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Groundwater Potential Evaluation Using Geo-electrical Resistivity Method

Lazarus G. Ndatuwong
Senior Lecturer, Department of Pure and Applied Physics, Adamawa State University, Mubi, Nigeria
Kasidi Simon
Senior Lecturer, Department of Geology and Mining, Adamawa State University, Mubi, Nigeria

Abstract:
A resistivity survey was carried out at the permanent site of Federal College of Chemical and Leather Technology (CHELTECH), Zaria, with the aim of investigating the subsurface for groundwater potential. A total of thirty nine (39) vertical electrical sounding (VES) points were occupied along six profiles that run North-South of the study area using the Schlumberger electrode configuration. A maximum electrode spacing of 100m was employed at all the sounding points. Result from the interpreted data show that the study area comprises of different lithology which are mostly clay/sandy soil, laterite, weathered layer, fractured basement and fresh basement. Based on the result obtained, the weathered basement is considered as the aquiferous zone in the study area. It has a thickness that varies between 1 and 37m. From the result of this work, the It is found on the various profile around the following VES points; 24, 25, 36, 21, 18, 30, 7 and 8.

Keywords: *Groundwater, Subsurface, pseudo-section, Basement, Lithology*

1. Introduction

Groundwater is one essential but necessary substitute to surface water in the world today. It is often of potable quality and does not require expensive treatment and permits scaled development using infrastructure that is usually of lower cost in relation to surface water. It's no doubt a hidden, replenish able resource whose occurrence and distribution greatly varies according to the local as well as regional geology, hydrogeologic setting and to an extent the nature of human activities on the land (Abubakar and Auwal, 2012). Groundwater occurrence in any region of the world is largely dependent on the nature and type of aquifer in such environment. This is because the nature and type of aquifer determines the quantity of groundwater that can be abstracted in a particular area to support her population. This is why it is extremely important to determine the groundwater potential of an area for sustainable development and management.

2. Geographical Location of the Study Area

The study area, which is the permanent site of the College of Chemical and Leather Technology (CHELTECH) Zaria, lies within latitude 11^o 7N to 11^o 12N and longitude 7^o 38E to 7^o 42E about 2km along Bassawa road from old Kano road Junction Palladan as shown in figure 1.

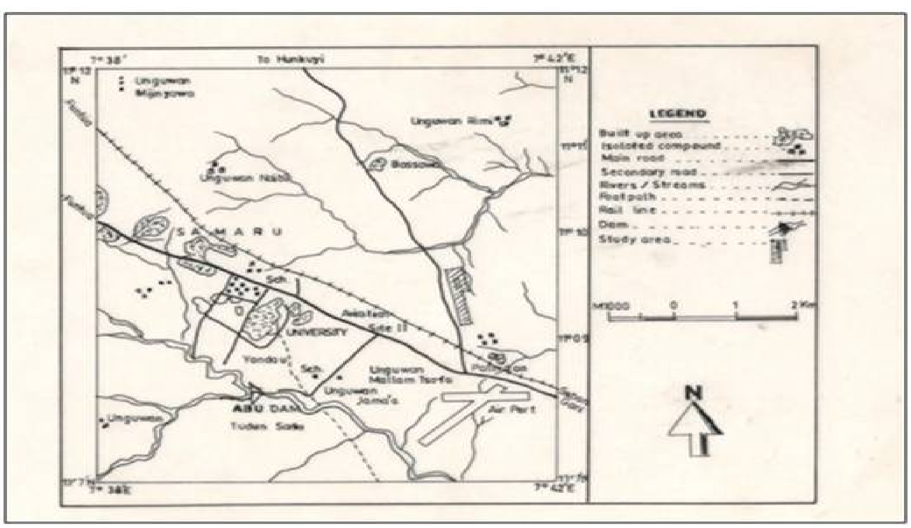


Figure 1: Map of Zaria showing location of study area

3. Local Geology and Hydrogeology of the Study Area

The study area is underlain by migmatite and granitic – gneisses, which are Precambrian rocks typical of the Nigerian basement complex (Fig.2). The granitic intrusions that form a suite of batholiths (the Zaria batholiths) path of which outcropped as the Kufena hill, which are mainly granites, gneisses and schists further showed that the study area is made up of the older grantic rocks. Structures like fractures, faults and joints play prominent roles in groundwater studies. They control the flow, recharge and discharge modes of groundwater in an area, especially when overlain by a weathered basement (Akpoborie, 1972). The superficial deposits that cover most of the basement rocks in the study area act as recharge to the aquifer. Alluvial deposits postdating the older laterite and broadly contemporaneous with younger laterite overlie most of the area (Wright and McCurry, 1970).

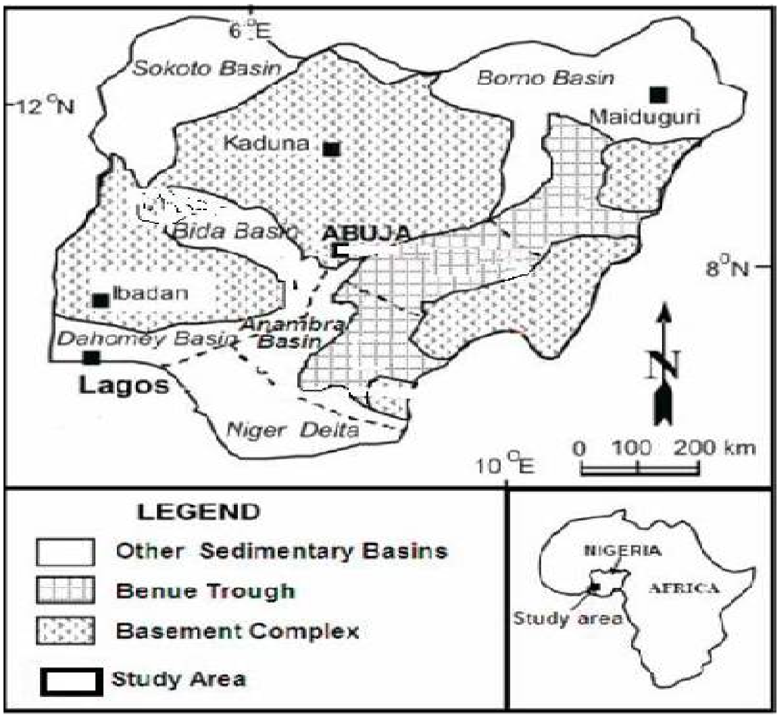


Figure 2: Geology map of Nigeria

4. Material and Methodology

Geophysical investigations consisting of 39 vertical electrical sounding (VES) points using the Schlumberger four-electrode array were taken within the study area. Six profiles numbered A-F were established in the study area. The VES points were occupied on 75m N-S by 60m E-W grid along the six profiles, as shown in Fig 3. The geoelectric configuration used in the study is the Sclumberger collinear four symmetrical electrode configuration. The current electrode separation is 200m while the potential electrode changing correspondingly from 0.5-10m. The measurements were made with SAS 300 ABEM Terrameter units. IPI2win software is used for the interpretation of the field sounding data and subsequently used to produce the pseudo-section.

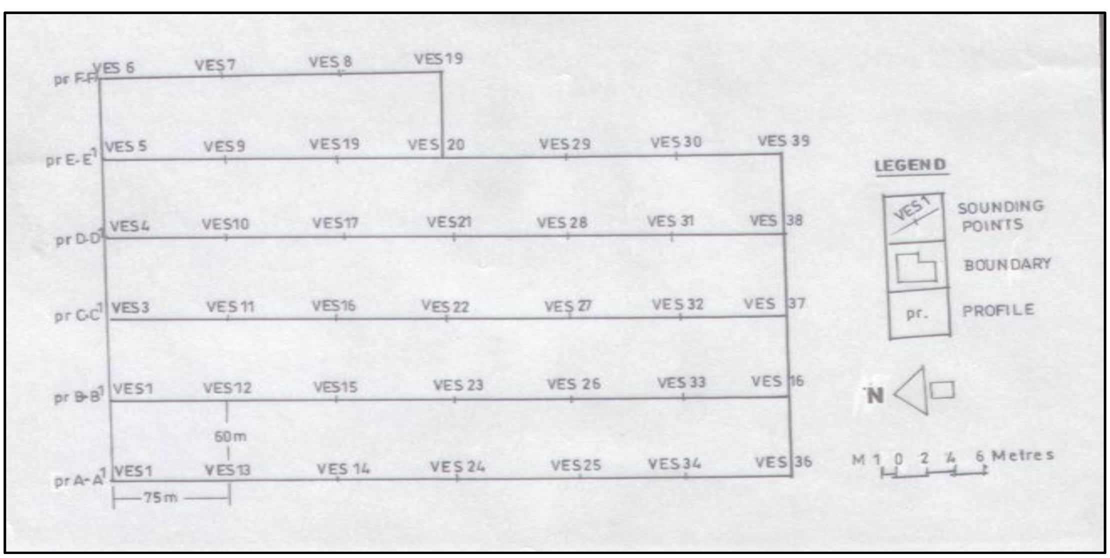


Figure 3: VES station layout

5. Result and Discussion

Most geophysical surveying is concerned with the measurement and analysis of some measurable quantity as a function of either distance or time or both. The resistance values obtained at each VES station were multiplied by the corresponding geometric factor to obtain the value of the apparent resistivity. Interpretation of geophysical data is simply expressing the information acquired from geophysical field measurements in terms of geology. The data obtained was processed and quantitatively interpreted using available geological information of past survey in Zaria region (Table 1) and presented as resistivity pseudo-section along the six profiles.

Rock Type	Resistivity (ohm m)
Sandy Clay / clay sand	> 100
Lateritic soil	> 1000
Weathered Basement	10 – 490
Fractured Basement	200 – 1000
Fresh Basement	> 1000

Table 1: Resistivity values of rocks adopted in this work as compiled from Shemang (1990) and Ajayi and Hassan (1988)

5.1. Profile A-A'

The profile consists of seven VES points, the pseudo-section for apparent resistivity is shown in Fig. 4a. A low resistivity value at a depth of about 16 – 40m was observed at around VES 24 and 25, this suggest a weathered basement which is a good potential for groundwater exploration in the study area.

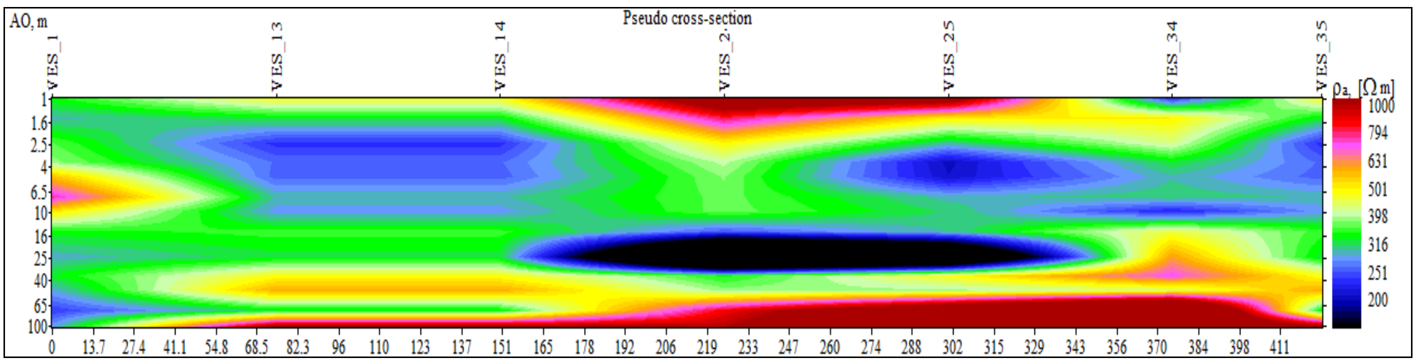


Figure 4(a): Resistivity pseudo-section of profile A-A'

5.2. Profile B-B'

The pseudo-section for this profile consist of seven VES points (Fig.4b). The potential for groundwater is observed around VES 36 at a depth of about 25m. The value of the resistivity observed that the location suggest a fractured basement.

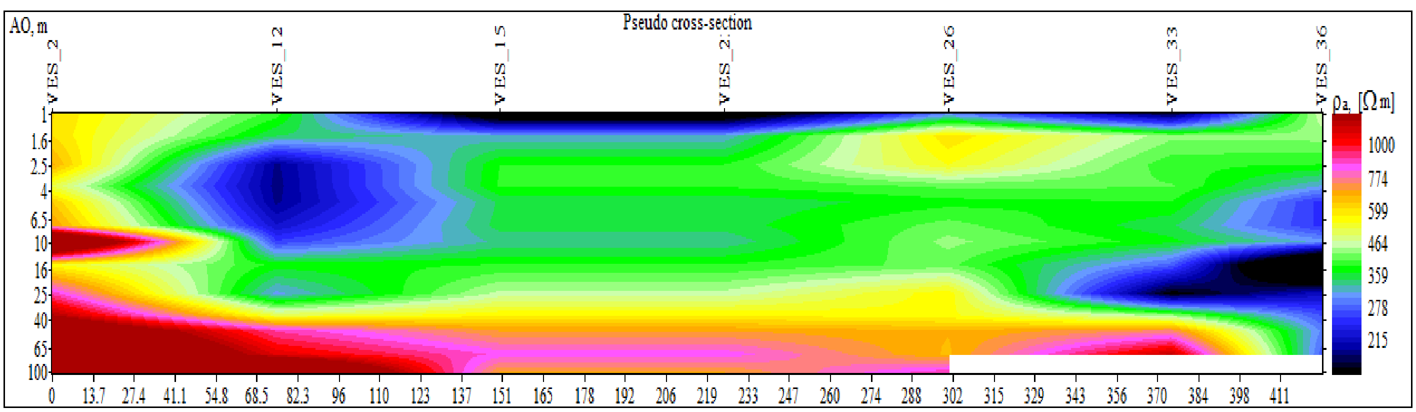


Figure 4 (b): Resistivity pseudo-section of profile B-B'

5.3. Profile C-C'

The pseudo-section for this profile is shown in Fig. 4c below with seven VES points. The section is covered with low resistivity value at the surface which indicates a sandy clay soil formation. There is no potential for groundwater exploration on this profile.

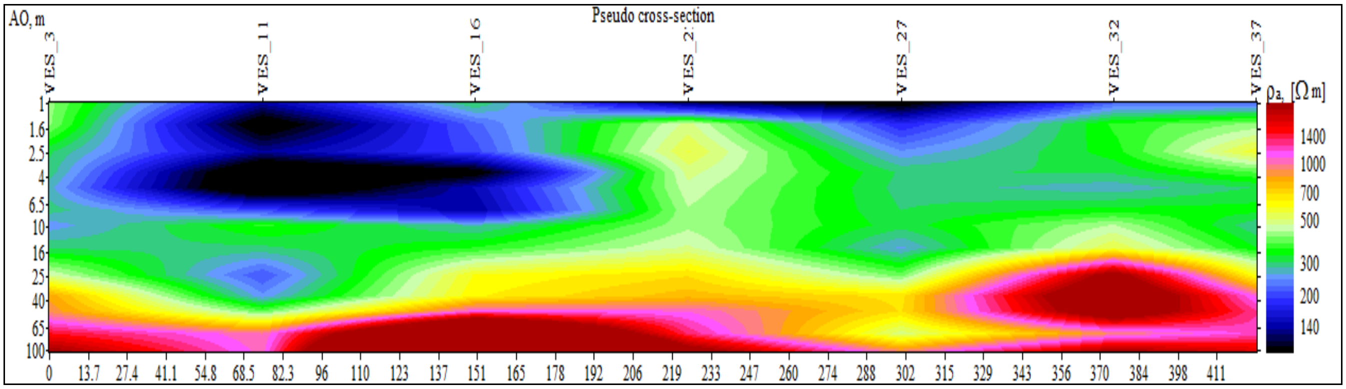


Figure 4 (c): Resistivity pseudo-section of profile C-C'

5.4. Profile D-D'

The pseudo-section consist of seven VES points as shown in Fig. 4d. It is covered by lateritic soil (fresh and weathered), and has apotential for groundwater around VES 21 at a depth of about 25m, which adjourn to be a weathered basement.

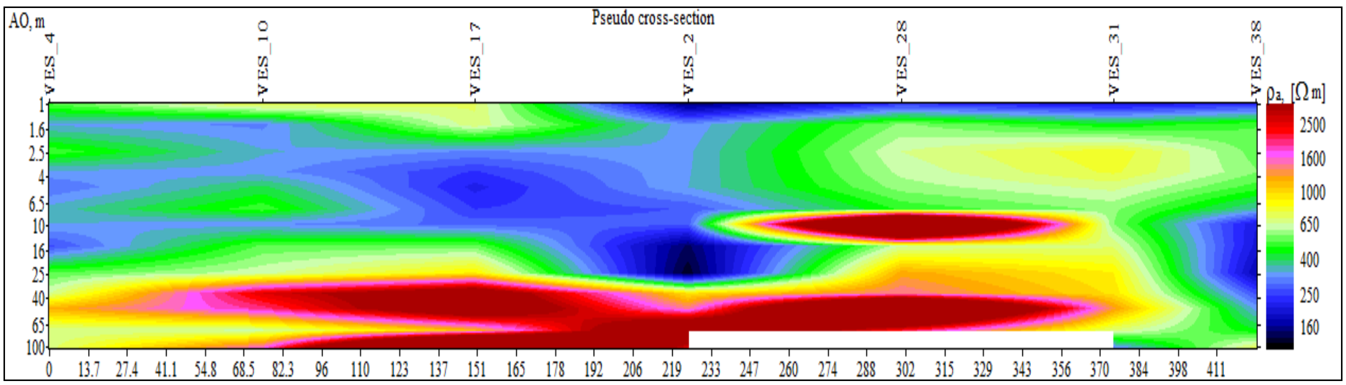


Figure 4 (d): Resistivity pseudo-section of profile D-D'

5.5. Profile E-E'

The profile is occupied by seven VES points and the pseudo-section is shown in Fig. 4e below. The profile has a potential for groundwater exploration around VES 18 and 30. The one around VES 18 is a fractured basement at a depth of about 50m while a weathered basement aquifer exist around VES 30 at a depth of about 40m.

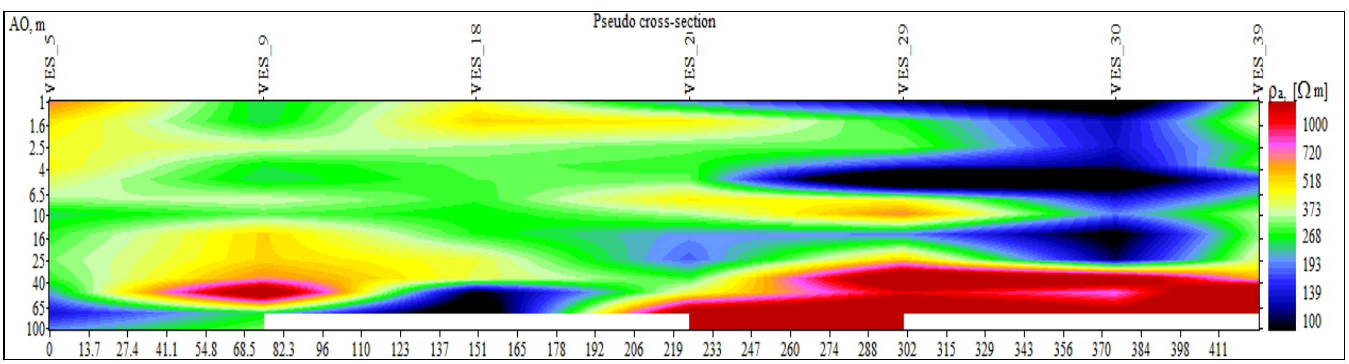
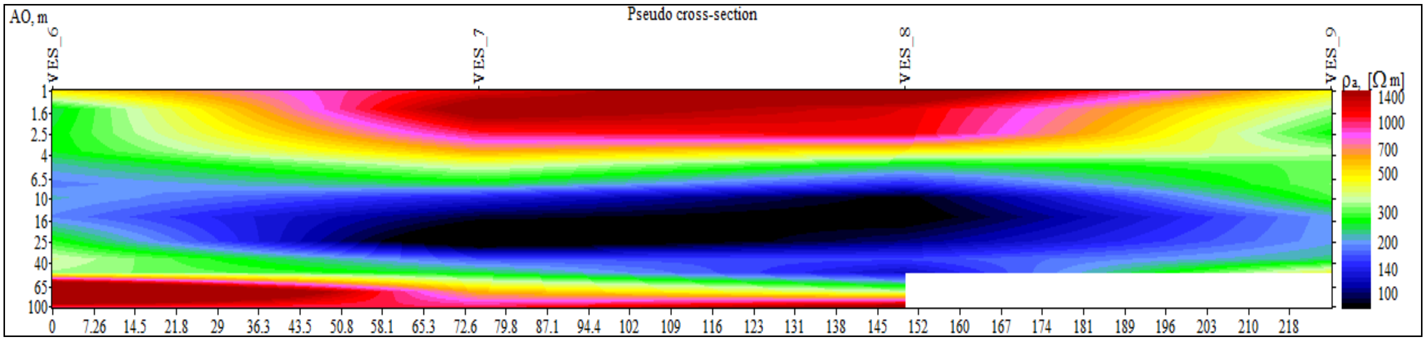


Figure 4 (e): Resistivity pseudo-section of profile E-E'

5.6. Profile F-F'

This profile consist of only four VES points and the pseudo-section is shown in Fig. 4f below. The profile has a good potential for groundwater around VES 7 and 8 at about 10 – 40m. The potential zone is adjourn to be a weathered basement.



(f): Resistivity pseudo-section of profile F-F'

6. Conclusion

The result of data analysis showed that the area under investigation exhibits two to four geoelectric layers down to the depth investigated by the maximum electrode spread used. It consists mainly of sandy/clay and lateritic soil over laying the weathered / fractured basement with the fresh basement as the bed rock. In order to determine the area with suitable and exploitable groundwater potential there are certain conditions necessary to guarantee the presence of exploitable groundwater in the basement area. The parameters to consider are; a good conductive zone, the presence of suitable aquifer, a reasonable thickness of the aquifer. From the result of this work, the weathered and fractured basement is considered as the aquiferous zone in the study area. It has found on the various profile around the following VES points; 24, 25, 36, 21, 18, 30, 7 and 8.

7. References

i. Abubakar Y. I. and Auwal L. Y. (2012): Geoelectrical Investigation of Groundwater Potential of Dawakin Tofa Local Government Area of Kano State Nigeria. American International Journal of Contemporary Research Vol. 2 No. 9; p188-197.
ii. Ajayi, C.O and Hassan, M. (1989): The delianation of the aquifer overlying the basement complex in the western part of Kubanni basin of Zaria. Journal of Nigeria mining and geology. Vol. 26 No. 1
iii. Akpoborie, I. A. (1972): Hydrogeological control of structurs along Samaru creek. Unpublished B.Sc. Project, Geology Department, A.B.U Zaria.
iv. Shemang, E.M. (1990): Electrical depth soundings at selected well sites within Kubanni River Basin Zaria. Unpublished M.Sc Thesis, Physics Department, A.B.U. Zaria.
v. Wright, J.B and McCurry, P. (1970): The geology of Zaria sheet 102 SW, Zaria and its region. In Department of Geography, Occasional paper No. 4, ed. by M.J Mortimore, Geography Department A.B.U Zaria.