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ACCESSIBILITY AND UTILIZATION OF WATER FROM IMPROVED SOURCES AMONGST THE RURAL COMMUNITIES OF NORTHERN BAUCHI STATE, NIGERIA

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ABSTRACT

This research examines the accessibility and utilization of water from improved sources in the rural communities of Northern Bauchi State. Field survey was used to generate data for this study; the data were collected through field observation, administration of questionnaires, interviews, focus group discussions. Multi-stage sampling was adopted in this study. The result was presented in tables, chartsand the qualitative data was presented in narrative statements. The study revealed that, prior to the construction of solar boreholes about 65% of the respondents were obtaining water from unimproved sources, while 35% was from improved sources, the situation changed with construction of the solar boreholes, 84% of the respondents obtained water from the improved sources when compared with 35% before the installation of the solar borehole. The study showsthat 69% of the respondents are of the view that construction of improved sources particularly solar borehole has significantly increases access to clean water, 28% agreed that its partially increasedaccess to clean water while 3% disagreed with that, pointing out long queues and use of human power in the solar and hand pump boreholes as thechallenges. The study concluded that the innovation introducing solar boreholes is significantly improving access to clean water, but still much need to be done by the stakeholders to ensure wider coverage. The study recommends that in areas where access to clean water is low, solar boreholes should be provided and water development committees should be set up to manage the boreholes.

Keywords: Accessibility, Boreholes, Millennium Development Goals, Open wells.

INTRODUCTION

Among the resources that could be tapped from sunlight are solar energy and solar radiation or electromagnetic energy among others. This form of energy that is obtained from the sun is the World's most abundant and cheapest source of energy available from nature. It is free and automatically renewable every day especially in the regions of the World that experience overhead sunshine. Water on the other hand is a basic and essential human need. It is needed for socio-economic development of all human societies irrespective of state of development. The type of access and quantum of water supply as well as the quality of sanitation facilities available is among the determinants of quality of life, and its availability can contribute to poverty alleviation (Uneze *et al*, 2013). Water is not only used for consumption and domestic purposes, it is also a major driver of economic activities in agriculture, industry and transportation, among others.

Many lives have been lost in Africa due to unclean water supply. Most rural areas in Africa have their water sourced from streams and rivers, and many of these are contaminated, thereby making the water impure for consumption and other uses. Some of the ill-health which affects humanity especially in developing countries can be traced to poor water sources (Shehu, 2014). In many parts of the World, environmental conditions such as topography and weather have caused drought resulting in the drying up of surface water sources leading to acute scarcity.

Globally, water is in high demand to meet the varied needs of the ever-growing population (Akunai, 2014). Further estimates show that 1.8 million people die every year as a result of diseases caused by unclean water and poor sanitation (WHO, 2005 in Uneze *et al*, 2013). This problem is even more pertinent to developing countries where a large number of women and children in rural areas spend hours each day walking to collect water from unprotected sources such as open wells, muddy dugouts and streams. In Nigeria for example, large populations still do not have access to good quality water.

Although the whole world was working to achieve the Millennium Development Goals (MDGs) target, to halve, by 2015 the proportion of the population without sustainable access to safe drinking water, it was yet to be achieved in rural areas of sub-Saharan Africa (Akunai, 2014). Improved groundwater supplies (especially drilled hand pumps and solar boreholes) provided a lot of the water needs to rural dwellers within a reasonable distance of their home. It is estimated that from 2000, about 60,000 boreholes per year need to be provided in sub-Saharan Africa alone to meet the MDGs target. But this was yet to be achieved, thus creating a deficit in water supply (Akunai, 2014).

According to Dzokoto (2000) in Akunai (2014), access to good drinking water was a problem to rural folks in most developing countries mainly because they have no access to electricity. Improved water sources such as hand pump, diesel powered and hydro-electric powered boreholes have numerous limitations and problems including high operational and maintenance cost coupled with carbon emission associated with diesel powered boreholes and unavailability and reliability of electricity supply among others. Solar powered boreholes have been identified as a reliable and less costly source of water. Akunai (2014) reported tremendous increase in water delivery of boreholes when the solar pump was used to draw water as compared to manually powered boreholes.

Construction of solar powered boreholes is among the leading strategies adopted to address acute shortage of water especially in the rural areas of developing nations (MDGs/CGS, 2012). In Bauchi State, Millennium Development Goals (MDGs) provided over 200 solar powered boreholes from 2007-2011 to ease the problems of water shortage and encourage clean energy use. Notwithstanding these investments in the State, there are numerous challenges facing access to and utilization of water derived from the solar powered boreholes. In the northern part of Bauchi State, several communities are yet to access clean and safe drinking water. Even in those communities where solar powered boreholes have been provided, there is still inadequate access. It is believed that small to medium scale solar pumps mostly found in rural water supply projects with daily output of about 800 to 13,000 gallons per day (3,000 – 50,000 liters) are enough to satisfy the daily water demand of 2,500 people using the UNDP standards of 20 liters per person per day (SELF, 2008).

This study aimed at investigating rural communities' accessibility to improved water sources in Northern Bauchi State with a view to find out the progress made in the rural water supply in the area after the millennium declaration of 2000.

THE RESEARCH METHODS

Data and information for this study were collected through questionnaire, semi structured interview, focus group discussion and field observation. The questionnaires were administered with aid of research assistants who were trained on how to fill the instrument. The interview was effectively conducted with community leaders and Local Government officials to gather information on access and utilization of improved water sources. Focus group discussion was also held with women who are the major users of water in the households.

Description of the study area

The area is approximately located within Latitudes $11^0 12$'N and $12^0 31$'N and Longitudes $9^0 37$'E and $10^0 58$'E. The study area has nine Local Governments. The nine Local Governments are Katagum, Shira, Gamawa, Itas-Gadau, Giade, Zaki, Misau, Dambam and Jama'are Local Governments. The area has total land mass of about 12020 square kilometers; and shares border with Yobe state to the north and north- east, Jigawa to the north-west part and Darazo Local Government of Bauchi State to the south (Encarta Premium 2009).The study area has a population of 1,927,086 people based on the 2006 population census. Tribal groups include Hausa, Fulani, Karekare and Kanuri. There are cultural similarities in the people's language, occupational practices, festivals and dress, with high degree of ethnic interactions especially in marriage and economic existence. The area has the population density of 1-1999 persons per square kilometer (Encarta Premium, 2009).

Source: BAGIS 2017

Fig. 1: Map of the study area

Reconnaissance Survey

The study began with reconnaissance survey with view to becoming familiar with socio-economic characteristics of the people in the communities hosting the solar boreholes and to enable have clear understanding on how to design the instruments for data collection. A field visit was carried out to rural water supply units in the nine Local Governments and two locations of the solar boreholes in order to identify and verify the actual ground location, and characteristics of the visited villages or communities, so as to have a quick view of the socio-economic characteristics of the people in the study area. The reconnaissance survey also facilitated formal contact with official of projects executing agencies such as Bauchi State MDGs Support Unit, State Ministry of Water Resources, Rural Water Supply and Sanitation Agency and State Ministry for Rural Development among others.

DATA SAMPLING

The list of the solar boreholes constructed from 2007-2014 was obtained from rural water supply units of Local Governments of the study area. The sampling frame was made up of the 240 communities with solar boreholes.

A multi-stage sampling technique was adopted, classifying the nine LGAs as the first sampling unit. All the nine LGAs were selected at this stage. At the second stage, five communities were selected from each of the LGAs, irrespective of the number of boreholes to give a uniform geographic spread for the study area; at this stage balloting was used to select five communities installed with solar boreholes and these were drawn from nine LGAs of the study this is in order to give every community an equal chance of being selected. Through this process, 45 communities representing about 20% of all communities with solar powered boreholes were selected for the study. Bichi (2009) in Gay (1981) stated that if the population is large, say in thousands, the percentage population to be sampled should be a minimum of about 10% while for small population, about 20% will serve for descriptive research. At the final stage, purposive sampling was adopted in selecting respondents from households that were interviewed. Twenty five (25) respondents were interviewed in each of the sampled communities representing 5% of people supposed to be provided with water by a single borehole going by the MDGs (2000) standard of 1000 persons per borehole within a radius of 1000 meters of the water point. In addition to this, another questionnaire was also administered to every solar borehole operator in all the sampled communities.

Table 1 List of Sampled Communities or Solar Borehole Locations

S/no	Name of the community	Latitude	Longitude	LGA
1.	Dallari Kofar fada	11.643	10.60129	*Dambam*
2.	Garuza	11.62492	10.719	
3.	Tingariye	11.70836	10.71711	
4.	Unguwar Mabuga Dambam	11.68119	10.70511	
5.	Unguwar Magaji Bakin Kasuwa	11.68092	10.70872	
6.	Budumeri	12.10538	10.39652	*Gamawa*
7.	Bundujaro	12.22992	10.52912	
8.	Sabayo	11.93421	10.49111	
9.	Unguwar Amadu Yalo Gamawa	12.27073	10.52531	
10.	Unguwar Kudu Gamawa	12.26367	10.50456	
11.	Central Mosque Giade	11.3933	10.20025	*Giade*
12.	Doguwa Unguwar Yamma	11.38192	10.16235	
13.	Ragwaran	11.551	10.244	
14.	Tagwaye	11.35953	10.16857	
15.	TudunmMaje	11.3943	10.20035	
16.	Kashuri Unguwar Yamma	11.823	10.2	Itas/Gadau
17.	Mashema Health Clinic	11.808	9.944	
18.	Magama Itas	11.85914	9.96579	
19.	Sabuwar Unguwa Atafowa	11.96508	10.06645	
20.	Walai Unguwar Yamma	11.85932	10.11392	
21.	Beddorgel	11.684	10.049	Jama’are
22.	Jabbori	11.67752	9.99972	
23.	Guda	11.632	9.9	
24.	Hanafari Unguwar Gabas	11.604	9.878	

25.	Unguwar Nepa Jama'are	11.67274	9.92731	
26.	Bidawa	11.54773	10.15152	Katagum
27.	Fatara	11.794	10.215	
28.	Gandun Wamabi	11.67249	10.18447	
29.	Gursoli	11.672	10.235	
30.	Kujuru	11.66704	10.14896	
31.	Aftaka	11.41864	10.46311	Misau
32.	Jarmari	11.30392	10.38333	
33.	Madakeri	11.31997	10.31883	
34.	Sabore	11.411	10.45642	
35.	Unguwar Marina Hardawa	11.42222	10.46489	
36.	Dango Unguwar Yamma	11.50317	9.97083	Shira
37.	Darajiya Kofar fada	11.6381	10.00979	
38.	Kilbori	11.5689	10.06418	
39.	Suddu	11.40444	10.03296	
40.	Adamami	11.43171	9.89147	
41	Agoguma	12.3779	10.3553	Zaki
42.	Barnesu	12.33269	10.35006	
43.	Garin Gami	12.10538	10.27725	
44.	Sansan	12.33261	10.34006	
45.	Tashena	12.30538	10.28825	

DATA ACQUISITION

Both field survey and documentary data were acquired in this study. The field survey data were acquired through questionnaire administration, semi-structured interview, and field observation and focused group discussion. While documentary data were acquired through the records from the rural water supply unit of the LGAs and some institutions involve in the development of the boreholes.

Documented Data

The documented data was obtained from LGAs and other relevant agencies pertaining to the previous boreholes projects, which includes historical records, maintenance and expenses incurred. The agencies includes Bauchi State MDGs support unit, rural water supply and sanitation agency and State Ministry of water resources among others. The list of solar powered boreholes was obtained from the rural water supply units in the nine Local Government of the study area. There was a problem of inconsistency and underreporting with data provided by the L.G.As, in order to verify records, a list of solar boreholes constructed. From the records, it was observed that 240 solar powered boreholes were installed by thirteen different governmental and nongovernmental organizations from 2007-2014 in the nine Local Governments. Other sources of secondary data are unpublished thesis, journals, internet sources, reports and conference papers.

Questionnaire Administration

Two different set of semi structured questionnaires were prepared and administered to water users and solar borehole operators. The first questionnaire was administered to water users to obtain information relating to sources of water within the target communities and accessibility to solar boreholes among others. The second questionnaire targeted the solar borehole operators to obtain information relating to demographic characteristics of the respondents, functionality, efficiency and components affecting the functioning of the solar boreholes.

Semi-structured Interviews

Two interview schedules were prepared. The first interview schedule targeted community leaders to obtain information on the level of community satisfaction with water obtained from solar boreholes and role of the boreholes in the improvement of water sanitation and hygiene. The second interview schedule was to obtain information from L.G.A officials relating to the solar boreholes advantages over other sources of water, the major problems encountered in the utilization of solar powered boreholes and how the problems could be addressed.

Focus Group Discussion (FGD)

An interview schedule guided nine FGD sessions were held with women who are among the major users of water. In each of the FGD sessions, the number of respondents was 10 participants of same gender (female).

DATA ANALYSIS

The quantitative data collected, were sorted and coded with Microsoft excel 2007 and later entered into statistical package for social sciences (SPSS 16.0) for analysis. Descriptive statistics such as tables, charts and percentages were used to present the quantitative data. The qualitative data was presented in a narrative statement to explain the views of the respondents in accordance with semi structured interview, focus group discussion and field observation and included in the discussion of results.

RESULTS AND DISCUSSION

Sources of Water within the Target Communities

The sources of water in the area were classified into two (2), the improved water sources and the unimproved water sources. The improved water sources are hand pumps, diesel powered boreholes and solar boreholes while the unimproved sources are open wells, ponds and streams. In general, the type of water sources utilized within the communities studied depends on three important determinants these include the quantity, quality and distance covered to access the water source.

Prior to the installation of solar boreholes, most respondents were obtaining water for domestic uses from unimproved sources particularly open wells, rivers and streams. Table 2, shows more than half of the respondents (65%) were obtaining water from unimproved sources hand dug and open wells. This implies that majority of people depend on unhygienic sources for water supply which have adverse effect in their health. While 35% of the respondents were using improved water sources (hand pump and diesel boreholes), out of 35% obtaining water from improved water sources, hand pump borehole accounted for 31.12% of the sources while only 3.55% of the respondents were obtaining water from diesel powered boreholes. The sources of water varied from one settlement to another. For example, none of the respondents interviewed in Dambam, Gamawa, Misau and Shira used diesel powered boreholes (Table 1). Before construction of the solar boreholes only few individuals used rivers and streams as the water sources as explained by the community leaders during an interview session, but these contaminated sources were only used for drinking by the animals, irrigation, building and bricklaying purposes.

Table 2: Sources of water prior to construction of solar boreholes

L.G.As	**Respondent sources of water prior to construction of solar powered borehole**						
	Open wells	%	Hand pumps	%	Diesel boreholes	%	Total
Dambam	51	4.53	74	6.58	0	0.00	125
Gamawa	103	9.16	22	1.96	0	0.00	125
Giade	102	9.07	22	1.96	1	0.08	125
Itas/Gadau	88	7.82	20	1.78	17	1.51	125
Jama'are	47	4.18	59	5.24	19	1.69	125
Katagum	65	5.78	57	5.07	3	0.27	125
Misau	114	10.13	11	0.98	0	0.00	125
Shira	54	4.8	71	6.31	0	0.00	125
Zaki	110	9.78	14	1.24	1	0.08	125
Total	**734**	**65.24**	**350**	**31.12**	**41**	**3.55**	**1125**

Sources of Water after Installation of the Solar Borehole

With construction of solar boreholes, there were changes in the sources of water among the respondents. Figure2 shows that about 84% of the respondents obtained water from the improved sources (solar powered boreholes, hand pumps and diesel powered boreholes) when compared 35% prior to the installation of the solar borehole. Out of 84% of the respondents obtaining water from improved sources, 69% obtained water from solar borehole. About 15% of the respondents still use hand pumps while less than 1% use water from diesel powered boreholes. The study also found that only 16% of the respondents are obtaining water for drinking and domestic uses from unimproved sources (open wells) as compared to 65% before the construction of the solar borehole. It is evident from the data in Table 2 that after the installation of the solar boreholes, the respondents patronized solar borehole more than the other improved water sources and this can be attributed to the simplicity of PV pumping systems.

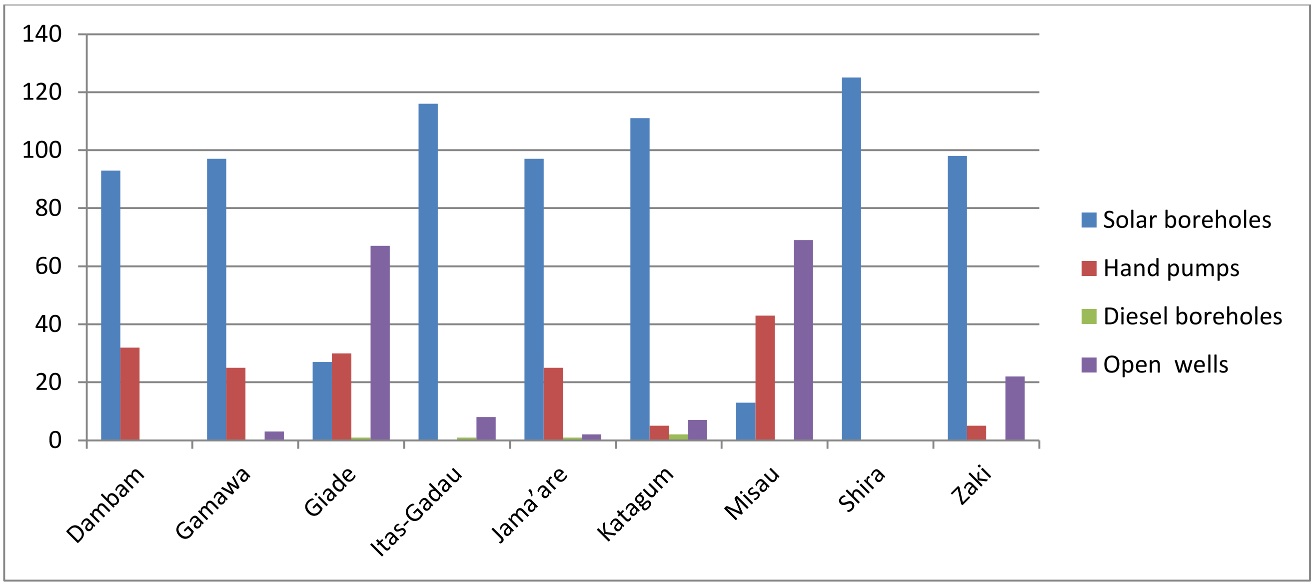

Fig. 2: Sources of water after installation of solar powered boreholes

During the focus group discussions (FGDs) none of the sampled communities use ponds or streams as major source of water for drinking and domestics purposes. Most of the water from streams and rivers are now used for watering livestock, small scale irrigation and laying of mud bricks. This is a reflection of the need for quality water for drinking and cooking. With increased education and health awareness, more people are conscious of the quality of water utilized. In addition to water from improved water sources, FGD respondents explained that in the rainy season, some households practice rain water harvesting to provide additional water for drinking and domestic uses. Respondents were of the view that harvested rain water from roof- tops of residential buildings was good and safe enough for drinking and other domestic purposes. This implies that residents have more access to water during the wet season than the dry season. Thus, respondents have higher quantity of domestic water supply during the rainy season than the dry season.

Proximity to Water Sources

As highlighted by respondents, preference of water choice is influenced by a number of factors including proximity and ease of collection of water. It was found that proximity or closeness to water source is among the yard stick for the choice of water sources among the respondents. Based on the perception of respondents interviewed over half (57%) reported that solar boreholes are the closed water sources to their households, while about one third reported that open wells are the close water sources (Figure 3). About 14% and 2% are closed to hand pump and diesel boreholes respectively. The higher level of accessibility to solar boreholes can be attributed to the strategic locations of the boreholes at the centre of the settlements and the piping of water to locations and households in some areas. This can be seen in Table 3 there is variability in the respondent's proximity to the various water sources across the nine LGAs of the study area.

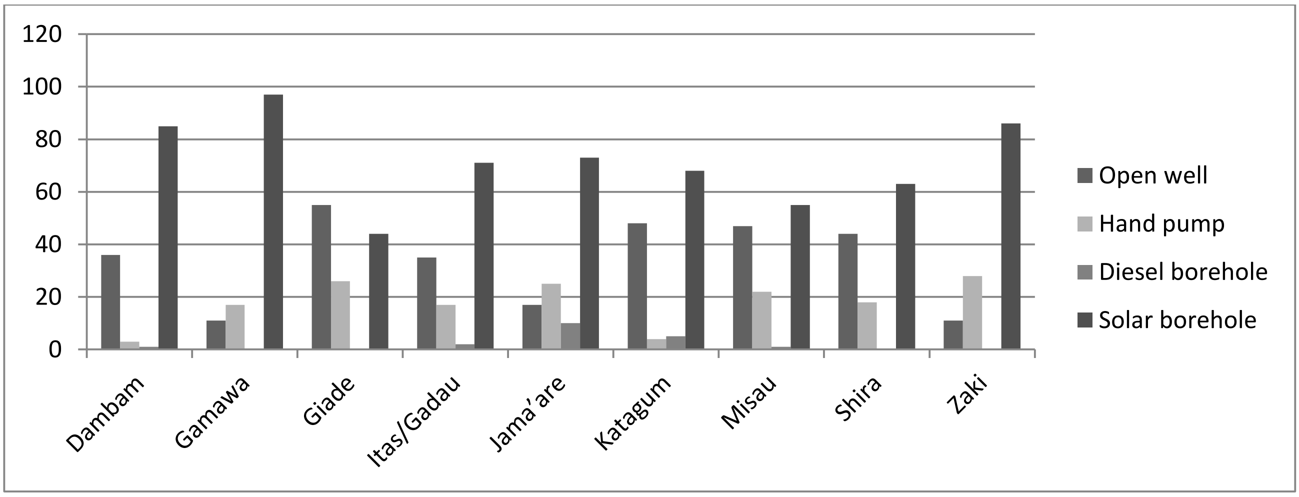

Fig. 3: Proximity to Water Sources

Access to Safe Water Supply

Respondents interviewed are of the view that construction of solar boreholes increased access to safe water. Figure 4, shows that 69% of the respondents are of the view that it significantly increases access, 28% agreed that it partially increased access to improved sources while 3% disagreed that it increases access to safe water supply in the communities. In rural areas of Sub-Saharan Africa various studies have shown that construction, rehabilitation and management of community based improved water sources have yielded positive results in providing safe and clean water to communities. Most community leaders interviewed pointed out that with installation of solar boreholes and hand pumps; supply of portable water to the communities has been boosted. They further reported that the risks associated with travelling long distances to streams and rivers especially in dry season are now reduced. L.G.A officials interviewed are in full of a support that a solar powered borehole is capable of providing more water than many hand pumps with much ease. This study further revealed that about 10% of the water users household were also piped, connected or reticulated with water from the reservoir of the solar powered boreholes in the study area. It was observed that in the twelve communities sampled, after solar borehole was piped or reticulated across the communities. This according to the community leaders have increased chances of access to clean water and allowed door step water collection for the people residing in the area.

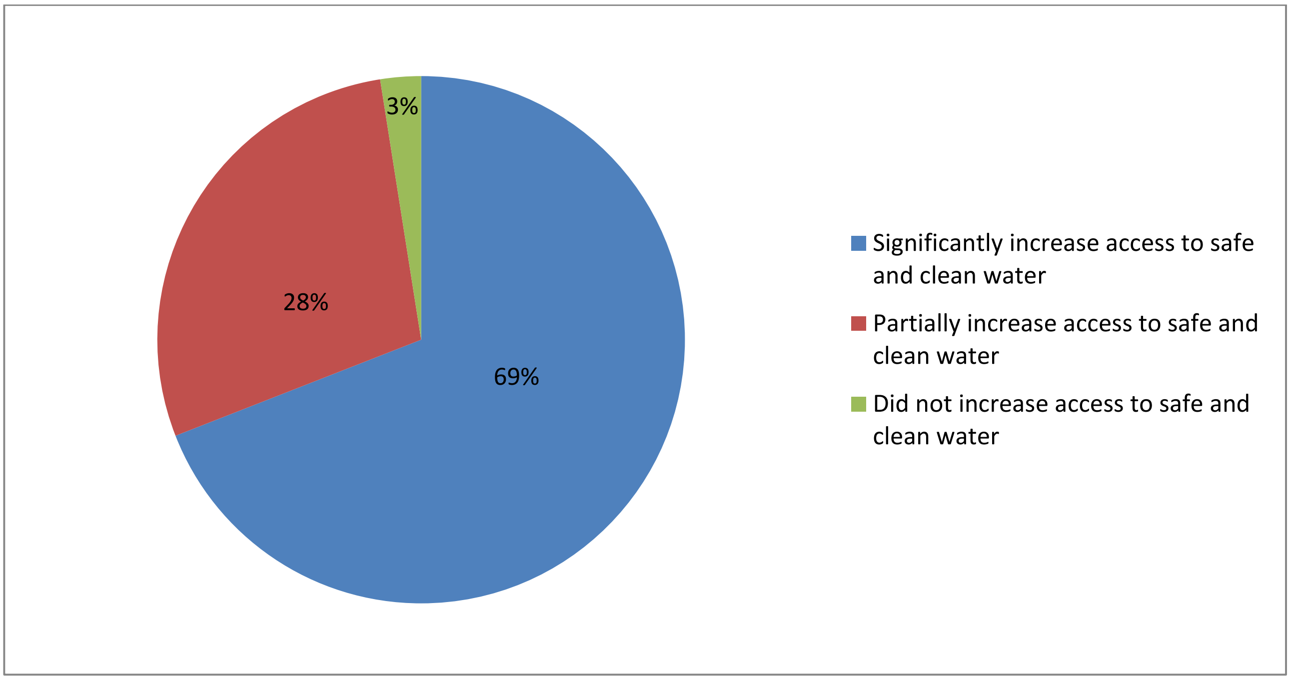

Fig. 4: Perception of respondents on whether solar boreholes increased access to safe and clean water

Community leaders unanimously agreed that the construction of solar boreholes have improved the access to safe and clean water. It was also observed that in twelve communities surveyed, the water from solar boreholes has piped into the villages thereby reducing the time and physical distance of water collection. In addition to this about 10% of respondents had water reticulated from the overhead tanks of solar boreholes to their residents.

Community Perception on Water Usage in the Households

Respondents interviewed were of the view that the quantity of water used in households has changed as a result of the installation of the solar boreholes. Table 3 present the opinion of respondents which indicates that; 96% reported an increase in the quantity of water used in their respective houses after the installation of the solar boreholes. The study found that 1% of respondents reported decrease in the quantity of water used in their households and attributed that to long queues at borehole during the day while 3% reported no change in the amount of water used in their households. During the FGDs, respondents were in consensus that the construction of the boreholes especially solar borehole provided increased supply of safe and clean water.

Table 3: Perception on water usage in the households

LGAs	Respondent view on water usage in the households					
	Increase	%	Decrease	%	No Change	%
Dambam	121	10.76	2	0.18	2	0.18
Gamawa	124	11.02	1	0.09	0	0.00
Giade	116	10.31	4	0.36	5	0.44
Itas/Gadau	123	10.93	0	0.00	2	0.18
Jama'are	111	9.87	4	0.36	10	0.89
Katagum	122	10.84	0	0.00	3	0.27
Misau	124	11.02	0	0.00	1	0.09
Shira	119	10.58	1	0.09	5	0.44
Zaki	124	11.02	0	0.00	1	0.09
Total	**1084**	**96.36**	**12**	**1.07**	**29**	**2.58**

Distance to the Solar Powered Boreholes

Based on the perception of the respondents, physical distance to solar boreholewas used to determine the closeness of each water collection point. One of the reasons why a great deal of time and energy is spent fetching water in rural areas is because many of the sources are of considerable distance from households. Table 4 shows that 56% of the respondents interviewed are within the radius of 1000 meters to the water points satisfying the MDGs standard while 44% of the respondents were outside the 1000 meters of the water point. This signifies the need for construction of additional solar boreholes and hand pumps boreholes within the communities to enable increase access to clean water as stressed by the respondents during the interview sessions. Access to safe water within a reasonable distance is part of MDGs effort in reducing poverty by the year 2015.

Table 4: Distance to Solar Powered Boreholes

LGAs	Distance in meters							
	<250m	%	250-500m	%	500m-1Km	%	>1Km	%
Dambam	5	0.44	23	2.04	27	2.40	70	6.22
Gamawa	9	0.80	30	2.67	35	3.11	51	4.53
Giade	21	1.87	36	3.20	16	1.42	52	4.62
Itas/Gadau	7	0.62	41	3.64	24	2.13	53	4.71
Jama'are	15	1.33	43	3.82	24	2.13	43	3.82
Katagum	10	0.89	25	2.22	26	2.31	64	5.69
Misau	10	0.89	42	3.73	16	1.42	57	5.07
Shira	19	1.69	38	3.38	35	3.11	33	2.93
Zaki	4	0.36	16	1.42	37	3.29	68	6.04
Total	**100**	**8.89**	**294**	**26.1**	**240**	**21.3**	**491**	**43.63**

CONCLUSION

The findings show that access to and provision of improved water sources particularly solar boreholes in the rural communities of the study area have significantly helped in reducing acute shortage of clean and safe drinking water. The higher level of accessibility to solar boreholes can be attributed to the strategic locations of the boreholes at the centre of the settlements and the piping of water into different locations and households in some communities. Majority of people interviewed depend on unhygienic sources for water supply which have adverse effect in their health prior to provision of the solar powered boreholes. But the situation changed rapidly after the installation of the solar boreholes. It was reported increase in the quantity of water used in the respective houses with provision of solar boreholes and other improved water sources. Furthermore, more than half of the respondents interviewed are within the radius of 1000 meters to the water points satisfying the MDGs standard. The preference of solar borehole choice is influenced by number of factors including proximity (piping across the community) and ease of collection of water. Thus the introduction of solar powered borehole has significantly improving access to safe and clean water supply especially to the rural communities of the study area, but still much need to be done by Governments and other stakeholders to ensure wider coverage and access to portable water supply in the area.

RECOMMENDATIONS

The recommendations of this study are:-

i. Government should provide more solar boreholes in rural communities of the study area particularly where they have none.

ii. Governments and development partners need to improve the monitoring and evaluation of various solar powered boreholes projects executed.
iii. Local communities should be committed in safeguarding these installations from theft and vandalization.
iv. Government and local communities should devise ways of piping the water into their respective houses for easy water collection; this will help children concentrate more on their education pursue.
v. Government should train the operators on various repairs and maintenance strategies in order to improve performance of the installed solar powered boreholes.

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