WATER SUPPLY, SANITATION AND HEALTH RISK IN A TROPICAL SUB-SAHARAN REGION

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ABSTRACT

Water is a very important abiotic component of the environment. It is difficult to imagine a clean and sanitary environment without water. Nevertheless, rapid population growth has not been accompanied by an increase in the delivery of essential urban services such as water supply and sanitation. This poses a risk on the right of the public to healthy living. The study assesses the water supply and sanitation coverage in Jalingo, Taraba State, Northern Nigeria and proffers engineering solutions to stimulate access to water supply and sanitation. It also tests for physico-chemical parameters and bacteriological parameters of water meant for drinking. The analysis of water available for distribution and water requirements show that Jalingo water works function at 15.8% capacity and has a short fall in 2013 of 20,114.450 m^3 representing 84.2%. Similarly there is a high indication that sanitation facilities are inadequate. This is justified by the field survey which shows the absence, or near absence, of sanitation facilities as a large population use open field and the river for defecating in the eighteen zones that make up Jalingo. To deal with this menace, the existing nine boreholes should be overhauled and new VIP latrine with hand washing facilities be constructed in schools, hospitals, parks, markets and some locations to close the gap. Government should go into private public partnership and bilateral collaboration with both local and international financial donor agencies such as the UNICEF, African Development Bank, MDGs, etc. with the sole aim of building safe water and sanitation infrastructure to improve human health and dignity.

Keywords: sanitation, water, Jalingo, physicochemical parameters, bacteriological parameters.

1 INTRODUCTION

Provision of basic water supply and sanitation facilities to people, especially living in rural and urban areas is still a major concern for Nations, UN and other agencies working for their welfare in the developing countries, Nigeria inclusive. Absence of these basic facilities leads to poor health and also affects the livelihood of the poor and vulnerable communities with the increase in rural–urban migration; Jalingo has been floated with water vendors because of the inability of the State water works to supply adequate potable water to this growing population. The Nigerian Government has long considered the provision of water supply and sanitation services to be the domain of the federal, state and local governments. However, the public sector has not been successful in meeting more than small portion (18%) of the demand for water and sanitation of residential and commercial users. This is also the situation in Jalingo, where the services are in critical short supply. This poses a risk on the right of the public to healthy living.

1.1 Sanitation

Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. An improved sanitation facility is one that hygienically separates human excreta from human contact. Improved sanitation generally involves physically closer facilities, less waiting time, and safer disposal of excreta [1], [2]. But 99% of people living in industrialized countries have access to improved sanitation; only 53% of populations in

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developing countries have such access. Within developing countries, urban sanitation coverage is 71%, while rural coverage is 39% [3].

2 THE STUDY AREA

The area of study covers the basement complex area of Taraba State. It lies between latitude 8° 53' 0" North, 11° 22' 0" East and has an aerial extent of about 195 km^2. It is bounded to the North by Lau Local Government Area, to the East by Yorro Local Government Area, to the south and West by Ardo Kola Local Government Area Jalingo has a population of 139,845 people according to the 2006 population census, with a projected growth rate of 3% (Shuwabolo et al, 2009). The relief of Jalingo consists of undulating plain interspersed with mountain ranges between Kwaji-Mika to the east and Kona to the west, stretching to Kassa Gongon to the south exist this compact massifs of rock outcrops. The mountain ranges run from Kona area through the border between Jalingo and Lau LGAs down to Yorro and Ardo Kola LGAs in a circular form to Gongon area, thus given a periscopic semi-circle shape that is almost like a shield to Jalingo town. Jalingo metropolis is drained by two rivers (Fig. 1), Mayogwoi and Lamurde, which empty their content into the Benue river system at Tau village. Furthermore, Jalingo has a mean annual rainfall of about 1,200 mm and annual mean temperature of about 29°C. Relative humidity ranges between 60–70% during the wet season to about 35–45% in the dry season. Jalingo is located within the Northern Guinea savannah zone characterized by grasses interspersed with tall trees and shrubs. Some of the trees include locust bean, shea butter, eucalyptus, baobab and silk cotton tree. The major ethnic groups of Jalingo LGA are the Fulani, Jibu Kona and Mumuye, while other ethnic groups such as Hausa, Jenjo, Wurkum and Nyandang are also found. The area has no industries; it is driven by agriculture and public service [4].

3 METHODS AND MATERIALS

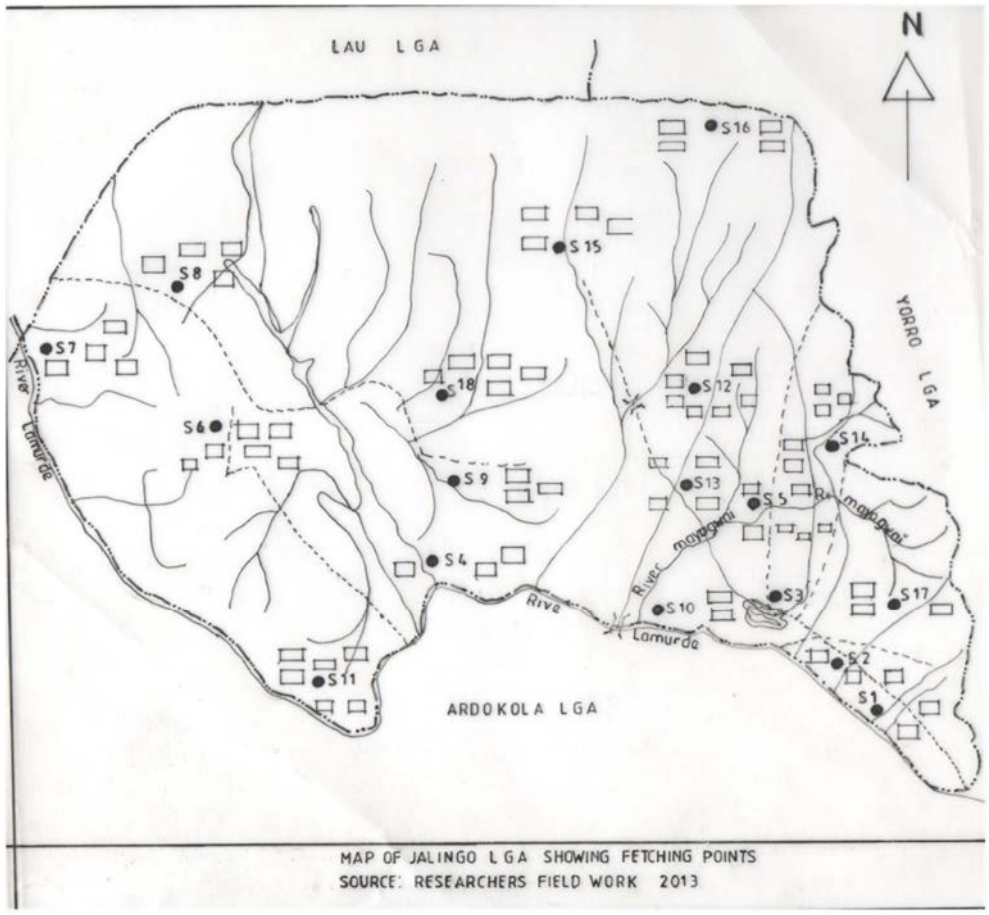
3.1 Materials

Laboratory examination of some physicochemical and bacteriological parameters such as Turbidity, Ph, TH, EC, DO, Cl, NO_3, Pb, Fl, Cu and coliforms were carried out in view to assessing the quality of water consumed. TPh1 kits with serial number T4201196 manufactured by Myron l company was used in analysing Conductivity, TDS, and pH. Turbidity was analysed using Standard kit model 2100A manufactured by HACH in 2010 and acquired by Taraba State Water Supply Agency in 2012. Smart Spectrophotometer model L0904013 manufactured by LaMotte in 2012 and acquired by Taraba State Water Supply Agency in the same year was used to analyse for DO, pH, Cl, Fl, and Pb. Some of the materials also used are: sterilised plastic bottles, conical flasks, beakers, stirrers and spatulas, measuring cylinders, appropriate reagents for every parameter tested, cotton and other necessary laboratory equipment.

3.2 Methods

3.2.1 Collection of water samples

The water samples were collected from the selected locations within the 18 zones that make up Jalingo. These points were selected on the basis of highest volume of consumers and the long duration (12 hours daily) it takes for lifting water from them. Samples from improved sources S3 (Borehole), S5 (Borehole), S8 (Borehole), S16 (Borehole), S17 (Borehole), S18 (Tap) and unimproved sources S2 (Tube well), S6 (Tube well), S7 (Tube well), S10 (Tube well), S11 (Tube well), S12 (Tube well), S13 (Tube well), S1 (Hand dug well), S4 (Hand



• S1=Sabon-gari zone	• S7=Karofi zone	• S13=A.A. Kassa zone
• S2=Kogin Sarki zone	• S8=Mafindi zone	• S14=Abuja Phase II zone
• S3=Baraya zone	• S9=Duala zone	• S15=Mayodassa zone
• S4=Yandan zone	• S10=Magami zone	• S16=Mile six zone
• S5=Primary Board zone	• S11=Nukkai zone	• S17=Nassarawo zone
• S6=Dawaki zone	• S12=Jankada zone	• S18=Road Block zone

Figure 1: Map of Jalingo showing selected sampling points.

dug well), S9 (Hand dug well), S14 (Hand dug well), and S15 (Hand dug well) were collected using two-one litre bottles (200 ml) for each fetching point. Samples were collected between the hours of 6.00 am and 7.00 am from 10th June 2013 to 17th June 2013 and taken to Taraba State Water quality control laboratory for physical and chemical analysis and American University of Nigeria water and waste water laboratory for bacteriological analysis.

3.2.2 Collection of other data

The method of collecting other relevant data consists of reconnaissance survey of water supply and sanitation facilities. 250 homes spread across the 18 zones in the study area were

randomly surveyed while administering questionnaire. Two departments of government were also administered with 25 questionnaires each. The choice of the departments was timely because of their responsibility in this area of study. Non-formal interviews were also conducted with the heads of departments and some selected field staff, because not all the staff agreed to make comments on the topic of this study. However, questionnaire was not administered to water supply agency because the department of research and statistics under the directive of the management participated fully in monitoring and obtaining data for alternative water providers in the 18 zones of the city, but other staff of the agency participated in the survey when contacted at home.

The questionnaire was divided into four sections A, B, C, and D. Section A elicits background information about the respondents. Section B seeks information about the respondents' access to water supply. C sought for the respondents' access to sanitation facilities, and section D seeks information on sanitation from the relevant authorities responsible for inspection and/or enforcement of sanitation in the study area. Similarly, the impacts of sanitation status on the locality were examined through interviews with Head of Departments of Public Health and Sanitation in the State Ministry of Environment and Jalingo Local Government respectively.

3.2.3 Challenges during data collection

During the data collection process, some of the respondents in government departments declined to comment on the topic for the fear of the reactions from their immediate bosses and the government of the day. Some household refused us access into their sanitary facilities largely because of their religion and personal decisions. The management of the Taraba state water agency did not accept open discuss on the topic rather they engaged the department of research and statistics to participate in gathering data from alternative water providers (tanker, trucks, trolley, etc.) which will be used as data base for the agency. Uncontrolled migration of rural dwellers to the city is also a challenge that makes determination of water demand difficult even at global level. Therefore, there is the need to undertake sustainable, (monitoring and evaluation) studies to guarantee access to water and sanitation in the study area.

4 RESULT AND DISCUSSION

A total number of 300 questionnaires were distributed, out of which 250 were for respondents across the study area while 50 were for the government agencies responsible for sanitation within the study area. 214 out of the distributed 250 questionnaires, which were completed and returned, were used for the data analysis. Similarly 25 each were administered to departments of public health and sanitation of the ministry of environment and Jalingo LGA respectively. Out of these, 16 were completed by the ministry and returned for analysis, while 11 were completed by the Jalingo LGA and returned for analysis.

4.1 Demographic characteristics of the respondent

Data from the demographic section yielded information about respondents' demographic characteristics. The majority of the respondents were male (75.70%) while others (24.30%) were female. Majority of the respondents were in the age bracket between 21–30 years (35.51%). This suggests that the class of respondent are the chief users of water and sanitation facilities in the homes. Furthermore, it shows that those who suffer the adverse effect of poor sanitation and water supply are the younger people who often times do not have the way withal to access good drinking water and rank the highest in population.

70.09% of the respondents had acquired tertiary education, 16.36% had secondary education, and 7.94% had primary education while vocational education and non-formal education had 2.80% respectively. When the respondents were asked to indicate their occupation, 62.15% was found to be civil servants while 16.36% were unemployed. Traders made 12.15% and other professions scored 9.35%.Having demonstrated that the study area is dominated by civil servants, 64.49% own their homes either by building them or getting from government. Some 10.75% of the respondents own their homes on loan and 24.77% live in rented apartments. When asked how long each respondent lived in their respective homes, 38.32% lived in their homes between 11–20 years. 33.64% lived between 1–5 years while 23.83% spent 6–10 years in their homes while 3.74% have spent less than one year in their homes. From the information obtained, 30.37% of the respondents had 6–10 people in a home. 25.23% had more than ten persons per home. While 20.09% of the respondents had six occupants per house.15.89% had four occupants and 6.07% had two occupants per house. Only 2.34% had one occupant. The government departments involved in responding to water and sanitation issues are the departments of public health and sanitation of the ministry of environment with 59.26% response and Jalingo LGA 40.74% respectively.

4.2 Analysis of access to water supply

Considering the source of water used by the respondents (Fig. 2), 30.37% source water from wells, 20.09% source their water from tanker trucks while 19.63% get pipe borne water. Also, 19.63% source water from private and commercial boreholes. Only 8.88% depend on stream/rivers for water. Rain water take 0.47% while other sources of water scored 0.93%.

Considering other results (Fig. 3), which show the number of times water is supplied to the study area, it was revealed that pipe borne water is supplied twice a week, this scored 28.04%. 22.90% of the respondents got portable water daily, while 21.96% get once a week. 3.74% are supplied water once in two weeks and 6.07% obtained tap water once in a month while 17.29% get water in a non-consistent and undefined pattern.

When the respondents were asked the kind of disease they have suffered in recent times, 53.74% identifies the cases of typhoid fever. 20.56% of the respondents suffered cholera in recent times while diarrhoea scourge has affected 17.76% of the respondents. Other health diseases affected 7.94% of respondents which were water related.

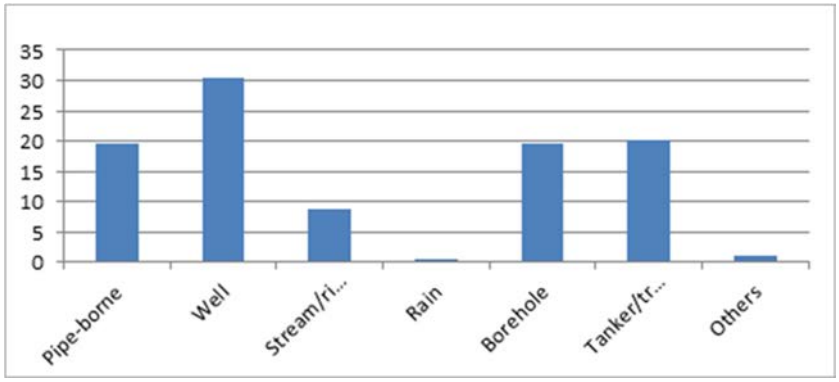


Figure 2: Different sources of water from the studied area.

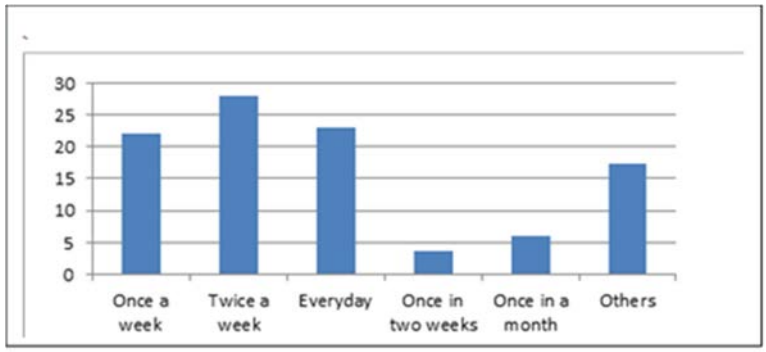


Figure 3: Frequency of pipe borne water supply.

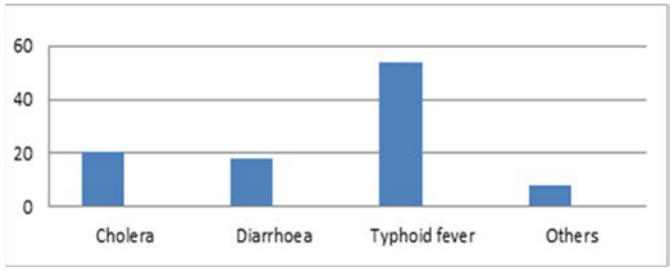


Figure 4: Diseases affecting respondents.

4.3 Water quality

Laboratory examination of water samples was carried out during this research from improved sources as thus: S3 (Borehole), S5 (Borehole), S8 (Borehole), S16 (Borehole), S17 (Borehole) S18 (Borehole) and results are shown in Table 1.

The result showed that pH value ranged from 6.00 to 8.20 with S16 (mile six) having slightly acidic water. All other points were satisfactorily within WHO and Nigerian standard for drinking water [5]. The turbidity of the samples, it was found that S17 (Nassarawo) and S18 (Road Block) recorded slightly high turbidity above the acceptable limits by [1]. All other samples were adequate within acceptable limit. Turbidity is generally caused by suspended and fine particles and colloidal impurities like clay, silt, algae, and plankton. It is characterised by undesirable taste and odour in water [6]. All samples were within limit for TDS [1], and may be due to pollution from high densely residential and small scale industrial areas. These explain why the study area recorded low TDS being an agrarian area with growing population at 3% per annum. The values of EC from the six points were within limits set by [1] and [5]. Total hardness had values from S3 (Baraya), S8 (Mafindi) and S17 (Nassarawo) as 400, 200,and 188 respectively which are above the maximum acceptable limit [1], [5]. Hard water is mainly an aesthetic concern because of the unpleasant taste. It also reduces the efficiency of soap and causes scale formation in pipes. It is worthy to note that the World Health Organization did not have any recommendations for levels of Ca2+ and hardness in drinking water [1] but researchers have suggested that a minimum of 20 mg/L [8] and an optimum of about 50 (40–80) mg/L [9], [10] calcium present in drinking water

Table 1: Physical, chemical and bacteriological parameters of improved source of water.

S/N	Parameters	S3	S5	S8	S16	S17	S18	WHO standards	Remarks
A	**Physical**								
	pH	8.20	7.50	7.20	6.00	7.20	7.50	6.50–8.50	Fair
	Turbidity (NTU)	4.00	4.60	3.50	4.61	5.02	5.40	5.00	Slightly high
	TDS	496.00	320.00	112.00	358.00	322.00	168.00	500.00	OK
	Conductivity (µs/cm)	740.00	365.00	160.00	538.00	189.00	380.00	1000.00	OK
B	**Chemical (mg/l)**								
	Hardness	400.00	132.00	200.00	50.00	188.00	115.00	150.00	High
	DO	0.29	1.68	4.60	4.20	4.50	1.90	10.00	Low
	Chloride	1.00	1.00	0.50	0.00	0.30	0.50	250.00	OK
	Nitrate	1.35	2.08	0.82	0.46	0.60	0.95	50.00	OK
	Lead	0.10	0.20	0.10	0.16	0.08	0.04	0.01	High
	Fluoride	1.86	0.01	1.20	0.18	0.09	0.42	1.50	Fair
	Copper	0.04	0.04	0.03	0.01	0.42	0.45	1.00	OK
C	**Bacteriological**								
	Total plate count	3×10^2	$4x10^2$	$2x10^2$	$12x10^2$	$4x10^2$	$4x10^2$	$5x10^2$	OK
	Total coliforms	0	0	0	0	0	1	10	OK
	E.coli	0		0	0	0	0	0	OK

may be the most suitable for human consumption [8]. Long-term consumption of very high hard water might lead to an increased incidence of urolithiasis, anencephaly, parental mortality, some types of cancer, and cardiovascular disorders. The DO values range from 0.29–4.60 mg/l. This is within WHO acceptable limits. According to [6], chloride recorded values 0.00–1.0 mg/l which is less than the maximum permissible limit prescribed by [1], [5], [11]. [10] further stated that the presence of chloride in excess is injurious to human health. Therefore, the level of chloride found in the sample is satisfactory. Nitrate (NO_3) recorded values ranging from 0.46–2.08 mg/l which is also within the maximum permissible limit stipulated [5], [11]. Excess of nitrates in 50 mg/l is known to cause severe health impact such as cyanosis, and asphyxia (blue baby syndrome) [5]. From the test to determine the amount of lead present in the water samples, it was found that values range from 0.04–0.20 mg/l. This value is above the maximum permitted by [5] and is known to cause cancer, interfere with vitamin D metabolism, affect mental development in infants, toxic to the central and peripheral nervous system [5], [11].

Fluoride was tested and results show a value range from (0.01–1.86) mg/l. This value for S3 (Baraya) is not adequate and above the permissible limit. However, the remaining samples indicate values within maximum permissible limits. Copper was tested and values obtained

range from 0.01–0.45 mg/l which is an acceptable range. It was also seen from the individual samples to be below the maximum permissible limit as stipulated in the following standards [5], [12]. When a metal ion such as copper exceeds its requirement by an organism there is the potential for toxic effects.

4.4 Sanitation analysis

From measuring the access to sanitation, 45.79% use pit toilet, and 45.39% have access to water closet. Another 6.54% use VIP toilet while 1.40% use open field.1.87% residing by the river bank defecate in the river (see Fig. 5).

When sanitation facilities were surveyed, it was found that 37.85% had one toilet in the home. Most of which had population size greater than six users. 30.84% had two toilets while 16.36% had three toilets in each of their homes.16.36% had access to three toilets while 6.54% had four toilets. Only 8.88% had five toilets in their homes. 36.45% did not know the size of their septic tanks. 25.70% had 2 m×3 m×2 m while 19.16% had a size of 2 m×2 m×2 m and 18.69% sized 1.8 m×1.8 m×1.5 m. Public toilet had 22.90% and 77.10% of the toilet were private. 53.27% found it difficult to construct at least one toilet while 46.73% could easily build one. 67.76% clean their toilets daily and 20.56% clean twice a week, while 11.68% clean up once a week. 55.14% had toilets that were aged five years and above, and 17.29% had toilets aged between three to four years. Some 19.16% had toilets aged two to three years while 8.41% had toilet aged one to two years. 63.08% had never evacuated their septic tanks.36.92% had their toilets evacuated via various means. When the mode of sludge disposal was surveyed, 66.36% indicated that sludge is disposed on dump sites.

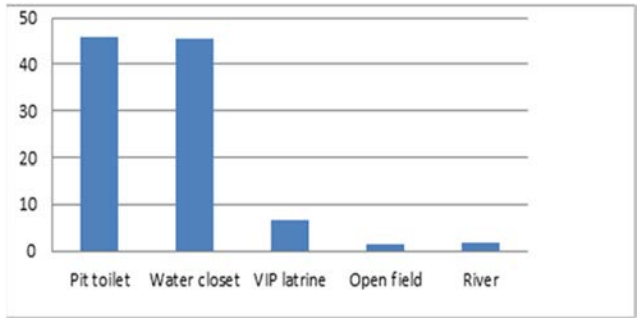


Figure 5: Type of toilet in use.

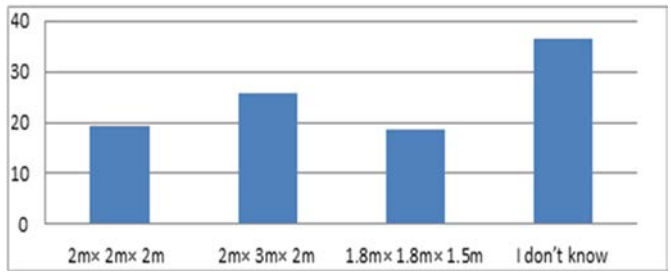


Figure 6: Size of septic/soak away.

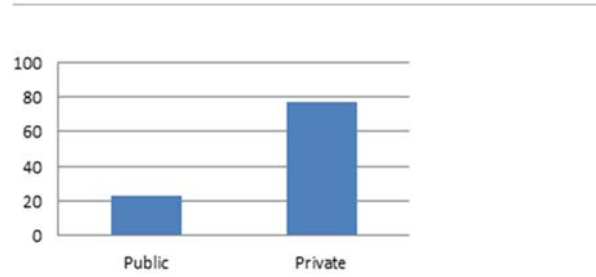


Figure 7: Class of toilet.

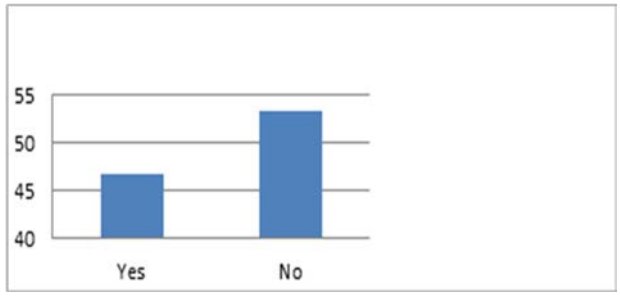


Figure 8: Ease of constructing toilet.

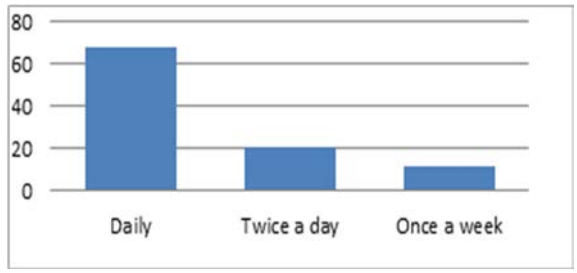


Figure 9: Number of times toilet is cleaned.

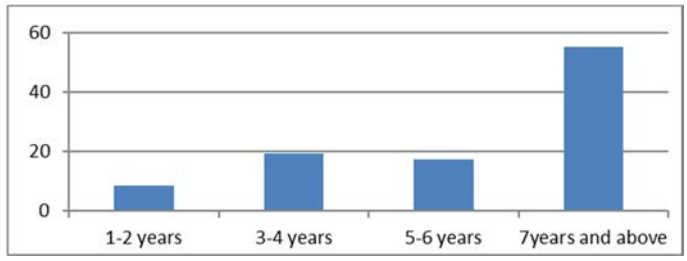


Figure 10: Age of toilet.

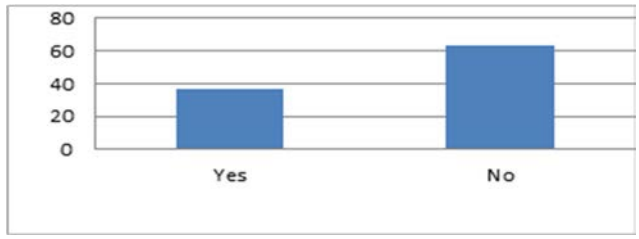


Figure 11: Evacuated toilets.

4.5 The government of Taraba and sanitation

On the item that measured the availability of sludge removal equipment, 70.37% affirmed the non-availability of sludge removal machines and 29.63% answered there are adequate machines for sludge removal. Sludge treated before disposal scored 55.55% while non-treated scored 44.44%. From Table 2, the method used in treating sludge before disposal show that drying bed and incineration scored 29.63% each while spraying on land got 0.00%. Other methods of disposal scored 22.22%. In the department of health, Jalingo local government and state ministry of environment it was found from the survey that 66.67% affirmed lack of manpower across all cadre and units of operation while 33.33% were comfortable with the present staff strength. When the challenges faced in the discharge/enforcement of sanitation was enquired of from the respondents 33.33% decry poor staffing, welfare and logistics. 29.63% registered their fear for lack of equipment or machines. 14.15% identified lack of funding from government and donor agencies as one of the challenges while, 3.70% point to lack of manpower and 18.5% did not identify any challenge militating against the discharge of their duties in the sanitation field.

5 CONCLUSION AND RECOMMENDATION

Reasonable access to water is defined as the availability of at least 20 litres of water per person a day from an improved source within one kilometre of the dwelling [13]. And it is also evident in the result from the questionnaire where 19.63% of respondents have access to pipe borne water while water from hand dug wells and other unimproved sources prove to supply low quality water at a higher quantity over distances more than 200 meters to the homes at the extreme of every zone. This takes more than 30 minutes per each fetch and it is an indicator of no access as recommended by World Health Organization [13]. This also is a pointer to the absence of safe drinking water in Jalingo. It was discovered that the greatest population use well water, and a second largest population access water from tanker/trucks which is described by World Health Organization as unimproved sources and largely seen to be an access gap [13]. Also, we can further conclude that the mixed sources of water consumed in Jalingo is polluted with lead (Pb) which is found to be hazardous to human health and is reported to be responsible for kidney and liver diseases [4]. Secondly, Sanitation which is an important economic factor to the existence of human beings was assessed and results showed that a good percentage of Jalingo inhabitants had improved sanitation facilities installed in their residence but were compelled by poor access to water to use traditional pit latrines/soak-away which require minimal water usage. The incessant strike by the state work force demanding for improved wages and the national minimum wage regime placed a challenging toll on the governments' financial state which influenced the halt in recruitment of manpower into the service. These therefore denied the benefiting agencies of

Table 2: Responses from government agencies responsible for sanitation in Jalingo.

Sanitation issues as perceived by ministries		No. of respondents	% of respondents
1. Inspection of sanitation facilities	Daily	15	55.55
	Weekly	4	14.81
	Monthly	8	29.63
	Total	27	100
2. Type of sanitation facility	Private toilet	8	29.63
	Public toilet	19	70.37
	Total	27	100
3. Sludge evacuation equipment	Yes	8	29.63
	No	19	70.37
	Total	27	100
4. Sludge treatment before disposal	Yes	15	55.55
	No	12	44.44
	Total	27	100
5. Method of treating sludge	Drying bed	8	29.63
	Spray on land	0	0.00
	Incineration	13	29.63
	Non	0	0.00
	Others	6	22.22
	Total	27	100
6. Staff strength	Yes	9	33.33
	No	18	66.67
	Total	27	100
7. Challenges in discharging duty	Lack of equipment	8	29.63
	Lack of manpower	1	3.70
	No challenge	5	18.52
	Lack of funding	4	14.15
	Poor staff welfare/logistics	9	33.33
	Total	27	100

the right of staffing the relevant departments for effective implementation of policies and programmes such as sanitation, hygiene education, sanitation inspection and enforcements. It was also discovered that the lack of public awareness campaign to the populace in adhering to good sanitation norms poses the tendencies for disease transmission and infection. In conclusion, Jalingo is lacking safe drinking water and sanitation and urgently requires a step by step effort by all the key water and sanitation players to improve the water and sanitation state in Jalingo.

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