Lapai Journal of Applied and Natural Sciences

LAJANS Vol 7(1): 85-84

RESEARCH PAPER

Variation In Seasonal Water Availability In Hand-Dug Wells In Lapai And Agaie, Niger State

[*1]Usman, M.N., [2]Adama, C. K. and [1]Usman, A.A.

[1]*Department of Geography, Federal University of Technology Minna, Nigeria*

[2] *Department of Geography, Ibrahim Badamasi Babangida University, Lapai, Nigeria*

ABSTRACT

This study focused on the comparative analysis of bedrock correlation to water availability in hand-dug wells in the Lapai and Agaie towns of Niger state. The objective of the study is to assess the seasonal variation of water availability in hand-dug wells of Lapai and Agaie during the wet and dry seasons. A systematic sampling method was used to collect data for this study. The t-test distribution statistical method was employed to compare the seasonal variation between the bedrocks. A total of twenty wells were sampled and readings were recorded from the study area during the wet and dry season. Data were collected through the general study of the area, oral interviews, general observations, and measurement of water wells through the use of ropes and measuring tapes; locations and elevation of the wells were taken through the use of a GPS. Results show that the average water depths in wells of Lapai are shallower (both wet and dry seasons) than those at Agaie with an average depth of 17.311m (Lapai wet), 21.88m (lapai dry) and 24.56m (Agaie wet) and 34.73m (Agaie dry) respectively. The variation in water depths is higher during the wet season at both Lapai and Agaie than during the dry season. It is suggested that alternative sources of water be provided to meet the demand of the growing population of the study area and reduce scarcity, especially during the dry season.

Keywords: Seasonal Variation, Ground Water, Availability, Hand-dug Wells.

INTRODUCTION

Water is a vital resource for human existence and the growth of any community is a function of the availability of basic infrastructures such as potable water, good road, electricity and industries (Amadi, 2010). Water exists in three (3) forms which makes it applicable to many uses in life. On Earth, 96.5% of the planet's water is found in oceans, 1.7% in groundwater, 1.7% in glaciers and ice caps and 0.001% in the air as vapour (UNEP, 2007). Portable quality water is precious, we cannot live without it, it is sensitive and irreplaceable and there is no substitute for it (Annan, 2003).

Water is classified into two (2) main categories and they are surface and groundwater. Surface water is the water over the crust of the earth's surface, which is found in seas, rivers, lakes, streams and ponds. Groundwater is water found within the pore spaces of geologic material beneath the surface of the earth. It is derived from precipitation on the earth's surface which gradually percolates to the subsoil through formation under the force of gravity. Groundwater is that which exists below the earth's surface, within saturated layers of sand, gravel and pore-spaces in sedimentary or crystalline rocks while freshwater is the water from the zone that is not invaded (Buddemeier and Schloss, 2006). Groundwater is known to be more appropriate and meets the criteria of quality water, the most widely used source of water in most African countries, Nigeria inclusive (Pickering & Davis, 2012). The quality of groundwater is the result of all the processes and reactions that act on the water from the moment it condensed in the atmosphere to the time it is discharged by a well or spring and varies from place to place and with the depth of the water table (Selvam and Sivasubramanian, 2013). A water well is a hole, sham, or excavation used to extract groundwater from the subsurface. (Harter, 2003). Most wells in Nigeria are used to obtain groundwater; some wells are used for purposes other than obtaining ground water. Oil and gas wells are examples of this. Monitoring wells for groundwater levels and groundwater quality are other examples. Still, other purposes include the investigation of subsurface conditions,

Received 26 May, 2022
Accepted 15 December, 2022
Address Correspondence to:
nmayadi@gmail.com

shallow drainage, artificial recharge, and waste disposal (Harter, 2003).

Groundwater is of significant importance to northern Nigerians where the amount of rainfall is limited to very few months of the year with annual rainfall of 1000-1500m and surface water sources are usually inadequate. The concept of groundwater management centres on the establishment of norms leading to the optimization of factors necessary for the economic utilization of the resources without disturbing the system irrevocably (Nwankwoala *et al.,* 2004). Despite the favourable and large groundwater occurrence reported globally, the Northern Nigerian situation appears to be critical since the majority of the area is underlain by crystalline rocks which are either igneous or metamorphic in origin and lack primary porosity and permeability (Olasehinde, 2010).

Problems of water quality and availability continue to rise especially as the communities keep on increasing in population. The emphasis on water sources and quality at the rural levels is becoming more urgent considering the prevailing scarcity of water and water-borne diseases in Niger State. There is more dependence on groundwater as an alternative supply in the study area. Therefore, the development and efficient management of groundwater resources is of great concern. The alternative for many who can afford it is to install hand pumps or deep wells (drilled and hand dug) to draw clean water from the ground depending on the depth of the water table. The depth of potable water tables generally depends on the geology as well as on the regional and local topography, considering the limited availability of water and the aspiration of the people, the rural water supply and sanitation programme was put in place in Nigeria in the early 1980s (Habila, 2003). Under this programme, the Petroleum Trust Fund (PTF) drilled over 3,000 boreholes and over 2,500 wells were built nationwide between 1996 and 1999.

Even though, research was carried out by Suleiman (2014) on the use of hand-dug wells to estimate the depths of underground water in Bida, Niger State, similar research was also done by Isah (2012) on the access and sources of water supply in zone B district in Niger State. Baraje (2012) also made similar research on the access and sources of water supply in zone C district in Niger State but not much work has been done on seasonal variation of water availability in hand-dug wells of Lapai and Agaie, Niger State. This research aims to assess the bedrock correlation to water availability in hand-dug wells of Lapai and Agaie, Niger State and the objective is to assess the seasonal variation of water availability in the study area.

METHODOLOGY

Study Area

Niger State is of one the 36 states of Nigeria, created out of the defunct North Central geo-political zone. The state shares its borders with Kebbi State (North), Kwara (South West), Kaduna (North East) and the FCT (South East). The state has a common boundary with the Republic of Benin along New Bussa, Agwara and Wushishi Local Government Areas. The location of the State is between longitude $3^0$30’ and $7^0$20 East of the Greenwich Meridian and latitude $8^0$20’ and $11^0$30’ north of the equator. The Provisional result of the 2006 National Population Census was 3,950,249. The State is comprised of 25 local Government Areas covering a total land area of 83,266,779 km or about 8.3 million hectares which represents 8% of the total land area of Nigeria. Soils are predominantly light and well drained. The state experiences distinct dry season and wet season with annual rainfall varying from 1,100mm in the Northern part to 1,600mm in the Southern parts.

Lapai is a Local Government Area in Niger State, Nigeria, adjoining the Federal Capital Territory and also sharing its border with Paikoro, Agaie and Gurara LGAs. The town is about 56km East of Minna, Niger State. Lapai is located at latitude 9º3'00"N and longitude 6º34'00"E. It has an area of 3,051 km² and a population of 110,127 (Niger State Bureau of Statistics, 2011 Edn).

Agaie is a Local Government Area in Niger State, Nigeria. It has an area of 1,903km^2 and a population of 132,907 at the 2006 census (Niger State Bureau of Statistics, 2011 Edn). It is situated at latitude 8º55'50"N and longitude 6º24'29"E.

The area alternates between dry and rainy seasons and falls within the Guinea Savannah. The maximum daylight temperature is about 34ºc in March while a minimum temperature of about 24ºC is recorded in December. The mean annual temperature is about 31ºC (Niger State Bureau of Statistics, 2011 Edn). The study area is well-drained by River Tankpolo and its tributaries. These streams are seasonal and are dry for most of the year except during the rainy season, hence the need for a groundwater source as a good alternative in the area. The study area stands at an elevation between 140m and 150m above sea level in the East and drops slightly to 125m in the Northwest and Southwest. The study area is low-lying with some hills in the northeastern portion, around Ebugi and Mashina.

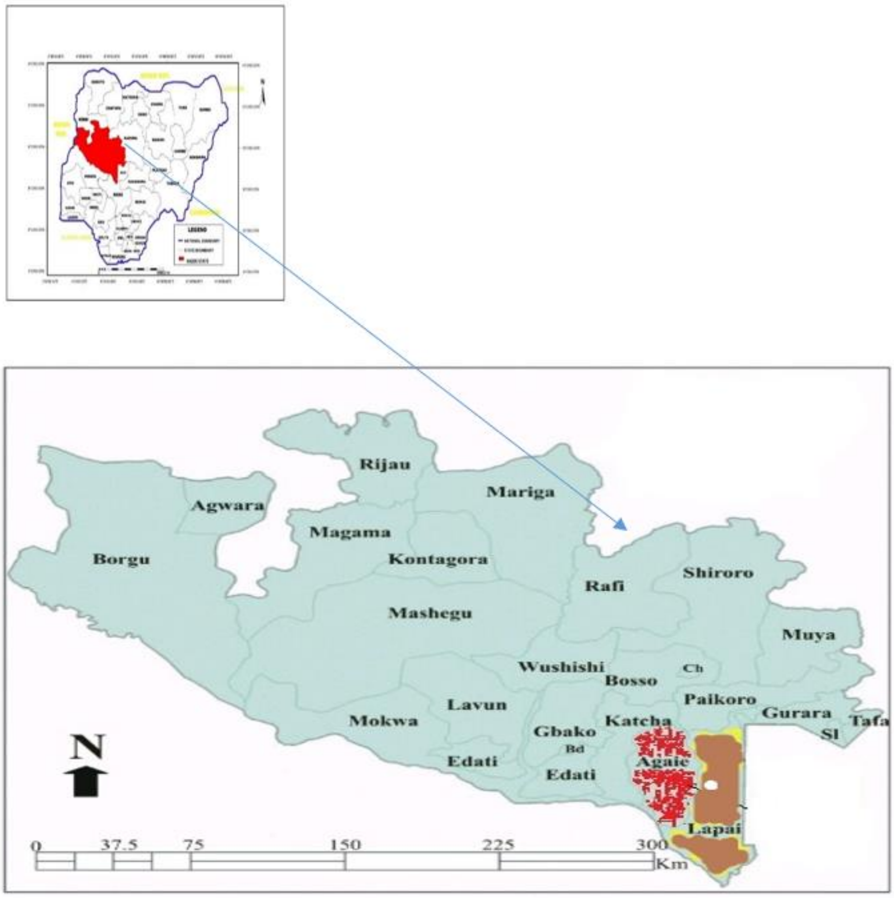

Fig. 1: Map of Niger State showing Lapai and Agaie (The Study Area)
Source: Ministry of Lands and Housing, Niger State

Sampling Method and Analysis

Systematic sampling was employed in the collection of primary data for this study. This was due to the uneven distribution of wells in the study area. A total of 64 and 56 wells were located in Lapai and Agaie respectively. The sample points were narrowed to ten (10) in Lapai and Agaie making a total of 20 samples in all. The sample selections were limited to the main town of Lapai and Agaie for accuracy. Depths to the water table of the wells was measured using measuring tape to describe the seasonal variation of water during the wet and dry seasons. The water level in the hand-dug wells were measured during wet and dry seasons through the use of ropes and measuring tapes, and the location and elevation of wells through the use of a GPS. The depth of twenty samples of wells was measured in October and January in Lapai and Agaie.

Various analytical tools were used to analyze the data collected during the fieldwork exercise. Statistical Package for Social Sciences (SPSS) and Microsoft Excel 2007 was used. The tools include the Arithmetic mean and statistical Average. The t-test distribution statistical method was employed to compare the seasonal variation between the bedrocks. The data collected were imputed into the computer system and analyzed using Microsoft Excel (2007 version) to produce the relevant statistical presentations in charts and tables for easy understanding.

RESULTS AND DISCUSSION

Fig. 2 below shows the graphical representation of data (depth (m)) obtained from each well within the basement complex (Lapai) during wet and dry seasons. The lowest depth measurement can be found during the wet season and the highest found during the dry season which are 7.51m and 49.1m respectively. This means that the highest water level is found during the wet season as compared to the lowest water table level found in the dry season. The average depth for the wet season is 17.311m whereas the average for the dry season is 21.88m as shown in Fig. 3 below. This shows a slight variation in the depths of the wells within these two seasons of about 4.57m. It can be concluded that during the wet season, wells in Lapai have recharged up to the height of 4.57m through rainfall as rainfall is the major source of ground water recharge. The lower the value (depths), the higher the water level in the wells. 17.311m in the wet season represents a higher water level as compared to the 21.88m in the dry season representing a relatively lower water level.

Looking at Fig. 4 below shows the depth (m) in a graphical representation as obtained from each well within sedimentary (Agaie) during wet and dry seasons. The lowest depth measurement can be found during the wet season and the highest found during the dry season which are 14.2m and 62.8m respectively. This means that the highest water level is found during the wet season as compared to the lowest water table level found in the dry season. The average depth for the wet season is 24.56m whereas the average for the dry season is 34.73m as shown in figure 4.4 below. This shows a variation in the depths of the wells within these two seasons of about 10.17m. It can be concluded that during the wet season, wells in Agaie have recharged up to the height of 10.17m through rainfall as rainfall is the major source of groundwater recharge. A depth of 24.56m during the wet season represents a higher water level as compared to a depth of 34.73m during the dry season representing a relatively lower water level.

From the graph below (Fig 5), it can be seen that Agaie has a relatively higher lower depth measurement as compared to the depth measurement in Lapai. Comparing the variations between the two same seasons within Agaie and Lapai, there is a 7.25m difference in the wet season for Lapai and Agaie and a 12.85m difference in the dry season for the two regions.

Looking at Fig. 7 and Fig. 8 it is observed that the highest measurements are found in the dry season of Agaie 62.8m while the lowest are found in the wet season of Lapai 7.51m. This means that water could be found in wells as low as 7.51m in Lapai and extremely lower at Agaie in some areas where it goes as far as 62m. These differences in depths of wells between Agaie and Lapai are correlatable to the different bedrock found in these two regions. Lapai is underlain by hard unconsolidated rocks which are relatively impermeable. As rain falls, it is usually collected in wells or washed away through run-off, this is why Lapai has a higher water table and is readily available and easier to access as compared to Agaie which is underlain by some bedrocks which allows for easier groundwater flow and movement.

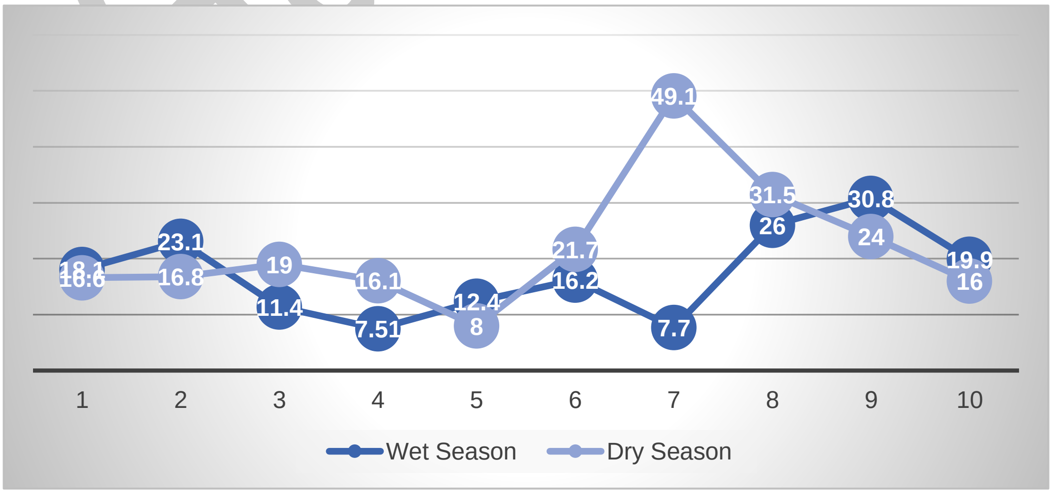

Fig. 2: Depth (m) of Wells in Lapai, Wet and Dry Season

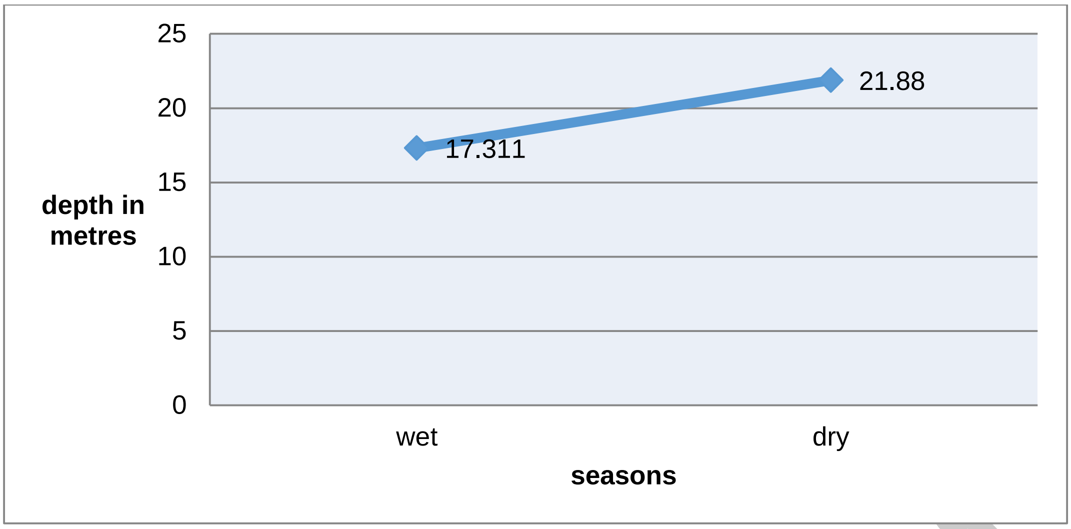

Fig. 3: Seasonal Variation of Water Availability in Hand-dug wells of Lapai

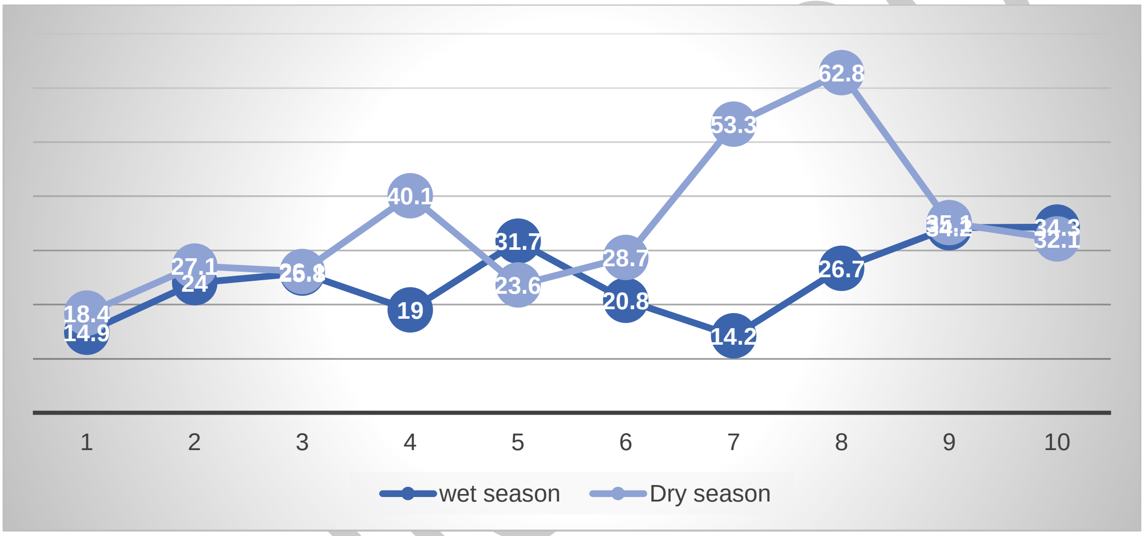

Fig. 4: Depth of wells in Agaie, Wet & Dry season

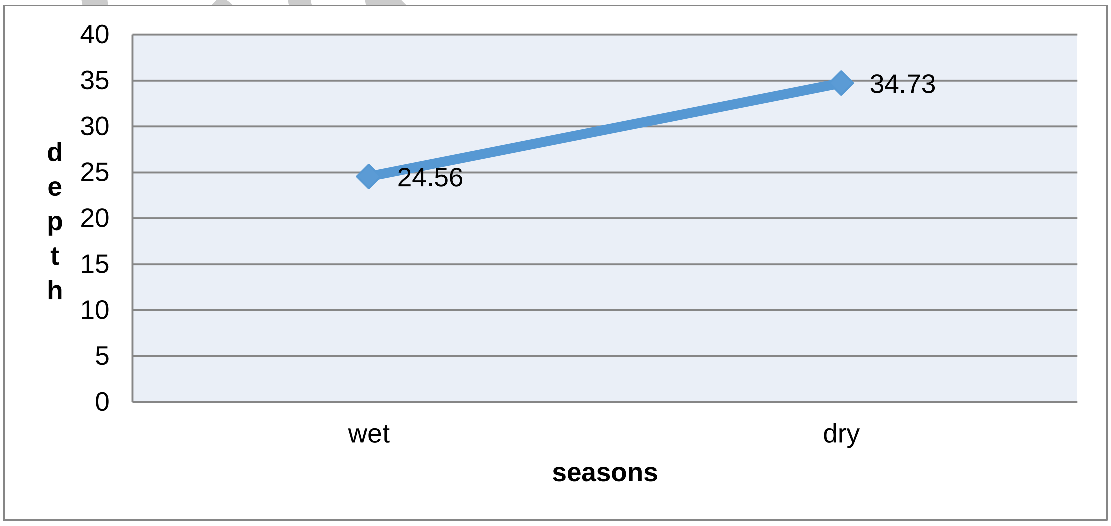

Fig. 5: Seasonal Variation of Water Availability in Hand-dug Wells of Agaie

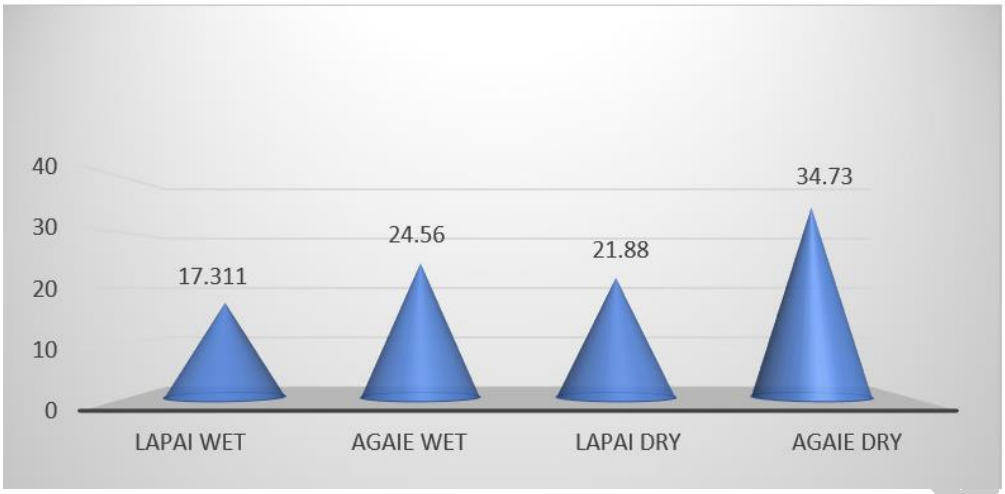

Fig. 6: Average Depth of Hand-dug Wells in Lapai and Agaie within Two Seasons

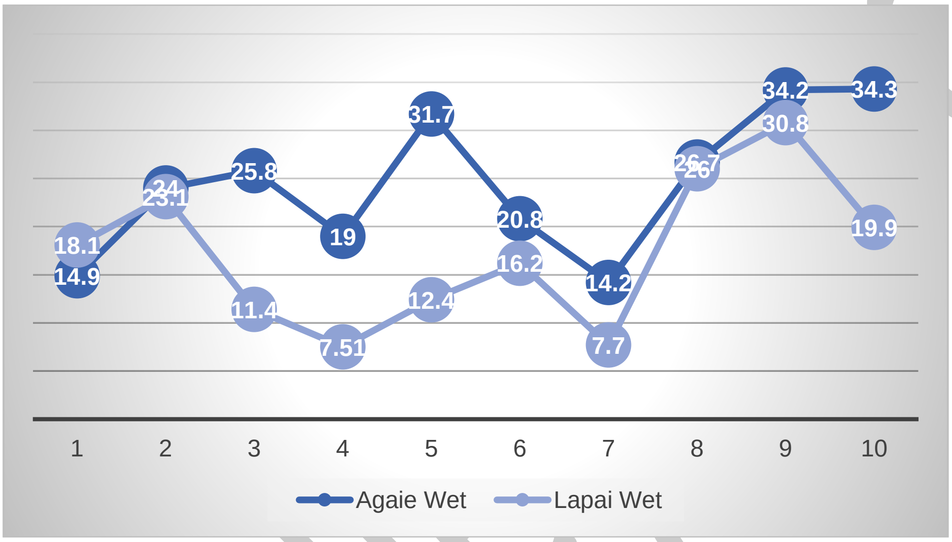

Fig 7: Depth of Wells for Agaie Wet and Lapai Wet

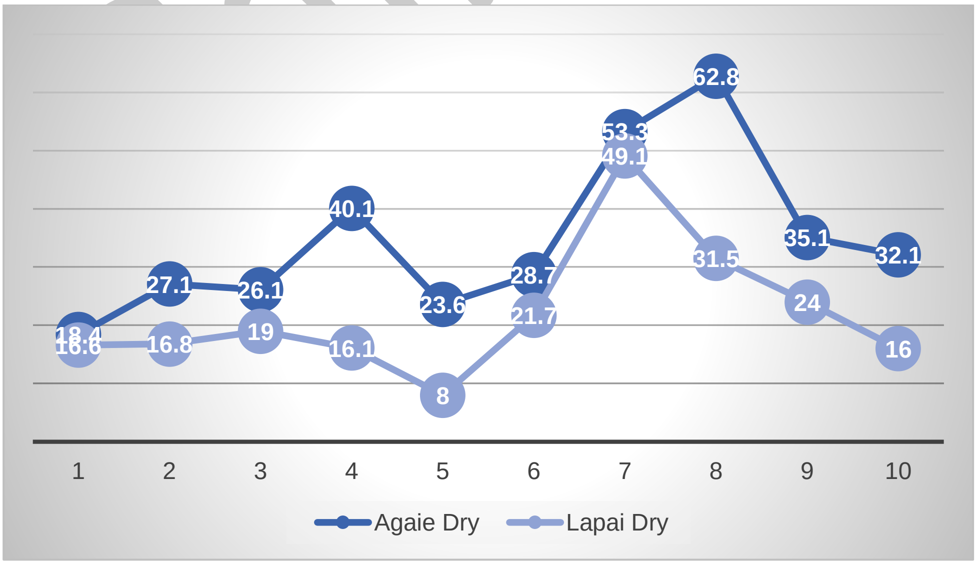

Fig 8: Depth of wells for Agaie Dry and Lapai Dry

Conclusion

Access to clean portable well water has tended to stratify societies based on general accessibility level. It was observed that the study area enjoys a substantial amount of clean portable water during the wet season all through the areas due to the rainfall but this is not the case during the dry season. This can be directly attributed to the lack of rainfall and the inability of the bedrock to retain and yield an appreciable amount of water. It was observed that water found during the dry season at Lapai is significantly lower than water found at Agaie during the dry season. This shows that underlying bedrocks play a significant role in water availability.

Recommendation

The Federal Government should increase the budget for water supply to meet up with the rising population growth which can be achieved by digging more wells in various communities of the study area.

The Federal Government should set standards for water measurement and complete hydrologic studies in all local government areas of the federation. This can be achieved by digging wells at strategic points in each community which can be used to provide monthly data for effective management of groundwater resources. The information gathered can be managed, analyzed and used for water availability assessments, water mapping and planning for future water supplies and also to enforce water laws and help groundwater users identify and solve water needs.

REFERENCES

Amadi, A.N. (2010). Hydrogeological and Geophysical Study of Bosso Area of Minna, North-Central Nigeria. *Bayero Journal of Mathematical science.* 3 (1), Pp 66-73.

Annan, K. (2003). World Water Day; Special United Nation Report, March.

Baraje S. J. (2012): Sources and Accessibility of Water Supply in Zone A' Districts of Niger State: unpublished undergraduate project. Department of Geography, Ibb University Lapai. Nigeria.

Buddeimeier, R.W., and Schloss, J.A. (2006). Groundwater Storage and Flow. http://www.kas.ku.edu/Hihplains/atlas/apgengw.html Retrieved 17th Novemeber, 2015.

Habila, O.N. (2003). *Public Water Supply Quality Management in Nigeria*. Conference Paper WEDC CONF 29.

Harter, T. (2003). *Water Well Design and Construction*. ANRPublication 8086. New York.

Isah, S.I. (2012): Sources and Accessibility of Water Supply in Zone B' Districts of Niger State: *Unpublished Undergraduate project.* Department of Geography, Ibb University, Lapai. Nigeria

Niger State Bureau of Statistics, (2011 Edn). *Facts and Figures on Niger State*. Niger: Niger State Planning Commission.

Nwankwoala, H.O., Odero, D.R., Semu, E., and Kamau, G. (2004). Estimating Aquifer Parameters in parts of the Port-Harcourt and environs using pumping test data. *Unpublished M. Phil thesis*, Rivers state University of Science and Technology, PortHarcourt, Nigeria.

Olasehinde, P.I. (2010). An Integrated Geological and Geophysical Exploration Techniques for Groundwater in the Basement Complex of West Central part of Nigeria. *Journal of National Association of Hydrogeologists* (water resources), 10(1), 46-49.

Pickering, A.J, and Davis, J. (2012). Freshwater Availability and Water Fetching Distance Affect Child Health in Sub-Saharan Africa. *Environmental Science & Technology*, *46*(4), 2391-2397.

Selvam, S.M.G, and Sivasubramanian, P. (2013). Hydrochemical characteristics and GIS-based assessment of groundwater quality in the coastal aquifers of Tuticorincorporation, Tamilnadu, India. *Applied Water Science*, *3*(1), 145-159.

Suleiman, H. (2014). Using Hand-dug Wells to Estimate Depths of Underground Water in Bida. Unpublished BSc Project.

United Nation Environmental Programme (UNEP), (2007); Water in the Climate System. Vital Water. Special Report (AGU).