Analysis of Socioeconomic Benefits of Water Supply Projects in Jos Metropolis, Nigeria

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Abstract

Increasing demands for water resulting from economic growth, climate change, pollution and concomitant population growth, therefore work to increase pressure on available resources and also increase the cost of water treatment, This study examines the socioeconomic benefits of water supply projects like dams, reservoirs, overhead tanks, underground pipelines and water treatment plants in Jos metropolis to individual water users in Jos metropolis. The socioeconomic benefits were also identified and examined in relation to the gains achieved by the Plateau State Water Board subscribers in Jos metropolis, Nigeria. The study found out that the water supply projects are executed for social, political and to some extent economic reasons and are not sustainable due to the inability of Plateau State Water Board (PSWB) to charge commercial rates and enumerated the benefits of these water supply projects to households to include reduced distance to water sources, time savings and reduction in diseases rate, among other things. It concluded that some level of commitment should be achieved to enable the PSWB become sustainable to be able to replicate these projects in unserved locations of Jos metropolis. Recommendations such as full capacity utilization of state owned water supply utilities, provision of alternative areas for farming purposes, recreation and fishing to the inhabitants of water supply project areas, among others were proffered.

Keywords: Socioeconomic, Benefits, Jos metropolis, Plateau State, Water Supply.

INTRODUCTION

Water is used for domestic purposes (potable water), industry (utility water) and agriculture (irrigation): flood control, power production; inland water transport and recreation (Ali, 2018). This opinion hinges on water role in improving the health of the users by reducing the debilitating effects of water borne diseases. Many environmentalists are of the opinion that water supply projects are executed to provide flood protection and full charges should be paid by users to ensure conservation and protection of water resources (AfDB, 2010). The other school of thought views water as social, economic and environmental good because their projects are built for multipurpose uses. While water is provided to protect the environment through flood control, its supply to the users can serve the purposes of enhancing their health, by reducing the prevalence of water borne diseases and also generate revenue to the service providers so as to enhance the viability and financial sustainability of these projects (Ali, 2018).

The benefits of investing in water supply projects and services encompasses the social, environmental and economic, these are benefits to government, individuals and households and even the environment. The benefits from improved water supply according to Araral and Holamo (2007) include time saved in fetching water, cost savings on non-incremental water consumption, reduced incidence of water borne diseases, flood control, employment opportunities, decreased distance to water source, and increase in water consumption per capita and time and travel costs, flood control among others. Government has a responsibility to the citizens to put in place the social infrastructure like roads, schools, health infrastructure and

services, water supply projects and services at the cost that can deliver enormous benefits to individuals and the entire citizenry. Some of the benefits to government of improved water supply projects and services are not limited to reduced burden and cost of epidemics and diseases, flood control, water supply reliability but to increase government revenue generation among others.

Cessti and Malik (2012) examined the indirect economic impacts of three dams: Bhakra dam in India, Aswan High dam in Egypt and Sobradinho in Brazil, these authors used different input and output models and calculated scenarios to find the value addition or income multiplier values with and without a dam. They found that the net income was positive multiplier in all cases as agricultural productivity and size increased, stable electricity was made available to rural households and flood control was implemented. These lead to increased incomes particularly for the poorest households. However, by only assessing changes in incomes, the multiplier effects on income do not necessarily capture the full range of benefits and costs that dams bring (Wong, 2012).

The existence of dams for water supply in most communities has brought about very good road networks, electricity, and development of security operatives to guard against vandalization of equipment and installations built by government at the dam sites. The completion of these projects lead to associated positive benefits of increased access to potable water supply to households. Apart from these, Kaliel (2001) pointed out that water projects will be life sustaining and income generating and will also give jobs to increase the income of the people. Water supply projects reduces health problems, the time spent each day fetching water as the average distance to water for the population served has reduced substantially, builds human capital at both government and community levels, which can then contribute to the success of other projects, and it has contributed to the development of some private sector enterprises (Hill and Mtawali, 1989). Hutton (2017) in assessing investments in water and sanitation investments identified lower morbidity and mortality, improvement in general wellbeing and standard of living, reduction in water borne diseases and general healthy living as benefits of investing in water supply and sanitation projects and sector. This study therefore examines the socioeconomic benefits of water supply projects in Jos metropolis, Plateau State, Nigeria.

MATERIALS AND METHODS

Jos metropolis is located between latitudes [9^o 54' - 10^o 10'N] and longitudes [8^o 48' - 9^o 30' E]. The study area comprises Jos South and Jos North local government areas with their headquarters in Bukuru and Jos respectively. The area is situated within the northern senatorial zone of Plateau state, and is bounded by Barkin-Ladi and Jos East to the east, Riyom to the south and Bassa local government areas to the west (see Figure 1). The areal extent from north to south is 104km while from east to west is about 80km on an elevation of 1,250m above sea level with Shere hills having the highest peak of 1,777m above sea level with an area of 1002.19 Km^2 (Mohammed *et al*, 2010).

Most rivers in northern Nigeria owe their origins to the Jos Plateau due to its height above other regions in the northern Nigeria and is the source of Kaduna, Gongola, Korot, Shimanker, N'gell, Kassa, Delimi, Hadeija-Jama'are, Wase and Tenti rivers. The volume of these rivers are high during the rainy season and low during dry seasons due to the nature of rainfall and other climatic elements of the area (Bingel, 1978; Jiya and Musa, 2012). The presence of these rivers, streams, dams, hand dug wells, ponds and springs constitute very good water resource base for the area. Some of the rivers that the government has dammed and is harnessing for potable water supply to the populace are Nupis, Shen, Gwash, Rafin-Sanyi, Agog rivers and

Yelwa pond. The dams built on these rivers are: Tolle Mache, Yakubu Gowon, Liberty (Laminga), Lamingo (Gwash), Kogingiri and Yelwa Dams built by the government at different times. The intensive rainfall presents great potential for rain harvesting to the quantities that will cater for households, industries and other water consuming units' need for water right to dry periods.

Figure 1: Plateau State showing the Local Government Areas.

Precipitation of the area ranges from 70cm to 100cm during the peak period. The wet season is between May and October, while the dry season is between November and April. The wet season is influenced by prevalence of the warm moist maritime south westerly monsoon winds that blows from the Atlantic Ocean south westward hinterland while the dry season is linked to the dry tropical continental north easterly Hamatan winds that are cold dry and dusty mass blowing from the Sahara desert (Ariyo, 2000).

The study area comprises of Jos city and Bukuru town which have fused together by urbanization and population growth. The metropolis has two local government areas – Jos South and Jos North local government areas and expanding to cover parts of Bassa, Jos East, Riyom and Barkin-Ladi by the urbanization efforts of the state government through the

implementation of the Greater Jos Master Plan. Jos has a heterogeneous population with Berom, Anaguta, Afizere, with few of Jere and Buji in Bassa and Jos North Local Government Areas.

The population of the metropolis is put at 1,255, 914 based on the 2020 population projection (National Population Commission, 2006). It has a density of about 391 persons per square kilometre and is the most densely populated and urbanized place in Plateau State.

Data on water supply projects like dams, pipelines, reservoirs, treatment plants, their capacities, year of construction and their locations were obtained from Plateau State Water Board. Others from Federal Ministry of Water Resources' reports complemented by field works. Data on benefits to individual water service subscribers on the other hand were determined through the use of questionnaires on the target respondents. A survey of the water supply projects of Laminga (Liberty), Lamingo (Gwash) dam, Yakubu Gowon dam, Yelwa dam, Tolle mache and Kogingiri dams and other potential project sites within the study area were undertaken on 19th June 2019. Similarly, a visit to different parts of Jos North and Jos South Local Government Areas including the Plateau State Water Board headquarters which constitute the area where the water users are resident was equally undertaken. Jos city was found to be segmented into 21 districts with details of all the 23,453 households connected to the pipe borne water system as at end December 2014.

Sampling Techniques and Procedures

The area has been designated into 21 water supply districts (Bukuru A - C) and (Jos A - S) by Plateau State Water Board, with each district having varied number of residents that are connected to piped water system. The sample size of 378 was determined using the educational and psychological measurement table of Krejcie and Morgan (1970) at 95% confidence level with a degree of accuracy of 5%. Due to large sample population, the researcher adopted a systematic sampling approach in the selection of some districts for questionnaire administration. The districts were first listed alphabetically and after selecting the first district, each 3rd district was selected and this brought the number to seven districts with a connection population of 8,402. Also, to further arrive at the number of respondents in each of the seven districts, the population of piped connections of each of the districts was divided by total 8,402 and multiplied by 378 as depicted in Table 1.

Table 1: Sample Population in the Selected Districts in Jos Metropolis

S/N	Name of District	No of Piped Connections	Sample
1.	Bukuru A (Fire service)	1266	57
2.	Bukuru D (Metred)	487	22
3.	Jos C (Lamingo)	1521	68
4.	Jos F (Central) Naraguta Area	2334	105
5.	Jos J (Laranto)	957	43
6.	Jos M (Ali Kazaure)	597	27
7.	Jos Q (Rikkos)	1240	56
	Total	8402	378

The sample size as determined by Krejcie and Morgan (1970) has the following formula:

$$n = \frac{X^2 * N * P(1-P)}{(ME^2 * (N-1)) + (X^2 * P * (1-P)}$$

Where;

n= sample size
X^2= Chi square for the specified confidence level at 1 degree of freedom
N= Population size
P= Population proportion (.50 in the table)
ME= Desired margin of error (Expressed as a proportion)

In this study, only descriptive statistical tools were used in data presentation and analysis. The examples of descriptive statistics used in analysing the results are frequency tables, maps and bar graphs and pie charts.

RESULTS AND DISCUSSION

The benefits of water supply and the projects are enjoyed by both government and the water subscribers (users) in the area. The benefits accruing to users of water bother on connection fees, water rates and fees affordability, social, economic and other unquantifiable social, economic and environmental benefits, while the benefits on the part of government bother on revenue generation, ability to fulfil social and political obligation to the citizenry among other ones. Associated with water supply projects are also social and economic benefits to users like improved health of residents, improved volume of water supply and its sufficiency over a period of time.

Most potable water users in Jos metropolis connected to the piped water supply system agreed that they witness an improvement in health status of their family members after connection. Over 68% of the respondents shared this view while over 31% on the other hand said there is no improvement in health status of their family members after connection as different views were expressed by residents for connecting to PSWB pipe line system. This view agrees with the result of Ali (2018) which showed that majority of water subscribers with Jos area had connections with the public water supply source and multitudes of other alternate sources.

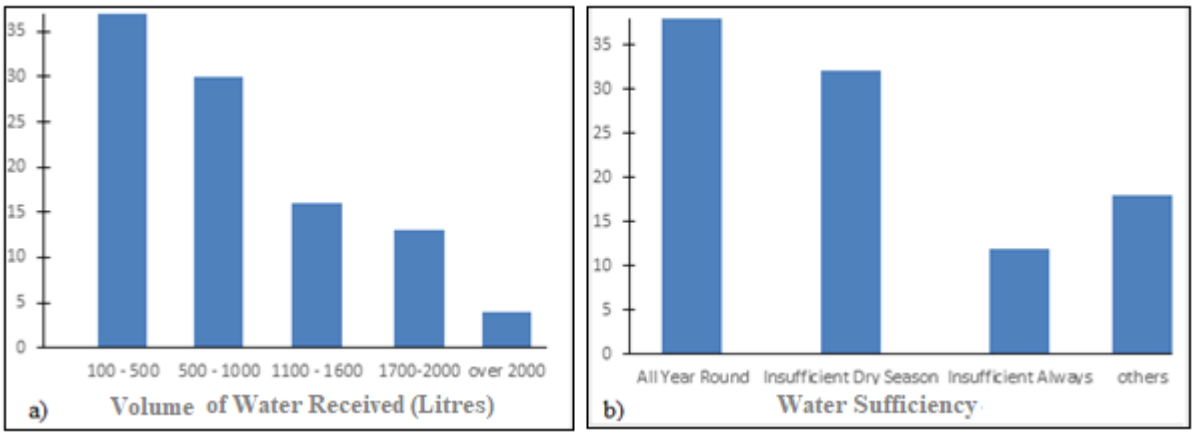

Figure 3: Information on water, a) Volume of water received, b) Water sufficiency.

About thirty-four percent (34%) of the respondents said they receive 600 – 1000 litres of water in a day, 1100- 1600 litres was received by 59 respondents and 46 of these respondents receive between 1700 – 2000 litres and only 3 said they enjoyed over 2000 litres of water in a day from pipe borne water system (see Figure 3a). On the sufficiency in the volume of water supplied, over 41% of the respondents said the volume is sufficient for their potable needs as they store up more in their overhead tanks for use during hours of supply down time.

This study disagrees slightly with the findings of Ali *et al.* (2020) in which majority of respondents said they need between 81-100 litres of water for potable uses, those who claimed

that 10-50 litres of water is sufficient for their daily potable uses constitute 24.44% of the respondents, 22.22% said they need between 71-80 litres in a day and 21.11% depend on 51-70 litres per capita per day while over 101 litres is utilized by just 13 number of respondents from all districts in Jos North Local Government Area (LGA). Due to water scarcity, the people of the area have adapted to the use of managing with the available quantities from both main and alternate sources

Over thirty-Eight percent (38.8%) of the respondents in Figure 3b said that the volume of water supplied is sufficient for their needs for drinking, cooking, washing and gardening all year round, 31.6% said that the insufficiency of water is just during dry seasons and 13.3% are saying that water is not available to them always, these people maybe those in rocky and highland areas where wells don't succeed and pipe borne water is not always available. Sixteen percent of the respondents on their part did not say anything as those interviewed said that water supply conditions are not permanent as sometimes they get water and some other times they don't.

Table 2: Socioeconomic Benefits of water Supply Projects

Variables	Benefits	Freq	%
Benefits of pipe borne water	Improved health of household members	90	23.9
	Time saving	191	50.8
	Reduced distance to water points	60	16.0
	All of the above	35	9.3
	Total	376	100.0
Proximity benefits	Source of water	100	26.6
	Small scale irrigation	48	12.8
	Recreation and tourism	56	14.9
	All of the above	172	45.7
	Total	376	100.0
Other benefits	Relatively fair rates	239	63.6
	Sufficient water volume	43	11.4
	Very good quality	3	.8
	Long duration of supply	28	7.4
	All the above	63	16.8
	Total	376	100.0
Duration (hours) of water supply	1 – 3	144	38.3
	4 – 6	108	28.7
	7 – 9	98	26.1
	10 – 13	26	6.9
	Total	376	100.0

About 24% of the respondents are of the view that pipe borne water brought about enormous benefits to their households in area of improvement in health status of their members. Majority of the respondents constituting 50.8% as shown in Table 2 said pipe borne water connection saves them the so many hours wasted daily in sourcing for water. Sixteen percent (16%) of the residents expressed the view that they are saved from covering a very long distances to get water when they were not yet connected while 35 of the 376 respondents said that they are connected to the pipe born water due to all the reasons. WaterAid (2008) identifies multiple impact areas of their water and sanitation projects: livelihoods and incomes, socio-cultural life,

health and hygiene, psychological impact, education, gender issues, community management and sustainability.

Table 2 also shows benefits of water user's proximity to water supply projects to include sources of water, small scale irrigation, recreation and tourism. Over Twenty-Six percent (26.6%) of the respondents are of the view that their nearness to water supply offer them the opportunity to access water easily for the 12.8% of the residents around the river banks and are into small scale market gardening and benefit from nearly abundant water source for irrigation purposes. The residents of Lamingo, Ratt, Shen and Du and Laminga belong to this category. These water supply projects also offer many people very scenic vistas for swimming, sightseeing and recreation, 14.9% of the respondents said that their proximity to these water projects benefit them in areas of recreation and tourism.

Over 45% forming the majority of the respondents view the water supply projects to be beneficial to water users in all ways (see Table 2). Other benefits associated with water supply projects according to respondents are relatively fair rates paid by residents, sufficient water volume, very good quality and long duration of supply. The same Table 2 shows that 63.6% of respondents view the rates they pay to be fair, 16.8% of the respondents see all of these benefits to be available to them. Forty-three of the respondents said they have sufficient water volume supplied them by the Plateau State Water Board while only 3 and 38 respondents respectively said they receive good quality water and a long duration supply.

The Plateau State Water Board water supply uptime is put at 7 hours as against the AFDB desired level of 8 hours a day as shown in Table 3 but majority of the respondents (38.3%) in Table 4 said that they receive only 1 – 3 hours of supply. Twenty-eight percent (28%) of the respondents said they receive 4 – 6 hours of supply in a day, those who receive 7 – 9 hours of supply which falls within the AfDB minimum number of hours as 98 of the 376 respondents in Jos metropolis and 26 respondents said they receive water between 10 – 13 hours in a day, these number of hours of water supply translated to 100 - 500 litres of water according to 141 respondents (37.5%) in Table 3. Yildiz (2017) supported the assertion that water resources

Table 3: Time and Amount Spent and Saved from WSP Improvement

Variables	Time/Amount (H/N)	Frequency	%
Time spent by households during hours of no supply	1 – 2 hours	139	37.0
	3 - 4 hours	45	12.0
	5- 6 hours	160	42.6
	Over 6 hours	32	8.5
	Total	376	100.0
Amount saved from improvement in water supply and connection to piped water system	1000 – 50000	162	43.1
	51000 – 100000	134	35.6
	101000 – 150000	53	14.1
	Above 150000	27	7.2
	Total	376	100.0
Households' alternate water sources	Vendors	46	12.2
	Tankers	52	13.8
	Well	188	50.0
	Boreholes	81	21.5
	Other	9	2.4
	Total	376	100.0

development projects enable developments in a wide range of areas from agriculture to tourism, energy to health sector. Thus they can be considered as an engine for a country's development. Keeping on in operation of this engine, especially under the changing climate conditions is directly related to ensuring water security.

Thirty-two (32) respondents said the volume supplied from the system is just sufficient for their household needs and 11.4% receive very insufficient quantum of water in Table 3, 43.1% said that their connection to the piped water system of Plateau State Water Board has enabled them to save up N1, 000 – N50, 000 being amount spent on providing water for diverse household uses from vendors, tankers, boreholes and streams located from their dwelling places. Over 35% said they save between N251, 000 – N100, 000 yearly on buying of water. Fifty-three of these respondents who probably use plenty water daily or with larger household size said that their savings from connection to the pipe borne water ranges from N101,000 to N150,000 per annum while 7.2% saved above N150,000. Katko and Hukka (2017) agreed that good access to water supply projects and services bring about enormous socioeconomic benefits to the population.

Table 4: Water Consumer's Responses on Intangible Benefits

Intangible benefits	Freq	%	Unit
Cost savings	45	11.90	Naira/day
Time savings	56	14.89	Hours/day
Reduced women & children drudgery	60	15.63	-
Reduced incidences of water borne diseases	75	19.84	Days/incidences
Increased water consumption per capita	50	13.22	Litre/Households/day
All of the above	91	24.07	-
Total	376	100	

Consumers are of the view that they save costs in diverse areas as a result of their connection to the pipe borne water system in in the area. About twelve (11.90%) percent said that they save a lot of cost in Naira terms in a day and 14.89% of the respondents said they save some hours in a day for the reduction in the burden of going to fetch water from women and the children, 15.63% said that their wives and children are now channelling their energies to other usable ventures from the energy and time saved from going out to fetch water daily. Seventy-five respondents representing 19.84% on their part are of the view that there is a drastic reduction in incidences of water borne diseases, this 13.22% of the residents of Jos metropolis has equally led to a quantum leap in water consumption per capita by households and 24.07% of the respondents are of the view that all these intangible benefits were enjoyed by their households resulting from connecting to the services of Plateau State Water Board. Wateraid (2008) agreed that improved water supply to residents lead to drastic reduction of water related diseases in an area and advocated for personal and domestic hygiene activities to be strengthened as they are critical determinants of household health.

Table 5 depicts the water quality indicators of taste, odour and colour, over 42% of the respondents view the taste, colour and odour of the water as average, and those that see the taste as bad are 38.6% and said that the water supplied to them is generally of bad quality. Forty-three (43) respondents representing 11.4% are of the opinion that the quality of pipe borne water from the Plateau State Water Board is good. The change in taste, smell and colour (quality) of water, the interviewees at the Water Board said that this may be attributed to eroded pipes, infiltration of dirts into leaking pipes and the inability of the board officials to purify water from source with the right quantum of chemicals. With these inadequacies in quality and

volume of water supplies to residents, 26.6% of the residents as is in Table 6 said they are satisfied, while 60.4% said they are not satisfied with the quality and volume of water supplied

Table 5: Level of Satisfaction with Volume and Quality of Water Supply

Variables	Level of satisfaction	Frequency	Percentage
Quality of pipe borne water	Good	43	11.4
	Average	160	42.6
	Bad	145	38.6
	Others	28	7.4
	Total	376	100.0
Satisfaction with volume and quality of water relative to amount paid	Yes	149	39.6
	No	227	60.4
	Total	376	100.0
Level of satisfaction with water services	Very satisfied	169	44.9
	Satisfied	204	54.3
	Dissatisfied	2	.5
	Very dissatisfied	1	.3
	Total	376	100.0
Level of sufficiency with water volume	Sufficient	32	8.5
	Very sufficient	157	41.8
	Insufficient	144	38.3
	Very insufficient	43	11.4
	Total	376	100.0

while only 13.0% are undecided. This, only (2) respondents said they are very satisfied, 54.3% said they are merely satisfied while 44.9% said they are dissatisfied and only one (1) respondent was dissatisfied with the services received from the Board (Table 5).

CONCLUSION

From the findings of this study, the water supply projects were executed for social, political and to some extent economic reasons and are not sustainable due to the inability of Plateau State Water Board (PSWB) to charge commercial rates to be sustainable in their operations. To consolidate on the gains and benefits of these water supply projects to households to enhance reduced distance to water sources, time savings and reduction in diseases rate, among other things, there is need for high level of commitment to service delivery excellence. Increased access to water supply to water users in in the study area is the surest way to low burden of sickness and diseases, minimal outbreak of water borne diseases like cholera, dysentery and other water related diseases.

All the underutilized and unutilized capacities of all the water supply projects (WSPs) should be harnessed and all issues should be promptly resolved to also enhance their capacities to provide quality and volume of water that will satisfy the consumers and bring about other benefits.

Due to rising population, urbanization and economic activities in the area, the capacities of water supply projects should be expanded from the highly available potentials in ponds, springs, rivers and ground water and extend coverage to unserved areas like Rantya, Gurra Topp, Diye, Gada-biyu, Rukuba Road, Du, Shen, parts of Lamingo area and Little Rayfield.

The government should provide alternative compensational fishing grounds, settlements, recreational areas and farmlands to the original owners of the land in form of either money or land to enable them harness socioeconomic benefits that are associated with water supply project execution.

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