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Challenges Facing the Attainment of the Millennium Development Goals (MDG's) in the Water Sector: The Niger State Example, Central Nigeria

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Authors' contributions

This work was carried out in collaboration between all authors. Author AI-N was the lead researcher and the head of the hydrogeologists that supervised the all boreholes drilled in the area of study. Author UD was the chief consultant for the programme. He supplied all the background data on the on the programme including operational modalities. Author AMJ was the head of the technical team that collected all technical data from the field. All authors have read and approved the final manuscript.

Original Research Article

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ABSTRACT

In an effort to realize tangible sustained improvements in the quality of life and living conditions of the Nigerian Populace, the Federal Government delegated responsibility for the implementation of various projects in the health, education and water sectors to the office of the Senior Special Assistant to the President on Millennium Development Goals (OSSAP – MDG'S). Main objectives of the water projects is the provision of water through motorized/solar powered boreholes complete with generator and operating rooms as well as hand pump boreholes. Mode of operations of the MDG's involves the appointment of consultants to oversee the entire projects in the various states of the federation. Contracts are then awarded to contractors, based on open bids, in lots and each contractor given a specified period to complete the project. A careful study of the programme showed that at best 50 – 60% success rate was achieved in some areas and less than 30% in some others. The main challenges mitigating against the attainment of higher success rates lies

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on the failure of contractors to provide adequate drilling machines and accessories to suit the local geology of the area, improper geophysical surveys and lack of experienced hydrogeologists/geologists to supervise operations. It is recommended that prospective contractors must be licensed, and water well drilling consultants must also have met the stipulated requirements. Borehole designs must also meet the approved standard, parameters for chemical and biological analysis must also be clearly stated.

Keywords: Groundwater; aquifer; quick-wins; poverty eradication.

1. INTRODUCTION

The Millennium Development Goals (MDGs) are eight goals to be achieved by 2015 that respond to the world's main development challenges. The MDGs are drawn from the actions and targets contained in the Millennium Declaration that was adopted by 189 nations and signed by 147 heads of state and governments during the UN Millennium Summit in September 2000. The eight MDGs break down into 21 quantifiable targets that are measured in 60 indicators. The goals are;

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, Malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development.

According to the World Water Development Report (WWDR), problems of poverty are inextricably linked with those of water – its availability, its proximity, its quantity and its quality. Improving the access of poor people to water has the potential to make a major contribution towards poverty eradication. In Nigeria, evidence from the 2006 Millennium Development Goals Report (MDGR) shows that there is a likelihood of achieving three of the eight goals in Nigeria; achieving universal basic education; ensuring environmental sustainability; and developing global partnership for development, while the health and poverty eradication MDG's remain daunting challenges for Nigeria. A critical barrier to planning for achievement of the MDG's continues to be the availability of up to date data on most of the indicators. This is compounded by the limited funding available for data generation and management.

Constituency projects during the Obasanjo administration were conceived, planned, designed and implemented by the relevant federal Ministries, Departments and Agencies (MDAs), and sponsored by members of the National assembly, each of whom was actively involved in identification and siting of the scheme(s) in their individual constituencies. However a radical departure from this in the Yar'adua administration saw to the delegation of this responsibility to the office of the Senior Special Assistant to President for the Millennium development goals (OSSAP-MDGs) under the title "2008 quick Wins MDGs (QW-MDGs) Projects". In order to improve project delivery and achieve higher success rates, the OSSAP-MDGs has elected to utilize the significant resource base of indigenous architectural, engineering and quantity surveying consulting firms to contribute to the efficient, honest and timely execution of the 2008 QW-MDGs projects.

Access to safe water underpins the achievement of most of the other MDGs. There can hardly be substantial human development without access to safe water; most classrooms will remain empty with pupils out looking for water, most hospital facilities will be stretched to the limit with people suffering preventable diseases as a result of poor water and sanitation facilities. Provision of water and sanitation should therefore be considered as the driving force of the poverty reduction programme of the government [1]. One of the greatest contributions of water to the human development is by improving health and reducing the time needed to search for water. It means that access to safe water will ensure the physical well being of man and free his time for other pursuits that will contribute to his economic freedom and that of the country at large, pupils will go to school on time, have time to read, women will have more time to be engaged in productive economic activities and infant mortality will be drastically reduced. Fig. 1 below shows the map of Niger State. One Hundred and Forty Four (144) boreholes were billed for Niger state.

1.1 Aim and Objectives

The study is aimed at assessing the challenges facing the attainment of the Millennium Development Goals in the water sector in Niger State, central Nigeria.
The main objectives of the study are to:

i) Assess the methods adopted in the implementation of the water sector MDG's in the study area.
ii) Determine the effect of geology on groundwater development in the area.
iii) Identify problems faced in the implementation of the water sector MDG's.
iv) Propose mitigation strategies to solve problems identified in (iii) above.

Fig. 1. Map of Nigeria showing Niger State

2. MATERIALS AND METHODS

Preliminary studies carried out in the area involved collection of data from the OSSAP-MDG's and the National Management Consultants as background information on the implementation strategies of the MDG's. Mapping of the area was conducted using the Garmin GPS (Etrex Legend), this was used to determine the coordinates and altitudes of the various beneficiary communities. The geology was determined using the traverse method by the use of compass/clinometer and hammer using the contour map that was obtained from the initial mapping of the area, on a scale of 1:25,000, as the base map. All drilled boreholes were carefully logged to determine the water bearing zones. Pumping test was conducted on all the boreholes to determine the well yield. The information obtained was used to draw water level contour maps and subsequently groundwater potential maps of the area. Success was determined as a factor of the quantity of water each of the boreholes was able to yield within a particular period of time.

3. RESULTS AND DISCUSSION

3.1 Geographical and Geological Setting

Niger state lies between longitudes 4º 00 – 7º 15' E and latitudes 8o 15' - 11º 15' N, the state is bordered in the north by Kaduna and Kebbi states and in the south by Kogi state. It shares boundary in the west with Kwara state and Benin Republic and in the east with the Federal Capital Territory and Kaduna state. It is divided into twenty five local governments with a landmass of about 80,000.00 square kilometer and a population of 3,920,000 (2006 census). The climate comprises of a rainy season and a dry season. The seasonal rainfall regime gives rise to longer wet season of about seven months with average monthly rainfall of 250mm, and a dry season of about five months with little or no rains at all. In the month of November to March, the dry north easterly air stream (the tropical continental air mass, i.e. Harmattan) dominates and leads to a low relative humidity, high daytime temperature of about 35ºC while in other months mean temperature is 30ºC. About one half of the land mass of Niger State is underlain by the Basement Complex rocks while the other is occupied by the Cretaceous sedimentary rocks of the Bida Basin and part of the Sokoto (Iullemeden Basin). The boundary between these runs in a northwest – southeast direction, with the Basement rocks to the north and the sedimentary Formation to the south, Fig. 2 shows a generalized geological map of Niger State.

The Basement rocks consist of a suite of Precambrian gneisses, migmatites and metasedimentary schists crosscut by granitoids [3,4]. The gneisses and metasedimentary schist which constitute the host rocks to the granitoids and are found mostly flat-lying outcrops. They are often not well exposed except along river channels and road cuttings [5].

The sedimentary Formations on the other hand consists of loosely cemented sandstones of varying grain sizes, siltstones, clays and shale, and are often capped by lateritic and/or ironstone concretions, particularly in upland areas [6] these cover much of the state. At the northwestern part of the state occurs the sedimentary Formation of the Sokoto (Iullemeden) Basin. The sedimentary deposits belong to the Upper part of the continental interclaire which comprises of a group of poorly fossiliferous sediments covering a very extensive area and lies unconformably on the Basement [7]. The lithologic units comprise generally of sands and grits, which are conglomeratic in places. The cement is ferruginous and clayey with

colours varying from dominantly reddish-brown, through pink to yellowish brown. It is poorly sorted and cemented, semi-consolidated and fine to coarse grained [8].

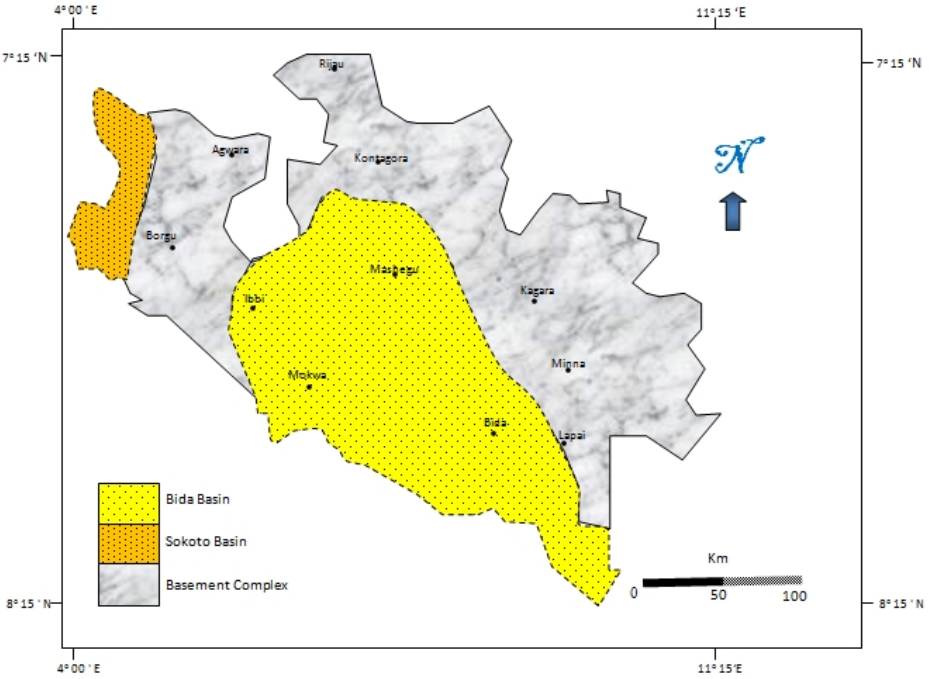

Fig. 2. Generalised geological map of Niger State [2]

A typical weathered profile of the Basement consists of two main zones, firstly the surficial zone which ranges between two to ten meters in Minna and over thirty meters in Kontagora, and secondly the fractured or fissured rock zone, which range from about twenty meters to over sixty meters, these usually constitute the water bearing zones of interest in groundwater development. Excellent yields are obtained where both zones serve as the aquifer, while a somewhat reduced yield is obtained where only one of the units represents the aquifer. In the sedimentary Formations the aquifer is represented by the sandstone, conglomerate and grits. In some parts of the state groundwater potential is very low, where boreholes will have to be drilled to a minimum depth of one hundred meters and the Birnin Gwari schist which extends through Pandogari to almost Minna also has a very low groundwater potential. In the sedimentary areas the aquifers are in a semi-confined with the saturated zone starting mostly from 100m, the schist on the other is mainly a Metasedimentary rock resulting from the metamorphism of clay/shale which is an impermeable material that does not transmit water easily to wells placed in them. Fig. 3 shows areas with a very low groundwater potential in Niger state. The low groundwater yield in these areas is directly linked to the local geological conditions. The rocks underlying the areas are mostly crystalline rocks with low permeability and low fracture density.

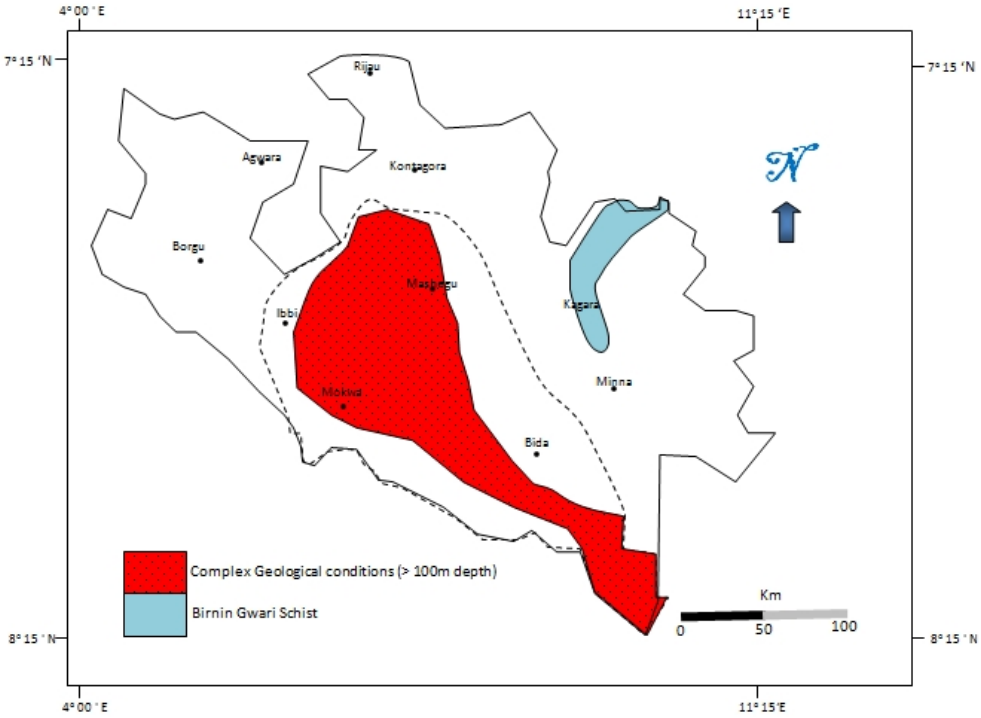

Fig. 3. Areas with low groundwater potential in Niger State

3.2 Implementation

The successful delivery of the 2008 Quick Wins Millennium Development Goals (QW-MDGs) program depends, to a large degree, on the quality of the planning provided at the beginning of the project and the diligent monitoring of the project during execution. Components of the Water Sector (WS) include the following;

I. WS 01
- Borehole with submersible pump
- 45m3 overhead tank on 6m Tower
- 15KVA Generating set
- 1 No Generator house
- 1 No Security / Operators house
- Limited reticulation
- Chain link fence

II. WS 02
- Construction of borehole with solar powered submersible pump, panels and inverters
- 45m3 overhead tank on 6m Tower
- Security / Operators house
- Limited reticulation
- Chain fence link

III. WS 03

- Construction of hand pump boreholes
- Construction of watering platform.

The MDG's programme effectively commenced in Nigeria in 2005, meaning it was already five years late, also the country had not been fulfilling its financial commitment of one billion dollars annual allocation to its implementation. The QW-MDGs 2008 Projects was effectively expected to commence on the 27th August 2008 with the programme preparation/initializing phase and to be completed on 30th June 2009 with the programme wrap-up/completion activities. The programme, as at the time of this report, has only attained between 60 – 70% completion, with some sites even yet to be surveyed. Unlike other sectors which are mostly construction that involve just one or two professionals with others often being artisans, borehole drilling is a specialized operation that requires specialized machines and tools and experienced experts. The machines and tools must suit the local geology and professional expertise must be combined with experience of the driller for any meaningful success to be achieved. Most boreholes failed as a result of inadequate drilling machines and tools and lack of professional experience by the contractors who all local based.

The main objectives of the water supply programme are to provide expanded access to safe drinking water for Nigerians (especially rural and semi-urban residents), thereby reducing incidence of water borne diseases; and also to provide water for livestock and other uses thereby increasing food production. With a population of 3,920,000, people thirty percent of this population live in urban areas while the remaining seventy percent live in semi-urban to rural areas, these represent the percentage with limited access to potable water. The main goal is to halve by 2015, the proportion of people without sustainable access to safe drinking water by supplying at least a population of 1,372,000 people with potable water.

Implementation of the 2008 QW-MDGs programme involved a number of organizations interacting at different levels with the Federal Government being the main client. Others include the National Assembly (NA), the Programme Steering Committee (PSC), the MDAs, the National Management Consulting (NMC), the State Project Consultants (SPCs), and the Contractors / Suppliers. The National Management Consultant (ETAT Consulting Ltd) oversees the contractor / supplier selection process through the tender process, prepares the project designs, bills of quantities and other operational guidelines. The NMC generally monitors and control the implementation of the project in accordance with the approved design, schedules and specifications, and within the agreed contract price. The State Project Consultants (SPCs), of which Dodo Project Consultants is one of the forty three selected professional consulting firms, are responsible for the direct supervision / administration of QW-MDGs projects in the states / areas assigned. Fig. 4 below shows the organizational matrix of the MDGs QW-MDGs project. The National Steering Committee (NSC) is the body set up by the federal government to oversee the entire activities of the MDG's, the committee works in conjunction with the National Assembly and the Ministries, Departments and Agencies (MDA's) in determining projects to be carried out under the programme. The Office of the Senior Special Assistant to the President on MDG's (OSSAP-MDG's) is the implementation arm of government that executes the projects determined by the NSC, this it does through the National Management Consultant (NMC) who in turn is responsible for State Project Consultants (SPCs) in each state.

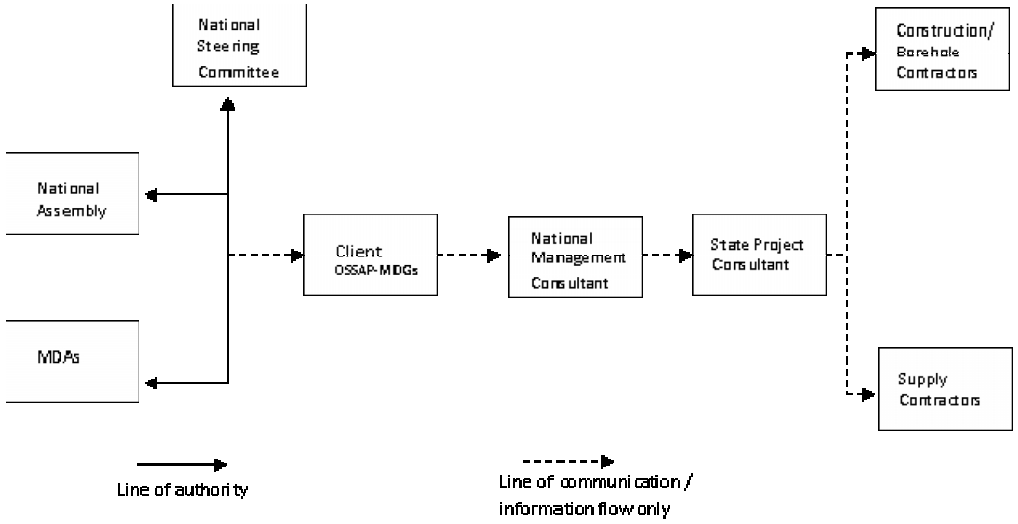

Fig. 4. Organizational matrix of the MDGs QW-MDGs project

The State Project Consultant is responsible for monitoring the quality of the work executed and goods supplied / installed to confirm that they meet the specifications and quality standards. The success of the programme therefore lies squarely with the SPCs, they should be well positioned to provide effective monitoring and evaluation of all water projects to ensure that they conform to the approved design specifications, this is the greatest challenge of the SPCs, especially in terms of borehole drilling and installation.

3.3 Prospects

Supervising over one hundred boreholes scattered all over a state with a large land mass, like Niger state, is no mean feat. It requires a lot on personnel costs and logistics to monitor progress in drilling till completion. Dodo Project Consultant employed the services of hydrogeologists and geologists, to see to the successful monitoring and execution of all borehole projects in the state. The steps followed towards programme implementation includes;

- Site identification and noting of the site geology
- Site hand over to contractor and advise to contractor on what to expect in terms of the geology,
- Submission of all geophysical survey reports by contractors; study and approval / rejection of the survey reports,
- Drilling of all approved sites under supervision of a consultant geologist
- Determination of depths and static water levels of all drilled boreholes
- Pump testing of all approved boreholes for yield and aquifer properties
- Sampling of water for quality analysis
- Installing with hand / submersible pumps of all approved boreholes
- Construction of platforms / animal drinking troughs to approved specification
- Capacity building for beneficiary communities
- Handover of the project to the community.
- Problems

Most of the projects could not be completed within the stipulated period, while most of those that were completed could not meet the required specifications for a productive well, as a result of several factors chiefly among which includes:

- Non availability of competent drilling rigs to suit the particular terrain by the contractor;
- Lack of basic knowledge of the geology of the area to allow for preparation by the contractor in terms of men and machine;
- Improper conducting of geophysical surveys to determine most suitable site for groundwater development;
- Sub contracting out the work or engaging less competent local drillers to execute the work;
- Lack of adequate funding, most contractors complain of not been adequately mobilized early to commence work early;
- Inaccessibility of some of the targeted areas for drilling machines in terms of roads, bridges and obstacles like hills, for example in the Azza and Edati areas of Niger state;
- Locations of different boreholes to be drilled by a single contractor, some of the locations are so scattered for hundreds of kilometers within the state that it becomes practically impossible for the contractor to access all of them, or even engage a driller to drill the boreholes;
- Proper timing of the programme to avoid the work spilling into the rainy season, accessibility is always greatly reduced during the rainy season and also eventual yield of the well may be greatly influenced by the season; and
- Lack of proper supervision / monitoring of the contractors due to insufficient funding, this limits the number of experienced professionals that can be attached to each contractor for proper supervision.

The millennium Development Goals has the capacity to attain poverty eradication through the provision of adequate drinking water to the Nigerian populace by the 2015 if adequate measures are taken to improve on the success achieved in the 2008 QW-MDGs project and avoid problems encountered during the period. Access to potable drinking water has the capacity eradicate poverty because it can free the time needed to get water from long distances for other economic activities, children spend most of the time required for education on the search for water and easily fall to water borne diseases which can easily lead to morbidity and if not properly treated even mortality.

Table 1 below summarises the average depth of boreholes drilled by contractors in the state listed according to the terrain. It could be seen that despite the higher success rate recorded in the Basement terrain. Failure rate is equally high. This can be attributed to the incompetence of some of the contractors in handling work in a hard rock terrain. The failure rate recorded in the sedimentary terrain is as a result of the locations been within areas with complex geological conditions that requires a minimum depth of one hundred meters, this depth is beyond the maximum limit of hand pump (60m). Some of the failed boreholes in the Basement area falls within the Birnin Gwari schist belt.

Table 1. Average depth and yield of boreholes according to the terrain

Terrain	Av. Depth (m)	Yield (l/s)	Av. Drawdown (m)	Failures (%)	Success rate (%)
Basement	35	0.8	24	30	60
Sedimentary	45	1.2	27	25	55

4. CONCLUSION AND RECOMMENDATIONS

Nigeria, the most populous country in Africa, with an estimated population of 140 Million, most of whom do not have access to potable water, and land mass of 923,768 km2, most of which holds vast amounts of groundwater, has the potential of becoming one of the most developed countries by the year 2020 if the various targets of the MDGs can be met. The water sector should be considered as the vanguard in the attainment of the goals, especially poverty eradication, health and universal basic education. Hydrogeologists should be incorporated fully at all levels of the programme planning and implementation, right from the NMCs down to the SPCs to ensure that the sector achieves the desired goals. The proposed National Water Policy (2009) should be incorporated fully into the programme and the National Borehole Reporting Format be adopted as the standard format for reporting all boreholes drilled and should form the basis on which final valuations are carried out on any successful project.

It is therefore recommended that:

- At the planning stages the NMCs should require that all SPCs should submit reports on the local geology of their various states / areas so as to be able to give reasonable costing of the boreholes, distinguish areas with difficult / complex geological conditions and also areas that drilling may not be feasible so as to guide the National Assembly member and the Steering Committees on the viability of the projects earmarked for particular areas.
- In order to provide continuity in the programme, the present SPCs should be retained, especially those that have performed reasonably well, they would have had an added advantage of having gained a lot of experience from the previous programme, improve on success and avoid problems encountered earlier. This will greatly improve work efficiency and ensure success of the work.
- Contractors must be registered with the relevant professional bodies guiding their operations and must be licensed by the relevant licensing authority as having the capacity and requisite professional manpower to handle drilling operations successfully.
- Minimum drilling depths and yields should be specified in the contract document, in Niger state for example, basement areas have an average depth of forty meters (40m) for hand pump boreholes and fifty to sixty meters (50 – 60m) for motorized boreholes, shallow sedimentary aquifers have an average depth of between forty and fifty meters (40 – 50m) for hand pump boreholes and sixty to eighty meters (60 – 80m) for motorized boreholes. In the areas with difficult or complex geological conditions hand pump boreholes are not feasible because depths often go beyond 100m.
- Most borehole drilling contractors and drillers are very familiar with drilling activities within the areas they operate, thus a driller working in Niger state might find working in Borno state a great challenge. It is therefore necessary that contracts be awarded

to contractors working in particular areas or a contractor, from the tender or bidding stage, be allowed to select areas he will prefer to work. This will allow some measure of flexibility in the operation and reduce to the barest minimum the number of failures and period required to complete the project.

- Boreholes should also not be too scattered for a single contractor, all boreholes in one area should be lumped together in a lot and awarded to a single contractor, even if a contractor has to travel a long distance to reach his area, he knows all his boreholes are within that area and as such will endeavour to get to the site well prepared to finish the work and pull out immediately within a minimum period.
- Contractors must have been certified by the SPCs to actually own a rig, or must be made to show evidence of been able to make one available at any time required, this may be in form of leasing certificates or partnership evidence with reputable drilling companies that may not be involved in the programme.
- Stringent rules must be applied on mobilization of men and equipment to site within a stipulated period or the contract revoked. Some contractors deliberately delay operation until rainy season, then come up with excuses on bad roads or simply drill shallow borehole to tap the rainy season water which simply dries during the dry season leaving the programme another failure. A higher success rate was achieved in Niger state because each step of the project execution was followed systematically. The geophysical survey will have to be approved by the resident hydrogeologists before commencement of drilling. The drilling rig will then be inspected and certified fit for drilling in the particular terrain before drilling can commence. Once drilling is completed pumping test is carefully conducted for yield and aquifer properties. If certified okay the borehole is then approved as having met the design specification.
- The National Borehole Reporting Format should be adopted for reporting all boreholes drilled under this programme. On this form all the borehole data are filled by the Hydrogeologist / Geologist at the end of which he affixes his seal, appends his signature and COMEG registration number. This will ensure that professional ethics are upheld in the construction of each borehole.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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