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ASSESSING THE SUSTAINABILITY OF BOREHOLE FOR POTABLE WATER SUPPLY IN SELECTED COMMUNITIES IN AKOKO AREA OF ONDO STATE, NIGERIA

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Abstract
Field survey was used to collect data on the year of construction of boreholes, estimated population of users, donor agency, type of pump fitted and where non-functioning, the year of failure and cause(s) of failure from at least five (5) communities in each of the four local governments in Akoko Area, Ondo State Nigeria. Also, oral interview was conducted to extract information on the communities' involvement in the ownership and management of boreholes, methods adopted, challenges and prospects. Results showed that all the 110 boreholes assessed were constructed between 1995 and 2014 with 51 (about 46 %) constructed between 2005 and 2009 with an average user population of 500 people. 53 boreholes were fitted with manual pumps, out of which 30 of them (about 57 %) were already non-functioning, while 57 were solar-powered/motorized boreholes out of which 28 (about 49 %) were also non-functioning. Majority of the boreholes were found to have failed between 5 and 10 years with various reasons adduced for the failure. Although about 10 % of the respondents said their communities were involved in boreholes ownership, the arrangement was not sustained owing to some stated reasons. Thus, the study recommended amongst others, creation of water and sanitation unit in a relevant department of all local governments to attend to borehole and other related matters in the state, formulation and implementation of appropriate policy framework for the involvement of communities in borehole management in the area, for sustainable water supply.

Key Words: *Assessment, Sustainability, Potable water, Borehole, Hand pump, Communities*

Introduction

The importance of water to the existence of human life cannot be over-emphasized. Almost all activities of man require the use of this unique natural resource in one way or the other. Water is needed for all body metabolic activities - respiration, digestion, etc., agricultural and industrial productions and for domestic use (Akoteyon *et al*., 2011**;** Nwankwoala and Nwagbogwu, 2012; Subramani *et al*., 2012). Maguvu and Mutengu (2008) asserted that communities and individuals can exist without comfort, shelter or food for a period, but they can hardly survive the deprivation of water for more than a week. Health officials have also stressed the importance of drinking at least eight glasses of clean water every day to maintain good health (WHO, 2004). Therefore, adequate water supply to any

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community is crucial and a determining factor in dictating the healthy condition of such a community.

Healthy living which can be directly influenced by good sanitary measures is related to access to adequate potable water supply. Adedeji and Ajibade (2005) had observed that access to safe drinking water and sanitation is critical in terms of health especially for children. Many health challenges such as mortality, morbidity and poverty have been reported in the literature as consequences of lack of safe drinking water supplies as well as poor sanitary condition (Nwankwoala, 2011; WHO, 2010; Abaje *et al*. 2009). In addition, unsafe drinking water was said to have contributed to numerous health problems in developing countries including the one billion or more death incidents of diarrhea that occur annually (Mark *et al*., 2002).

Despite the inevitability of water for human life, its supply is grossly inadequate in many developing countries of the world. The situation is more worrisome in Nigeria especially in the rural areas. For instance, recent reports by the World Health Organisation (WHO, 2010) placed Nigeria at third position globally on the list of countries with inadequate water supply and sanitation coverage. The report further adjudged Nigeria as one of the countries that are "off-track'' in meeting the water and sanitation targets of the Millennium Development Goals (MDGs) by 2015, due to lack of coordination, abandonment and poor funding of various water projects. In 2009, Nigeria was ranked 130 out of 147 countries on the world Water Poverty Index (WPI) (FRN, 2009). Inability to supply water through pipe-borne system makes it difficult to cover many homes in both urban and rural areas of Nigeria. Many water supply systems started some years back are not yet completed while those completed are not optimally and efficiently utilized. Thus, for this and many other obvious reasons, at least 52 % of Nigerians do not have access to improved drinking water supply (Orebiyi *et al*., 2010). The figure could also be higher in the rural areas of the country considering the fact that attentions of governments are more focused on the urban centres.

Consequently, many households have resorted to self-help to salvage the situation by constructing shallow wells, but the wells can hardly ensure adequate water supply in terms of quantity and quality. This is because shallow wells do not provide all-year round water supply and the water quality is inadequate. As a result, governments at all levels have adopted the construction of boreholes as an alternative to pipe-borne water supply and as a quick solution to the perennial water supply problem, especially in the rural areas. Therefore, many boreholes have been sunk in most semi-urban and rural areas of the country to supply water with different types of pumps fitted; some manual and some motorized. This, of course, is a common scene in Akoko Area of Ondo State where at least 75 % of the about 40 towns and villages are rural and are not connected to public pipe-borne water supply. However, it has been observed that many boreholes sunk by the successive governments are either not properly done or well-maintained to last long in the rural areas. Thus, the extent to which the boreholes constructed have effectively served as an alternative to pipe borne water supply is not known. Hence, this paper attempts to assess the sustainability of borehole for potable water supply in Akoko Area of Ondo State.

Materials and Method

The Study Area

Akoko (Figure 1), the study area, is located North-East of Ondo State and South-West of Nigeria. The area falls within

longitude $5^0$31' to $6^0$06' east of the Greenwich meridian and latitude $7^0$18' to $7^0$45' north of the equator. Akoko covers an areal extent of about 2465.6 km^2 occupying a generally undulating terrain with an altitude ranging between 270 m and 2750 m above sea level (Olorunlana, 2013). The climate is tropical with two distinct seasons- the dry and wet seasons. The wet season begins in April and ends in October or occasionally early November while the dry season is usually between November and April. Owing to its location in the northern part of Ondo State, the area is drier and receives less rainfall compared with other parts of the state with an annual average ranging between 1480 mm and 2500 mm, relative humidity of 60-85 % and temperature of between 28° and 32° (Ajayi, 2008). The vegetation of the area consists of the mixture of both the rainforest and Guinea Savannah type characterized by light forests, shrubs and scattered cultivation with different plants and trees which may reach a height of 5 m and even more.

There are about 40 towns and villages in Akoko divided into four local government areas- Akoko South-East, South-West, North-East and North-West with the inhabitants predominantly farmers. Despite the common culture, the people of the area speak diverse dialects apart from the Yoruba language common to all and it is arguably the largest ethnic group in the present Ondo State with the population figure of about 701,785 (NPC, 2006).

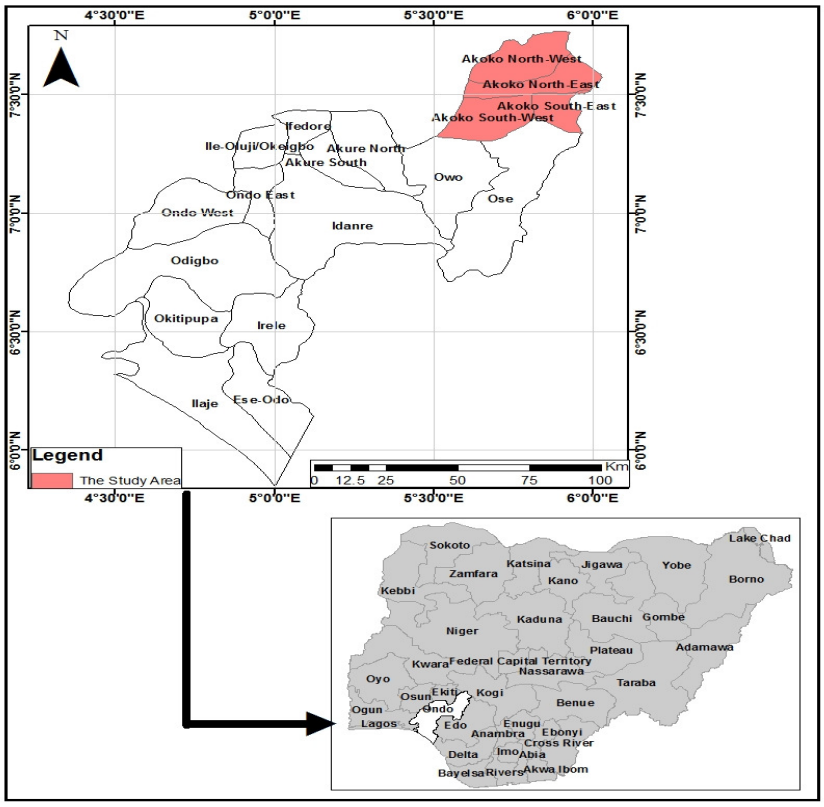

Figure 1: Map of Ondo State of Nigeria showing the location of Akoko Area

Data Collection

Data collection was done through field survey and oral interview between March, 2013 and January, 2014. A survey of at least five (5) communities in each of the four local governments in Akoko was carried out to

collect data on a minimum of five (5) boreholes (functioning or non-functioning) from each of the selected communities. In each case, information such as year of construction, estimated population of users, donor agency, type of pump fitted and where non-functioning, the year of failure and cause(s) of failure were obtained. Also, oral interview of at least one leader in the communities where the boreholes were sited was carried out to extract such information as level of involvement in ownership and management, availability of borehole committee and the procedure for raising fund for repairs (if any) when there is breakdown, availability of spare parts and the agency responsible for repair.

Results

The results of the field survey (Figure 2a) on the year of construction of the selected boreholes revealed that none was constructed before 1995 as the sites of the boreholes constructed earlier could not be identified easily. This coincided with the period when the Ondo State Water and Sanitation Project (WATSAN) actually started its full-blown operation. All the boreholes constructed during the period were manually operated. The results further showed that of the 110 boreholes surveyed, 9 (about 8 %) were constructed between 1995 and 1999, 12 (about 11 %) sunk between 2000 and 2004, 51 (about 46 %) provided between 2005 and 2009 and 38 (about 35 %) constructed between 2010 and 2014. Further analysis of the results also revealed the percentage of the boreholes still functioning as follows: less than 45 % of the borehole constructed between 1995 and 1999, about 50 % of those sunk between 2000 and 2004, 29 % of those between 2005 and 2009; and 68 % of those provided between 2010 and 2014 (Figure 2b). In all cases, an average of 500 people was estimated to be patronizing each of the boreholes.

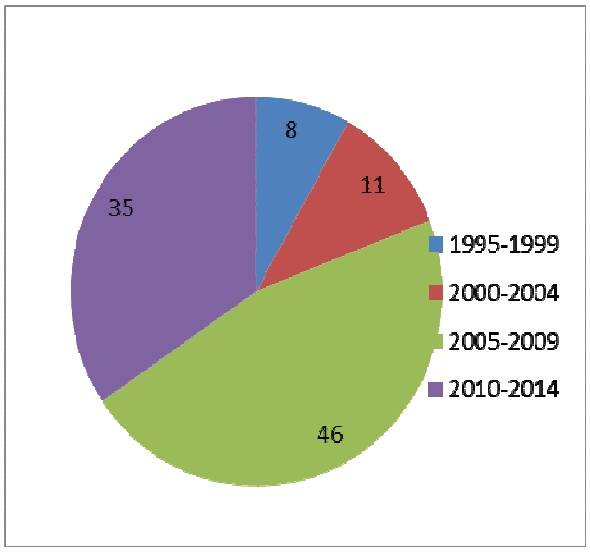

Figure 2a: percentage distribution of boreholes with respect to year of construction

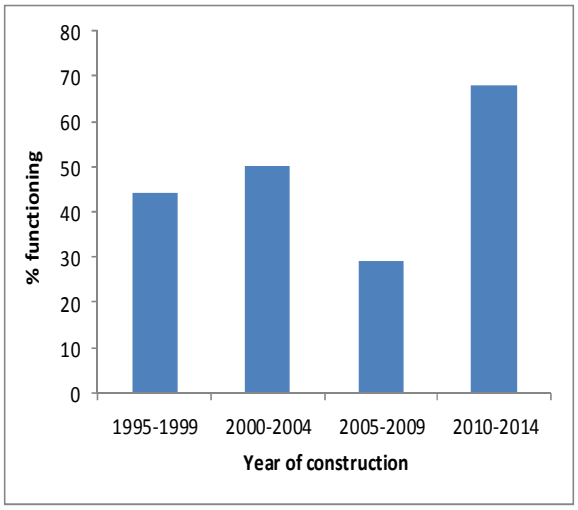

Figure 2b: percentage of functioning boreholes with respect to year of construction

Of the about 89 boreholes provided by the Ondo State Government (ODSG) during the period under study, 52 (about 58 %) are already non-functioning. A further examination of the result also showed that over 60 % of the boreholes failed within the first 5years of its existence. Causes of failure according to the respondents ranged from predominantly faulty pumps to stolen parts.

This was very common with the solar-powered boreholes which appeared to be more prone to damage due to its rather complex/sophisticated nature. Less than 40 % (3 out of 10) supplied by international donor agencies had broken down also; of these, one was not completed (abandoned project), while more than 57 % of the constituency projects were already non-functioning.

Out of the 53 boreholes fitted with manual pumps, 30 of them (about 57 %) were already non-functioning with majority caused by damaged pumps (Table 1). However, of the 57 solar powered/motorized boreholes, 28 (about 49 %) were also non-functioning owing to broken pipes and mostly stolen parts and damaged solar panels. The previous government in the state between 2003 and 2008 had embarked on the use of solar-powered pumps rather than the usual hand pump in majority of the boreholes constructed during the period. With the solar-powered pump, water distribution within the neighbourhood through the laying of pipes to a distance not more than 100 m in most cases from the boreholes site such that more people are served without having to trek long distance or staying on long queue was possible. Apart from this, the system also helped to conserve the human energy used on hand pumps as taps are fitted at strategic locations where users can get water with ease. Good as the method was, respondents during interviews were of the opinion that the cost of the solar panel could make it difficult for the community to afford its repair. They also reasoned that the complexity of the system might have contributed to its high susceptibility to damage.

Table 1: Result of borehole failure rates in Akoko Area of Ondo State

No of boreholes	Types of pump	Functioning	%	Non-Functioning	%
53	Hand pump	23	47	30	57
57	Motorised/solar-powered	29	28	51	49

With respect to the involvement of the communities in the ownership and management of the boreholes, only about 10 % of the respondents indicated that their communities were involved in the ownership and management of the boreholes, especially at the inception. This was common with the hand pump fitted boreholes particularly those constructed between 1995 and 1999. Under the arrangement, each community where the borehole was sited constituted a management committee which helped in raising fund used for repairs when the need arose. The committee also had the responsibility of reporting cases of breakdown of boreholes to the WATSAN Officer at the local government level whose duty it was to arrange for repairs while the communities might be asked to pay for spare parts used. Some of the committees were also involved in the day-to-day sensitisation of users on the appropriate ways of handling hand pump to prevent frequent breakdown; they also sometimes arranged for the locking and unlocking of the pumps in the morning and evening time, respectively. In few cases, volunteer technicians who are members of the community were trained to handle pump maintenance and repair of simple cases of pump breakdown. However, some leaders also responded that some members of the communities could not contribute to the maintenance of boreholes either due to poverty or as a result of the belief that it was not their duty to maintain government property. They further submitted that the zeal with which the communities accepted the responsibility then soon waned down owing

to poor motivation by the government, uncooperative attitude of some members of the communities, political manipulations and high cost and sometimes non-availability of spare parts.

Nevertheless, respondents were unanimous in their submission that they were never involved in the management and ownership of most of the boreholes constructed by the federal government agencies, international donors and as constituency projects by federal legislators. They added that, frequent cases of breakdown were observed amongst such boreholes; while many of them were never completed, a few others were unproductive right from the first day. Accordingly, when some of the projects breakdown, it was usually impossible for them to pin-point the particular office to run to for help. Again, the volunteer technicians earlier trained on the maintenance of hand pumps could as well not do much as many of the boreholes supplied through these means were motorized/solar-powered or fitted with strange hand pumps on which the technicians had no skill. Similar problems were also encountered with the solar-powered boreholes constructed across the state between 2003 and 2008 according to the respondents. It was in the opinion of the respondents that solar panels are costly and mostly beyond the financial capacity of the communities where the boreholes are sited in addition to the fact that the skill to repair the system is not readily available within the areas.

Discussion

A survey of about 292 boreholes earlier carried out in six states in Nigeria had shown that while 246 were fitted with hand pumps, only 46 had motorized pumps fitted on them (Eduvie, 2006). While the study further put the percentage of non-functioning hand pumps at 60.2 %, Mogaji *et al*. (2013) gave 43.7 % as the percentage of non-functioning boreholes fitted with hand pump in Owo, Ondo State Nigeria. Given that 57 % of the surveyed boreholes fitted with hand pumps are already non-functioning, the results of the present study can be said to be comparable with the two earlier mentioned. Furthermore, while the earlier study by Eduvie (2006) emphasized that the failures were most likely due to poor design and construction, hydrogeological factors and operational and maintenance failures, the respondents at the sites of the boreholes under the present study could not agree less, but added poor siting and scarcity of spare parts as other reasons for the failure of the hand pump fitted boreholes. According to the respondents, the insistence of some political leaders on dictating the location of the boreholes even in defiance of the result of geophysical survey made some of them to be unproductive right from inception.

Besides, while the present study showed that many more boreholes were motorized, the percentage of non-functioning ones (Table 1) are less than those of hand pump fitted boreholes, a result that is also similar to the earlier studies. In the present study, many of the boreholes fitted with motorized pumps are more recent than those of the hand pumps, a situation that might have helped their functionality. Additionally, the effects of wear and tear with the passage of time cannot be wished away in any machine especially those that are used very often and by people of different ages and knowledge like a hand pump. This might have been one of the reasons why many more of the boreholes installed with hand pumps are non-functioning presently. Nevertheless, it was further revealed during oral interviews that majority of the solar panels did not last more than between 6 months to 2 years while some were damaged by some unscrupulous politicians who felt that the succeeding

government could not take the glory of the achievement of the government under which the boreholes were constructed. Similarly, some respondents posited that some contractors might have deliberately carted away the solar panels after the exit of the government who awarded the contracts probably because they were not promptly paid.

A study on the rates of borehole failure has shown that less than 50 % installed water points (including hand pumps and motorized) function in most cases in Nigeria (Eduvie, 2003). This shows that provision of potable water through the use of boreholes could be highly unreliable and may not be a sustainable alternative to pipe borne water supply. Several factors can be responsible for the failure of boreholes to ensure sustainable supply of water to its target users after its completion. Auckhinleck (2013) listed such factors to include insufficiency of the groundwater as stored in the aquifer serving a particular borehole to meet community population. Although the present study did not include this aspect, the results of the field survey indeed showed that most of the boreholes failed as a result of faulty parts or outright abandonment/non-completion in very few cases. Interactions with the communities also showed that while they were ready to continue to contribute to the management and maintenance of the boreholes, they were discouraged by the lack of motivation from the government and non-availability of spare parts.

Despite the foregoing, there are reasons to believe that governments would continue to construct boreholes to meet the immediate need of the people especially in the rural areas. This of course appears to be an easy option in the short term, considering that governments are generally facing dwindling revenue with competing demands in the country at the moment. Attractive as this option is, the rate of failure of boreholes cannot justify the expended revenue in most cases. For instance, records showed that each of the solar-powered boreholes constructed between 2003 and 2007 by the ODSG were contracted out at between 4.5 and 6.5million Naira, depending on the environment. The government at present spends between 3 and 4.5 million Naira on motorized and solar-powered boreholes, respectively. This shows that the government may have to spend close to a billion Naira to cover the 203 electoral wards in the state and this may not still be enough and sustainable. In addition to the amount spent, many of the boreholes hardly serve beyond 5 to 10 years before they become permanently damaged. However, with good planning, such a whooping amount if judiciously used to rehabilitate existing water works and expand pipe network, might go a long way to solve the perennial problem of potable water supply in the state in general and Akoko Area in particular.

Conclusion

Boreholes with hand pumps installed on them are the most common technology adopted to implement rural water programmes in Sub-Saharan Africa and current dependency level on boreholes by rural communities globally is estimated to be 75% (Auckhinleck, 2013). Reports also showed that boreholes currently serve an estimated 1.5 billion people globally, and has proved to be highly reliable if properly managed and maintained (MacDonald, 2005). However, the current study has shown that high rates of breakdown of boreholes in Akoko Area of Ondo State, Nigeria affects their sustainability and ability to continually serve as a reliable source of potable water in the various communities where they are located. Although high rates of failure were applicable to all types of boreholes, irrespective of the type of pump fitted, the

present study showed that hand pump fitted boreholes are more vulnerable to failure. Reasons for boreholes failure ranged from non-involvement of communities in the management and maintenance of boreholes, scarcity and high cost of spare parts, poor siting, stolen parts and abandonment/non-completion.

Recommendations

Therefore, the study recommends the following**:**

(1) Creation of Water and Sanitation Unit at the relevant department of the local government areas in the state and fortification of same with spare parts and technicians to cater for the repair and maintenance of the available boreholes in the local governments.

(2) Involvement of the communities in the management and maintenance of the boreholes will also go a long way in increasing their lifespan. This should include provision of policy framework that will automatically bequeath on the communities the responsibility for the ownership and management of boreholes once completed.

(3) Regulation of construction of boreholes with appropriate standard set for providers/contractors will help in solving the problem of poor siting and sub-standard contract implementation.

(4) In view of the frequent cases of abandonment of boreholes provided by federal government agencies, it is suggested that such a responsibility should be completely transferred to the state and local governments.

(5) Completion of rehabilitation and expansion works on the existing water works e.g. Awara Dam to serve the people of Akoko should be vigorously pursued by the ODSG. This should be followed by improvement and extension of pipe borne water to all communities in the area.

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