Civil and Environmental Research
ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online)
Vol.7, No.8, 2015

Water Supply Challenges of a University Community: The Case Study of Afe Babalola University, Ado-Ekiti (ABUAD) Ekiti State, Nigeria

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Abstract
The availability of adequate water supply both in quality and quantity is essential for human existence. With the exponential increase in population, access to improved water remains an important pre-condition for sustaining human life, maintaining eco systems and for achieving sustainable development. This paper evaluates the water supply in a university community, with Afe Babalola University as a case study. This work has been carefully carried out to show the way forward in the Nigeria Water Sector; Reviewing the current situation in the university, the huge investments that has been made by The Nigerian Government and External Partners alike, the benefits the populace stand to derive by making the a healthy one, and liberalization of the Water Sector Administration. For the sake of this work, the focus shall be limited only to Social and Economic Development of Water in Nigeria.
The paper however concludes that research grants should be given to the researchers in water sector. Geophysical investigation for groundwater development should be carried out before exploitation of groundwater to ensure maximum yield. Also modern conventional water treatment plant should be designed, constructed and located at strategic places in the country to enhance regular provision of potable water and safety and the government should be ready to work towards the realization of the set goals.
Keywords: Water, Development, Challenges, University.

1.0 INTRODUCTION

Water supply is the provision of water by public utilities, commercial organizations, community endeavours, private owner or individuals, usually through system of pumps, pipes, storage tanks and proper network. It occupies more than half of the earth and it is consider inevitable to man. Water exists in three forms such as; solid, liquid and vapour. The various uses of water cannot be over emphasized. The various uses can be summarized into industrial use, domestic use and recreational use. Most times, these various uses of water are required in a pure state in other to avoid any water borne infections leading to casualties. In every community, nation or society, water is very essential to the wellbeing of such a community and the lack of it can lead to death.

Access to safe drinking water refers to percentage of total population of people using improved water drinking sources which include household connection, public stand pipe, bore hole, protected dug well, protected spring and rain water collection while improved water sources include: unprotected well, spring, river or pond, tanker truck water, vendor provided water etc. as cited by. It is important to note that all natural water contain a variety of contaminants arising from erosion, leaching and weathering processes amongst others.

Water supply systems get water from a variety of locations, including groundwater aquifers, surface water lakes and rivers, conservation and the sea through desalination. The water is then hence purified, disinfected through chlorination. Treated water is then pumped to reservoirs or allowed to flow by gravity through the use of overhead tanks or reservoirs at a certain meter head. Once water is used, proper discharge of water is also very important in discussing the complete cycle of water supply. Polluted water is typically discharged in a sewer system and treated in a sewage treatment plant before being discharged into a river, lake or sea or reused for landscaping, irrigation or industrial use as in some developed countries. The groundwater in a typical basement complex environment such as ABUAD is usually contained in a weathered and fractured basement rocks or alluvial deposits within flood plains (Olorunfemi and Fasuyi, 1993).

1.1 ABUAD CAMPUS AND ITS ENVIRONMENT

Afe Babalola University is located on 130 hectares at an altitude of 1,500ft above sea level which *ipso facto* provides a cool and ideal climate for learning, sporting activities and commercial agriculture.
According to NIMET (2007), the annual mean temperature is between 18^0C and 33^0C with relatively high humidity.

The state considered to have the highest number of professors in the country. It is the first and only one of its kind in Ado-Ekiti. It is known for accommodating the best of brains within the country and overseas. It also provides convenient learning environment for undergraduate studies in a vast array of disciplines such as engineering, medicine, law, accounting, economics, intelligence and security, international relations, mass

media, computer sciences, geology and tourism among others. It creates an opportunity for students all around the country to be brought together in learning. Also it creates job opportunities for natives of this community and gives students an avenue for research and extensive learning. Considering the topography, environment and climatic conditions of this region, it is a region surrounded with mountains, rocks, hills, valleys and sediments. Due to the environment of this region, sourcing for adequate and efficient water supply has become a big deal to inhabitants of this community. Although the region faces problems with developing an adequate and efficient source of water for it populace but the environment of the region is not be blamed for its plight. Notwithstanding developing an adequate source of water is not the only problem the ABUAD community faces with water; providing the proper source, storage, treatment and distribution all contribute to the cycle of providing water for the populace.

1.2 WATER CHALLENGES

Ekiti state is a place surrounded by rocks, hills, mountains, rivers and streams. Besides the so many natural endowments of the state, the availability of water in its natural state is a major problem faced by the ABUAD campus. ABUAD campus covers a vast area of land mass big enough to design a standard airport. It structures comprises of various faculty buildings, cafeterias, a multipurpose hall, hall of residence, on-going guest house and sport complex. The community is known for its great compromise in providing engineers less trouble with soil problems for foundations and hence construction. Most of the soil found in this community is from sedimentary rocks which weather into sand and silt. The region is fortunate to have frequent rain and wind storms during the rainy season which accounts for the high rise in water table, runoff and also occurrence of perennial streams and waters. Foundation problems are rare in this region because of its bedrock formation underneath the earth surface. Although contrary to that advantage, the bedrock formation underneath the soil makes it difficult to dig and obtain water in much volume. The source of water in ABUAD community is the borehole. In such a region, providing water for a large populace with the use of a borehole is rather difficult. In this report we shall discuss on the current water situation facing ABUAD community; the source of water, storage facilities, treatment process and its distribution.

The Major challenge of water supply in ABUAD can be traced to the location which is of basement complex (rock). We have shortage of water in ABUAD because of defective pumping, low recharge rate, poor maintenance of systems and unreported defects in systems by the users.

2.0 SOURCES OF WATER IN ABUAD

The Major source of water in ABUAD is boreholes. The natural spring at the central power house which analysis was carried out and it was about 20litres and above per 30 seconds. The pump installed there at submersible level is about 7.5Hp with string size of 2inches. Also, the underground reservoir is about 450,000litres designed capacity. Other sources include natural spring at central power house and Underground reservoir.

2.1 FACTORS FOR SELECTING SOURCES OF WATER

Many factors are to be considered in choosing an adequate source of water for a populace. Some of these factors include; the topography of the area, height of water table, soil formation, cost, climatic and weather conditions, presence of rivers and streams. In most cases, cost is usually the most decisive of all the factors although all factors put into consideration helps decision making easy. There are various ways to source for water; water can be gotten from wells, precipitation, runoff, underground and groundwater, streams, rivers, dams etc.

The source of water provided by the ABUAD campus is the borehole. The borehole gets its source of water from underground water. It requires driving piles deep down, hitting the bedrock and penetrating into the aquifer to get sufficient water. The underground water is a good source of water especially when gotten far below the water table like in wells. In cases where the water table is high and the aquifer filled with water, underground water provides good adequate water and hence can be considered as a viable source. Nevertheless in ABUAD campus, it is different. Due to the soil formation and bedrock strata found beneath the soil on ABUAD campus, it makes it difficult to locate an aquifer/penetrate the water table hence making the option of underground water insufficient for the high population of the campus. In the campus endeavour to provide sufficient water for the population, it dug lot more boreholes in other to meet the increasing demand of the campus. The campus acquired 5 more boreholes making a total of 32 boreholes. The cost of acquiring these boreholes is about 8 million depending on the depth dug to acquire water. Due to the rock formation beneath the ground/soil, water is not gotten in much volume as the crack found on rocks is the only medium which water uses to flow to the surface. The cracks found on the rocks limits the volume of water supposed to reach the surface. With the ground water as a source of water for the campus, high yield pumps are required to pump water from underneath the ground up to heights about 3-5m.

Considering the other ways water could be obtained, it is rather difficult, time consuming, labor demanding and requires relatively a high cost to set up which makes the option of the underground water using a

borehole the most viable for the ABUAD campus. A borehole is a narrow shaft bored in the ground, either vertically or horizontally.

2.2 TREATMENT OF WATER

The treatment process carried out on water production and distribution is most times always active in the fluid till it reaches the consumers thus making it safe throughout from reservoir through to flowing taps. Water treatment describes any industrial scale processes used to make water more acceptable by its end-users. These can include use for drinking, washing, cooking and many other uses. Such processes maybe contrasted with small scale sterilization practiced by some depending on the volume of contaminants. The aim of all water treatment process is to remove existing contaminants in the water or reduce the concentration of such contaminants so the water becomes fit for its desired consumers. The process involved in treating water for drinking purpose maybe solid separation using physical processes such as settling and filtration, and chemical processes such as disinfection and coagulation. Biological processes are employed in the treatment of waste water and these processes may include, for example, aerated lagoons, activated sludge or slow sand filters. This biological process is hence not obtainable in Nigeria as the country is yet to start water recycling.

Disinfectants ozone is a gas that can be found in the stratosphere due to the fact that ultraviolet (UV) radiation is emitted by the sun on oxygen molecules. Accordingly, it provides protection against harmful UV radiation. Ozone is made up of three atoms of oxygen as its chemical formula indicates. It is a very strong oxidant and it is one of the main disinfectants when purifying water. it is known to be the most powerful chemical disinfectant used in water purification treatment. Two of the main processes of industrial water treatment are boiler water treatment and cooler water treatment. A lack of proper water treatment can lead to the reaction of solids and bacteria within pipe work and boiler housing hence, a proper water treatment method should be adequately adopted. A combination selected from the following is used for municipal drinking water treatment worldwide:

- Pre-chlorination – for algae control and any biological growth
- Aeration – along with pre-chlorination for removal of dissolved iron and manganese
- Coagulation – for flocculation
- Coagulant aids, also known as polyelectrolytes – to improve coagulation and for thicker floc formation
- Sedimentation – for solids separation, that is, removal of suspended solids trapped in the floc
- Filtration – removal of particles from water
- Desalination – process of removing salt from water
- Disinfection – for killing bacteria.

There is no unique solution (selection of processes) for any type of water. Also, it is difficult to standardize the solution in the form of processes for water from different sources. Treatability studies for each source of water in different seasons need to be carried out to dictate the most appropriate processes. Automation of water and waste water treatment is common in the developed world. Capital cost, operating costs available quality monitoring technologies, locally available skills typically dictate the level of automation adopted or required. The process of water treatment is very essential to ensure suitable water for drinking and various uses in other to avoid water borne diseases and eventually loss of life.

2.4 STORAGE

Storage of water is necessary in harnessing the proper distribution of water to an area. The idea for the storage of water is essential for providing water when the source of water is deficient. Adequate volume of storage for water is dependent on the volume the source provides. So in the design of a proper storage facility the source/supply and demand for water must be taken into consideration. There are various ways water could be stored. Rain or precipitation can be stored in surface water like rivers, lakes and ponds. In this case the amount of water that can be stored depends on the size of the basin. Water for domestic use like cooking, drinking and washing is very essential as a person will need a maximum of 5litres of water every day for domestic purpose only.

Types of water storage;

1. A pipe network for distribution of water to the consumers and other usage points (such as fire hydrants).
2. Connections to the sewers (underground pipes) are generally found downstream of the water consumers, but the sewer system is considered to be a separate system rather than part of the water supply system.

2.5 NOTABLE IMPROVEMENT

The natural spring at the back of the central power house has been discovered to have about 20 litres of water per

second. Also the rivers around the university can support other sources of water.

2.6 CAUSES OF THE SHORTAGE OF WATER IN ABUAD

Causes of the shortage of water in ABUAD include break down or system failure, poor maintenance, unreported defect, power rationing, staff or student recklessness and defective pumping.

3.0 METHODOLOGY

This study was done through experiment. Data were generated from various sites through oral interview with the experts and users. Various groundwater exploration and exploitation means were examined for necessary optimization for health, energy, safety and environment. Information were obtained on various boreholes in Afe Babalola University and other strategic areas to ascertain the draw down at various locations.

Preliminary activities involved collection and grouping of data and selection of sites based on groundwater utilization. Questionnaires were administered to each of the selected sites by engineers, geologists and other experts.

3.1 WATER DEMAND IN AFE BABALOLA UNIVERSITY

Water use falls into several major classes, each of which is associated with certain quantity and quality requirements. These classes include water for drinking and cooking, waste disposal, crop production, aquaculture, livestock, industrial use, recreational use, navigational uses, and ecological values such as survival of natural lake, riverine or wetland communities. The quantity of water required for activities within each of these classes is influenced mainly by variables such as climate and precipitation.

World health organization has evaluated the water demand to be 100 liters per persons per day. The ABUAD campus presently has a population of about six thousand people including teaching and non-teaching staffs and students, and it spends about a volume of 1200litres of water to satisfy the needs of its populace every day. A cash total of about 5 million naira has been spent in sinking boreholes at various locations in order to meet the demand of water in the campus. The campus presently has an average of about 30 boreholes with 3 reservoirs of about 1000litres in volume.

Table 1 shows the various types of boleholes in Abuad their details.

Table 1: Various types of Boleholes in ABUAD and their details

S/N	Location	Nomenclature/ Source	pump size(Hp)	String size(inches)	status	users	Depth(ft)
1	New guest house	Domestic borehole	1.5	$1\frac{1}{4}$	yet to be connected	New guest house	300
2	Front of college 1	Domestic borehole	1	1	dormant	college	120
3	Back of college 1	Domestic borehole	1	1	dormant	All colleges	120
4	Left back of college 1	domestic	1	1	dormant	All colleges	120
5	Right back of college 1	domestic	1.5	$1\frac{1}{4}$	dormant	All colleges	300
6	Back of college2	industrial	10	3	functioning	Kitchen, laundry, annex hostel, Cafeteria 1	600
7	The back of boys hostel	domestic	1.5	$1\frac{1}{4}$	regulated	All the three boys hostel	300
8	Sport complex	domestic	1	1	Yet to be connected	Sport complex	120
9	Towards the second adjacent	domestic	1.5	1	regulated	The boys hostels	100
10	Left side towards the anatomy building	domestic	0.5	1	Yet to be connected	The hall of residence	120
11	Abuad female hostel	domestic	1	$1\frac{1}{4}$	Very good	Female hostel an cafeteria 2	300
12	Back of Abuad female hostel	domestic	0.5	1	regulated	Abuad female hostel	120
13	Back of Abuad female hostel(behind A and D wing	domestic	1.5	$1\frac{1}{4}$	functional	Abuad female hostel	300
14	Central hall of residence	domestic	0.5	1	dormant	Female hostels	120
15	Beside Alfa Balgore hall	domestic	1	$1\frac{1}{4}$	dormant	Alfa Balgore	120
16	Ventures Local kitchen (cafeteria 1)	industrial	7.5	2	dormant	Owolabi hall, bakery,laundry,preprint press, annes hostel, abuad offend ant hostel	600
17	Front of kitchen	domestic	1	1	Pumping to capacity	All ventures	120
18	Beside Water plant	domestic	1	1	Pumping to capacity	All Abuad ventured	120
19	In front of laundry	industrial	1.5	1	Pumping to capacity but not satisfying the users	laundry	120

20	Back of the water plant	domestic	1.5	$1\frac{1}{4}$	Pumping to capacity but, not connected	All ventures	300
21	Old Abuad quarters(front of c block)	domestic	1	1	Pump to its capacity	Serves block A,B and C	120
22	Front of block f	domestic	1	1	Working to capacity	All blocks in the quarters	120
23	Back of block I	domestic	0.5	1	It is regulated because of low yield, also low recharging strength	All occupant of old staff quarters	125
24	Front of block j	industrial	7.5	2	defective	All blocks in the staff quarter	400

4.0 RESULTS AND DISCUSSION

Measurements of well yield were compared at various locations of boreholes in the university

4.1 DAMS AND RESERVOIR

In the past, large dams have often been the focus of water storage. Many large dams have brought significant social and economic benefits. For example, Egypt's Aswan High Dam built in 1960s has protected the nation from drought and floods and supplies water used to irrigate some 15 million hectares. However, dams can also have great negative impacts such as overflow of dams leading to flood, loss of lives and property. Reservoirs on the other hand store water just in enough quantity sufficient for its consumers. In ABUAD campus, it makes use of reservoirs of various capacities due to the demand of the campus. The reservoirs store water and supply water to overhead tanks in which water is then allowed to flow under gravity to its users. In adequate storage of water, the volume of water per person is catered for and hence proper designing is carried out. Storage tanks can be designed using steel or reinforced concrete. In ABUAD overhead storage tanks are at heights up to 10m and reservoir tanks which supply the overhead tanks with water are made of steel structures. The total volume, capacity of ABUAD reservoir is estimated 1million gallons of water.
Table 2 indicates the various types of reservoirs in ABUAD.

Table 2: Various Types of Reservoirs in ABUAD.

S/N	LOCATIONS	TYPE OF RESERVOIR	CAPACITY (LITRES)
1	Central pump house	Under ground	450,000
2	Guest house	Under ground	300,000
3	Central water pump station (mains)	Under ground	224,000
4	Back of college 1	Surface tank (rectangular shape) placed on a flat surface.	52,000
5		Surface vertical tank (cylindrical shape)	1,000,000
6	Back of boys hostels	Elevated tank on a plate form	12 tanks of 84,000
7	Front of female hostel	Elevated tank on a plate form	6 tanks of 42,000
8	Back of female hostels (A and B wing)	Elevated tank	6 tanks of 36,000
9	Back of female hostels (C and D wing)	Elevated tank	6 tanks of 36,000
10	Back of wema hostel	Elevated	80,000
11	Old staff quarter		5,000 each block
12	New staff quarter		42,000
13	Ventures		12 tanks of 84,000
14	Behind printing press	Elevated tank	6 tanks of 30,000

4.1 Pumping Stations in ABUAD

Two transfer pumps which one is 2Hp and the other 1Hp. These are transfer pumps which transfer water to stain well in front of ABUAD female hostel.

Back of block A and B, the pump house. It is design to accommodate 2 pumps which one is avail of capacity 7.5Hp.

Back of female hostel block C and D. it is design to accommodate 3 pumps which all are working to their designed capacity of 2Hp each.

Water mains- the manifold design to accommodate 2 pumps of 7.5Hp each which are installed already and functional.

Back of college 1, it is design to accommodate 4 pumps having one to be 5.5Hp and others 3.5Hp. Only two pumps work the 5.5Hp and a 3.5Hp.

Behind old male hostel, it is design to accommodate 3 pumps 1.5HP each of which two pumps are functional.

Behind former female hostel 3 pumps 2Hp each

Ventures, its design to accommodate 2 pumps, 3.5Hp 3 phase existing but grounded and 1.5/2HP 1 phase functional.

Old staff quarters 2Hp each block.

New staff quarters, its design to accommodate 2 pumps 2Hp each but only one functional.

4.2 SOLUTION TO THE SHORTAGE OF WATER IN ABUAD

The solution to shortage of water includes:

1. Construction of elevated tanks in different locations
2. Making spare parts available
3. Increase power supply
4. Good supervision
5. Construction of dams
6. Adequate maintenance through routine inspection and prompt release of spare parts
7. Student and staff should imbibe good maintenance culture.
8. Employment of professionals and specialists to assist in the operation and maintenance of water resources.

5.0 CONCLUSION

The water supply routine in Afe Babalola University is commendable. The routines, which are source, treatment, storage and distribution, are the same as regards any place on earth that deals with water supply. The underground water source is not a viable option for this region because of its rocky terrain and because of that it has resulted in a scarcity of water for its populace. They are several ways water can be sourced some of which are from rivers, lakes, precipitation and wells. Treatment of raw water using both chemical, physical and in some cases biological processes are all carried out in other to ensure the water meets the desired standard for consumption. Water treatment is done so as to disinfect water pollutants. Chlorination is done so as to prevent contamination of water from pipeline or pipe network hence making the water safe and pure until final consumption. So changing the source of water from underground water which has little output in this region to another source which has a much higher output should be put into consideration. Not with standing, the underground water source is cheap compared to its alternatives. The cost implication of the other sources that could be considered in Afe Babalola University would be very expensive but a combination of the underground water source and a dam from the river behind the campus is relatively cheap to consider and hence design.

Geophysical investigation for groundwater development should be carried out before exploitation of groundwater to ensure maximum yield for optimum benefit of the university community.

Also, at times in rainy seasons when the water level could be high and output is higher than its usual output, larger volumes of storage tanks should be made available and water stored in them so that when the source is short of water, the stored water hence becomes the new source of water to be supplied for further water supply routine like treatment and distribution.

I hence recommend that another source of water be made available to avoid the dependency of only one source of water and also large volume storage tanks be made available to increase the volume of water stored and also provide storage of water directly from the source. So that when the source is no longer efficient the stored water in tanks and reservoirs serve as an acting source.

When right policy on water utilization is put in place, it will save cost, enhance yield of groundwater, control the draw down at various locations, quality of water used in production, conserve water and check indiscriminate drilling thereby protecting earth sedimentation from quakes, tremor and instability.

5.1 RECOMMENDATION

Research grants should be made available for groundwater development projects. Industries, engineers, geologists and other experts must be ready to do more research on the groundwater flow to obtain necessary information in order to enhance exploitation and utilization water.

Also modern conventional water treatment plant should be designed, constructed and located at strategic places in the university to enhance regular provision of potable water and safety and the government should be ready to assist the entire Ekiti state towards the realization of the millennium goals.

ACKNOWLEDGMENT

We appreciate the founder of Afe Babalola University for his support, cooperation and interest in water development in Nigeria. We also thank the university community for their notable contribution to humanity.

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