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Original Research Article

Operational Status of Water Borehole Schemes in South-Eastern Nigeria

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ABSTRACT

This study was carried out in south-eastern states of Nigeria to evaluate the status of water borehole schemes. The study utilized questionnaires and field observations to achieve its purpose. Some 42.86% of the boreholes studied are dysfunctional in Abia state due to pump (77.78%) and generator (22.22%) failures respectively. In Imo state, 54.32% of boreholes studied are dysfunctional due to pump (70.46%) and generator (29.54%) failures respectively. In Anambra state, 38.89% of boreholes studied are dysfunctional due to pump (52.38%) and generator (47.62%) failures respectively. In Enugu state, the study indicated that 15.1% of boreholes studied are dysfunctional due to pump (62.5%) and generator (37.5%) failures respectively. Evidently, the adoption of a well-structured maintenance programme is therefore fundamental to the development of sustainable water supply in these states.

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1. INTRODUCTION

The development of groundwater especially in the rural areas has been supported by the federal, state and local governments due to the availability of ground water in most areas, relative low cost of abstraction when compared to surface water schemes and abstracted water being potable without treatment (Agunwamba, 2000a). In addition, the external supporting agencies have committed huge sum of money through provision of drilling rigs, geophysical equipment, chemical laboratory kits, hand pumps and spare parts to ensure sustainability of the programme (Agunwamba, 2000b). Most of the drilled boreholes have failed and more are failing at a very alarming rate (Agunwamba, 2000c).

Generally, a water borehole scheme properly sited and developed will usually consist of some or all of the following components: well opening, casing screen, riser pipe, submersible pump, connecting cable, gravel-packing, well head, starter panel, generator, over-head service tank and pipe reticulation. A water borehole scheme may fail at the starter panel due to faulty contactors. An improper setting of the relay timers may result in over current and over voltage passage which can burn the pump (Hoko and Hertle, 2006). The generator may fail to start due to one fault or the other and the system can be described as failed. A leaking riser pipe will result in reduced pressure in the supply pipeline and water supply to the overhead tank may be cut off. All these components failure can occur independently or collectively. A study by Okere (2010) revealed that over 8% of the 53 private and 17 government owned boreholes in Abia and Imo States were non-functional due to maintenance problems, thus interrupting water supply in those communities. The study was limited to two states in south-eastern Nigeria and causes of the breakdown of the water boreholes were not identified. This study is set to identify the functional and non-functional water boreholes and reasons for their poor condition. This study covered water boreholes schemes, both privately-owned and government-sponsored in Abia, Anambra, Enugu and Imo states of south-eastern Nigeria.

2. MATERIALS AND METHODS

2.1. Study Area

South-eastern Nigeria is an area covering about 76,358 km^2 east of the lower Niger and south of the Benue valley. The region is located between latitudes 4° N and 7° N and between longitudes 7° E and 9° E (Figure 1).

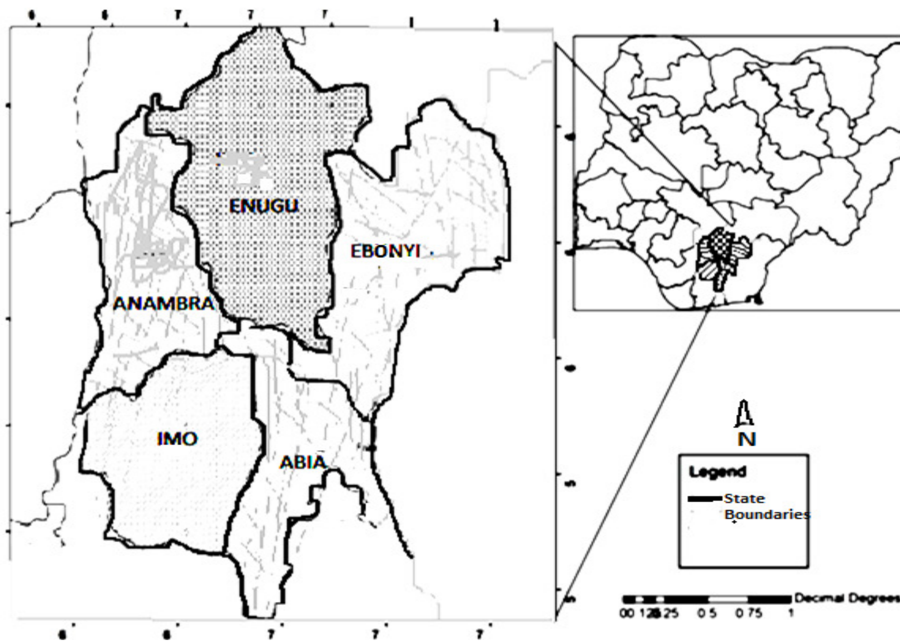

Figure 1: Major towns of South-eastern Nigeria (Ofomata, 2001)

In terms of relief, the land surface of eastern Nigeria can be classified into three broad units. These are the plains and lowlands (including the river valleys), the cuesta landscapes and the highlands (Ofomata, 2001). Climate-wise, eastern Nigeria is characterised by seasonal distribution of rainfall which depends on the interaction of the Tropical Continental air mass, the Tropical Maritime air mass and the Equatorial Easterlies. The rainfall pattern which is controlled by the movement of the Inter-tropical Convergence Zone (ITCZ) is characterised by a long wet season from April to July, with a short dry season in August, followed by a short wet season from September to October (Ofomata, 2001). The rainfall of utmost importance for soil erosion within the region are the short duration rains that fall at the beginning and at the end of the rainy season due to their intensity and violence (Ofomata, 2001). Five major soil classes are recognised within eastern Nigeria based on morphology, degree of profile development, mineral properties of the underlying rocks, and the slope of the terrain. These are the lithosols, young soils derived from recently deposited materials, ferruginous tropical soils, ferrallitic soils and hydromorphic soils (Ofomata, 2001). In geo-political terms, it contains five out of the 36 states of Nigeria, namely Abia, Anambra, Ebonyi, Enugu and Imo. Ebonyi State was excluded because of its peculiar geology of low transmissivity and had very few boreholes.

2.2. Data Collection

Data for this project came from questionnaires and interviews with project managers and technicians linked to water boreholes in south-eastern Nigeria. The total number of boreholes (functional and dysfunctional), percentage of functional and dysfunctional water boreholes were computed and presented in simple bar charts. The data was further processed to evaluate the borehole component (generator and pump) breakdown.

3. RESULTS AND DISCUSSION

3.1. Status of Boreholes in Abia State

In Abia State, the number of dysfunctional boreholes amounted to 18 of the total 42 boreholes in February 2017 as depicted in Figure 2.

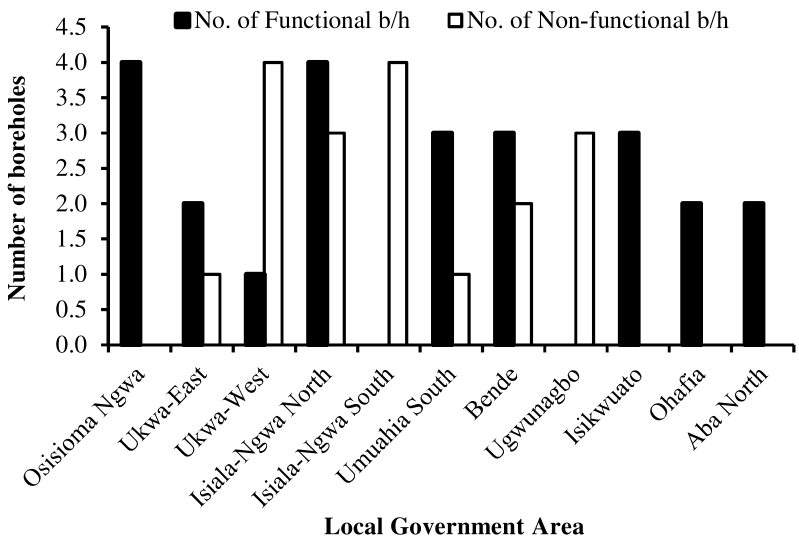

Figure 2: Status of water boreholes in Abia State

Figure 3 shows that 14 of the dysfunctional boreholes in Abia state were not functional due to pump problems, while 4 boreholes were dysfunctional due to generator breakdown.

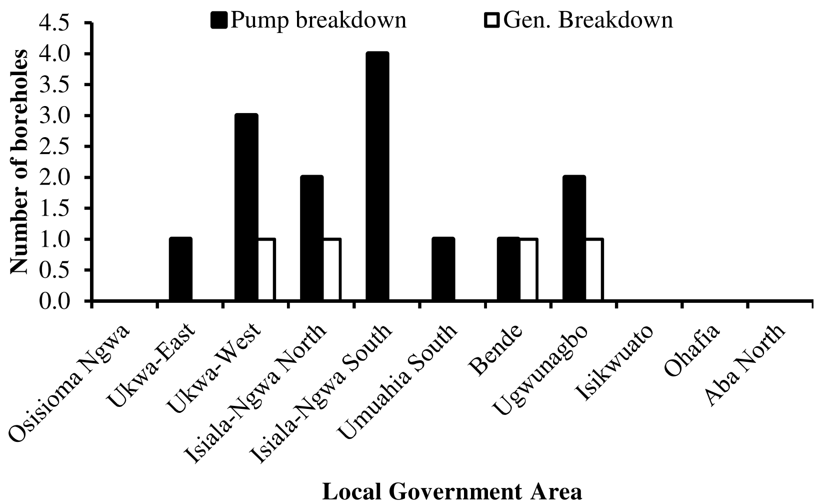

Figure 3: Status of faulty borehole component in Abia State

3.2. Status of Boreholes in Imo State

For Imo State, 44 boreholes out of a total of 81 were dysfunctional as shown in Figure 4. Figure 5 indicates that of the 31 boreholes were not functional due to pump problems, while 13 were dysfunctional due to generator breakdown.

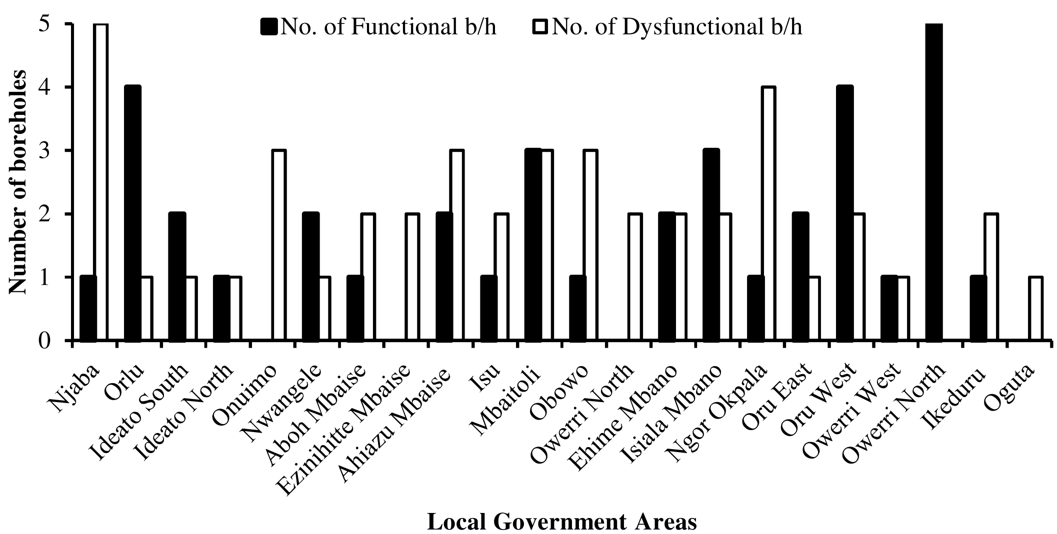

Figure 4: Status of Water Boreholes in Imo State

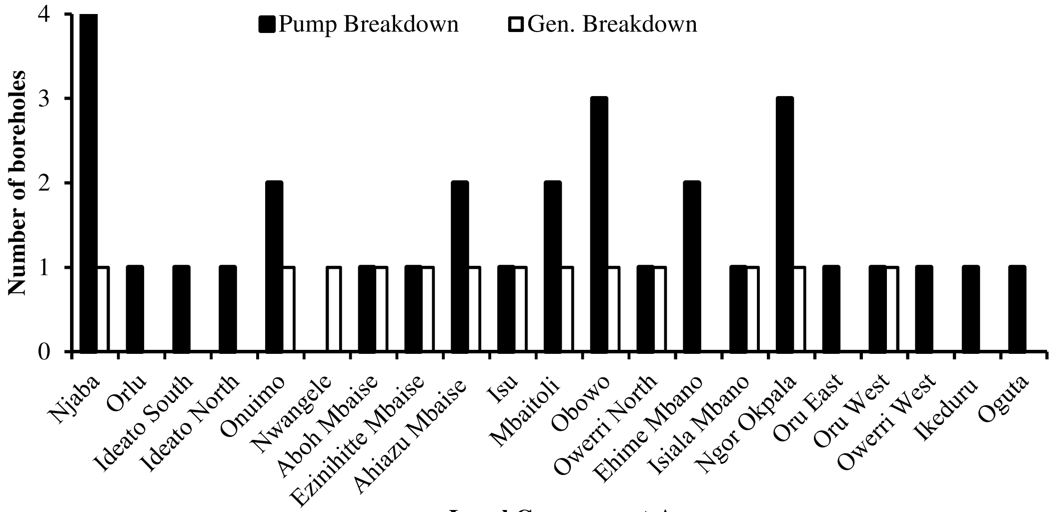

Figure 5: Status of faulty borehole component in Imo State

3.3. Status of Boreholes in Anambra State

In Anambra, the number of dysfunctional boreholes was 21 boreholes out of a total of 54 as shown in Figure 6. Figure 7 indicates 11 boreholes were not functional due to pump problems, while 10 were dysfunctional due to generator breakdown.

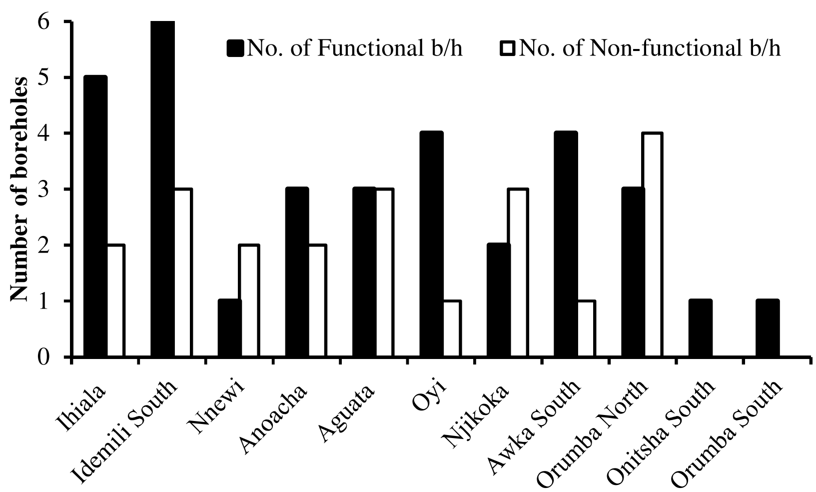

Figure 6: Status of water boreholes in Anambra State

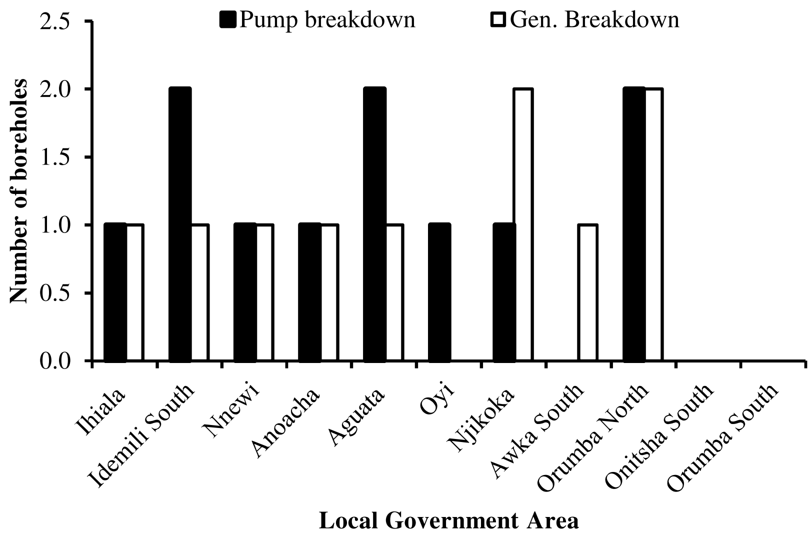

Figure 7: Status of faulty borehole component in Anambra State

3.4. Status of Boreholes in Enugu State

The number of non-operational boreholes in Enugu State amounted to 8 boreholes out of a total of 53 as depicted in Figure 8. Figure 9 indicates that 5 boreholes were not functional due to pump problems.

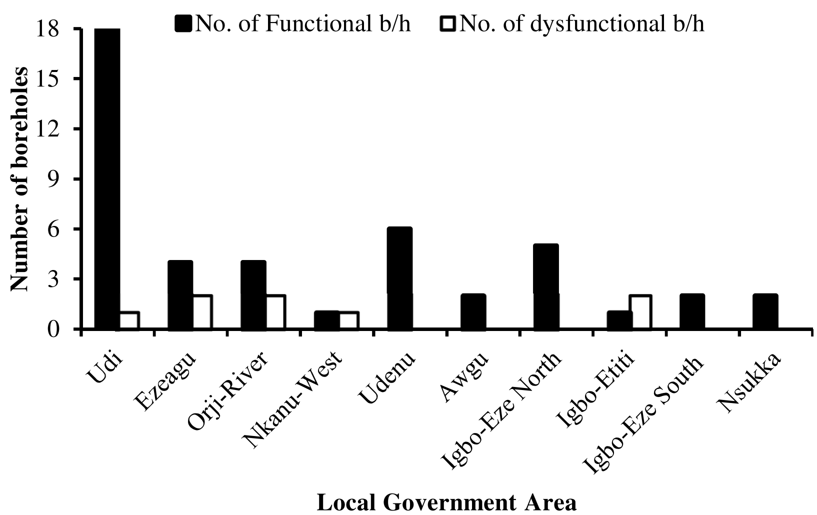

Figure 8: Status of water boreholes in Enugu State

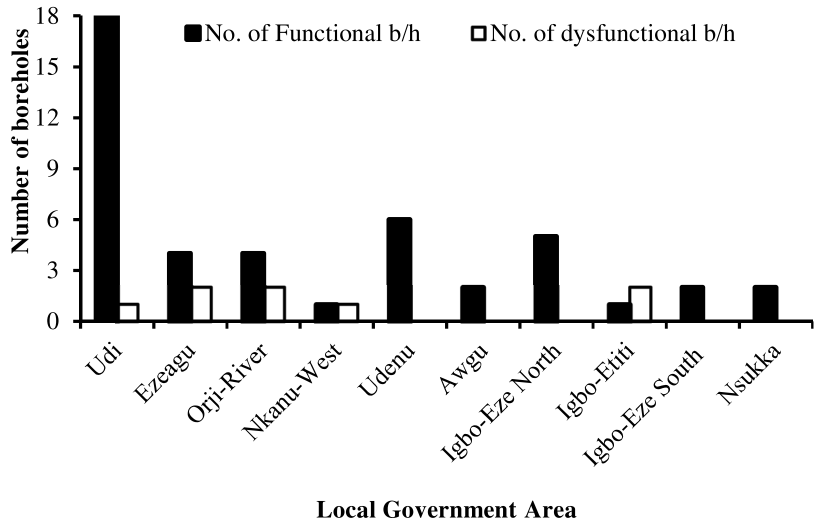

Figure 9: Status of faulty borehole component in Enugu State

When expressed in percentages, Enugu State had the least percentage (15.1%) of borehole, whereas Imo state had the highest (54.32%). This is maybe due to a better maintenance programme by the Enugu government or the host communities of the water schemes. This explanation is supported by the report of Agunwamba (2000b), who revealed that Enugu State had one of highest budgetary allocation to water scheme rehabilitation in Nigeria. In terms of faulty components, Imo and Abia States had least frequency of generator breakdown (22.2 to 29.54%) due to their similar shallow groundwater table. This is consistent with the findings of Okere (2010) who reported that very deep boreholes require more energy. Thus, small generator capacity may lead to frequent breakdown due to overload. Enugu and Anambra States have deeper boreholes than the other two states (Nwachukwu, 2015).

4. CONCLUSION

The status of boreholes in south eastern Nigeria was studied. 91 out of 230 sampled boreholes were not non-functional. Results indicated the absence of a planned maintenance programme in the area, the success of which requires equipping the water corporation with space parts, maintenance equipment and tools. The non-functional boreholes should be rehabilitated and all completed ones commissioned to mitigate the disastrous health problems caused by scarcity of water.

5. ACKNOWLEDGMENT

There is no acknowledgement associated in this work.

6. CONFLICT OF INTEREST

There is no conflict of interest associated with this work.

REFERENCES

Agunwamba, J.C. (2000a). *Rural Water Supply: Success and Failures in Rural Processes and Prospects*. In: Elohi, E.C. Ayichi, D., Okoye, C. U. (Eds). Central Publishing, Owerri.

Agunwamba, J.C. (2000b). Effective Maintenance of Rural Boreholes. *Water Resource*, 6 (12), pp. 7-14.

Agunwamba, J.C. (2000c). Optimal Maintenance of Rural Borehole Schemes. *NJEM,* 1(2), pp. 13-22.

Hoko, L. and Hertle, J. (2006). An Evaluation of the Sustainability of a Rural Water Rehabilitation Project in Zimbabwe. The Case of Mwenezi, Gwanda, Bulilima and Mangwe. *Physics and Chemistry of the Earth*, 31(15-16), pp. 699-706.

Nwachukwu, M. C. (2015). *Model Development of Least Cost Maintenance of Water Borehole Schemes in South-Eastern States of Nigeria.* Unpublished Ph.D thesis, Department of Civil Engineering, Federal University of Technology, Owerri.

Ofomata, G.E.K. (2001). Soil Erosion in Enugu Area of Nigeria. *Nigerian Geographical Journal*, 7 (8), pp. 45-49.

Okere, E. O. (2010). *Optimization of Preventive Maintenance of Boreholes in Abia and Imo States*. Unpublished Master's thesis. Federal University of Technology, Owerri.