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FINANCIAL COST ANALYSIS OF PUBLIC WATER SUPPLY PROJECTS IN JOS METROPOLIS, PLATEAU STATE, NIGERIA

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ABSTRACT

Water is precious and indispensable resources that support man, his activities and the general function of an ecosystem. The increasing demand for water resulting from economic growth, climate change, pollution and concomitant population growth, therefore work to increase pressure on water and the cost of its treatment. This Study examines the financial costs of water supply projects in Jos metropolis to the government of Plateau State. Only documented secondary sources of data from Plateau State Water Board (PSWB) were explored for information on number of subscribers and the cost incurred across the years for water production and supply. Frequency tables were used for presentation and analysis of data. The study found among other things that, the total sum of N5, 089,516,239.55 was spent on operations, maintenance and repairs in different areas of PSWB operations. The cost of expansion of water supply projects on the other hand was put at N4, 678,172,065.70, the years 2016, 2017 and 2018 recorded the highest with the peak of N7.049bn in 2018. It concluded that the cost incurred in the development of water supply projects are very exorbitant and may outweigh the expected year on year returns. Recommendations such as cost sharing between government and private sector through public private partnership to ease the burden of these expenditures on them; Plateau State Water Board should embark on serious recovery drive to recover any accumulated receivables over time ;PSWB should also automate some processes to cut down cost of production, the government should provide alternative compensational fishing grounds, settlements and farmlands to the original owners; the Board should explore alternate power sources to cut the costs on electricity supply and amount spent on diesel for their operational activities.

Keywords: Cost, Jos metropolis, Plateau State, Water Board, Water Supply

INTRODUCTION

Water is central to life and all human activities as the origin and evolution of life became possible on earth because of its existence. It is one of the most indispensable resources and a basis for most civilizations in the world as considerations for settlements in space were done with water as the primary reason (Ali, 2018, Aswathanarayana, 2001; Cech, 2005). The list of the uses of water is in exhaustive, apart from its domestic and industrial uses, water provides habitat for fishes and some mammals (wildlife), it is also used for tourism, agriculture (irrigation), and construction, recreation, and transportation purposes. Because of its centrality to all

forms of life, it serves different purposes to the environment and mean different things to different people. It strongly relates to quality of life as its availability in quality and quantity for various uses (drinking, cooking, washing, bathing, sanitation and gardening) is closely linked to man's well being (Martins, 2001).

Increasing demands for water resulting from economic growth, climate change, pollution and concomitant population growth, therefore work to increase pressure on available resources and increase the cost of water treatment (Cech, 2005, Kelly and Adger, 1999 and FAO, 2012). The State governments are vested with the statutory responsibility of providing safe water to the urban, semi-urban and rural populace of Nigeria (NWSP, 2000). Many states have made very significant investment in urban water supply by building dams, laying of pipes, house connections and provision of prepayment metres to residents all aimed at supplying potable water to the larger proportion of urban population. The result of this effort according to (Water Aid, n.d) has often been very disappointing as only few water subscribers receive services that are somewhat unsatisfactory and erratic.

The two main types of costs incurred in water supply projects as it is in other infrastructure are the investment and recurrent cost items. Investment costs include: planning and supervision, hardware, construction and protection of water sources among others. Recurrent costs on the other hand, include: operating materials to provide a service, maintenance of hardware and replacement of parts, regulation and control of water supply, ongoing protection and monitoring of water sources, water treatment and distribution and continuous education (training) activities. In most developing countries, the cost of most public projects such as roads, electricity and dams are borne by the government due to their classification as public goods (Ali, 2018).

Operations and Maintenance cost according to Araral and Holmemo (2007) typically consist of the cost of labour, fuel, electricity and spare parts. These costs are defrayed by project owners but always borne by the end users in cases of utilities that can recover full costs. These costs embody administrative, maintenance and all charges and are known as Operations, Maintenance and Repairs (OMR) costs. Initial construction cost on the other hand consists of the money used in defraying construction cost from consultancy, cost of installation, design, building, engineering and construction. The recent government policies of privatization, commercialization and public private partnerships is now ceding part of these responsibilities to the private sector investors and only serve as regulator of the sector (Okwor, 2010 and FMWR, 2012).

Hutton and Haller (2004) pointed out that to be able to improve access to water and sanitation; there should be two considerations from societal perspectives: in terms of financial projects (interventions), it is important to make a clear distinction between the public and private sectors or spheres. Should water and sanitation be provided at zero or subsidized cost by the government or the beneficiary pay the full cost? Are there other agencies that are to bear some of these costs, such as Non-Governmental Organizations or the private sector? In terms of who receives the benefit, a similar public- private distinction should be made with a further disaggregation by benefiting government ministry on the other hand and private sector beneficiary on the other (Okwor, 2010).

The building of dams and construction of other water supply projects for water production to municipal and industrial users are technically complex, extremely costly and takes a long time to accomplish. The cost of maintenance, repairs and operations overtime add to the initial construction cost makes it very difficult and takes longer periods for the projects to break even and become profitable to the government if they are eventually established for profit making purposes or for social or environmental protection purposes (Wong, 2013 and Nwankoala, 2011). These water supply projects as stated by Wong (2013) involves significant and high capital upfront cost which necessitate large loans from development agencies and banks. The years or even decades of building with no revenue generation, and long repayment period tie up a country's budget, all while providing no guarantee for future benefits as countries are vulnerable to currency devaluation and interest rate fluctuations. According to Kraemer, Gorlach and Peilen (2004) water and its management can be undertaken from three perspectives of economic, social and environmental. Any of these perspectives used by government in undertaking the water supply projects would determine the profitability and viability or otherwise of the project (Ali, 2018).

The initial costs of construction of a typical water supply project include expenditures on head-works, initial land clearing, equipment and materials, fence, roads and drains and contingencies and land cost (Savva and Frenken, 2002). PSWB (2002) listed capital investment, acquisition of fixed assets, capital work in progress, prior year adjustments and long-term loans to be part of investment costs. All firms, individuals and governments incur daily costs on their various activities and transactions in order to produce such goods and services that meet the needs of their customers (ADB, 1999, Ahmed, et al 2007 and FAO, 2012). These costs bother on stationeries, repairs and services of equipment, plant and machinery among so many things. A sizeable amount of money spent by most State Water Agencies (SWAs) go to operations cost which consist mostly personnel, administrative and chemicals for purification to be able to live up to the required standard for drinking water quality. In spite of so much money sunk into the operational activities of these State Water Agencies, there are no commensurate achievements to match these huge investments (FMWR, 2006). This study is aimed at assessing the financial costs of public water supply projects in Jos metropolis, Nigeria.

MATERIALS AND METHODS

Study Area and Sources of Water

Jos metropolis is located between latitudes 9^0 54' N and 10^0 10' N and longitudes 8^0 48' E and 9^0 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 of Jos metropolis 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, Gajere, Adigun and Folayan, 2010).

Figure 1: Plateau state showing the LGAs

Source: GIS Laboratory, Department of Geography and Planning, University of Jos, 2018

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 metropolis are Nupis, Shen, Gwash, Rafin-Sanyi, Agog rivers and Yelwa pond with Tolle Mache, Yakubu Gowon, Liberty (Laminga), Lamingo (Gwash),Kogin – giri and Yelwa Dams built on them. The intensive rainfall in Jos metropolis 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. However, the technology and the awareness for the harvesting though cheap and simple is not being embraced by

most water users due to long rainy season that guarantee abundant precipitation for nine months. Apart from this there are a lot of streams, ponds, mine pits, lakes and smaller rivers which compliment other major water sources in their raw forms which if developed along with dams will contribute potable water to the piped water system (Daloeng, 2006 and Ali, 2018).

Jos metropolis experiences AW climatic type and falls within the koppens AW climatic sub-region. Generally, weather conditions are warmer during the rainy season (April-October) and much colder during the hammattan period (December-February) (Ariyo, 2000). The mean annual temperature of the city ranges between 20^0c and 26^0c. These temperature ranges are due to the influences of rainfall, relief and cloud cover at different periods and seasons of the year. Relative humidity is lower during the dry season between November to March and is very high during the wet season with the peak values of between 81% and 84% in July and August (Bingel, 1978, Ariyo, 2000, Nyong, et al, 2003, Nyong, et al 2008).

Precipitation on the Jos Metropolis ranges from 70cm to 100cm during the peak period. The study area has wet and dry seasons. The wet season takes about 8 to 9 months between mid-March and end October, while the dry season takes about 3 to 4 months from mid-November to mid-March (Ariyo, 2000). The wet season is influenced by prevalence of the warm moist maritime south westerly monsoon winds which blow from the Atlantic Ocean south westward hinterland while the dry season is linked to the dry tropical continental north easterly winds (Hammattan) a cold dry and dusty mass blowing from the Sahara Desert (Ariyo, 2000).

Jos metropolis comprises of Jos city and Bukuru town, which have fused together due to long years of 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. The population of Jos city 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 kilometer and is the most densely populated and urbanized place in Plateau State. Due to the presence of so many higher institutions, church institutions, commercial activities, administrative activities, which have over the years mobilized and are continuously attracting labour, capital and entrepreneurship, all these have combined to make Jos to assume the status of a cosmopolitan city**.**

Secondary Data of Water Supply

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 database. Information on cost of water supply projects which include the initial investment costs, operations, maintenance and replacement costs and the cost defrayed by users in enjoying these services like connection charges, monthly bills were obtained from documented sources such as Plateau State Budget and annual statement and state water board spanning the same period of twenty-seven (27) years (1991-2018). In this study, only descriptive statistics such as frequency tables were used in data presentation and analysis.

RESULTS

Water Supply Projects in Jos Metropolis

Plateau State Water Board is a government owned agency established by Plateau State Water Board Edict No. 4 of 1991 and charged with the responsibility of providing potable water services to the over 3 million citizens of both Jos metropolis and other local government areas of Plateau State. Apart from other water supply projects in other parts of the state, the board manages six major dams, which provide water for households, commercial activities and industries within the Jos metropolis. These dams are Tolle Mache, Yakubu Gowon Dam, Yelwa Dam, Kogin-giri Dam, Laminga (Liberty) and Lamingo (Gwash) Dams. The water produced from these Dams is transported through pipes of different sizes to treatment plants after which it is distributed to consumers (Ali *et al.,* 2020).

The Board has six Departments which include Administrative, Commercial, Accounts, Operations, Quality Assurance and Technical. It has four additional units namely: Planning Research and Statistics, Public Relations, Legal and Management Information System. The Operations department is charged with the functions of water production, treatment and distribution. The Commercial department on its part maintains customer database of about 23,000 which are billed based on the flat rate tariff system, the Finance and Accounts Department on the other hand has the mandate of managing the accounts of the Board. See details of the summary of the Board and other information in Table 1. The Board has 367 employees and serves only about 560,000 people representing only about 56% of the entire population within Jos metropolis. Apart from the untapped potential of their inability to extend service coverage to serve over 440,000 number of people in Jos metropolis, they have very high non-revenue water rate of 58% and an uptime of 7 hours in a day which is below the acceptable desired level of at least 8 hours prescribed by the African Development Bank (AfDB) as shown in Table 1 with over 500,000 households, the board is currently connected to only 23,453 leaving up to 476,547 households unconnected and relying on the water sources that are considered unreliable for drinking and other potable uses.

Table 1: Basic Features of Plateau State Water Board

Characteristics/year	2018
Population served	3 million (Statewide)
Population served	560,000(Jos metropolis)
Number of dams/ Treatment Plant/Reservoirs	6/4/8
Total Number of connections	23,453
Number of employees	367 as at June 2016
Non-revenue water	58 %
Service coverage	20%
Average domestic tariff	N2500
Total daily water production	50400m^3
Total daily water distribution	50400m^3
Average Hours of service per day	7 hours
Length of piped water connections	400Km
Proportion of the connection that is metred	425 (1.8%)

Source: SUWASA, 2015

Table 2: Number of piped connections and water supply districts in Jos metropolis

S/N	Name of District	Number of Piped connections (households)
1	Bukuru A (fire service)	1266
2	Bukuru B (Yelwa)	1089
3	Bukuru C (RaholKanamg)	1203
4	Bukuru C (Metred)	487
5	Jos A (Main)	1415
6	Jos B	1116
7	Jos C (Lamingo)	1521
8	Jos D (Nassarawa)	2331
9	Jos E (Kabong)	1049
10	Jos F (central)	2334
11	Jos G (U/Rogo)	1703
12	Jos H (Kufang)	1636
13	Jos J (Laranto)	957
14	Jos K (Fudawa)	853
15	Jos L	883
16	Jos M (Ali Kazaure)	597
17	Jos N (Federal Lowcost)	1299
18	Jos P (Industrial)	35
19	Jos Q (Rikkos)	1240
20	Jos R (Utan)	249
21	Jos S (Rayfield)	189
	TOTAL	23452

Source: PSWB (n.d)

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 29th May 2017. Similarly, a visit to different parts of Jos North and Jos South Local Government Areas including the Plateau State Water Board headquarters which form the Jos metropolis where the water users are residents was equally undertaken on 30th May 2017. On the course of this survey, it was established that the whole of Jos city was segmented into 21 districts with details of all the 23,453 households connected to the pipe borne water system as at end December 2018, see Table 2.

Financial Costs of Water Supply Projects to Government in Jos Metropolis

This involves the financial resources committed to the capital investment in initial water supply project construction, operations, and maintenance and replacement expenditure. Table 3 and 4 show the total amount spent by the government of Plateau state on the construction, rehabilitation and maintenance of water supply projects (dams) in Jos metropolis.

Table 3: Cost of Expansion of water pipeline Distribution

Business Office	Amount (Cost) (N)
Jos main	206,757,835.20
Jos Central	174,065,674.55
NassarawaGwong	374,041,454.73
Laranto	215,588,595.73
Kabong	63,939,621.08
Utan	174,898,612.08
Shen to Rayfield	656,232,683.61
Bukuru A, B & C	1,080,892,477.72
Fudawa	44,788,326.00
Laminga	415,403,766.57
Kufang/Federal Lowcost	947,410,810.84
General Items	529,353,513.95
Rayfield	206,142,867.49
Total	**5,089,516,239.55**

Source: Plateau State Water Board, 2015.

The costs incurred in water production include the initial amount utilized in building the water projects and amounts incurred on daily operations, maintenance and replacement (OMR) by the Plateau State Water Board. The total amount used in initial construction of supply projects in Jos metropolis include cost of dams, cost of construction of reservoirs, treatment plants and overhead tanks. Tables 3 and 4 show the expenditure of over N5.08bn and N4.67bn totaling over N9.6bn spent on water supply projects as initial investment and rehabilitation amounts in Jos metropolis.

Table 4: Cost of Expansion and Rehabilitation of Water Supply Projects

Scope of Work	Amount (Naira)	Location
Expansion of pipeline distribution network	7,275,571.61	Jos Metropolis
Dredging of Yelwa& Rabin Du Ponds	963,089,210	Yelwa
Installation of equipment for YGD & Treatment Plant	258,264,847.74	YGD
Replacement of 2 Generators for YGD & Treatment Plant	248,086,358.71	YGD
Construction of Tank at Wild Life Park	179,714,269.05	Fed. Lowcost
Construction of Water Treatment Plant	680,068,297.54	Old Filter House
Concrete tank at Dwei Du	393,173,511.05	Dwei Du
Dredging of Yelwa& Rabin Du	25,000,000.00	Yelwa
Expansion of pipelines at Yelwa& Rabin Du	166,500,000.00	Yelwa
Initial cost of YGD phase 1 and 2	1,757,000,000.00	YGD
Total	**4,678,172,065.70**	

Source: PSWB, 2009 and Author's computation,

Table 5: Financial Costs of Water Supply Projects to Plateau State Government

Year	Cost(Expenditure)
1991	16,278,216
1992	44,969,626
1993	91,733,882
1994	85,474,877
1995	131,024,465
1996	160,143,614
1997	168,590,668
1998	134,689,833
1999	414,159,206
2000	38,7425,000
2001	513,338,911
2002	281,700,946
2003	265,434,124
2004	381,617,662
2005	426,256,673
2006	251,212,131
2007	393,347,489
2008	235,290,250
2009	251,440,500
2010	398,608,436
2011	594,779,140
2012	575,692,075
2013	616,298,584
2014	952,987,189
2015	(6,294,234,445.28)
2016	6,492,912,085
2017	6,679,296,220
2018	7,049,696,259
Total	**13,927,670,118.72**

Source: PSWB Financial Statement Series 1991- 2018 and Author's computation

The year on year expenditure on the operational activities of Plateau Water Board reveals that as at 2018 the financial cost of N13, 927,670,118.72 with years 2016, 2017 and 2018 recording the highest with the peak of N7.049bn in 2018. This may be attributable to the favourable releases of budgetary amounts and improved revenues generated by the State Water Agency in these years as against the previous ones. In 1991 the costs were minimal and increased steadily from N16m to N168.5m in 1997 and declined in 1998 and subsequently fluctuating intermittently across the years as shown in Table 5. This result agrees with the findings of Ali (2018), Vivan, Ali and Adamu (2015) which found that the water supply project initial, investment and repairs costs are so high and need the partnership of all stakeholders to be able to provide sustainable supply to the citizenry in Jos metropolis.

DISCUSSION

Plateau State Water Board serves only about 560,000 people representing only about 56% of the entire population within Jos metropolis. The area has untapped potential customer base of over 1million people but currently supply water to only 440,000 number of people.The presence of riversNupis, Shen, Gwash, Rafin-Sanyi, Agog rivers and Yelwa pond with Tolle

Mache, Yakubu Gowon, Liberty (Laminga), Lamingo (Gwash),Kogingiri and Yelwa Dams, streams, dams, hand dug wells, ponds and springs constitute very good water resource base.These present very high potentials for high level water production and supply to the teeming population of the area. The very high non-revenue water rate of 58% and an uptime of 7 hours in a day which is below the acceptable desired level of at least 8 hours prescribed by the African Development Bank (AfDB) present high level water and revenue leakages. The board is currently connected to only 23,453 leaving up to 476,547 households unconnected and relying on the water sources that are considered unreliable for drinking and other potable uses (Ali, et al 2020).

Plateau State Government has invested heavily to provide potable water to the over 1 million inhabitants of Jos metropolis. The State Government was able to put in place six dams, four treatment plants, eight reservoirs and a network of pipes to produce and distribute water to households and institutions within their areas of coverage. The expenditure on the operational activities of Plateau Water Board reveals that as at 2018 the financial cost of N13, 927,670,118.72 with years 2016, 2017 and 2018 recording the highest with the peak of N7.049bn in 2018. This may be attributable to the favourable releases of budgetary amounts and improved revenues generated by the State Water Agency in these years as against the previous ones. In 1991 the costs were minimal and increased steadily from N16m to N168.5m (Ali, 2018).This fall short of the World Bank estimates of the investment in Water Supply and Sanitation required to meet 2015 sector MDG targets range from US$2.5 billion (MDG Office) to US$4 billion annually (US$1.7 billion for water supply spending (WSP, 2011).

CONCLUSION

The study has shown that the cost incurred in the development of water supply projects in initial construction, operations, maintenance and replacement have far outweighed the expected revenues they earn year on year. This study has also shown that there is a strong economic case for investing in improved water supply services, when the expected cost per capita of different combinations of water supply improvement are compared with the expected economic benefits per capita. Also, for the averted costs of health care for diarrhea cases, these savings to the health sector and the patient may not be realized as the greatest proportion of health care costs are usually fixed costs. This on the other hand, make the populations to appreciate time savings, such as the benefits of more time spent at school for children, less effort in water collection (especially women and children), less journey time for finding water points.

Recommendations

The Board should build more water projects in different locations and increase their rate of households, commercial and institutional connections to unserved areas as this would boost the board's revenue base and make them become viable and profitable and also eventually bring down costs. The involvement of private sector organizations in different level of development among developed and developing countries is highly growing. The use of the framework of Public Private Partnership (PPP) for developing strategic water supply projects in Jos metropolis in areas of Build Operate Transfer (BOT), Build Own Operate Transfers (BOOT), Lease Rehabilitate,

Operate Transfer (LROT), Build Transfer Lease (BTL) and Joint Ventures(JVs). This will lead to cost sharing and ease the burden of these expenditures on the government. Plateau State Water Board part from embarking on serious recovery drive to recover any accumulated receivables over time and automate some processes to cut down cost of production. 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 minimize the rates of water pollution associated with recreations that increase the cost of water production. The Board should explore alternate power sources to cut the costs on electricity supply and amount spent on diesel for their operational activities.

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