

LOCATION ANALYSIS OF PUBLIC WATER FACILITIES IN FUNTUA TOWN, KATSINA STATE, NIGERIA

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ABSTRACT

Adequate supply of clean water is an absolute prerequisite to the provision of proper health care and industrialization. The availability of water from the tap saves a good deal of time and energy, when compared to drudgery of having to carry water containers over long distance. This study analyzed the location of public water facilities and assesses the availability of water supply in Funtua town with the view of mapping, taking inventory and creating a robust geo-spatial database for adequate analysis of public water facilities in Funtua town. Method and procedures that was employed to conduct the study include data input (GPS reading of boreholes), data manipulation (the use of GIS software) data analysis and data output. The analysis shows that; Funtua town has the total of 204 public water facilities. Out of each 47 of the boreholes are not functional and needs urgent technical services. The town has seven political wards, four out the seven wards in Funtua town have adequate water supply according to United Nation regulations set by United Nations Development Programme (UNDP, 2012) standards of 15 liters of water per individual. The wards are Anguwan Musa, Anguwan Rabi, Maigamji, Makera. The remaining three wards that include Anguwan Ibrahim, Dandutse and Sabon Gari fall short of this standard and are considered to have inadequate water supply. Therefore, additional boreholes are recommended in the affected wards. Damaged or blocked public water facilities should be repaired to service the current and future population in the study area. A comprehensive public water facilities distribution system database should be developed, so as to provide holistic information about the facilities. This will equally be immense aids in terms of decision making.

Key words: Adequacy, Analysis, Location, Public water Facilities.

Introduction

Location is seen as that property of objects which Geographers consider central to their study and problems of understanding objects or phenomena which interests them (Lewis, 1977). In Geography, the term location is used

to identify a point or an area on the earth or elsewhere and this may be through the use of absolute or relative terms. Location is said to be relative when it is described in relation to other points or areas. An absolute location

uses a specific pairing of lines of latitudes and longitudes in a Cartesian coordinate grid (Abler, et al, 1971). Portable water is a critical requirement for human life. Its provision in adequate quantity and quality is a national and international concern (Danilo, 2009). According to Biemans et al. (2006), about 69% of the earth surface is covered by water. However, the distribution of water across the globe is uneven in terms of quality and quantity, while it is found in abundance in some places, in others, it is scarce. The demand for portable water supply increases in most developing countries as a result of increase population and urbanization. In recent times, the rate and dimension of urbanization has increased, which resulted to having more than 50% of the world population living in urban areas of which 64% of them are in developing countries (United Nation Development Programme, UNDP, 2012). The increasing rate of population and water demand has compounded the issue of water resources depletion in many parts of the world. Towns and cities in developing countries are currently facing serious challenges of efficiently managing the scarce water resources, as well as the issue of sustainability of conventional water management (Zeraebruk et al., 2014). Access to clean water is a growing political issue around the world. In 1977, basic survival needs were stressed at the Mar del Plata conference held in Argentina, a major international effort to address world water problems organized by the United Nations. The issue of the right to basic water need was illustrated in the Mar del Plata conference in Argentina by the statement that "All people have the right to access drinking water in quantity and quality equal to their basic needs". As population of the world keeps increasing, many societies are faced with challenges to provide clean water sanitation services of significant concern in meeting basic

human and ecological needs for water, vital for survival and good health (Warner 1995). In Nigeria, availability of water controls the spatial distribution of population and settlements. Modern water supply networks are usually those situated along the major trade and transportation networks (Mathew and Faruq, 2016). All improved water supply in Nigeria is from public water supplies (Oyebande 2005). However, the pattern of water supply varies from one settlement to another. Generally, as the population of a settlement increases, the service efficiency to the expanding population will decrease. This usually creates the disparity in supply of water to different areas of the settlement. There are various means from where humans traditionally source for water particularly in the tropical region. The sources range from rain water, surface (streams and brooks), and hand dug wells as well as boreholes (Ajibade, 2005; Chaudhery, 2005; Ufoegbune, et al. 2009). The most dominant source of water supply in most of the developing countries especially in Nigeria is public water wells and boreholes (National Ground Water Association 2009). Water facility is the excavation or structure created in the ground by digging, driving, boring or drilling to access ground water (Texas Ground Water Production Committee Publication 2000). Public water facilities comprises those physical means or contrivances like boreholes, dug wells and taps that provide populace with quantity water require for their daily needs (Anwuri, et al, 2015). Public water facilities as a source of water need to be properly planned for over space to avoid or minimize pollution and contamination that can result to an epidemic or other related health hazards. Despite the dominance and popularity of public water facilities in urban and rural areas in Nigeria, public water wells suffer from neglect or inadequate consideration by the government and decision makers (Amali, 2012). The

decision on number and the location of source of public water is one of the fundamental problems facing urban planners (Israel, 2009). The planning of water resources in accordance to standard has been neglected in many local communities, as such, United States Environmental Protection Agency, [USEPA] (2001), set standards of 15 meters away from pit latrine/soak away, 1.5 meters from property line, 150 meters from treatment ponds, wastewater absorption, storage or retention and 30 meters from surface or subsurface store chemicals such as gasoline, diesel, fuel, home heating oil, fertilizer, pesticide etc. In Nigeria, a minimum of 15 to 30 meters distance setback between a hand dug well and all potential sources of contamination is the benchmark standard set by the National Standard of Drinking Water Quality (NSDWQ, 2007). Similarly, Alberta Environment (2009), recommends that a well or borehole should be at least 15.24 meters and 30 meters away from septic tank and septic system drain field. The major purpose of the setback isolation distances is to protect water wells from pathogens contamination by ensuring sufficient time for pathogens attenuation. In terms of personal needs, an average water supply for drinking, cooking and personal hygiene in any household is at least 15 liters per person per day. An average man requires 2.5 liters of water daily for drinking (United Nation Development Programme, [UNDP] 2012). Geographic Information System (GIS) technology has obtained growing acceptance in the distribution and management of facilities. As rightly noted by Lo and Yeung, (2002); the Geographic Information System techniques and processes were deployed in the accomplishment of mapping the spatial distribution of water facilities. Since, geospatial maps of the facilities are produced by the combined efforts of many professions using a variety of technologies.

The aim of this research is to analyze the spatial pattern of public water facilities and develop a geo-database for Public water facilities in Funtua Town.

This aim will be achieved through some specific objectives which include to:

- i. identify and map out the location of the existing public water facilities in Funtua town.
- ii. examine the conditions of the existing public water facilities in Funtua town.
- iii. examine the extent to which public water facilities conform to the UNDP (2012) standard in respect to the population of the study area.

Study Area

The study area for this study is Funtua town, Funtua Local Government Area (LGA) of Katsina State, Nigeria. Funtua Town is located between latitudes $11^{\circ}30'00''\text{N}$ to $11^{\circ}33'00''\text{N}$ and longitudes $7^{\circ}16'30''\text{E}$ to $7^{\circ}19'30''\text{E}$. It is the administrative headquarters of Funtua Local Government Area, Katsina State, Nigeria, and covers an estimated land area of about 76.11km^2 . It is bordered by Bakori Local Government Area to the Northeast, Dukke ward to the Northwest, Dandume Local Government Area to the Southwest and Mai Gamji ward to the southeast (Figure 3.1). The major wards that make up Funtua town include: Anguwan Ibrahim, Anguwan Musa, Anguwan Rabi, Dandutse, Maigamji, Makera, and Sabon Gari. (Danrumpa 2014). The town has a total population of 134,423 with a growth rate of 2.5% (NPC, 1991) and projected to 195,964 by 2017. Funtua town is a predominantly Hausa-Fulani with small proportion of Yoruba, Igbo and other ethnics groups. Seasonal Migration takes places especially in the dry season to the southern part of the country in search of part time jobs. This is known as "*Chinrani*". The climate of Funtua town is tropical continental. The climate is considered to be of Aw type by

Koppen-Geiger's climate classification. The raining season start from March and end October. The total annual rainfall is about 1024mm. The average minimum and maximum temperature is 19°C and 32°C respectively. Funtua lies in the great Hausa plains of northern Nigeria that is composed of basement complex rocks that cover over 50% of the Nigerian Landmass. Funtua is generally composed of undulating plains which generally rise up to between 600 and 700m above sea level (Abaje 2007). The continental sediment of Funtua plains consist of field spastic clayey sandstones and grits with small basal pebble beds. Funtua town has very few rivers; many of which are either intermittent/seasonal or reduced drastically in volume during the prolonged dry season (Babsal, 1998). Gouruwa and Anguwan Wanzamai streams are the only streams that are found within Funtua town. These two streams are seasonal in nature notably the Gouruwa stream which originates from Gouruwa village and flows northeast of Funtua town. It drains Funtua low cost, Yankara behind central Motor Park to Tudun wada, dawn to Mairuwa dam (Bagori dam). Another channel originates from Anguwan Wanzamai, flows northwest of Funtua town to Anguwan Ibrahim near Comprehensive Hospital along Sokoto byepass and extends to Angudodu

village down to Gwagwaye dam (Beri-beri dam). The soils are largely clayey vertisol soils (locally called "*Laka*") and about five meters in depth, and fine in texture. The soils are occasionally difficult to work, tending to become waterlogged with heavy rains and to dry out or crack during the dry season. In Funtua town and its surroundings the soils are more fertile in nature. The vegetation of Funtua is the Sudan Savanna type which combines the characteristics and species of both the Guinea and Sahel Savanna (Abaje, 2007). The major occupation of the inhabitants of Funtua town is farming. The major crops grown by the farmers include maize (*zea mays*), guinea-corn (*sorghum spp*), millet (*panicum miliaceum*), soya-beans (*glycine max*), cotton (*gossypium hirsutum*) and groundnuts (*arachis hypogaea*) at both commercial and subsistence levels (Adefila, 2014). In addition, horticulture is practiced mostly along the main streams and rivers where vegetables like okro, tomatoes, onion, sugar-cane, lettuce and spinach are cultivated. Animal Husbandary is also practiced by the inhabitants; the animals kept include cattle, sheep, donkey, horses and goats (Udo, 1970). The nomadic cattle Fulani rear their cattle, while the Female hawk locally prepared fermented milk in the town.

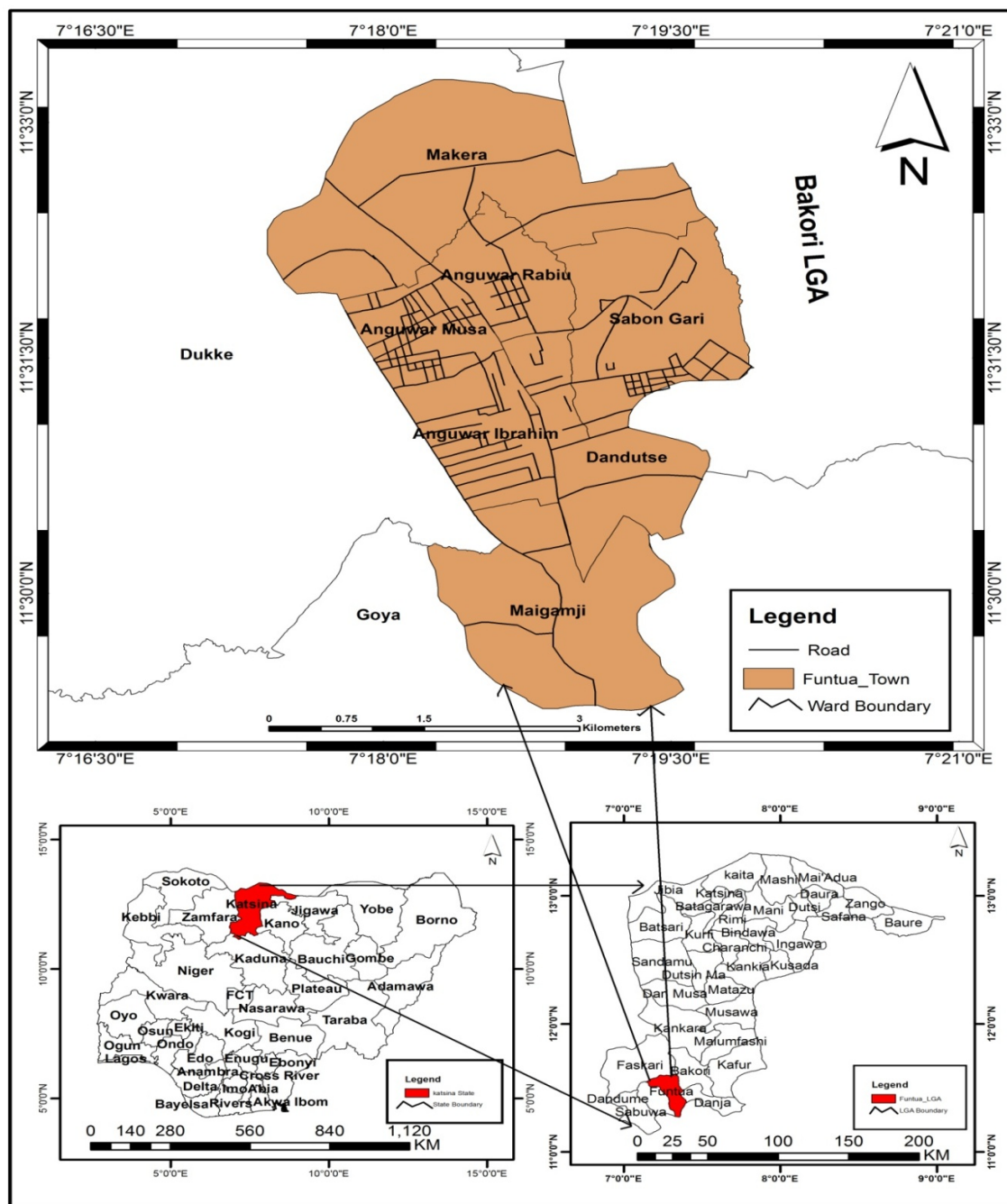


Figure 1: Study Area

Source: Adapted and modified from google map of Funtua Town (2018)

Materials and Methods

The types of data above were obtained from both primary and secondary sources. The primary data sources include direct field observations and measurement. This entails the use of handheld Global Positioning System (GPS) receiver (GARMIN eTrex 10) to acquire the geographic coordinates of the public water facilities point locations. A score sheet was developed by the researcher and was used in obtaining the attributes of each of the facilities and their characteristics like functionality, type, and capacity, year of drill and service hours. Secondary sources of data were acquired from Katsina State Ministry of Land and Survey, Ministry of Water Resources, National Population Commission and Rural Water Supply and Sanitation Agency (RUWASSA), where data regarding the number of existing public water facilities, population figures of the Funtua town and administrative map of Funtua town were acquired. Journals, textbooks, news papers, published and unpublished thesis and dissertations were used. Administrative map of Funtua was scanned, imported into ArcMap environment of ArcGIS 10.3 overlaid on the google earth image of Funtua town and then georeferenced using map to image georeferencing method. The seven political wards that constitute Funtua town: Anguwan Ibrahim and Anguwan Musa, Anguwan Rabi'u, Dandutse, Mai Gamji, Makera and Sabon Gari, were used as reference points for the georeferencing. The georeferenced map was auto rectified and then given the same coordinate with image using Universal Transverse Mercator (UTM) Global Coordinate System (GCS) projection and Minna Zone 32N datum. UTM systems were chosen because it is in metric units and has the capacity to enable the researcher calculate the length, distance and other measurements that may not be possible with geographic coordinate system. Two shape files were created in ArcCatalog environment and

given same coordinate system with the map and image. The shape files were later imported into the ArcMap environment and used to digitize the base map of Funtua town which was also used subsequently for result presentations. The coordinates and their attributes were copied from the score sheet and GPS device into Microsoft Excel 2016 environment and then saved as CSV (comma delimited) format. A robust geodatabase were created and integrated into ArcGIS 10.5 environment from which queries were made for subsequent analysis. For example; which boreholes require servicing? Which boreholes are not functioning? Which of the wells are dried in the study area? And which ward has water adequacy with respect to (UNDP, 2012) standard. The analysis is based on the following equation:

$$\text{Water adequacy} = \frac{\text{Yield/day.}}{\text{Population}} \quad \text{which}$$

means that the average yield of facilities per day is divided by the total population of that same ward to get the consumption per person per day. Point locations of the public water facilities, as saved in Excel as CSV (comma delimited) were overlaid on the map and query by selection was used to assess water adequacy in relation to the population of each political ward in the study area. The population of 2017 as projected from the 1991 population census according to Newman's (2001) method of projection was used (See Table 1). The basis for the use of 1991 population census instead of 2006 census figure was due to the fact that 2006 population census document of Funtua town has no population figures at ward level. The Newman's (2001) formular for projecting the population is given as:

$$P_n = P_0 + \left(\frac{1+R}{100} \times P_0 \right) n$$

Where:

P_n = Population in the recent year

P_0 = Population in the base year

R = Annual growth rate

n=Number of intermediary years

The projected population is shown in Table 3.1

Table 1: Projected ward population of Funtua Town

College	Population (1991)	2017 Projected Population
Anguwan Ibrahim	16,534	35,134
Anguwan Musa	17,878	38,003
Dandutse	13,577	28,852
Maigamji	14,518	30,843
Makera	7,528	16,003
Nasarawa	6,452	13,702
Sabon Gari	15,727	33,427
Total	134,423	195,964

Source: Author's Projection, (2017)/NPC 1991

The projection of each political ward was added on the attribute table of the wards boundary map of the study area through the Editor tool. Yield per facilities was adopted from the information obtained from the Water Board, but constant rate pumping tests were conducted in some specific selected facilities per political ward. The attribute table was then queried to produce adequacy map that showed two categories of areas that had adequate water supply and those areas with inadequate water supply.

Results and Discussion

The findings revealed that there are two hundred and four (204) public water facilities at the time of the study. These public water facilities are located within the seven different political wards in Funtua town (Table 2). However the public water facilities are not

equally distributed within the wards as can be observed from the table 2, Anguwan Musa has the highest number of public water facilities (51) followed by Maigamji and Makera wards with (41) and (27) each respectively, Anguwan Rabiu has (25), while Anguwan Ibrahim, Sabon Gari and Dandutse with (23), (22) and (15) respectively. Those public water facilities are distributed across the all the seven wards that made up the study area, except public stand pipes (PSP) which did not extended to all the wards. This result is not surprising because the mixture land uses and difference in the population which the facilities serve in order to meet the demands of the people. However, not all the public water facilities are extended across Funtua town, facilities like public stand pipes (PSP) and dug wells are not found in Dandutse ward due the rocky nature of the area.

Table 2 Public water facilities in Funtua town

Ward	Hand Dug Well	Hand Pump	Motorised Borehole	PSP	Solar Borehole	Service Tank	Total
Anguwan Ibrahim	13	19	5	8	6	—	51
Anguwan Musa	2	8	7	3	3	—	23
Anguwan Rabi'u	2	12	5	4	1	1	25
Dandutse	—	11	4	—	—	—	15
Maigamji	16	9	6	7	2	1	41
Makera	6	10	7	4	—	—	27
Sabon Gari	2	12	5	3	—	—	22
TOTAL	41	81	39	29	12	2	204

Source: Authors Field Analysis, (2018)

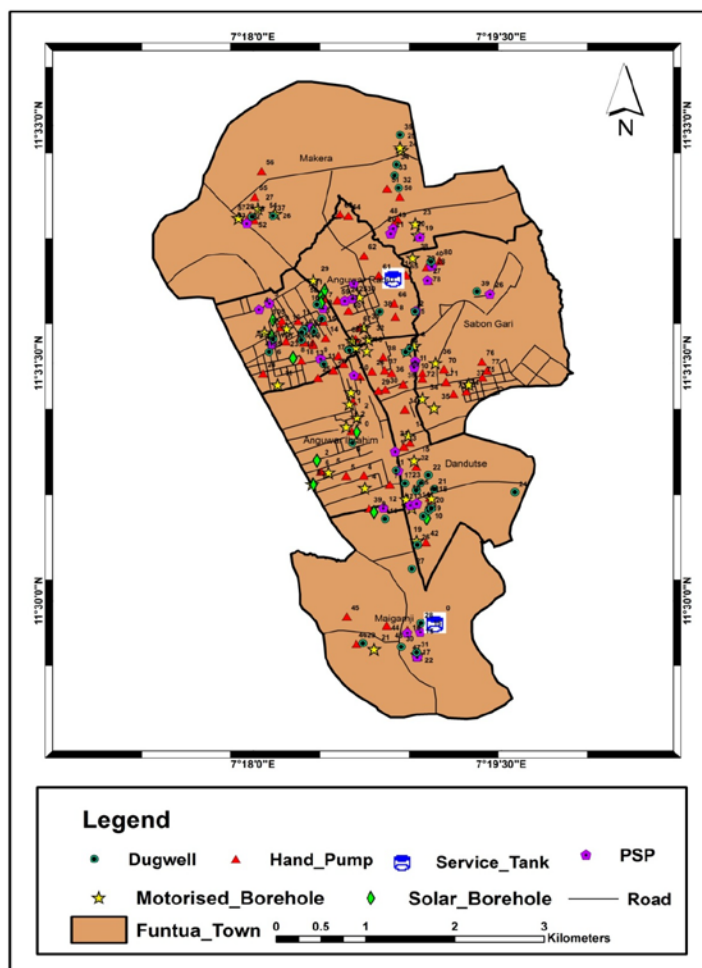


Figure 2: Spatial Location of Public Water Facilities in Funtua Town

Source: Author's Field Analysis, (2018)

The query assisted with “selecting all non functional public water facilities in the study area. Other queries were performed includes number of boreholes that required service, dry well that required dredging. The selected facilities were highlighted, right clicked was done on the shape file (containing the

facilities) and the software was commanded to create layer from the selected features. The public water facilities selected were identified as those that are not functional and results were screen shot by the help of snapping tool and the result were presented in figure 3 to 4.15 respectively.

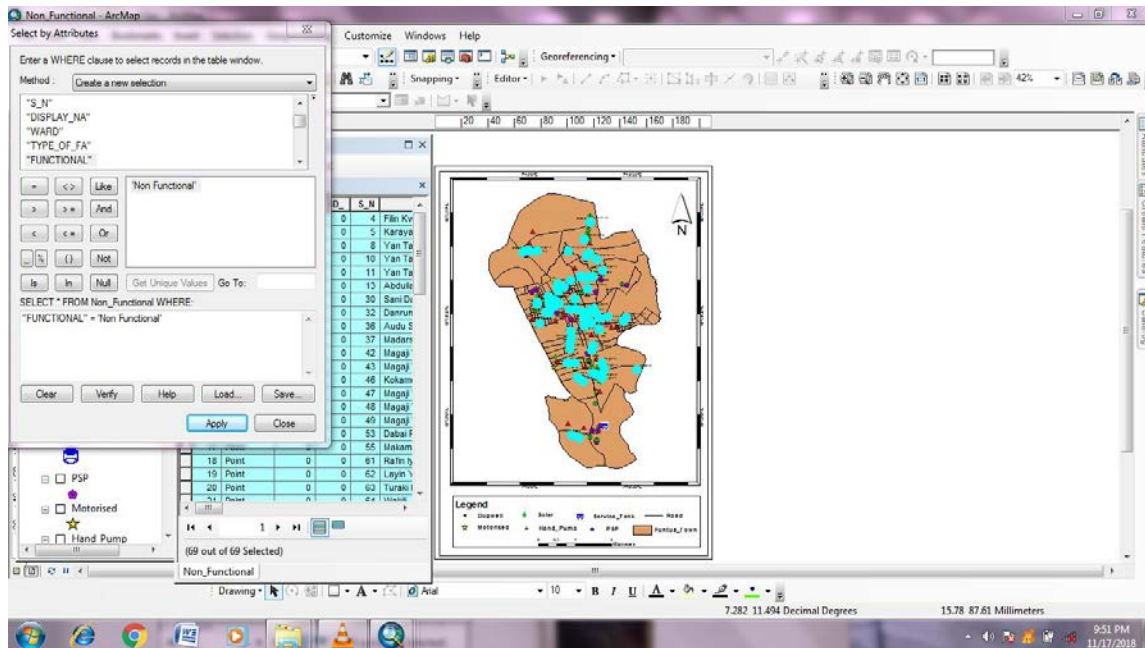


Figure 3: Query operation showing Non functional Water Facilities in Funtua Town

Source: Author's Field Analysis, (2018)

Table 3 Non Functional Public Water Facilities in Funtua town

Ward	Non functional Facilities	Low/dry yield	Technical Breakdown	Negligence
Ang. Ibrahim	6	3	3	—
Anguwan Musa	19	3	10	6
Anguwan Rabiu	9	2	7	—
Dandutse	8	6	2	—
Maigamji	11	4	6	1
Makera	10	2	7	1
Sabon Gari	6	3	3	—
TOTAL	69	23	38	8

Source: Author's Field Analysis, 2018

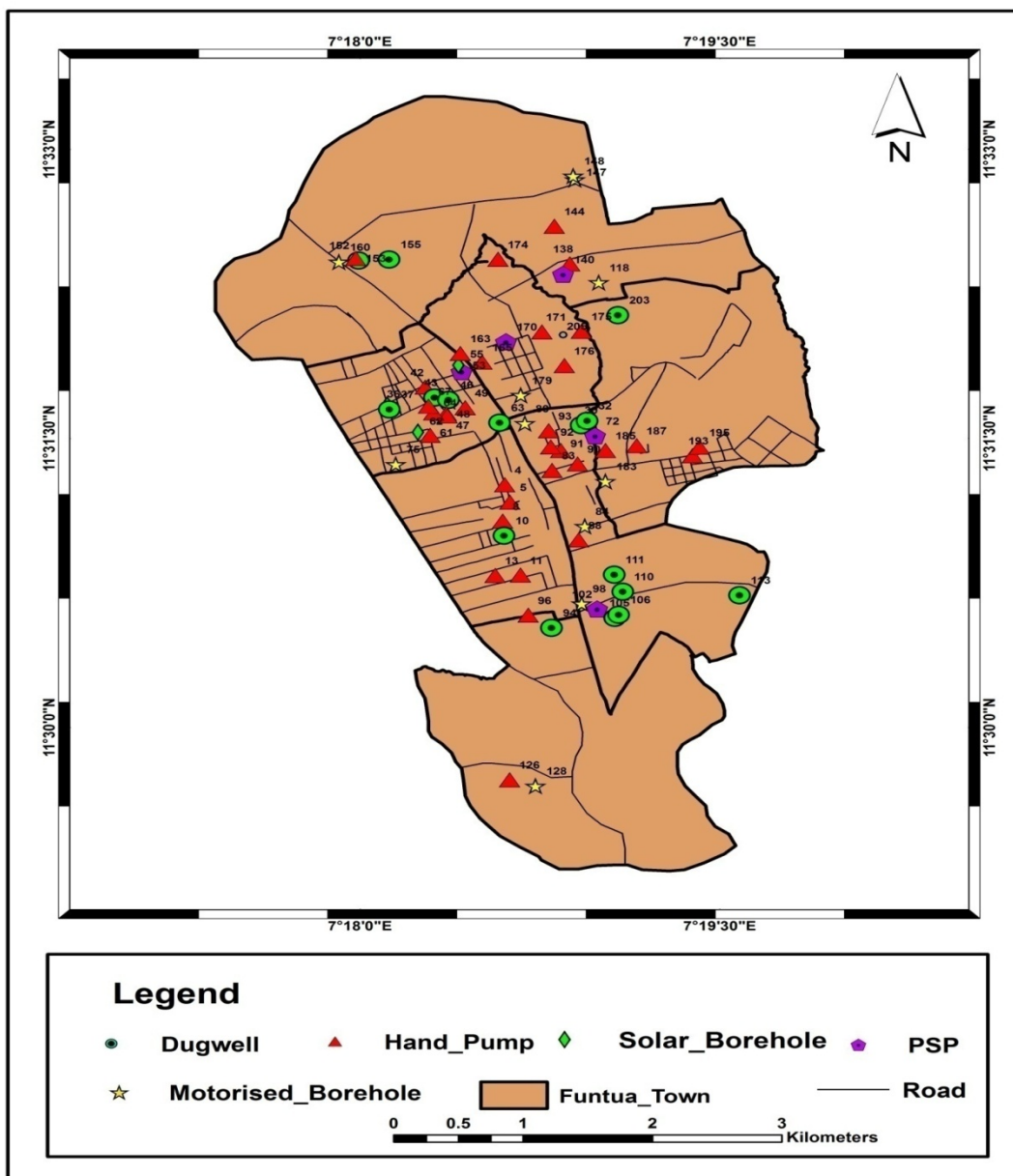


Fig. 4: Spatial Location of Non Functional Public Water Facilities in the Study Area.
Source: Author's Field Analysis, (2018)

Out of 204 public water facilities in Funtua town, 66 of them are not functional which account for 32.4% of all the public water facilities. As observed from the table 3 the non functional public water facilities includes 33

hand pump boreholes account for 50%, 21.2% hand dug wells account for 21.2%, about 16.7% are motorized boreholes and 7.6% are public stand pipes while 4.5% are solar powered boreholes.

Table 4 Borehole that requires service in Funtua town

Ward	Frequency	Percentage
Anguwan Ibrahim	5	10.6
Anguwan Musa	11	23.4
Anguwan Rabi'u	7	14.9
Dandutse	8	17.0
Maigamji	4	8.6
Makera	7	14.9
Sabon Gari	5	10.6
TOTAL	47	100

Source: Author's Field Analysis, 2018

Based on the findings in this research 47 of the boreholes have technical breakdown and required services. Five of the boreholes are located in Anguwan Ibrahim ward, 11 are located in Anguwan Musa, 7 are located in Anguwan Rabi'u, 8 are located in Dandutse ward, 4 are located in Maigamji, 7 are located in makera and 5 are located in Sabon Gari (see table 4).

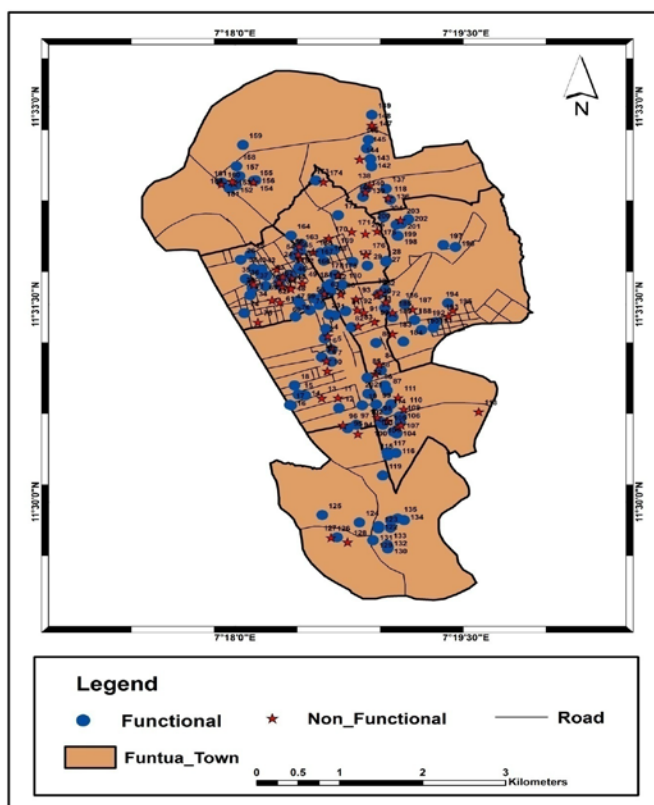


Figure 5: Spatial Location of Functional and Non Functional Water Facilities in Funtua

Source: Author's Field Analysis, (2018)

Risk - ArcMap														
Table														
Non_Functional														
FID	Shape *	FID_1	OID	S_ID	DISPLAY_MA	WARD	TYPE_OF_FA	FUNCTIONAL	YEAR_OF_CO	AVERAGE_MU	NAME_OF_RE	NAME_OF_PR	REASONS_F	NORTHIN
0	Point	0	0	4	Fim Kwalo	Anguwan Ibrahim	Hand pump	Non Functional	2005	0	Malam Musa Mai Magani	State Government	Technical Breakdown	11 31 15.6
1	Point	0	0	5	Karaya Road	Anguwan Ibrahim	Hand pump	Non Functional	2005	0	Basir Nura	State Government	Technical Breakdown	11 31 10.2
2	Point	0	0	8	Yan Tapki	Anguwan Ibrahim	Hand pump	Non Functional	1999	0	Yusuf Bode Ali	Local Government	Low/Dry Yield	11 31 04.3
3	Point	0	0	10	Yan Tapki 3	Anguwan Ibrahim	Dugwell	Non Functional	1997	0	Lawal Abdu Guga	Philantropist	Low/Dry Yield	11 30 59.7
4	Point	0	0	11	Yan Tapki 4	Anguwan Ibrahim	Hand pump	Non Functional	2013	0	Ahmed Jibril	FGN MDG	Low/Dry Yield	11 30 47.5
5	Point	0	0	13	Abdullahi Aminichi Road	Anguwan Ibrahim	Hand pump	Non Functional	2005	0	Bala Abu Adufu	Local Government	Technical Breakdown	11 30 47.4
6	Point	0	0	30	Sani Dan malam	Dan Dutse	Dugwell	Non Functional	1995	0	Abubakar Mansir	Local Government	Negligence	11 31 34.1
7	Point	0	0	32	Dainumphia Primary School	Dan Dutse	Dugwell	Non Functional	2012	0	Mund Kabir	Philantropist	Negligence	11 31 35.5
8	Point	0	0	36	Audu Sheme	Anguwan Musa	Solar	Non Functional	2004	0	Mai Sagir Salisu	Local Government	Technical Breakdown	11 31 40.4
9	Point	0	0	37	Madarsatul Aishat	Anguwan Musa	Dugwell	Non Functional	2004	0	Ishai Malam	Local Government	Negligence	11 31 39.0
10	Point	0	0	42	Magaji Wondo Road	Anguwan Musa	Hand pump	Non Functional	1992	0	Lawal Gwanda	Local Government	Technical Breakdown	11 31 46.0
11	Point	0	0	43	Magaji Wondo Road 2	Anguwan Musa	Dugwell	Non Functional	2001	0	Nura Abubulahi Maska	Local Government	Negligence	11 31 42.7
12	Point	0	0	46	Kokame Road 3	Anguwan Musa	Dugwell	Non Functional	1991	0	Mai Kabir	Local Government	Low/Dry Yield	11 31 42.0
13	Point	0	0	47	Magaji Wondo	Anguwan Musa	Hand pump	Non Functional	2001	0	Mai Faruk	State Government	Technical Breakdown	11 31 37.8
14	Point	0	0	48	Magaji Wondo 3	Anguwan Musa	Hand pump	Non Functional	2002	24	Ahmad Hamisu	State Government	Technical Breakdown	11 31 37.1
15	Point	0	0	49	Magaji Wondo 4	Anguwan Musa	Hand pump	Non Functional	2008	24	Ibrahim Dambu	Local Government	Technical Breakdown	11 31 39.6
16	Point	0	0	53	Dabar Road 2	Anguwan Musa	PSP	Non Functional	1996	0	Ahi. Ahmadu	Local Government	Negligence	11 31 50.8
17	Point	0	0	55	Maikama Road 2	Anguwan Musa	Solar	Non Functional	1991	0	Tasiu Lawal	Local Government	Low/Dry Yield	11 31 52.8
18	Point	0	0	61	Rafin'ya	Anguwan Musa	Hand pump	Non Functional	2004	0	Nasiru Maiagadi	Local Government	Technical Breakdown	11 31 31.0
19	Point	0	0	62	Layin'Yankai	Anguwan Musa	Solar	Non Functional	2011	0	Mai. Abdul Razzaq	Local Government	Technical Breakdown	11 31 31.9
20	Point	0	0	63	Turaki Road	Anguwan Musa	Dugwell	Non Functional	2013	0	Liman	State Government	Technical Breakdown	11 31 34.9
21	Point	0	0	64	Wakili	Anguwan Musa	Hand pump	Non Functional	2013	0	Mai. Umar Capentier	State Government	Low/Dry Yield	11 31 38.0
22	Point	0	0	67	Barfawa 2	Anguwan Musa	Hand pump	Non Functional	2013	0	Mai. Kabir	Local Government	Technical Breakdown	11 31 40.1
23	Point	0	0	72	Madarsa Maruwa	Dan Dutse	PSP	Non Functional	2005	0	Mai Saifullahi	Philantropist	Negligence	11 31 30.8
24	Point	0	0	75	Hassan Fari	Anguwan Musa	Motorised	Non Functional	2004	0	Ahi Maazu	Local Government	Technical Breakdown	11 31 21.9
25	Point	0	0	80	Kofar Dan Dutse	Dan Dutse	Motorised	Non Functional	2003	0	Mai Umar Kafinta	NGO/CBO	Technical Breakdown	11 31 34.6
26	Point	0	0	83	Mai Kwano	Dan Dutse	Hand pump	Non Functional	1998	0	Muktar	Local Government	Technical Breakdown	11 31 20.1
27	Point	0	0	84	Kofar Audu Guga	Dan Dutse	Motorised	Non Functional	2007	0	Malam Aliyu	Local Government	Low/Dry Yield	11 31 02.6
28	Point	0	0	88	Mai Gamji Road	Dan Dutse	Hand pump	Non Functional	2002	0	Sani	State Government	Low/Dry Yield	11 30 58.4
29	Point	0	0	90	Zamfara Road	Dan Dutse	Hand pump	Non Functional	2010	0	Mohd Rabi Usman	NGO/CBO	Low/Dry Yield	11 31 22.1
30	Point	0	0	91	Goi Goi	Dan Dutse	Hand pump	Non Functional	2009	0	Malam Yusuf	State Government	Low/Dry Yield	11 31 26.3
31	Point	0	0	92	Bakori Road	Dan Dutse	Hand pump	Non Functional	1995	0	Abba Nuhu	Local Government	Low/Dry Yield	11 31 27.4
32	Point	0	0	93	Zawiya	Dan Dutse	Hand pump	Non Functional	1996	0	Lawal Mai ludi	Local Government	Low/Dry Yield	11 31 32.4
33	Point	0	0	94	Anguwan Wanzamai	Mai Gamji	Dugwell	Non Functional	2009	0	Nasiru Dan Dabilyu	Local Government	Technical Breakdown	11 30 31.0
34	Point	0	0	96	Masaji Sumna	Mai Gamji	Hand pump	Non Functional	2014	0	Saminu Idris	State Government	Technical Breakdown	11 30 35.0

Fig. 6: Database of Public Water Facilities in Funtua Town
Source: Author's Analysis (2018)

According to United Nations Development Programme (UNDP, 2012) recommend that each and every individual is entitled to 15 liters of water per day. An average man requires 2.5 liters of water daily for drinking, 6.5 liters for basic hygiene practices and 6 for cooking need. In this study any ward that the

average yield of water supply in a day is less than 15 liters is regarded as inadequate in water supply in accordance to the standard above with wards that exceeded 15 liters of water supply daily are term adequate in water supply (see table 5).

Table 5: Conformity of UNDP (2012) Standard (Water Adequacy and Inadequacy)

S/No.	Political Ward	Population	Yield Per day	UNDP Standard	Average Yield	Result
1	Anguwan Ibrahim	35,134	183,348	15	5.2	Inadequate
2	Anguwan Musa	38,003	560,376	15	14.8	Adequate
3	Anguwan Rabi	13,702	223,128	15	16.3	Adequate
4	Dandutse	28,852	83,160	15	2.9	Inadequate
5	Maigamji	30,843	512,684	15	16.6	Adequate
6	Makera	16,003	265,104	15	16.6	Adequate
7	Sabon Gari	33,427	262,500	15	7.9	Inadequate

Source: Author's Field Analysis (2018)

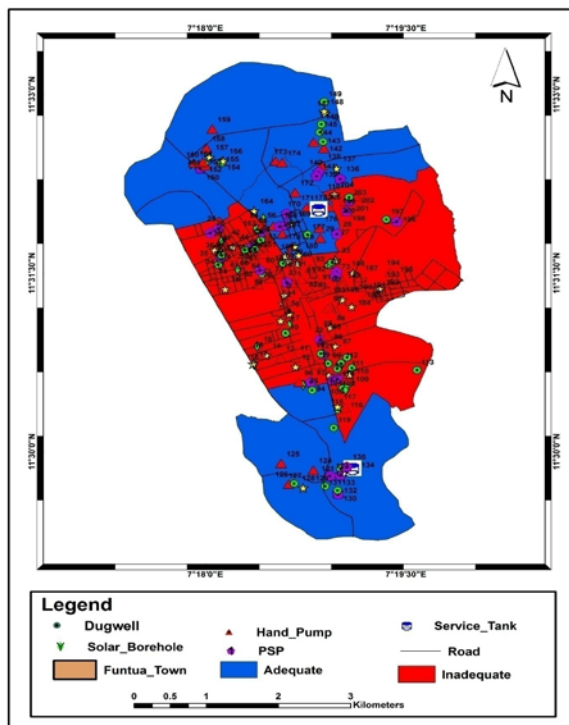


Figure 7: Conformity of UNDP (2012) Standard (Water Adequacy and Inadequacy)

Source: Author's Field Analysis, (2018)

Based on the findings in the Table 5, water supply is inadequate in three of the political wards, they include: Anguwan Ibrahim, Dandutse and Sabon Gari ward. Anguwan Ibrahim, Dandutse and Sabon Gari wards fall short of the UNDP, (2012) standard and so considered to have inadequate water supply. The summary of the analysis in Table 4.6 shows that four out of the seven wards in Funtua town have adequate water supply according to United Nation Development Programme (UNDP, 2012) standard. The wards are Anguwan Musa, Anguwan Rabiu, Maigamji and Makera. However, most of the wards that fall below the UNDP standard are mostly commercial and other activities that attract most populace to the town. The population of those areas overstretched the existing public water facilities since the demand is higher than the available facilities. These findings agreed with that of Naptali (2017) who used remote sensing and GIS in assessing water adequacy in Jimeta metropolis, Adamawa state, Nigeria, and found water shortages in nine wards.

SUMMARY OF FINDING

The results of this study revealed that Funtua town has a total of 204 public water facilities in their various categories ranging from hand dug well, hand pump borehole, solar, motorized, service tank to public stand pipes are distributed across the town. About 20% of such public water facilities are hand dug wells, 40% are hand pump boreholes, 19% are motorized boreholes, 6% are solar boreholes, 14% are public stand pipes and 1% belong to the service tank. The two service tanks are the reservoirs that stored water from treatment plan at Mai Ruwa Dam and subsequently distributed through the available public stand pipes within the town. The database created contains both spatial and attribute data. The spatial data are the coordinates for the location of each public water facility in Funtua

town. The attribute data include other useful information about the distribution of public water facilities such as type, year of drill, functionality, reasons for non functionality, service hours, yield and distance away from a source contamination. In Funtua town, 66.7% of the total number of public water facilities are functional while 33.3% are non functional. For the non functional facilities, 54.4% are as the result of technical breakdown, 33.8% are as the result of low yield while 11.8% are due to the negligence. The densely populated wards that attracted most of the commercial activities in the study area, like Anguwan Ibrahim, Anguwan Musa, Dandutse and Sabon Gari attracted the highest population of about 69.1% and have 54.4% of the total number of public water facilities. The remaining three wards which include; Maigamji, Makera and Nasarawa constitute 45.6% the total number of water facilities. Despite the dominance of the existing public water facilities in the densely populated areas they still fall short of water supply.

CONCLUSION

In conclusion, the location of the public water facilities in Funtua town is skewed and clustered in the areas where the population is dense and combination of commercial and Industrial activities. The distribution of the public water facilities in relation to the population revealed the trend of water demand in Funtua town is in high demand. This is because the distribution is based on the proportion to the population. Water as a basic human right should be accessible to all adequately and safely. This is because water is not only natural resources but also it is a base for the dignity and quality of life. Therefore the recommendation of this study is necessary for any serious government that is concerned about the wellbeing of its people and committed to alleviating the water crisis in the area

RECOMMENDATIONS

In line with the findings of this study, the following recommendations are made in order to support effective decision making by the government, Funtua Water Board, RUWASSA and other concerned organizations:

1. More public water facilities should be provided by Government, NGO's and Philanthropists in the densely populated areas of Anguwan Ibrahim, Anguwan Musa, Dandutse and Sabon Gari so as to boost water supply and to encourage commercial activities in the area.
2. The RUWASSA and Funtua water board should build a comprehensive public water facilities distribution system database so as to provide holistic information about its assets. This will equally aids decision making.
3. Damaged or blocked public water facilities should be repaired to service the current and future population in the study area.
4. Formation of Community Based Organization (CBO) and fund raising for community participation in installations and maintenance of public water facilities should be encouraged.
5. Future researches should concentrate on the pattern of water network, demand and supply, water facilities standards such as standards on number of persons per facility,

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