Motorized Rural Water Supply Points in Some Northern Nigeria States and the Way Forward towards Achieving the Sustainable Development Goals

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Abstract Nigeria made efforts towards achieving the Goal Number 7, target 7c of the Millennium Development Goals by 2015 and now currently working on achieving the Sustainable Development Goals. In order to support Nigeria's effort in improving access to safe rural water sources, a field work was carried out in the rural areas of Northern Nigeria (Sub-Saharan Africa) on documentation of Motorized Rural Water Supply Schemes, functionality status and challenges in operation and maintenance. The methodology engaged in achieving the project was based on use of instrument for collection of data, physical examination of water sources in the research area and interaction with members of the selected communities. Results showed that out of the 440 motorized schemes surveyed in the four selected States, the use of petrol/ diesel generators to power the schemes are predominant, these schemes accounted for 63.64% of the Motorized schemes. The use of electricity to power water supply schemes was found to be only 2.95% of all motorized schemes in the communities, about one third of motorized schemes found in communities were solar powered. From this research, it was concluded that Nigeria should re-strategize on the operations and maintenance of the rural water sources installed in communities if reasonable progress is to be made in achieving the Sustainable Development Goals.

Keywords Motorized Water Supply Schemes, Operation and Maintenance, Sustainable Development Goals

1. Introduction

In 2015, it was estimated that 663 million people worldwide still use unimproved drinking water sources, nearly half of all people using unimproved drinking water sources live in sub-Saharan Africa and the vast majority of those who do not have access to improved drinking water

sources live in rural areas, [1] this population must gain access to improved water sources. The situation prompted a field work in the rural areas of Northern Nigeria (Sub-Saharan Africa) on documentation of Motorized Water Supply Schemes. Nigeria, a Country in West Africa is found in the Tropics characterized by different types of climate; the Tropical Monsoon, Tropical Savannah and Sahel Climate. The Tropical Monsoon Climate is found in the Southern part of the Country, the Tropical Savannah Climate extends from the Western part of the Country to the North Central part, while the Sahel Climate is predominant in the North Eastern and North Western parts of the Country.

The Sahel or Tropical dry Climate has much lower annual rainfall compared to the Southern parts of the Country but is has good groundwater potential [2]. The rainy season in the Sahel region last for only about three to four months of the year; i.e. June to September and the rest of the year experiences very little or no rainfall. Temperature in the Sahel region can be as high as 40°C during the hot season and average annual rainfall records values as low as about 500mm [3]. The North Eastern part of the Country has geological formation favourable for groundwater storage; from which groundwater can be tapped through boreholes and hand dug wells for domestic water supply, studies on the groundwater sources in this region shows the positive potential in harnessing safe domestic water from the sources. [4]

The tropical savannah climate exhibits a well marked rainy season and a dry season. Temperatures range of 18.45 °C to 36.9 °C and an annual rainfall of about 1,500 mm is found in this region [5]. Groundwater supply is a major source of domestic water supply in this region of the country, research in the rural areas in this region show that groundwater exploration is common and communities are shown to participate in rural domestic water supply activities [6].

The Tropical monsoon climate has a very small temperature range of a maximum of 28 °C for its hottest

month while its lowest temperature is 26 °C in its coldest month. The annual rainfall received in this region is very high, usually above the 2,000 mm rainfall to about 4,000 mm of rainfall in the coastal region of Nigeria around the Niger delta area [5]. This region is characterized by streams and rivers on which various researches have been carried out giving the water quality in the region. [7]

Between 2010 and 2012, a research on motorized schemes used for domestic water supply in the Sahel and Tropical savannah climate regions of the Country was carried. The data collected presented the field situation in the country as Nigeria made efforts towards achieving the Millennium Development Goals by 2015. The selection of sites for the field work/ research was based on data from the Multiple Indicator Cluster Survey by the National Bureau of Statistics (NBS) on access to improved water supply in the country which showed that at the regional level, improved drinking water coverage was lowest at about 42% for the three Northern zones (North East, North West and North Central) while the south east and south- south zones had about 54% coverage, south west zone had about 71.1% coverage [8]. WHO/ UNICEF Joint Monitoring Programme (JMP) for Water Supply and Sanitation report recorded a decline in access to improved water supply in the country from 49% to 47% between 1990 and 2006 [9].

Nigeria made efforts in achieving the Goal Number 7, target 7c of the Millennium Development Goals aimed at reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation by the year 2015 [10]. Nigeria is currently working on achieving the Sustainable Development Goals especially in areas that relate to sustainable water supply including ‘Goal Number 6 – Ensure Availability and Sustainable Management of Water and Sanitation for All’, Goal Number 7- Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All’ and Goal Number 13 – Take Urgent Action to Combat Climate Change and its Impact’. This paper is focused on analyzing information on the use of Motorized Schemes in domestic water supply in Northern Nigeria and the way forward towards achieving the Sustainable Development Goals.

1.1. Objectives

- Conduct comprehensive inventory of motorized water sources in 12 Local Government Areas (LGAs) of 4 Northern Nigeria States and analyze data collected
- To determine functionality status of the water supply schemes
- To determine causes of breakdown of water supply schemes
- To assess the productivity levels of the water sources
- To give recommendations on the way forward for the Country on achieving the Sustainable Development Goals.

2. Materials and Methods

In order to support Nigeria’s effort towards increasing access to sustainable and safe domestic water sources, four Northern States of the Country were selected based on access to safe water sources by the National Bureau of Statistics [8], namely – Bauchi, Benue, Jigawa and Katsina States as shown in Figure 1, three Local Government Areas (LGAs) were selected in each State giving a total of 12 LGAs.

The fieldwork was planned and executed first, by the development of instrument for collection of information, instrument developed were pre-tested in training sessions, the finalized instrument were then used in collection of data. Local Government Water Sanitation and Hygiene (WASH) Unit officials were the local facilitator and enumerator in collecting data from the field. Training sessions were conducted for the Chief Enumerators and Enumerators for four Survey Teams with guidance and support provided by the Project Facilitators. Facilities on the field were physically examined, interaction with members of the communities was also a critical method used in collection of information.

Field work was conducted by inventory of motorized water sources focusing on three selected LGAs in the rural areas. The field work was planned and carried out with support of the United Nations Children’s Fund (UNICEF), Nigeria. All communities in the selected Local Government Areas were covered by working with technical partners and Government at all levels. Water facilities available in the communities were documented [11] and information on Motorized schemes is presented.

Figure 1. Location of the Four States Selected on the Map of Nigeria

3. Results

Results obtained from the inventory of motorized water sources are presented in Tables 1 to 5 and figure 2: Table 1 presents the names of States and Local Government Areas selected for the research.

Table 1. Names of Local Government Areas Selected in Four States

Bauchi State	Benue State	Jigawa State	Katsina State
Dass	Konshisha	Birnin Kudu	Bakori
Gamawa	Ogbadibo	Birniwa	Kaita
Warji	Oju	Roni	Maiadua

Findings on sources of energy to power schemes are presented in table 2:

Table 2. Source of Energy for Motorized Schemes

State Name	Total No. of Motorized Schemes	Petrol/ Diesel Generator Powered		Electricity Powered		Solar Powered	
		No.	%	No.	%	No.	%
Bauchi	110	64	58.18	6	5.46	40	36.36
Benue	34	30	88.24	1	2.94	3	8.82
Jigawa	110	88	80	2	1.82	20	18.18
Katsina	186	98	52.69	4	2.15	84	45.16
Total	440	280	63.64	13	2.95	147	33.41

The functionality status of the rural water sources were documented, the finds are presented in table 3:

Table 3. Functionality Status of Motorized Schemes

State	Total No. of Motorized Schemes	Percentage Functional(%)	Percentage Not Functional (%)
Bauchi	110	64.55	35.45
Benue	34	35.29	64.71
Jigawa	110	80.91	19.09
Katsina	186	58.6	41.4
Total	440	63.86	36.14

Common causes of breakdown of the water sources were documented as presented in table 4:

Table 4. Common Causes of Breakdown in Motorized Schemes

State	Total No. of Sources with Identified Problems	Pipe Leakages		Generator		Electrical Parts		Valve Related Issues		Pump Related Issues	
		No.	%	No.	%	No.	%	No.	%	No.	%
Bauchi	44	16	36.36	4	9.1	4	9.1	2	4.54	18	40.9
Benue	3	2	15.79	0	0	0	0	0	0	0	0
Jigawa	38	6	16.22	11	29	2	5.26	1	2.63	18	47.37
Katsina	37	6	24.59	9	24.3	2	5.41	0	0	20	54.05
Total	122	30	24.59	24	19.7	8	6.56	3	2.46	56	45.9

2961 Water Sources in the four States were surveyed, including streams, rivers and hand dug well. Table 5 presents the information given in communities on the impact of seasonal variation on water quantity from water sources.

Table 5. Impact of Seasonal Variation on Water Quantity Delivered from Various Sources

State	Total No. of Sources	Perennial Sources		Seasonal Sources		Information not Available	
		No.	%	No.	%	No.	%
Bauchi	731	636	87	78	10.67	17	2.33
Benue	376	307	81.65	52	13.83	17	4.52
Jigawa	1325	1217	91.85	96	7.25	12	0.9
Katsina	529	363	68.62	166	31.38	0	0
Total	2961	2523	85.21	392	13.24	46	1.55

WHO/ UNICEF Joint Monitoring Report [12] shows in Table 6, that by 2012 in the rural areas of Nigeria, only 49% of the population had access to improved drinking water sources, this shows that about half of the rural population did not have access to improved/ safe drinking water sources.

Table 6. Percentage Population with Access to Improved Drinking Water Sources in Nigeria

Year	Population x 1000	Urban		Rural		Total	
		Improved %	Unimproved %	Improved %	Unimproved %	Improved %	Unimproved %
1990	95617	78	22	28	72	46	54
2000	122877	78	22	38	62	55	45
2012	168834	79	21	49	51	64	36

Figure 2. Frequency Distribution of Number of Functional Schemes

4. Discussion

Table 1 presents the names of the four states selected for field work and the 3 LGAs selected per state. All the States are located in the Northern parts of Nigeria.

Table 2 shows that Katsina State has the highest number of motorized schemes installed with a total number of 186 schemes while Benue has only 34 schemes in the 3 LGAs. The Multiple Indicator Cluster Survey reported from the National Bureau of Statistics (NBS) [13] reported that in 2011, the percentage distribution of population using improved water from boreholes in Benue is 6.3%, explaining low figures of motorized water supply schemes in Benue State.

Out of the 440 motorized schemes in the four States, the use of petrol/ diesel generators to power the schemes are predominant, these schemes account for 63.64% of the Motorized schemes. The use of electricity to power water supply schemes is found to be only 2.95% of all motorized schemes in the communities, there is a need to strengthen the power sector close the gap created in the use of electricity powered schemes. About one third of motorized schemes found in communities are solar powered, this shows Nigeria's effort in mainstreaming climate change adaptation strategies into the water supply sector.

Table 3 shows that Jigawa State recorded the highest percentage of functional motorized water supply schemes which stood at 80.91%. Benue State recorded a very low functionality status of 35.29%, this was attributed to lack of capacitated personnel in the communities. Figure 2 shows the frequency distribution of number of functional schemes in relation to the total number of schemes.

Common causes of breakdown in selected number of water supply points in the communities were identified as shown in Table 4. Data on a total of 122 motorized water points were collected; these schemes showed the need for maintenance based on pipe related problems, breakdown of generators, problems related to electrical part malfunction,

replacement of valves in pumps and other pump related issues, in case of solar powered schemes, problems are related to pump or electrical parts. Issues relating to malfunctioning of the pumps accounts for 45.90% of identified causes of breakdown to schemes and communities lamented the lack of capacitated personnel to repair pumps installed in schemes. Only 6.56% of identified causes were related to electrical issues. The installation of the solar panels strongly supports the sustainability of the rural water supply schemes.

It is seen from Table 5 that 85.21% of the water source are perennial and do not experience changes in quantities of water available with seasonal variation.

Table 6 shows progress made in the percentage population with access to improved drinking water sources in Nigeria between 1990 in rural areas stood at 28%, in 2000 access stood at 38% and in 2012 access in rural areas was at 49%. Improved water sources in the rural areas include protected hand dug wells, hand-pump equipped wells/ boreholes and protected springs. Nigeria developed Standard for the handpumps installed in the country governed by the Nigerian Industrial Standards (NIS) [14].

Comparing figures of functionality of the motorized rural water sources as given in table 3 with Nigeria's current low access of about 50% of population to improved water sources from table 6 can be related to high number of non functional improved water sources.

4.1. Way-forward

Nigeria has developed a road map in the National Integrated Infrastructure Master Plan (NIIMP) by the National Population Commission (NPC), which is a 30 years Master Plan, with 3 numbers 10 years Strategic Plans and 6 numbers 5 years Operational Plans. The NIIMP concept was birthed in 2012 in which implementation was designed to commence in 2014 [15].

The NIIMP among other objectives is focused on:

- Prioritizing projects and programs for implementation in the short, medium and long term
- Promote private sector participation in infrastructure development
- Strengthen the policy, legal and institutional frameworks for effective infrastructure development.

This is a critical period for the Water Sector to key into Nigeria's Master Plan by the water sector leveraging resources towards achieving the Sustainable Development Goals. This Master Plan as it relates to the water sector will support implementation of plans for provision of sustainable rural water sources which will contribute to the reduction of water related diseases [16]. The following conclusions and recommendations are made to support the achievement of above set priorities.

5. Conclusion and Recommendations

5.1. Conclusions

More than 30% of installed motorized water sources were not functional in all sampled states except one, this closely related to the lack of capacitated personnel in the communities.

There is urgent need for Nigeria to re-strategize on the Operations and Maintenance of the rural water sources installed in communities if reasonable progress is to be made in achieving the Sustainable Development Goals.

Only 2.95% of the motorized water schemes are electricity powered, the NIIMP is an opportunity for reviving the non vibrant power sector in the Country. The use of electricity powered schemes will improve access to safe water sources in the country.

Issues relating to malfunctioning of the pumps accounts for 45.90% of identified causes of breakdown to schemes in communities, there is need to build capacity in communities to achieve sustainability of the installed water schemes. Key factors that influence the choice of Motorized Water Supply schemes are possibly related to the Operations and Maintenance and needs to be met include:

- Capacity building of Private sector within community
- Ensuring availability of spare parts in communities
- Cost recovery mechanism to be put in place
- Minimum Educational background of operators to be ensured

33.41% of all motorized schemes are solar powered, This is about one-third of motorized schemes in communities. Availability of solar powered water supply schemes installed in communities show effort in mainstreaming climate change

adaptation strategies in the water sector programs.

5.2. Recommendations:

1. Well defined Operations and Maintenance policies for sustainability of facilities within the rural communities must be formulated in the Country.
2. The strategy of increasing private sector participation in the water supply sector should be strengthened to support the increase of the number functional water sources in communities.
3. Government at all levels must ensure the mainstreaming of Climate Change adaptation into WASH sector policies, plans and programs.
4. Challenges of a large number of non functional sources can be mitigated by building the capacity of maintenance officers at the State, LGA and Community levels.
5. Development of rain harvesters should be promoted in Benue State as alternative to currently available options as rainfall pattern in the State can support this option. The water quality should be monitored based on international standards; guidelines are given in the World Health Organization Guidelines for drinking water [17].

Acknowledgement

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Appendix

QUESTIONNAIRE FOR DOCUMENTATION OF MOTORIZED DOMESTIC WATER SUPPLY SCHEMES IN FOUR NORTHERN NIGERIA STATES

Source Track Number			
State:	Local Government Area:		Date:
Name of Community/ Location			
Name of the Enumerator:			
Designation:	Chief enumerator:	Enumerator :	

Q NO.	QUESTION	REMARKS
1	Are there Motorized water supply schemes in Community? (If yes, Water source to be physically checked)	Yes No
2.	Type of Motorized water scheme	Petrol/ Diesel Generator Powered Electricity Powered Solar Powered Others
3.	Is the Motorized water scheme functional?	Yes No
4.	If the water source is functional, is the water source in use?	Yes No

Q NO.	QUESTION	REMARKS																
5.	Can non-functional water sources be repaired?	Yes No																
6.	Year of installation	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Not Available																
7.	Distance of the water source from nearest house?	Meters																
8.	Is this the main source of drinking water for the people using it?	Yes No																
9.	Population covered (estimated) – Population using water source	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Persons <input type="text"/> <input type="text"/> <input type="text"/> Households																
10.	Which are the other sources of drinking water available in your village? (Multiple options possible)	Hand-Pump Dug Well Stream River Any other (Specify).....																
11.	Are these water sources used for domestic purposes?	Yes No																
12.	State performance of hand pump equipped water sources																	
13.	How often do motorized schemes break down?	Weekly Every month Once in 03 months Half-yearly Once in a year Other (specify) Not sure / not specific timeframe																
14.	What are the common causes of breakdown?																	
15.	Last repair / maintenance done within – (Have you done any repairs till now – when was it?)	0-3 months 3-6 months 6M-1 year > 1 year Never repaired till now																
16.	During these repairs / maintenance what type of fault(s) were repaired?																	
17.	How much did community spend on last repair / maintenance? (This question is pertaining to last repairs / maintenance)	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> Naira Don't know																
18.	Specify kinds of repair / maintenance requirement (if known)																	
19.	Specify spare parts / resource requirement – (as told and assessed) (Even if community says no repairs / maintenance required; check water source for any requirement)	<table border="1"> <thead> <tr> <th>Type of spare parts / resource requirement</th><th>Qty</th></tr> </thead> <tbody> <tr><td>1.</td><td></td></tr> <tr><td>2.</td><td></td></tr> <tr><td>3.</td><td></td></tr> <tr><td>4.</td><td></td></tr> <tr><td>5.</td><td></td></tr> <tr><td colspan="2">No Need / No Requirement</td></tr> <tr><td colspan="2">Don't know / not assessed</td></tr> </tbody> </table>	Type of spare parts / resource requirement	Qty	1.		2.		3.		4.		5.		No Need / No Requirement		Don't know / not assessed	
Type of spare parts / resource requirement	Qty																	
1.																		
2.																		
3.																		
4.																		
5.																		
No Need / No Requirement																		
Don't know / not assessed																		
20.	Extent of maintenance / repairs required – (Make a judgment on the basis of - spare parts requirements, dismantling details, community perception, etc...)	Minor Average Major Beyond repairs No idea																
21.	Are Surface Water sources Seasonal or Perennial?	Seasonal Perennial																
22.	Is there change in quantity of water supplied at the source in the past five years from Motorized schemes?																	
23.	What are the signs of change in water table? OR How do you recognize change in water table? (Multiple answers possible)																	

Q NO.	QUESTION	REMARKS		
			a. Dry Season	b. Rainy Season
24.	How is the yield of water source during dry and rainy season?	High		
		Medium		
		Low		
		Poor		
25.	Does water quantity meet the daily water needs of the community?		a. Dry Season	b. Rainy Season
		Yes		
		No		
26.	WHEN FUNCTIONAL – How many hours does it work every day? Or How many hours it uses to work every day? (Ask for dry and rainy season one by one and record)	Season	a. Dry	b. Rainy
		6-10 hrs		
		11-16 hrs		
		17-20 hrs		
		Any other (specify)		
27.	For what purpose is / was water used by members of the community? (Multiple options possible)	Drinking All domestic purposes Garden watering Building blocks making Animal wetting / watering Others (specify) Not used		

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