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ASSESSMENT OF PUBLIC SAFE GROUNDWATER SOURCES IN BAUCHI STATE NIGERIA: A BASELINE STATUS FOR MONITORING PROGRESS TOWARDS SUSTAINABLE DEVELOPMENT GOAL 6

***[1]Ndububa, O. I.**

**[1]Department of Civil Engineering, Federal University, Oye-Ekiti, Ekiti State, Nigeria.*

****Corresponding Author's E-mail:** ndububaoi@yahoo.com **Phone**: +2348038793929*

ABSTRACT

The performance status of access to safe water sources in a community is determined by the percentage of the population using domestic water sources that meet international standards. Nigeria achieved a total of about 67% of the population with access to safe water sources by 2015 at the end of the period of the Millennium Development Goals. Ensuring universal access to safe and affordable drinking water for all requires investment inadequate infrastructure, this requirement led to the investigation of facilities currently available in Bauchi State of Nigeria. A baseline survey was conducted in the State towards monitoring progress on development goals, the baseline survey covered safe water sources and health facilities in State. It was found that Dambam Local Government Area recorded the highest access of 60.6% of the population with access to safe water sources, 33.33% of the population in Bauchi Local Government Area has access to public safe water sources while the lowest access recorded 5.26% in Toro Local Government Area. The functionality status of installed safe water sources in the State is currently low; Bauchi Local Government Area recorded a functionality status of 46% for the public motorized schemes and 66% functionality status for the handpump equipped boreholes. It was recommended that in working towards achieving Sustainable Development Goal number 6, massive repair and rehabilitation exercise is required to be carried out on non-functional water supply sources in the State to improve the access to safe water sources.

Keywords: *motorized boreholes, hand-pumps, safe water sources, groundwater*

INTRODUCTION

Nigeria's access to safe drinking water sources and acceptable sanitation practices contributes to global achievement on percentage population of people with access to safe water sources and adequate sanitation, national figures for Nigeria shows that only 67% of the population had access to at least basic improved drinking water sources (WHO, 2017). 300 million people without access to safe water sources worldwide, live in sub-Saharan Countries in Africa (UNICEF/WHO, 2015), as a result, a high percentage of the population without access to safe water sources are burdened with poor health based on the use of unprotected water sources such as rivers, streams, unprotected springs and unprotected hand dug wells. Many of these sources are found where open field defecation is practiced and flood-washed wastes affect the quality of water (FMWR, 2016).

Sustainable Development Goal (SDG) number 6 is to ensure availability and sustainable management of water and sanitation for all by the year 2030 (UNDP, 2018). Ensuring universal access to safe and affordable drinking water for all by 2030 requires investment in adequate infrastructure (UNDP, 2016). Preparedness for the achievement of the SDGs need to be supported by a series of elements including satisfactory mobilization and integrated management of resources (Wang and Wu, 2013). Access to safe water is measured by the percentage number of people who have acceptable means of getting an adequate amount of water that is safe for drinking, washing, and essential household activities (FMWR, 2005). The level of service in accessing safe water sources is used to describe the quality of the service being provided to users (Deverill et al, 2002), the level of service and basic indicators for measuring access to safe water sources revolve around quality, distance and time indices (Skinner, 2009). Efforts to provide safe water will be useless if polluted water eventually reaches the end users due to poor handling, it is therefore very important to protect stored water from contamination (Skinner, 2009). A wide range of ecological and human crises results from inadequate access (Sowjanya and Sailaja, 2017), the proximity of the safe water source to the household plays a major role in quantities of water used, the importance of reducing distance of new water sources in close proximity to end users cannot be over emphasized (Carter et al, 1997).

Nigeria successfully participated in the Millennium Development Goals (MDGs) in striving to achieve the eight international development goals that were established at the Millennium Summit of the United Nations in 2000 (UN, 2000). Nigeria achieved a total access of about 67% of the population to safe water sources by 2015 (UNICEF/WHO, 2015). The 2015 status forms the baseline for Nigeria on working at the Sustainable Development goals.

THE STUDY AREA

Bauchi State, is located in the North-Eastern part of the Nigeria; this State was created on 3rd of February 1976. The present Bauchi State's southern and northern limits are demarcated by latitudes 9°30'N and 12°30'N respectively, its western and eastern limits are bounded by longitudes 8°45'E and 11°0'E respectively, the State's total land area covers about 49,259 square kilometers (FMAWR, 2008). The state occupies a central location spatially among the north-east group of states in Nigeria as presented in Fig. 1. The rainy season months in the State are May to September, when humidity ranges from about 37 percent to 68 percent. Mean daily temperatures range from 29.2°C in July to October, about 11.7°C in November/December to February and 37.6°C from March to June of any year

(FMWR, 2008). Bauchi state is one of the states in the Northern part of Nigeria that span two distinctive vegetation zones, namely, the Sudan Savannah and the Sahel Savannah.

Figure 1: Map of Nigeria showing Bauchi State

Statement on research problem is based on analysing the status of the public safe water sources in Bauchi State in relation to the types of reported diseases in the State. Baseline data is required in any country to monitor progress of achieving results for sustainable water supply sources. Analysis of the information is to be used in taking informed decisions towards meeting the goal number 6 of the Sustainable Development Goals and support the monitoring and evaluation of the progress towards achieving the SDG set goals.

MATERIALS AND METHOD

The experimental design for the research is based on collection of data via primary and secondary sources which were subjected to data analysis using standard equations.

The primary source of information was from:

1. The Federal Ministry of Water Resources that conducted a baseline survey which covered public supply of safe water and health facilities in State. Safe public water sources in the State were identified as motorized boreholes and handpump equipped boreholes, other sources of ground water supply include protected and unprotected hand dug wells which are not public sources of water supply therefore not included in the report. The Federal Ministry worked along with the:
2. Bauchi State Ministry of Water Resources
3. Bauchi State Water Board, which is the main Government establishment responsible for water supply in the State.
4. Bauchi State Rural Water Supply and Sanitation Agency, which is responsible for rural water supply and the provision of sanitation facilities in all parts of the state.

Secondary sources of information were obtained from books, journals, online materials, relevant documents and published related works. Relevant raw data obtained from the Federal Ministry of Water Resources were analyzed

and presented using tables and descriptive statistical tools such as bar charts to determine relationship between the variables.

DATA COLLECTION

Types of data collected:

i. The attributes and functionality status of public water supply facilities.

ii. Reported cases of water related diseases from health institutions.

Data Analysis:

Determination of percentage water supplied to water demand water was carried out using the equation:

$$\frac{\text{Total Safe Water available in } m^3/day}{\text{Total Water Demand in } m^3/day} \times 100\%$$

Total percentage public water supply coverage was determined by:

Percentage Service Coverage = $\sum$ (PT) * [Average no of People per PT] + $\sum$ (hbh)* [Average no of People per hbh]) /Total population of the LGA

Where PT = public taps (10 public taps per motorized borehole); and hbh = hand pump boreholes (single outlet).

THE DEFINITION OF TERMS

For 'acceptable limits' of water demand and supply used in this report is based on the definition from the Federal Ministry of Water Resources' Water and Sanitation Policy (FMWR, 2005) and the World Health Organization (WHO, 2011) as follows:

Rural water supply is guaranteed minimum level of service 30 liters per capita per day within 250 meters of the community of 150 to 5,000 people, serving about 250-500 persons per water point. (FMWR, 2005).

Semi-urban (small towns) water supply represents settlements with population of between 5,000-20,000 with a fair measure of social infrastructure and some level of economic activity with minimum supply standard of 60 liters per capita per day with reticulation and limited or full house connections as determined by the beneficiaries / Government. (FMWR, 2005).

Urban water supply **represents** 120 liters per capita per day for urban areas with population greater than 20,000 inhabitants to be served by full reticulation and consumer premises connection (FMWR, 2005)

Basic service means a protected, year-round supply of 30 litres per capita per day in line with the 30 litres basic minimum utilized by international agencies preferably within 250 metres of the community and not exceeding 500 metres, serving about 250 persons per outlet. Higher levels of service are encouraged, but communities must pay for the added cost. (FMWR, 2005)

The WHO defines safe water as water having acceptable quality in terms of its physical, chemical, bacteriological parameters so that it can be safely used for drinking and cooking and no significant health risks occurs during the lifespan of the scheme from storage to end user (WHO, 2011).

RESULTS

From the data obtained, information on names of all the 20 Local Government Areas (LGAs) of the State, the Population of each LGA (from 2006 National Population Census figure (NBS, 2007) and Ref. World Population Review (2018)), number of functional water sources in each LGA, the estimated water demandand calculated water supplied to each LGA and percentage ratio of water supplied to water demand in each LGA is presented in table 1. Types and number of reported water related diseases in LGAs for Baseline year are presented in table 2. Figure 1 shows the results obtained for the percentage functionality status of public ground water facilities while figure 2 give a graphical presentation of the percentage water supplied in the LGAs and the percentage number of reported cases of water related diseases.

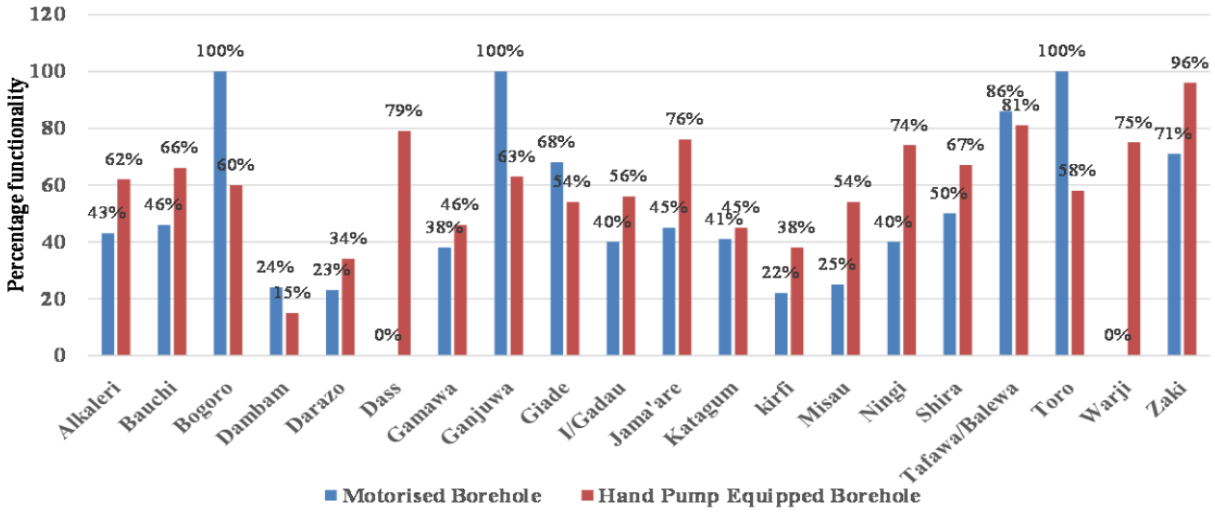

Figure 1: Percentage Functionality Status of Public Ground Water Supply Facilities

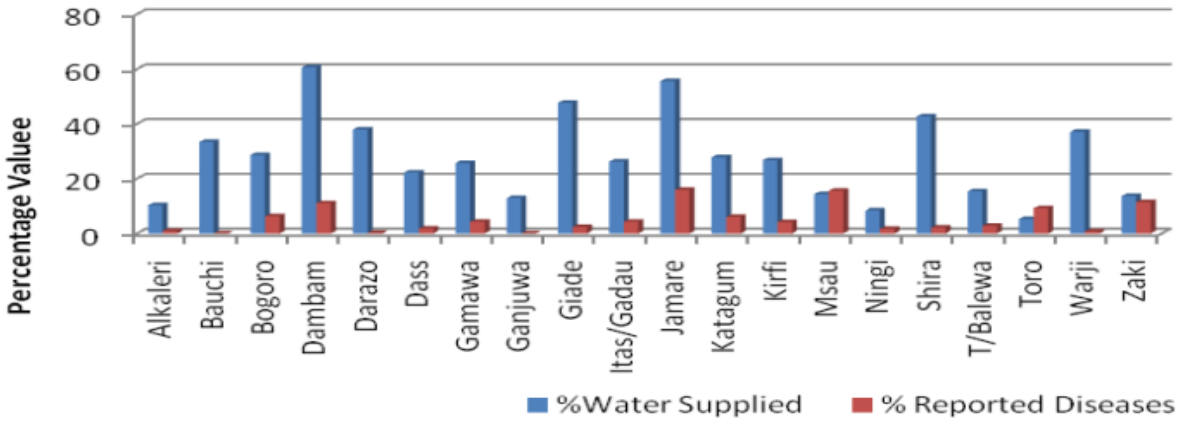

Figure 2: Water Supplied and % Reported Diseases in LGAs

Table 1: Names, Population of Local Government Areas, Number of Functional Water Sources and Estimated Water Demand

S/No	Local Government Area (LGA)	Population	Total Number Motorized Borehole Schemes	Number Functional Motorized Borehole Schemes	Total Number of Handpump Equipped Boreholes	Number Functional Handpump Equipped Boreholes	Estimated Water Demand (m^3/d)	Estimated Output/ Supplied (m^3/d)	% Ratio of Public Water Supplied against Demand
1	Alkaleri	324354	7	3	21	13	12650	1297	10.26
2	Bauchi	662065	13	6	94	62	79448	26483	33.33
3	Bogoro	98192	2	2	55	33	4124	1178	28.57
4	Dambam	153103	41	10	48	7	10105	6124	60.60
5	Darazo	303893	61	14	38	13	20057	7597	37.88
6	Dass	93268	0	0	47	37	4197	933	22.22
7	Gamawa	336148	16	6	61	28	13110	3361	25.64
8	Ganjuwa	268514	6	6	38	24	10472	1343	12.82
9	Giade	171114	19	13	41	22	7187	3422	47.62
10	Itas/Gadau	251727	25	10	18	10	10572	2769	26.19
11	Jama'are	130652	29	13	70	53	9407	5226	55.56
12	Katagum	361832	41	17	97	44	26052	7237	27.78
13	Kirfi	153978	9	2	48	18	6929	1848	26.67
14	Misau	253463	8	2	41	22	10645	1521	14.29
15	Ningi	410203	5	2	34	25	24612	2051	8.33
16	Shira	300183	34	17	46	31	11257	4803	42.67
17	TafawaBalewa	234529	7	6	31	25	9147	1407	15.38
18	Toro	388148	5	5	45	26	22124	1164	5.26
19	Warji	109161	2	0	72	54	4421	1637	37.04
20	Zaki	304052	24	17	25	24	22348	3041	13.61
	Total Figures	**5308579**	354	151	970	571	318864		27.59

Table 2: Types and Number of Reported Cases of Water Related Diseases in Local Government Areas for Baseline year

S/N	LGA	Diarrhea	Worm	Guinea	Dysentery	Typhoid Fever	Malaria Fever	miasis	Schistoso	Worm	Ring	Cholera	Trachoma	B	Hepatitis	ecci	Streptoco	ciasis	Onchocer	Reported	Number	Total
1	**ALKALERI**	307	0		204	106	724	0		6		0	0	0	0	0		0				1449
2	**BAUCHI**	5,091	0		2,570	2,084	473,450	74		79		470	21	9	51		0					484380
3	**BOGORO**	2,364	0		1,322	468	5,151	285		46		47	83	14	15		0					9890
4	**DAMBAN**	3,444	0		1,925	655	10,838	80		7		4	207	0	0		0					17534
5	**DAZARO**	47	0		45	31	146	3		7		19	1	6	0		9					336
6	**DASS**	512	0		391	326	999	62		9		141	17	5	215		14					2720
7	**GAMAWA**	1,250	0		1,291	438	3,554	119		24		0	0	0	0		0					6706
8	**GANJUWA**																					
9	**GIADE**	763	0		532	233	1,716	65		31		52	81	72	4		6					3674
10	**ITAS/GADAU**	1,406	0		690	206	4,025	20		25		128	55	2	0		0					6809
11	**JAMARE**	2,692	0		2,284	214	18,801	0		153		270	48	0	0		0					25291
12	**KATAGUM**	1,672	0		941	577	4,002	64		109		1,836	78	144	26		9					9570
13	**KIRFI**	2,012	0		836	434	3,201	14		7		4	43	6	22		0					6605
14	**MISAU**	6,478	0		4,228	705	12,645	63		47		129	112	12	0		0					24711
15	**NINGI**	369	0		347	671	674	0		38		453	0	0	0		14					2593
16	**SHIRA**	846	0		447	145	1,449	11		10		89	44	136	0		83					3394
17	**T/BALEWA**	495	0		535	728	1,472	113		94		557	57	75	47		85					4360
18	**TORO**	1,702	0		1,458	1,002	9,677	50		175		122	5	18	17		14					14594
19	**WARJI**	250	0		126	120	410	18		19		92	37	7	15		3					1131
20	**ZAKI**	2,248	0		1,728	1,941	3,844	0		0		4,807	1,812	344	490		684					17898
	TOTAL	33,948	0		21,900	11,084	556,778	1,041		886		9,220	2,701	850	902		921					

Table 2: Types and Number of Reported Cases of Water Related Diseases in Local Government Areas for Baseline year

ANALYSIS AND DISCUSSION OF RESULTS

Table 1 shows that the total population of Bauchi State as at 2015 is estimated at 5,308,579 (Five million, Three Hundred and Eight Thousand, Five Hundred and Seventy-Nine) people. The type and functionality status of the public water supply facilities in the State are also presented in table 1. The table shows that Darazo has the highest number of installed motorized schemes in the state with 61 installed schemes, however only 14 are functional, Katagum has the highest number of handpump equipped boreholes with only 44 functional sources out of the 97 installed. The status at any point in time of installed water sources will directly affect the safe water supply status of the State. Analysis of Nigeria's progress during the implementation of the Millennium Goals showed that installed capacity of safe water schemes operated below optimum due to high number of non-functional water sources. (Ndububa and Ndububa (2016). The most critical outcome of the analysis on the percentage values of water supplied to water demand in the LGAs shows that Dambam LGA has the highest value of 60.60% while Ningi and Toro LGAs have values as low as 8.33% and 5.26% respectively, an average of 27.59% value of water supplied in the State against demand. This result shows that there is no LGA that has fully met its water demand. Meeting the Sustainable Development Goal number 6 on access to clean water for all by 2030 requires provision of safe water sources across all LGAs in Bauchi State.

Use of safe water sources is not only based on functionality, research shows that 0.5 to 50 mg/l of iron content is found in natural water bodies and Zinc is found to occur naturally in soils with estimated content between 1 – 300mg/Kg (WHO, 2003), high levels of chemical compounds also impact on the use of installed facilities, correct application are now used effectively in micropollutant removal (Zavala and Lara, 2018), also poor water quality impact negatively on the health (Hemangi and Hitesh, 2017), it is paramount therefore that the groundwater's capacity to maintain its natural assimilative properties is protected (Chiejine, 2016), functionality must be coupled with safety.

Table 2 presents the numbers and different types of water related diseases reported in the State, malaria fever recorded the highest incidence in all the Local Government Areas while guinea worm disease was not recorded in any of the Local Government Areas. Risks of groundwater contamination which exists governed by the vulnerability and presence of contaminants in water also contribute to incidence of water related diseases (Sharadqah, 2017). In some countries groundwater has been contaminated by the very bad practice of pumping wastes down disused bores (Sinton, 2001) leading to occurrence of water related diseases in such areas.The sum of all incidents of specified water related diseases reported from all health institutions in LGAs are also presented in table 2. The table shows the number of times diseases are reported, Bauchi town has the highest number of reported cases of all reported diseases, this can be directly related to water quality, which is indicative pollution levels which will directly impact on the oxygen content in water (Ogbonna and Chinomso, 2010)

Although figure 1 shows that Bogoro, Ganjuwa and Toro LGAs recorded 100% functionality of installed water sources, values presented in table 1 shows that these LGAs have limited number of motorized water supply facilities. Figure 2 gives an analysis of the comparison of the percentage water supplied in LGAs and percentage number of reported cases of water related diseases. The chart shows an inverse relationship between availability of

safe water sources and incidence of water related diseases in most of the LGAs, the installed safe water sources have high impact on reduction of water related diseases.

CONCLUSION

The following conclusions are made from the analysis of results obtained from data:

1. The State recorded 27.59% of water demand met, with access to safe water sources at 5.26% of the demand in Toro Local Government Area.
2. The functionality status of installed safe water sources in the State is currently low, Bauchi Local Government Area recorded a functionality status of 46% for the motorized schemes and 66% functionality status for the handpump equipped boreholes.
3. 17 out of the 20 Local Government Areas has percentage functionality status of the handpump equipped boreholes with values greater than 50% while only 7 of the 20 LGAs had percentage functionality of 50% and above for the motorized schemes.
4. Incidence of water related diseases in the State is highly impacted by the availability of safe water sources.

RECOMMENDATIONS

1. Implementation of activities to increase access to public safe water sources has to prioritize interventions in Toro, Ningi, Alkaleri, Ganjuwa and Misau Local Government Areas that show very low access to safe water sources.
2. In working towards achieving the Sustainable Development Goal number 6, on access to clean water for all by 2030, massive repair and rehabilitation exercise is required to be carried out on non-functional water supply sources in the State to improve the access to safe water sources.
3. Regulatory bodies should be empowered to support the private sector/ individuals willing to engage in providing safe water sources in the State. Provision for revision of polices have been found to be significant in achieving results.
4. Ownership of installed safe water facilities should be encouraged by involving communities from the planning stages of new water facilities.
5. Managing and maintaining an environment in which community members participate in water supply projects will efficiently achieve desired outcome.

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