

ASSESSMENT OF PIPE BORNE WATER DISTRIBUTION SYSTEM IN GUSAU, ZAMFARA STATE

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ABSTRACT

Water is central to the survival of humanity. The need for water for domestic, industrial and other uses are rising every day and mostly depend on pipe borne water from water authorities/board as the conventional source of portable water in our metropolitan areas. Thus, the study examined the present distribution system in Gusau with the aim to identifying the spatial coverage of water distribution facilities as well as the extent of connectivity to households and their related problems. To achieve the aim of the study an interview was conducted with the officials of the board and questionnaire was administered to some selected households. Data was also collected from Ministry of Lands and Survey. It reveals from the study that very little progress was made in terms of the extension of water mains in the town since 1996. Furthermore topography is one the obstacle that hinder smooth water distribution activity in Gusau. Recommendation was made base on the findings.

Introduction

The pattern of human settlement from time immemorial has always been decided and control by certain natural but indispensable factors (Sule et al). Water is one of such factors. Apart from the availability of water in adequate quantity and quality distribution is also crucial. Life, health and hygiene all depend on an access to a quantitative and qualitative supply of drinking water. The adequacy in the supply of good drinking water determines health; welfare etc. in spite of this, however, the existing situation of pipe borne water supply in the most part of the world is largely inadequate to meet the ever increasing water demand of the population (WWWP, 2003).

In a study carried out in India (2000) on urban water supply and sanitation sector, it reveal that, the country is suffering from inadequate levels of services, an increasing demand- supply gap, poor sanitary conditions etc. According to the Central Public Health Engineering Organization (CPHEEO) estimates, 88% of urban population has access to a potable water supply. But this supply is highly erratic and unreliable. Transmission and distribution networks are old and poorly maintained; generally of poor quality. Consequently physical losses are typical, water is available for only 2-8 hours a day in most Indian cities. The situation is even worse in summer when water is available for only few minutes, sometimes not at all.

In Jakarta (Indonesia), less than a third of the population has direct connection to piped water system. Around 30% depend solely on water vendors, whose prices per liter of water are up fifty times those paid by households served by the municipal water company. Over a third of the populations rely on shallow wells (most of which are contaminated). Over half of all dwellings have no indoor plumbing and much of the population have to use drainage canals for bathing, laundry and defecation. Gusau, the capital city of Zamfara State, has been serviced with pipe borne water supply for about 37 years. It has an old water works with the capacity of about 20,000,000 litres per day. In addition to water works Four (4) boreholes were sunk to compliment the old water works which is now defunct, but its raw water source still serve as alternative source of raw water for the new water works . With the increasing demand due to demographic and spatial expansion of the town, contract was awarded for the expansion of Mains pipes and construction of three (3) additional storage Tanks. The new water works was commissioned in 1992 with a designed capacity of 40,000,000litre per day. In addition to this, water supply plan was prepare as a component of Gusau Master Plan 2010 as a guide for the expansion process. Despite this efforts, a lot of areas were not reticulated. This study seeks to focus on this areas. The problem of water supply increased with the creation of Zamfara State in 1996 when

Gusau assumed the status of state capital. The changed status of Gusau caused an unprecedented development of the town demographically and spatially, which intensified the need for water in both the old and newly developed areas. Despite all efforts, access to water remains a problem across socio-economic strata and space in Gusau. It is on this premise the study intended to investigate the water supply system and distribution in Gusau metropolis and factor militating against it

Background of the Study Area

Gusau is one of the areas that emerged during the jihad of Sheikh Usmanu bn.Fodio in the 17th - 18th century. People of Gusau are Hausa/Fulani by ethnicity. Gusau is situated in the Northern part of Nigeria. It is on the high plain of Hausa land on the bank of River Sokoto. Being in the northwestern part of the country and situated in the Sudan Savanna. It has a distinct wet and dry season. The wet season lasts between the month of April and September and the dry season between the months of October and March. The two seasons are characterized by southwest and northeast trade winds respectively. The mean maximum temperature of the area is about 36-38 degrees centigrade. Gusau is part of the geological belt of Precambrian age formed as a result of Igneous Rock that formed smooth rounded hill. These hills occasionally rise to 200m (Muhammad, 2007).

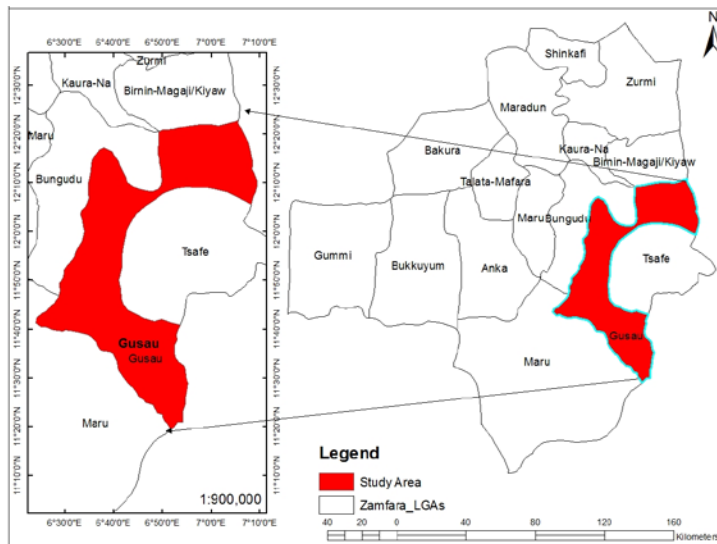
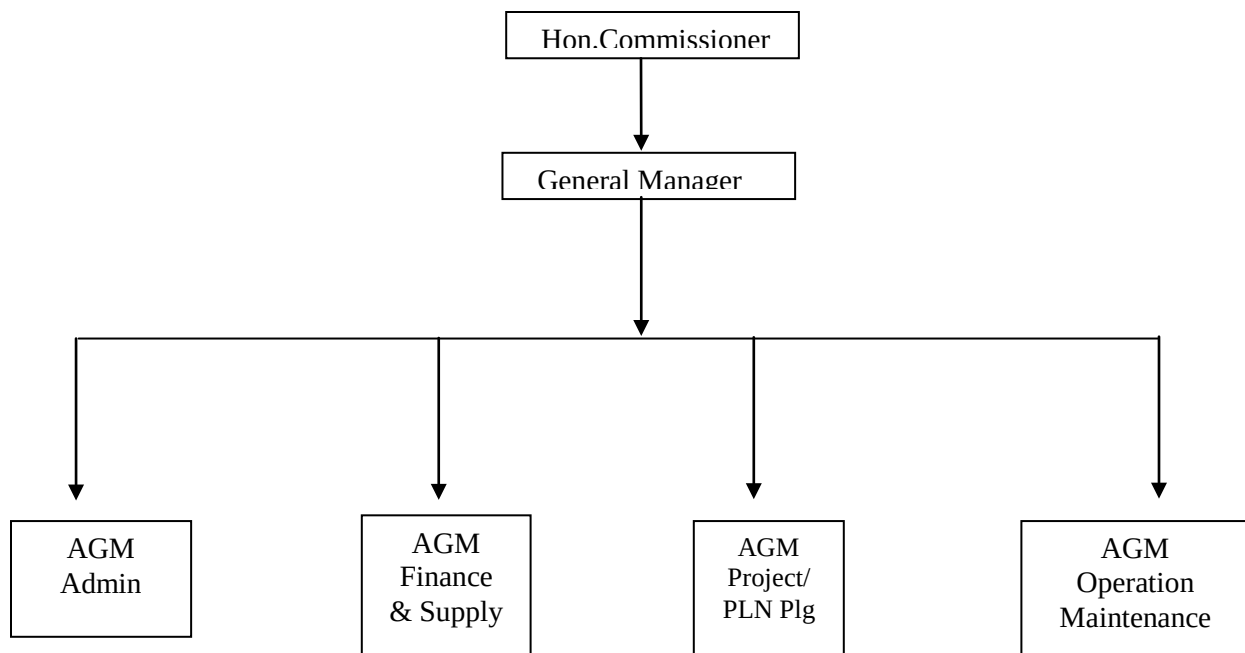


Fig. 1: Map of Zamfara State Showing the Study Area

An Overview of Water Supply in Gusau: Zamfara State Water Board

Zamfara State Water Board is a parastatal under the Ministry of Water Resources entrusted with responsibility of provision of Pipe borne water in Gusau metropolis and its environs. It is headed by a General Manager who is answerable to the Honorable Commissioner of the parent ministry.



Source: Zamfara State Water Board, (2015)

Fig. 2. Institutional Structure of Zamfara State Water Board, Gusau

Responsibilities of Water Board

1. Provision of portable
2. Extension of distribution lines to unserved areas
3. Repairs and replacement of damage pipes
4. Billing and collection of water rates
5. Maintenance of water supply equipment
6. Sinking and digging of public boreholes and wells

Beside the board, other institutions play roles for effective provisioning of water in the town (e.g PHCN, Planning Board etc). With all the contribution it has in the preparation of planning scheme for newly developed areas and population projections, planning board has very low or no impact in water supply activities of Gusau. Which on the ideal, Water Board should follow the guidelines of the planning board when they embark on any expansion project. This will ensure that, they

extend their services in accordance with the provision of Master Plan . Furthermore water board should have up to date projection from the planning board for effective water supply instead of supplying water without knowing the estimated or projected number of consumers, which is the case in Gusau. This has, contributed significantly in water distribution system in Gusau.

Management of the Public Water Supply System in Gusau

The overall management of the public water supply in Gusau is the responsibility of Zamfara State Water Board, Gusau. As described above, the General Manager who is answerable to the Honorable Commissioner, State Ministry of Water Resources oversees the activities of the board under the control of General Manager, are four AGMs heading various departments.

Table 1: Management of Zamfara State Water Board, Gusau

	Departments	Functions
General Manager	Administration	Overall management of the board, which includes personnel management, public relations etc.
	Finance and supply	Preparation of payments vouchers, billing and collection, collection of connection fees, supply of material to the board e.g. stationeries equipment etc.
	Project planning	The department is responsible for the planning and execution of the various project carried out by the board e.g. extension of service lines to areas of interest.
	Operation and maintenance	Repairs and maintenance of equipment as well as faults detecting.

Source: *Zamfara State Water Board Gusau, (2015)*

Methodology

Two types of data were collected for the purpose of this Study; Primary and secondary data.

Primary Data: This was generated from the fieldwork through the following methods.

a) Physical Observation: It involves the observation of the present situation with the view of been familiar with the various part of the study area with regard to water supply. This includes the observation of source(s) of raw water, reservoir as well as other water facilities in the designated area of study.

b) Questionnaire: Questionnaire was administered to two (2) groups of respondents;

1. The first Questionnaire was administered to a sampled of households in the study area was administered to household's heads, with the aim of acquiring information about the situation of water supply in the town.
2. The second Questionnaire was administered to the officials of water Board as a formal guided interview. Thus, A total of 367 households were selected from the total population of Gusau

metropolis (440,703) on the basis of 12 people per household on the average. Questionnaires were administered to this chosen sample, out of which 350 questionnaires were collected back. The analysis was done based on the collected number of questionnaires (350). Besides, questionnaire administered to the water board officials inform of guided interview were all presented in tables using frequencies and percentages as tools for analysis.

Result and Discussion:

Surface Water Sources

Gusau as the capital of Zamfara state receives it potable drinking water from Gusau new water works commissioned on 9th October 1992 as the main source. The water works comprise of a barrage (dam) located along Gusau-Magami road and the pre-sedimentation unit, with the treatment plant situated along Gusau-Zaria road. Barrage is the principal source of raw water in Gusau, followed by Koramar Wanke. Beside this, there is Damba Dam, which serve as the alternative source of water for Gusau water works also.



Fig.3 Water Distribution Facilities in Gusau

Table 2: Capacity of Reservoir and Treatments Plant

Facilities	Initial Installed Capacity (L)	Current capacity (L)	Location
Treatment plant	40, 000,000	10, 000, 000	Along Gusau Zaria road
<u>Reservoirs</u>			
Old Reservoir	3,000,000	> 3,000,000	Along Zaria-Gusau Road
New Reservoir	4,500,000	> 4,500,000	

Source: Zamfara State water Board, Gusau, (2015)

The daily initial design production capacity of treatment plant by 1991 is about 40,000,000litres per day. But presently, its capacity has reduce to about 10,000,000litres. The capacities of pre-sedimentation tanks are rather low, because silts filled them up. In addition, the produced water is subjects to losses, arising from old and damage pipes or blockages as well as illegal connections. All these adversely affects the quality and quantity of water supplies and necessitate the rationing of water in the town. Based on an estimated population of 440,703 presently, the average daily water supply from the public water system in Gusau met only about 27.7% of the demand for domestic consumption of 100 liters per capita per day.

Table 3: Gusau Water Demand, Supply and Shortfalls per Districts

Districts	Population	Demanded (1001/C/D)	Quantity Supplied (Litres)	Quantity Shortfall	Demand Met (%)
Mareri	122,075	12,207,500	3,236,000	8,971,500	26.5
Samaru	54,206	5,420,600	1,700,000	3,720,600	31.4
T/Wada	75,801	7,580,100	2,336,000	5,244,100	30.8
Janyau	79,294	7,932,700	2,116,000	5,816,700	26.7
G/Biyu	109,294	10,929,400	2,804,000	8,125,400	25.7
Total	440,703	44,070,300	12,192,000	31,878,300	27.7

Source: Hadi, (2009), Field work (2015)

It is established in table 3 that Samaru and Tudun Wada have the highest per capita in the planning districts, in fact above the general figure of the town (27.7 litres).

The table also reveals that, there is variation in the degree of water shortage across the planning districts. One of the reasons is the variation in the population density between the districts.

Table 4: Average Duration of Water Supply in the Planning Districts

Planning Districts	Average Supply (Day/Month)	Average Supply (Hrs/Day)
Mareri	6	2
Samaru	10	4
Tudun Wada	8	2.5
Janyau	7	2
Gada Biyu	7	1.5

Sources: Field Survey, Zamfara State Water Board, Gusau (2015)

Table 4 depicted that, there is variation in the duration of water supply between the district with Samaru having the longest flow duration in days and hours. The average flow duration in the town was Eight (8) days in a month and 2.5 hours per day (Gusau Water Board, 2015). This is an indication of water shortages in the town where by the duration of water flow is for just some hours and days that are insignificant to satisfy the demand

Pipe Network in Gusau

Different pipe types were used in Gusau in various stages of expansions, i.e. the initial and subsequent expansion carried out in the town. In the first place, Asbestos pipe (AC Pipe) was used. It was laid by Costein about 35 years ago. The size of the pipe used in networking are "12 and 8" along the major road (serve as the mains) while "3 and 4" inside the built up areas (serviced pipe). This is the type and size of pipe used in most part of Gada biyu planning district and old part of Gusau town. In 1991, when the last major expansion was carried out, Ductile pipe were used by Julius Berger. The size of the pipe network used was Eight inches (8") only. While the recent project carried out by some contractors in very few areas (most of Housing Estate constructed between 1999-2007), 6 "and 4" pipe size were used. The type used is called pressure pipe.

The distribution network is divided based on the distribution of storage tanks located at four different points in the town. The mains are routed from the storage tanks to various places they cover in the town.

Table 5: Distribution of Water Tanks in Gusau

Storage Tanks	Capacity	Location	Height
Tank 1	2,000,000	Gada Biyu	16.54
Tank 2	2,000,000	Unguwar Gwaza	16.54
Tank 3	4,000,000	Samaru	12.9
Steel Tank	4,000,000	Sabon Gari	—

Source: Zamfara State Water board, Gusau, (2015)

Tank 1: The tank is situated along Gusau-Sokoto road at Gada Biyu. It has the storage capacity of 2,000,000 litres. Areas under the supply from Tank1 are mostly areas in Gada Biyu planning district e.g `Low Cost houses, ZACAS, Gada Biyu New extensions and areas across the bye-pass near NNPC Mega Station, etc. While areas having water problems despite being reticulated includes: 100 Housing Units (Gida Dari) and Gidan Dawa etc. which as a result of the poor piping, damage pipe, and pipe blockage in those areas.

Tank 2: It is located along Gusau-Kaura Namoda road at unguwar Gwaza. It has the design capacity of storing 2,000,000litres. Tank2 is feeding areas like Tudun Wada, Labin-Labin, Unguwar Gwaza and some part of Canteen area with pipe bone water. Areas not reticulated in the catchment area of this tank includes; Hayin Buba , West and Southern part of Old Airport, Unguwar Gwaza Housing Estate, IBB layouts, areas surrounding IBB Hospital etc. While areas that were piped but are having water problem are Canteen area, Northern part of Tudun Wada Friday Mosque e.t.c. Furthermore, some areas in the catchment of Tank2 are on the high elevation in relation to the tank, making it difficult for water flowing down with gravity to reach such elevated areas. Similarly, the new low-density

residential areas that sprang up after the creation of the state at the eastern part of Labin-Labin couple with other houses in Tudun Wada that have high water system, contribute to the inadequacy of portable water in such locations.

Tank 3: It is located along Gusau-zaria road at Samaru, with a design capacity of storing 4,000,000 litres, it service Mareri and Samaru Planning districts. Areas having water problems that are connected to Tank3 includes: Housing Estates at Rijiyar Gabas, some areas around Ministry of Agriculture, Damba village and Damba Housing Estate as well as their environs.

Steel Tank: This tank is situated along Ahmadu Bello Way in Sabon Gari near Rail Way station. It has the design capacity of storing 4,000,000litres. It is to service areas in the old part of Gusau. Areas having water problems under the services of Steel Tank even though they are reticulated include: Southern part of Old Cemetery, western part of Zawiyya and other areas around Kofar Jange Cemetery. Areas that are not reticulated includes: western part of Canteen Ja'o, Southern part of Gadar Baga, and some parts of Mortgage House.

Table 6: Households Water Connection in the Planning Districts.

Plg. Districts	Connected Households	Percentage	Unconnected Household	Percentage
Janyau	43	61	27	39
Tudun Wada	29	41	41	59
Mareri	35	50	35	50
Samaru	51	73	19	27
Gada Biyu	38	54	32	46
Total	196	56	154	44

Sources: Field survey, (2015)

It is evident from Table 6 that out of 56% of the total household survey, 52% are actively connected to the pipe borne water supply system in the town (getting water supply or not disconnected for any reason), while 44% households are not connected to public water system totally.

Table 7: Some area with problem of connectivity in the planning districts

Planning districts	Areas not covered with distribution mains	Area covered but having water problems
Gada Biyu	1.Gada Biyu New Extension 2. Housing Estate at Alaswa	1.100housing unit 2. Gidan Dawa
T/ Wada	1 North and Eastern part of Tudun Wada 2. Western and Southern part of old air port 3. Housing units in Unguwar Gwaza	Central Tudun Wada Eastern part of old Yarima House 3. Some part of part of Tudun Wada mosque
Samara	1. Areas around ministry of Agric 2. Areas behind Gusau hotel	1. Housing estate at rijiyar Gabas
Mareri	1. Southern part of old cemetery 2. Western Part of Zawiyyah 3. Western Part of Kofar Jange 4. Damba Village	1. Western part of Canteen Ja'o 2. Southern part of Gadar Baga 3. Part of Mortgage house 4. Damba housing estate
Janyau		

Sources: Zamfara State Water Board, Gusau, and Field Survey, (2015)

Since 1991 when the new water works was commissioned, no any significant change in terms of expansion of networks or additional storage facilities has taken place, this make it difficult for newly developed areas to get connected due to the distance from the mains vis-à-vis the cost. The available public water supply facilities are not adequate to cope with growing population of the town.

Gusau, Proposed Water Supply Plan

Water supply plan is one of the components of master plan prepared for the town. Different proposals were made with regards to water supply, among which is the extension of water mains to area that are not reticulated in the built up areas and to other projected areas of development.

This is with the view to guiding the effective provision of water in the town. But to date, very little was done in terms of expansion of network to un-serviced areas.

Table 8: Level Water Supply Plan Implementation in Gusau

Districts	Length of installed pipe line (KM)	Percentage
Mareri	0	0
Samara	0	0
T/Wada	0	0
Gada Biyu	1.2	32
Janyau	2.5	68
Total	3.7	100

Sources: Reviewed Gusau Master Plan, (2020), Field Survey, (2015)

It was evidently clear from Table 8 that, very little expansion of water mains was carried out in the town and mostly in the built up areas since 1997. The provision of water is at a very slow pace. Since the preparation of the plan only two newly developed residential area were connected with public water supply. This serves as a pointer to the causes of water supply problems in Gusau. It evident from the table there is spatial variation in water supply in Gusau, were by a bulk of area developed after the creation of the state are not provide with distribution network of ;public water supply system.

Discussion

The accessibility here is in terms of being connected with public water supply. From the responses obtained as displayed in table 6. Connection varies from one planning district to another depending on the location. Most of the people that are connected are in the old part of the town, being that the mains were laid since in the 1970s and the supply of water was efficient, reliable and affordable by then. It should be noted that, accessibility or being connected does not translate that households are getting water from public water system. Table 6 also depicted that, Tudun Wada and Mareri Planning Districts have the lowest network connection to houses with 29 and 35

percent respectively which is attributed to the springing up of newly developed areas and no extension of mains to such areas was made. While Samaru has the largest coverage with 51% followed by Janyau and Gada Biyu Planning Districts.

The reason for not being connected across the planning districts has cost implication which is also attributed to the distance from the mains and insufficiency in the supply as even those connected, are patronizing other sources of water to bridge the gap between their demand and what is supplied to them.

The skeletal structure of water supply mains in some planning districts causes some households to be out of water connection due to the distance from the main. It could be attributed also to the cost implication, which was worsen by the poor services from the Board (e.g Mareri Planning District). It is revealed from the interviews conducted with officials of water board and some citizens that, the rationing is on sector-time basis, in which an area will have water supply at an interval of two (2) days and for only one-two hours on the average.

Thus, it can be concluded that, though households were connected with public water system, but due to one problems or the other-ranging from distance from the mains, poor piping, pipe blockage etc.-, they are not

getting water in sufficient quantity. While some that are not connected, are of the opinion that, to get connected is a waste of resources as the supply is not reliable.

Conclusion

As described earlier, the last major installation of facilities for the provision and distribution of pipe borne water was since 1991 when a new water works was commissioned and additional Tanks were provided, Mains were also extended to other un-served areas. These facilities are incapacitated by the increased demand of water in the town and no any significant change was made. More specifically, the distribution of storage tanks in the town is inadequate as there are only four storage tanks, with a combined storage capacity of 12,000,000 litres. Their location also matters, for instance, Tank2 (located at Unguwar Gwaza) is relatively situated on low elevation in relation to some areas connected to it; Unguwar Yarima, CID office etc. Thereby making it difficult for water coming down with gravity to climb such locations. Therefore causing water shortages in Tudun Wada and Janyua planning districts.

Furthermore, non-implementation of Gusau master plan proposal escalated the crisis of water in the metropolis, as provision was made for the enhancement of water supply in the town. Among which is the extension of mains to un-served areas in both the old and newly developed areas of town. Non-abidance to this provision has contributed significantly to the problem of spatial coverage of water distribution system in Gusau, and in turn aggravated the issue of water shortage. Table 7 portrays the level

implementation of the proposed water supply plan in Gusau Master Plan 2010.

Recommendations

Based on the inferences drawn from the study the following recommendations were offered for the enhancement of the pipe borne water supply in Gusau.

- i. Extension of mains to un-served areas:
As portrayed, some areas are not served with water mains in the town which result to such areas being blocked from receiving water from pipe borne water supply system in Gusau. This should be done in both the old and newly developed areas of the town.
- ii. Facilities that are in use presently, are short of meeting the water demand of the teeming population of the town, therefore, additional facilities should be installed to cope with teeming population and spatial expansion of the town .
- iii. Location of some areas in the town in relation to various storage tanks is a hindrance to those areas from water supply due to the elevation of those areas in relation to the storage Tank e.g. areas around Hayin Buba, CID office up to Unguwar Yarima, Therefore, such areas should be provided with the separate storage tank.
- iv. It was discovered that only one storage tank supplying water to the entire old part of Gusau, which is extremely short. In this case therefore, additional storage tank should be also be provided.
- v. Old and Corroded pipes should be checked and changed as they reduce pipe diameter (size) thus, reducing the quantity of water supplied.

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