



## Assessment of the Influence of Climate Change on Sustainable Water Supply in Osogbo, Osun State, Nigeria

Wale Adewoye\* and Olugbenga Adewale

### Abstract

The need to improve the standard of living necessitates the reasons to provide facilities and increases the land uses. However, there is the need to prepare for the side effect of high technological uses and the sustainability of the environment. Increase in land uses alters the natural cycles which is indirectly leads to global warming.

The paper takes a critical look on how climate change influences sustainable water supply in Osogbo, Osun State. Arise from the aim; the data source was from the secondary sources i.e. from Nigeria Meteorological Agency and the Erinle water dam. The sources are the official climate data provider in Nigeria and water supply provider in Osogbo, Osun State. Regression analysis was used to determine the relationships between the climatic elements and water supply at the end, it was discovered that there is a very weak relationship between the climatic element and water supply in Osogbo, Osun State. However, the study suggests that there is the need for urgent measures because of the ever increasing urban population and the pressure on the land uses as a result of socio-economic activities in the area. It is therefore become very imperative for the policy maker to include the menace of climate change into the policy formulation to create a synergy for sustainable water supply in the city.

### Keywords

Climate change; Sustainable development; Water supply

### Introduction

For a country or a region to become environmentally sustainable, it means that all the parameters that confer environmental sustainability must have been adequately taken care of. It also means that country would witness less poverty among its citizens, food security, less conflict; use of clean technology in the industrial sector [1] Environment provides all it needed to survive in the air, on water and on land. However, Nigeria environment is nothing to discuss because of its glooming picture across the total area of the country.

Environmental problems develops in various forms like erosion which can be inform of sheet erosion where large area of surface soil is lost, gully erosion which is disastrous and very rapid among the states in the South and South east geographical zones and some areas in the North east geographical zones especially in Gombe state [2] Coastal

and marine erosion is not left out this is a particular occurrence in Lagos state of the South western part of the country.

Another major environmental problem in Nigeria is flooding which occur throughout the country in three main forms of coastal, river and urban flooding. Though it is seasonal it most especially in wet season along the river bank, the mangrove zone and the swampy area of the country [3]. Desertification and drought is also a very serious environmental problem in Nigeria. This is the experience in the Northern part of the country where the vegetation type has been altered and the zone is gradually turning to a desert. This has therefore has a derelictions on the socio economic activities of the people living in the affected area.

Pollution most especially land, water and air pollution has done a lot of damages to the flora and fauna of the country. The natural habitat has been destroyed thereby making a serious effect on the natural ecosystem.

### Urbanization and congestion

This is a situation in our urban centers where there are pressures on the available natural and human resources. Cities like Lagos, Ibadan, Kano, and Port Harcourt etc experience rapid urbanization and congestion which later lead to the development of slums

### Solid waste disposal

Municipal waste heap is an eyesore in most of our cities, drainages are blocked; motorways are blocked making passages along the pedestrian lane very difficult. Specifically, non-biodegradable element like polythene bags plastic containers, Styrofoam packages tyres etc are common features in our cities.

However, Nigeria has a country, has key in to the concept of sustainable development of the United Nation General Assembly. Out of the seventeen goals of sustainable development, goal thirteen focuses on climate action where an urgent action is needed to combat climate change. Climate change or global warming is due to an increasing concentrations of atmospheric warming gases or greenhouse gases (CHG) especially carbon IV oxide (CO<sub>2</sub>) whose concentrations have increased from 280 part per million (PPM) in the 1800s to about 370 ppm now. To achieve a sustainable environmental management in Nigeria, access to water is very vital. Water is the most common substance on earth. It is more than 70% of the earth surface. It fills the oceans, rivers, and is to the ground and on the air we breathe.

The paper therefore makes a critical assessment of the influence of climate change on the sustainable water supply in Osogbo, Osun state, Nigeria.

### Research Problems

Osun state is most urbanized state in the country and this has great consequences on the land cover. There are various land uses and these have great effect in the environmental cycles i.e. Water, Nitrogen, Carbon etc. It therefore becomes imperative because of the environmental degradation occasioned by urbanization, socio economic activities which induced climate change. It is pertinent to have a critical assessment of how change in climate occasioned by

\*Corresponding author: Wale Adewoye, Department of Surveying and Geoinformatics, Esa-Oke-Osun State College Technology, Esa-Oke-Osun State, Nigeria, Tel:+2347036916399; E-mail: waleadewoye@gmail.com

Received: July 22, 2019 Accepted: July 30, 2019 Published: August 07, 2019

change in its element affect the sustainable water supply in the state capital, Osogbo.

The study intends to fully investigate the consequences of climate change on water supply in order to maintain the present and make provisions for the future. Consequent upon this, the study make a recommendation on the ways of improvement that can lead to sustainable water resources management in the region.

### The Study Area

Osun state was carved out of Oyo state on August 27, 1991. Its capital is Osogbo. It is located in south west of Nigeria. Osun state is landlocked; known as the state of virtuous. It occupies a land mass of approximately 14,875 km<sup>2</sup>. It lies between latitudes 06°, 55N and 08°, 07N, and longitude 04° 06N and 05° 05E. Osun state shares borders with Kwara state to the north Oyo state to the west, Ogun state to the south and Ondo and Ekiti states to the East (Figures 1 and 2). The state is currently made up of 30 local government areas (LGAs) and one Area office Ife-East Area office with its the headquarters at Modakeke. The LGAS spread across six administrative zones of Osogbo, Ede, Iwo, Ikirun, Ilesa and Ile-Ife. The zones are further classified into 3 senatorial districts namely Osun west, Osun central and Osun East [4].

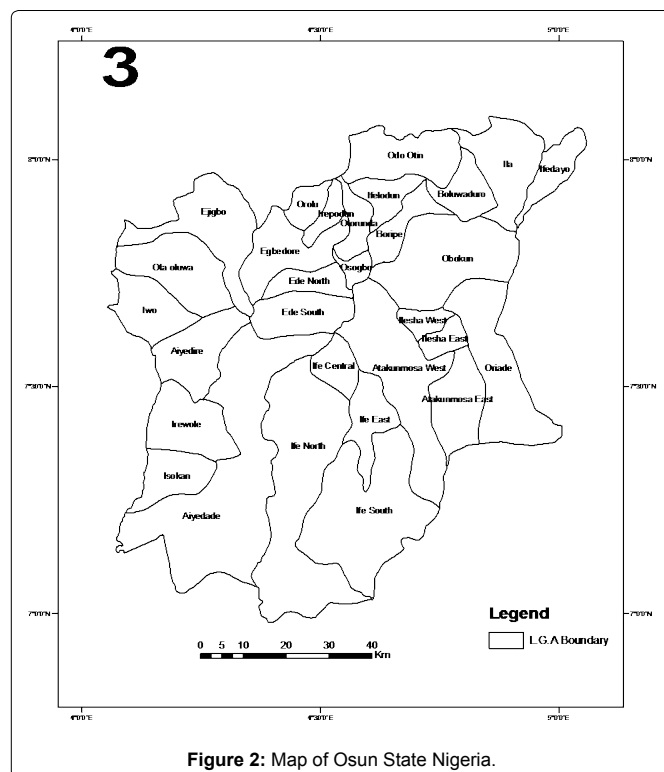
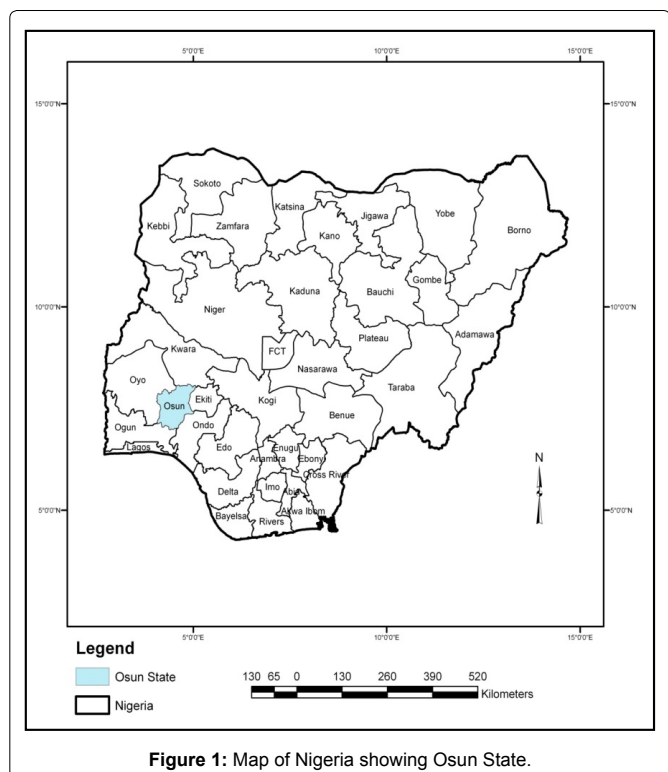
The state is situated within the cocoa belt of southwestern Nigeria. The people of the state are mostly farmers. Crops grown in the state include cocoa, palm produce, timber, rubber, citrus fruits cashew etc. Mineral such as gold clay, limestone and granite are exploited of mined in the state. Transportation in the state is either by road or rail. The people of the state are mainly traders’ artisans and farmers. Other occupations engaged in include woven textiles, tie and dye clothes leather work calabash carving etc. Quite a number of people are also employed in government establishments’ ministries and parastatals, education and health institutions in addition to a few raw materials processing industries located in the state (Table 1).

The state exhibits the typical tropical climate with prominent wet and dry seasons with fertile soil which encourages the production of crop and livestock. The rainy season generally occurs between April and October while the dry season occurs between November and March. There mean annual temperature for the state varies between 21.1°C and 31.1°C. The mean temperature is highest at the end of the harmattan which is from the middle of January to the onset of the rains. Rainfall figures over the state vary from an average of 1000 mm in the derived savannah agro ecology to 1200 mm in the rain forest at the onset of heavy rains to 1600 mm at its peak in the rain forest part of the state [5]. Though there are patches of savanna in the northern part of the state much of the state areas are still under tropical rain forest vegetation type with large expanse of forest around Ife south local government area.

Osun state is located in the heartland of the Yoruba nation and shares the distinctive high urbanization attributes of most part of Yoruba land with Yoruba as the main dialect. The people of the state trace their origin to Oduduwa and the town of Ile-Ife. The state derived its name from the river Osun a defied natural spring where annual traditional festivities are held. Yoruba and English languages are used for the business and official transactions and the major sub ethnic groups are Oyo, Ife, Ijesa and Igbomina of the Yoruba people. The people of the state have a rich cultural heritage which is eloquently demonstrated in all spheres of their lives. The culture final expression in their arts literature music and other social activities including dancing and dressing heritage [6].

### Sustainable Developments

The concept of sustainable development has been defined in many ways but the most frequently quoted definition is from our common future proposed by the World Commission on Earth and development also known as Brundtland Report of (1987) [1].



**Table 1:** Relationship between climate change (temperature and rainfall) on water supply in Osogbo between (1992-2011).

s/n	Year	Minimum temp. °C	Maximum temp. °C	Mean annual temp. °C	Annual rainfall (mm)	Population	Water supply (liters) m <sup>3</sup> /s
1	1992	18.7	31.2	24.9	1404.8	152172	3815089
2	1993	22.2	31.3	26.7	1243.8	157708	3337996
3	1994	21.2	31.3	26.3	1207.6	163445	5387230
4	1995	21.9	31.6	26.8	1452.5	169391	6953272
5	1996	21.1	29.3	25.3	1349.2	175553	5337031
6	1997	19.1	31.4	25.3	1230.21	181940	6128685
7	1998	20.4	32.1	26.3	1203.9	188559	3792428
8	1999	20.2	31.4	25.8	1529.3	195418	5692978
9	2000	20.7	31.8	26.3	1362.6	202527	7535148
10	2001	21.7	31.9	26.8	1014.9	209894	3571900
11	2002	21.5	31.6	26.6	1361	217529	5625045
12	2003	22	31.7	26.9	1422.2	225442	5079719
13	2004	21.6	31.2	26.4	1302.9	233643	5400628
14	2005	21.9	31.8	26.9	1129.21	242143	4915975
15	2006	21.8	31.7	26.8	1469.73	250951	4514367
16	2007	23.7	29.9	26.8	1421.6	263273	6859704
17	2008	23.2	30.2	26.7	1609.8	276278	6542450
18	2009	22.4	29.9	26.2	1310.2	289926	7169448
19	2010	19	30.1	24.6	1691.4	304283	5556331
20	2011	20.2	31.8	26	1241.3	319315	7182075
21	2012	19.9	30.9	25.4	1471.55	335089	6413063
22	2013	22.1	30.6	26.4	1106.3	351642	9965723
23	2014	22.2	30.4	26.3	1167.87	369013	15171174
24	2015	22.3	30.5	26.2	1165.72	334965	15271182
25	2016	22.4	30.4	22.5	1107.4	352173	15189632

Brundtland commission (1987) defined sustainable development as the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” .There are two basic needs of sustainable development. They are the concepts of needs, in particular the basic needs of the world poor which over-riding priority should be given and the idea of limitations imposed by the state of technology and social organization on the environment’s ability to meet then present and future needs.

It is therefore necessary to see the world as a system that connects space and a system that connects time. Osun state however belongs to the first concept where it is necessary for the government to provide essential needs for the poor as well as taken a very good consideration in the environment.

However, with a critical review of our common future debates on the environment and its impact on the socio economic and political development, the WCED has the following terms of reference.

- Propose long term environmental strategies for achieving sustainable development by the year 2000 and beyond.
- Recommend ways concern for the environment may be translated into a greater cooperation among developing

countries and between countries at different stages of economic and social development and lead to the achievement of common and mutually supportive objectives that take account of the interrelationship between people resources environment and development.

- To consider ways and means by which the international communities can deal more effectively with environmental country.
- To help define shared perceptions of long term environmental issues and the appropriate efforts needed to deal successfully with the problems of protecting and enhancing the environment a long term agenda for action during the coming decades and aspirational goals for the world community.

WCED defines sustainable development as “development that meets the needs of the present without compromising the ability of future generation to meet their own needs”. It goes on to recognize the inevitability of contending interpretations of the concept but nevertheless argues that these must share certain general features and must flow from a consensus on the basis concept of sustainable development and on a broad strategic framework for achieving it.

Everybody agrees with the basic argument of the concept but there seems to be no universal consensus on its meaning and implication.

The WCED thesis posted that the present generation has been reckless and wasteful in both its exploitation and use of natural resources by pursuing a series of socio economic and industrial policies which endanger global environmental security. Viewed as a doctrine of qualitative societal change, sustainable development underlines the perils of global environmental degradation, deforestation oil spill ozone depletion toxic waste etc. It also calls for the institution of policies that would: do less damage to the environment meet the "need" of the present generation and also allow "future generation" to meet their own needs.

To achieve the above objectives, the WCED urged governments to pursue on new developmental strategy that can both ensure consumed economic growth and ecological stability with less exploitation and use of natural resources. Achieving sustainable development in Nigeria implies a better quality of life for everyone now and generations to come. It offers a vision of progress that integrates immediate and longer term needs, local and global needs and regards social economic and environmental needs as inseparable and interdependent component of human progress much has not been done on the issue of sustainable development in Nigeria. Though Federal Environmental Protection Agency (FEPA) has been turned into a full fledge ministry yet it has not effectively used series of poverty eradication programmes and strategies for environmental management have been put in place. Therefore, Nigeria will start to benefit from the various measures.

However, sustainable development should not be brought about policies alone it must be taken up by society as a principles guiding the many choices each citizen make every day as well as the big political and economic decision that have ramification for many.

## Climate Change and Implications in Nigeria

Climate change is now widely reported and accepted global phenomenon with interest and awareness increasing massively in the past twelve months [7]. The potential disruption of future climate change is widely reported in the scientific literatures and the media and the expected input of climate change vary spatially relatively across small land masses.

Climate models provide projections not forecast and the models make different assumptions about the level of greenhouse gases [8] and the effect of climate change are studied by considering different scenarios. The key findings of the UKCIPO2 [9] scenarios are temperature will be hotter, a temperature increase of 2.5% is expected by 2050. The greater warming is expected to occur in the south and east and is expected to occur more in summer and autumn with higher summer temperature becoming more frequent.

However, in Nigeria violent conflicts in some sections of the country are actually attributed to climate change. This is because of its impact in the vegetation and the consequences on the socio economic activities of the area. For example, climate change induced desertification is driving Fulani cattle herders further down the southern trail where the grasses are still lush and then spurning more conflicts between them and the host communities. Ironically, unlike other developing nations where climate change is streamed into development strategies at all levels our government refuses to come to grips with the threat. There is low level of awareness about climate change in Nigeria and the way it is presented to the public. There is also no robust policy framework or instructional structure to face the global menace head on.

## Water, Socio-Economic Development and Importance

Water is the most common substance on earth. It covers more than 70% of the earth's surface. It fills the oceans; rivers and lakes, and is in the ground and in the air we breathe. Water is everywhere. Regardless of language or culture all humans share this basic need that is essential for survival. We drink water, cook with it, bathe in it sprinkle our lawns with it, fill our backyard swimming pools with it-even create parks based on it. We, however, take its abundance for granted when much of the world, especially Sub-Saharan Africa, access to clean water is a luxury. More than half of Africa's villages lack access to a clean water supply. In many of these villages, women and children must walk up to ten miles every day carrying heavy buckets and containers to fetch the day's supply of potable water for their households [10].

Ever since the world began, water has been shaping the earth. Rain hammers at the land and washes soil into rivers. The oceans pound against the shores, chiseling cliffs and carrying away land. Rivers knife through rock, carve canyons, and build up land where they empty into the sea. Glaciers plow valleys and cut down mountains. Water helps keep the earth's climate from getting too hot or too cold. Land absorbs and releases heat from the sun quickly. But the oceans absorb and release the sun's heat slowly. So breezes from the oceans bring warmth to the land in winter and coolness in summer.

Our demand for water is constantly increasing. Every year, there are more people in the world. Factories turn out more and more products, and need more and more water. We live in a world of water. But almost all of it, about 97% is in the oceans. This water is too salty to be used for drinking, farming, and manufacturing. Only about 3%, of the world's water is fresh. Although the world as a whole has plenty of fresh water, some regions have a water shortage. Rain does not fall evenly over the earth. Some regions are always too dry, others too wet.

A region that usually gets enough rain may suddenly have a serious dry spell, and another region may be flooded with too much rain. Some regions have a water shortage because the people have managed their supply poorly. People settle where water is plentiful, near lakes and rivers. Cities grow, and factories spring up. The cities and factories dump their waste into the lakes and rivers, polluting them. Then the people look for new sources of water. Shortages also occur because some cities do not make full use of their supply. They have plenty of water but not enough storage tanks, treatment plants, and distribution pipes to meet the people's needs. As our demand for water grows and grows, we will have to make better and better use of our supply.

### Water in our daily lives

Every plant, animal and human being needs water to stay alive. This is because all the life processes, from taking in food to getting rid of wastes, require water. But people depend on water for more than just to stay alive. We also need it for our way of life.

### Water in living things

All living things need a lot of water to carry out their life processes. Plant, animals and human beings must take in nutrients (food substances). Watery solutions help dissolve nutrients and carry them to all parts of an organism. Through chemical reactions, the organism turns nutrients into energy, or onto materials it needs to grow or to repair itself. These chemical reactions can take place only in a watery solution. Finally, the organism needs water to carry away waste products.



## **Water for irrigation/agriculture**

It is estimated that 70% of world-wide water use is for irrigation. In some areas of the world, irrigation is necessary to grow any crop at all, in other areas it permits more profitable crops to be grown or enhances crop yield. Various irrigation methods involve different trade-offs between crop yield, water consumption and capital cost of equipment and structures [10].

Irrigation methods such as most furrow and overhead sprinkler irrigation are usually less expensive but also less efficient, because much of the water evaporates or runs off. More efficient irrigation methods include drip or trickle irrigation, surge irrigation, and some types of sprinkler systems where the sprinklers are operated near ground level. These types of systems, while more expensive, can minimize run off and evaporation. Any system that is improperly managed can be wasteful.

In most countries, people have had a rich heritage of managing and living with their environment including water since time immemorial and they have demonstrated to be effective custodians of water for agricultural purposes. Rainfall and water has been central to their lifestyles, and influencing their farming activities.

Most of the plants that people raise need great quantities of water. For example, it takes 115 gallons (453 liters) of water to grow enough wheat to bake a loaf of bread. People raise most of their crops in areas that have plenty of rain. But to raise enough food for their needs, people must also irrigate dry areas. The rainfall that crops use to grow is not considered a water use, because the water does not come from a country's supply. Irrigation, on the other hand, is a water use because the water is drawn from a nation's lakes or wells. The water a nation uses for irrigation is important to its water supply because none of the water remains for reuse. Plants take in water through their roots. They then pass it out through their leaves into the air as a gas called water vapor. Winds carry away the vapor, and the liquid water is gone. On the other hand, nearly all the water used in our homes is returned to the water supply. Sewer pipes to treatment plants, which return the water to rivers so it can be used again, carry the water.

## **Water power or hydropower**

Water power or hydropower, furnishes about 7% of the world's commercial energy. Where water flows from a high place to a lower one, the gravitational energy of the falling water can be captured and used to produce other forms of energy. Most waterpower is used to generate electric power. Waterpower supplies energy without pollution and without using up the water in the process. But costly dams and other structures are required to harness waterpower.

People also use water to produce electric power to light homes and run factories. Electric power stations burn coal or other fuel to turn water into steam. The steam supplies the energy to run machines that produce electricity. Hydroelectric power stations use the energy of falling water from waterfalls and dams to produce electricity.

## **Water for industry**

It is estimated that 15% of world-wide water use is industrial. Major industrial users include power plants, which use water for cooling or as a power source (i.e. hydroelectric plants). Ore and oil refineries, which use water in chemical processes, and manufacturing plants, which use water as a solvent.

The industry in turn uses water in many ways. It uses water for cleaning fruits and vegetables before canning and freezing them. It uses water as a raw material in soft drinks, canned foods, and many other products. It uses water to air-condition and clean factories. But most of the water used by industry is for cooling. For example, water cools the steam used in producing electric power from fuel. It cools the hot gases produced in refining oil, and the hot steel made by steel mills.

Although industry uses a lot of water, only 6% of it is consumed. Most of the water used for cooling is piped back to the rivers or lakes from which it is taken. The water consumed by industry is the water added to soft drinks and other products, and the small amount of water that turns to vapor in the cooling processes.

## **Water for transportation/recreation**

After people learned to build crude small boats, they began using rivers and lakes to carry themselves and their goods. Later, they built larger boats and sailed the ocean in search of new lands and new trade routes. Today, people still depend on water transportation to carry such heavy and bulky products as machinery, coal, grain and oil. People build most of their recreation areas along lakes, rivers and seas. They enjoy water sports, such as swimming, fishing and sailing. Many people also enjoy the beauty of a quiet lake, a thundering waterfall or roaring surf.

## **Environment and tourism**

Explicit environment water use is also a very small but growing percentage of total water use. Environmental water usage includes artificial wetlands, artificial lakes intended to create wildlife habitat, fish ladders around dams and water releases from reservoirs timed to help fish spawn. Like recreational usage, environmental usage is non-consumptive but may reduce the availability of water for other uses at specific times and places. For example, water release from reservoir to help fish spawn may not be available to farms upstream [5].

## **Sanitation**

Sanitation is a field of public health. It involves various efforts to control the environment to prevent and control disease. Sanitation also includes personal cleanliness, which helps protect against disease and the presence of water is critical. In most countries various government agencies work together to protect the health of communities. Sanitary engineers work in designing and administering water treatment plants and sewage treatment plants. Government agencies establish and enforce laws that help promote a healthful environment. Sanitation activities include food processing and distribution, sewage treatment, solid waste disposal, water treatment and numerous other measures, such as control of air pollution and rodents.

## **Sewage treatment**

Sewage is water containing waste matter produced by people. It contains about a tenth of 1% solid waste. It comes from sinks and toilets in homes, farms, restaurants, factories, and office buildings. Much industrial sewage contains harmful chemicals and other waste materials. Sewage must be treated before it flows from sewerage systems into lakes, rivers, and other bodies of water. Untreated sewage contaminates the water and, in time, can kill fish and aquatic plants. The sewage makes the water unsafe to drink and can also prevent use of the water for swimming, fishing and other recreation [10].

## Water treatment

Most water must be treated before it is used for drinking, cooking, bathing, or laundering. Almost all untreated water contains bacteria viruses and other tiny organisms. It also may have an unpleasant odour and taste and contain minerals that make the water less useful as a cleaning agent [10].

## Nature's water cycle

The water of the earth move continuously from the oceans, to the air, to the land and back to the oceans again. The sun's heat evaporates from the oceans. The water rises as invisible vapor, and falls back to the earth as rain, snow-. Or some other form of moisture. This moisture is called precipitation. Most precipitation drops back directly into the oceans. The remainder falls on the rest of the earth. In time, this water also returns to the sea, and the cycle starts again. This unending circulation of the earth's waters is called the water cycle or hydrological cycle.

## World distribution of water

The earth has an enormous amount of water, about 326 million cubic miles (1.4 billion cubic kilometers) of it. In a cubic mile, there are more than a million million gallons, or 3.8 million million litres. However, 97% of this water is in the salty oceans, and more than 2% is in glaciers and icecaps. The rest totals less than 1%. Most of this water is underground, and [he remainder includes the water in lakes, rivers, springs, pools and ponds. It also includes rain and snow and the vapor in. the air.

A country's water supply is determined by its precipitation. In regions with plenty of precipitation year after year there is plenty of water in lakes, rivers and underground reservoirs.

The earth as a whole receives plentiful rain. If this rain fell evenly, all the land would receive 34 inches (84 cm) a year. But the rain is distributed unevenly. Generally, the world's most heavily populated areas receive enough rain for their needs. These areas include most of Europe, Southeast Asia, the Eastern United States, India and much of China. But about half the earth's land does not get enough rain. These dry areas include most of Asia, central Australia most of northern Africa and the Middle East [10].

## Impact of Climate Change on Water Supply

The water cycle is a delicate balance of precipitation, evaporation and all of the steps in-between. Warmer temperature increases the rate of evaporation of water into the atmosphere. In effect, increasing the atmosphere's capacity to hold water, increased evaporation may dry out some areas and fall as excess precipitation on other areas. Changes in the amount of rain falling during storms provide evidence that the water cycle is already changing over the past 50 years. The amount of rain falling during the most intense 1% of storms has increased by almost 20%. Furthermore, rising temperature caused snow to begin melting earlier in the year. This alters the timing of stream flow in rivers that have their sources in mountainous areas

At a temperature rise, people and animal need more water to maintain their health. Also, many important economic activities like production at power plants, raising livestock and growing food crops also require water. The amount of water available for these activities may be reduced as earth warms and if competition for water resources increases.

## Research Method

Data for this study were obtained from the secondary sources.

The secondary data included the climate data obtained from the Nigeria meteorological agency (NIMET). The volume of water supplied from the Osun State water cooperation from Erinle Water Dam in Ede, Osun State. The research work is limited to Osogbo due to the fact that NIMET which is the official climate data provider covers Osogbo, Aside from the NIMET data, there is an official documentation of water supply record from the Erinle water scheme in Ede, Osun state.

## Nigeria Meteorological Agency (NIMET)

The Nigeria Meteorological Agency (NIMET) is the official climate data provider in the country. The agency was established to collect and process climate related data, issue weather forecast and give early warning for the safe operation of aircraft, ocean going vessels, national food production, drought, desertification, natural disaster and relief management, hydrological and water resources activities environmental pollution, ozone concentration and bio-metrological for climate and human health activities conduct research in metrology, as well as publish meteorological data and weather bulletin in the country/. The Nigeria meteorological agency also organizes and participates in all local and international fora on meteorology and hydrology. They also engaged in training of all cadres of metrological personal and support staff.

## Erinle water scheme

The Erinle Water Scheme is on River Erinle located in Ede Osun State. The water from Erinle water scheme supplies to Osogbo. The old Erinle water scheme was completed in 1954, with a reservoir capacity of 5,300,000 cubic meters. It is owned and operated by the Osun State water cooperation. The new Erinle Dam was completed in 1984 is about 330 meter above the sea level. The crest length is 677 meters and maximum height is 27 meters. The total storage capacity is 94,000,000 cubic meters. The spill way discharges at 800 cubic meters per second. The dam is used for water supply, flood control and fishing. The Dam is the major water supply to Osogbo the state capital.

## Results and Discussion

Regression model was used for the analysis. The climate data involved in the analysis are the maximum temperature, minimum temperature and annual rainfall. While the volume of water supply in cubic per meter was obtained from the Erinle water scheme for the years 1992-2016.

## Regression model

Regression is the amount of change in the value of one variable associated with a unit change in the value of another variable. When we are interested in the dependence of a random variable Y on another variable X which is not necessarily a random variable an equation which relates Y to X is usually called a regression equation. Regression analysis may be simple or multiple linear or nonlinear. A linear regression model is expressed as follows:

$$Y = \beta_0 + \beta_1 X_1 + E$$

Where  $Y_1$  = Independent variable

$X_1$  = dependent variable

$\beta_0$  = Constant terms

$\beta_1$  = Regression coefficient

$E_i$  = Error terms

Source: Author's computation (2016)

From the regression statistics the correlation coefficient ( $r$ ) was found to be 0.446. This implies a fair relationship between climatic elements and water supply from (1992-2016). Also the correlation of multiple determinants ( $r^2$ ) was found to be 0.199. This implies that climatic elements temperature and rainfall only, accounted for 19.9% variation in the water supply between the periods considered in the research work. While other factors, may be responsible for the variation in water supply.

The regression line equation between minimum and maximum temperature, rainfall and water supply is given as follows:

$$Y = 413267.068 - 3619.938 - 1480462.885 X + 4620778955.$$

Also, the significant values of the slope and the intercept of the regression line further buttressed that water supply does not totally depend on climatic element.

## Conclusion

The variation in the annual and seasonal rainfall also concluded that the climate is changing. The assessment of the relationship between climate change and water supply showed a weak relationship between the two. It therefore confirmed that the problem of climate change has little effect on the volume of water supplied and therefore presently does not call for any serious consideration.

## Recommendations

Based on the findings of It is therefore recommended that there must be an improvement in the water management strategies in order

to offset the anticipated consequences of climate change by reducing stress on the land cover.

There must be a policy that will ensure a balance between water demand and supply under the present socio-economics activities and climate change in Osogbo.

With the imbalances in the state of water supply and the effect of climate change. There must be a provision in form of adaptation and mitigation strategies to checkmate the menace. It is also recommended that there is the need for a new policy reform without delay in order to make water supply more environmentally, socially, economically and financially sustainable.

## References

1. Ugochukwu CLC (2008) Sustainable Environmental Management in the Niger Delta Region of Nigeria: Effects of Hydrocarbon Pollution in Local Economy.
2. Nigeria Country Analysis Brief (2005).
3. Federal Ministry of Finance Nigeria (2006).
4. Osun State Government (2013) Official Diary of Osun State Ministry of Information and Strategy, Osogbo.
5. Olawole MO (2012) Geospatial Analysis of Road Transport and Socio-Economics Development in Rural Areas of Osun State, Nigeria.
6. Fadipe OO, Ogedengbe MO, Jeje JO, Oladepo KT (2011) Characterization and analysis of medical solid Waste in Osun State Nigeria. *African J Envl Scie Tech* 5: 1027-1038.
7. Water UK Conference (2007).
8. Acreman M (2000) The hydrology of UK.
9. Hulme M, Lu X, Turnpenny J, Mitchell T (2002) climate change scenario for the United Kingdom: The UKCIPO2 Scientific Report.
10. Pelekelo L (2007) Role of water in the socio economic development. Its importance and links. *Aydpels*.

### Author Affiliations

Top

Department of Surveying and Geoinformatics, Osun State College of Technology, Esa-Oke-Osun State, Nigeria

### Submit your next manuscript and get advantages of SciTechnol submissions

- ❖ 80 Journals
- ❖ 21 Day rapid review process
- ❖ 3000 Editorial team
- ❖ 5 Million readers
- ❖ More than 5000 
- ❖ Quality and quick review processing through Editorial Manager System

Submit your next manuscript at • [www.scitechnol.com/submission](http://www.scitechnol.com/submission)