, Nigeria. Geneva Declaration, Working Paper, Geneva, Switzerland.

Krejcie, R.N., & Morgan, D.W. (1970). *Determining Sample Size for Research Activities.* New York: Academy Press.

Mohammed, S. O, Gajere, E. N, Adigun, A. B &Folayan, O.O (2010). A Study of the Relationship between Land use Surface Temperature and Land use/Land cover Characteristics using Remote Sensing and GIS Techniques in Jos Metropolis. Nigerian Journal of Space Research 9:77-88.

Mallo, S. J. (2007), Minerals and Mining on the Jos Plateau. ACON Publishers, Jos Nigeria

National Population Commission (2006). Population and housing census of the Federal Republic of Nigeria, *2*, Lagos: Federal Government Printers.

Nyong, A, Dabi, D.D, Adepetu, A, Berth, A & Ihemegbulem, V (2008). Vulnerability in the Sahelian Zone of Northern Nigeria. A Household Level Assessment. Journal of Climate Change and Vulnerability, Earth Scan pp 218 – 38.

Nyong, A. O, Adepetu, A, A, Ihemegbulem, V. C & Dabi, D.D. (2003). Vulnerability & Adaptive Capacity of Rural Populations in the Sahel to CC and Climate Variability: A case Study of Semi-Arid and Northern Nigeria. A paper Presented at the EMF Snow Mass Workshop "CC Impacts and Integrated Assessment" July 28- August 6, Snowmass Colorado, USA

Oruonye, E.D (2015). Assessment of the Socio-economic Impact of Kashimbilla Multipurpose dam Project in Takum LGA, Taraba State, Nigeria. Global Journal of Interdisciplinary Social Science 4(5): 9-15

Plateau State Water Board (2012). Schedule of Bills Payments and Water Board Districts and Number of Households Connected to Piped Water System. An Unpublished Report.

Schoeniech, K (1992). The Geomorphological History of the Jos Plateau. Jos Plateau Environmental Resources Development Programme Interim Report No. 30

Wong, E.S. (2013). Damning the dams: A study of cost-benefit analysis in large dams through the lens of India's Sardar Sarovar Project. A Bachelor of Arts Project submitted to Scripps College.

# NOTE TO CONTRIBUTORS

The *Osun Geographical Review* is an academic journal published twice a year (June and December) by the Department of Geography, Osun State University, Osogbo, Nigeria.

The *Osun Geographical Review* publishes original research papers and review articles all of which pass through peer review. Papers for consideration cut across the various fields of Geography, Urban and Regional Planning, Geographical Information Systems and Remote Sensing, Agriculture, Environmental Sciences, Sciences, Social Sciences and Humanities.

An article submitted for consideration should not exceed 20 pages typed double-spaced in MS Word 2003/2005 on A4 paper. An abstract of not more than 200 words stating the problem, methodology, findings and conclusion should accompany the article.

Contributors are expected to state in full, their names, address, telephone, e-mail and institutional affiliation on a separate cover page as all manuscripts are sent out for blind peer review.

The Harvard (author, date) system of referencing should be used. Footnotes should not be used at all.

In the text, references to publication shall appear as follows: "Adeniyi (2017) reported that"; Or "This problem has been a subject of debate in the literature before (Samuel, 2015). If there are 2 authors use 'and ': Asiyanbola and Yakubu (2016); but if citied within the parentheses use '&': (Asiyanbola & Yakubu, 2016).

**Journal:** Omisore, E.O. (2012): Conservation of historical sites in Ile-Ife, Nigeria: A factor analytical approach. *Ife Research Publications in Geography* Vol.11: 1-13.

**Book:** Ologunorisa, T.E. (2006): *Flood Risk Assessment and Management in Nigeria*. Selfers Educational Books, Makurdi.

**Chapter in book**: Ekanade,O. (2006): Climate change and land use scenarios for 21st century. In: Adejuwon, J.O. and Ogunkoya, O.O. (Eds). *Climate Change and Food Security in Nigeria*. Obafemi Awolowo University Press, Ile-Ife, pp.157-168.

**Thesis:** Odekunle,T.O. (2003): *Rainfall Predictability in Southwestern Nigeria*. Unpublished PhD Thesis, Department of Geography , Obafemi Awolowo Universty, Ile-Ife, Nigeria.

Note that all citations in the text must be listed in the reference list.

**Tables:** Each table should be numbered in sequence using Arabic numerals (e.g. Table 1). A table should also have a title that summarizes the whole table with a maximum of 15 words. Tables should be inserted one after the other in the main text of the manuscript submitted for consideration.

**Figures:** All line drawings and photographs are classified as figures. Figures should also be inserted one after the other in the main text of the manuscript submitted for consideration.

Note that any manuscript which does not conform to the above instructions may be returned for necessary compliance before it is subjected to review.

The original manuscript should be submitted electronically to:

The Editor-in-Chief
*Osun Geographical Review*
Department of Geography
Osun State University, Osogbo, Okuku Campus
E-mail: