



EVALUATION OF RURAL WATER SUPPLY SCHEMES IN SELECTED COMMUNITIES IN ORIRE LOCAL GOVERNMENT, OYO STATE, NIGERIA.

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ABSTRACT

Operation and maintenance of water supply scheme is one of the challenges militating against sustainable water provision in rural areas. This study focused on the evaluation of water supply scheme in selected communities in Oriire Local Government of Oyo State. The study involved assessment of the available water supply scheme, its sustainability level and the quality of the water facility. Field work involved the use of structured questionnaire to obtain information and data on socio-economic status, water use, accessibility, functionality while the water quality of the non water supply scheme (river water source) was determined at the laboratory. Chi square, T-test and Kruskal-Wallis test were used to analyse the data obtained from the field. The study revealed that there is irregular supply of water from the water supply scheme due to inadequate planning for maintenance and rural water supply scheme is not sustainable. It was observed that when local communities participate directly in planning their water supply systems, these systems are more likely to be sustainable than systems that are imposed by government or donor association. The tested drinking water quality was found to be adequate in term of pH, biochemical oxygen demand, chloride ion, total dissolved solid and total hardness. For the water sample tested, all these were generally good except turbidity which was higher than 5NTU. The stream water in the community can also be developed to be the part of water supply scheme.

Keywords: *Water supply scheme, Community, Management, Sustainability*

INTRODUCTION

The importance of water to man and his environment is very obvious. Apart from air, the availability of water in adequate quantity and quality is the most crucial factor to human existence. Water is a vital resource for all living things, it is so important that when lacking or inadequate in quantity and quality, many activities of man are rendered almost impossible. For instance, water is used for all domestic activities such as cooking, washing, drinking purposes and watering of lawns; it is required for all body metabolic processes (Akoteyon *et al.*, 2011). Federal Republic of Nigeria (FRN), (2009) noted that the increasing relevance of water in national development cannot be overemphasized given that agriculture and food security are also critically dependent on water availability. This is because, planting time and crop yield are both determined by the onset, duration and the amount of rain that is recorded in a rainy season.

Consequently, numerous scientific and economic facts have posited that inadequate water supply can cause severe decrease in productivity and death of living species (Garba *et al.*, 2008 and Garba *et al.*, 2010). In modern times, access to safe drinking water is closely correlated with economic development, human health and general well being of the people. It is the duty of all governments to protect the health of the citizens. Government-owned public water utilities, such as Water Corporations, are statutorily charged with the responsibility of supplying water from conventional water treatment plants that use water from impounded reservoir (dams), flowing streams, lakes and deep boreholes. As the country population grew and industries increased, the supply of water by the public utilities became inadequate in quality and quantity. Systematic development of water supply and management in Nigeria dates back to the colonial times. The colonial administration developed domestic water supply as part of overall programme to improve the level of personal hygiene and environmental sanitation throughout the country, and thereby the health of the people. Unfortunately, as noted by Oyebande (1977), the priority accorded domestic water supply by the colonial administration had not been sustained by post independence governments of the country. For example, between 1946 and 1960 the average percentage of the total government expenditure on water was 11.4%, whereas between 1962 and 1975, it decreased to 4.5%. Although there was a steady increase in the percentage of the total government expenditure spent on water between 1975 and 1992, between 1992 and 1996, there was a 50% decrease in the total budgetary allocation for water supply (Areola and Akintola, 1997; Falusi and Gbadegesin, 1998).

The implication of this is that between 1992 and 1996, the total water supply for industrial, agricultural and domestic use increased at a rate of about 1.0% whereas population growth rate was 2.84% (NPC, 1991).

After almost sixty years of water supply development in Nigeria, it is shocking that only 60% of the population has access to safe drinking water, and in rural areas less than 50% of the households have access to good portable water (National Millennium Development Goals, 2005). Rural people in the country still depend very much on rivers, streams, ponds, and shallow wells for their water needs. During the dry season, some of these sources dry up and households have to invest a substantial amount of their resources to get water of doubtful quality. This has very serious implications for the economic development and social welfare of the people specifically and the country as a whole.

In Nigeria, the declaration of the water decade gave impetus for increased capital expenditure by local, state and federal government authorities on water development. There were also assistance in form of aids and grants from UNICEF, World Bank and other organisations. Many approaches covering a wide range of issues in search of sustainable water supply provision in the last three decades by the government are enumerated in Okeola (2005). Yet, many state water agencies (SWA) are finding it difficult to operate and maintain the few existing water schemes while water supply infrastructures are still at developmental stage or are completely absent in some communities (Rossiter *et al.*, 2010). Ellen and Kellog (2005) noted that several efforts have been made to increase provision of domestic water for both rural and urban homes. However, water is still unavailable to many, especially those located in sub-Saharan Africa, South Asia and East Asia. Furthermore, studies shows that water availability is affected by status. While some people pay dearly for domestic water, others have access to adequate portable water and sanitation due to their socio-economic status. (Hunter *et al.*, 2009; Linda 2005).

Operation and maintenance agreement(s) increases the lifespan of the water supply facilities and proper running of rural water infrastructure and this could be attained with community. However, in order to ensure proper maintenance of community water supply schemes, the local communities must be involved in the planning and maintenance. Therefore, the objectives of this paper is to examine socio-economic characteristics of respondents in the study area, assess the available of water schemes, sustainability level of such schemes and water quality of the (scheme) non-water supply schemes in the study area.

MATERIALS AND METHOD

The study area (longitude 4°30'E and latitude 10°5'N) is in Orire Local Government in Ogbomoso area of Oyo State as shown in Figure 1 (Adeboye and Alatise, 2008). Ogbomoso is located at an elevation of 342 meters above sea level, having Ikoyi-ile as Orire LGA's headquarter. It was established in May 1989 with 10 wards and population of 170,858 individuals (NPC, 2006). It covers a total estimated land area of 2,040 km², inhabiting over 100 communities such including Tewure, Obama, Elelu, Atere, Idi-iroko, Bosunla, Iluju, Apiko, Saamo, Igbori, Odun-Ifa and Olokoto among many others (Adabanija and Sunmonu, 2010). This study covers Elelu, Obama, Onila, Idi-iroko, Okusubu, Bosunla and Atere communities.

Structured questionnaires sectioned into three parts was prepared to collect respondent's background information (demographic and socio-economic status), water scheme status (availability, accessibility and sufficiency) and Management of water scheme (operation and maintenance). Out of 200 administered questionnaires, 150 were recovered, providing needed primary data base on household levels for analysis. Chi square, T-test and Kruskal-Wallis test (H-test) were applied to analyse the data collected.

The study further looked into the quality of other alternative water sources available in the study area. Water samples were collected from streams in Obama, Olode-Elelu, Onila, Okusubu communities in (a) sterilized 500ml containers. Collected samples were taken for laboratory analysis within 6 hours of collection using standard water quality test methods and procedures. The results of the analysis were then compared with World Health Organization and Nigerian Standard for Drinking Water Quality (WHO, 2006; NSDWQ, 2007).

RESULTS AND DISCUSSION

Socio-Economic Background of the Respondents

Data from the administered questionnaire showed that less than half of the respondents (42%) are literate. Also, 20% earn less than ₦5,000.00 per month, 57.3% of the respondents monthly earnings ranges from ₦5000 – ₦20000, 12% earn ₦20000 and ₦30000 while 10.7% earn between ₦30,000 and ₦40,000. However it should be noted that their income varies with season because they sell agricultural products during raining season than dry season. The result of the socio-economic data of respondents revealed that not only are the people unable to afford portable water supply scheme for themselves, (but) they may also not be aware of the importance due to their educational level.

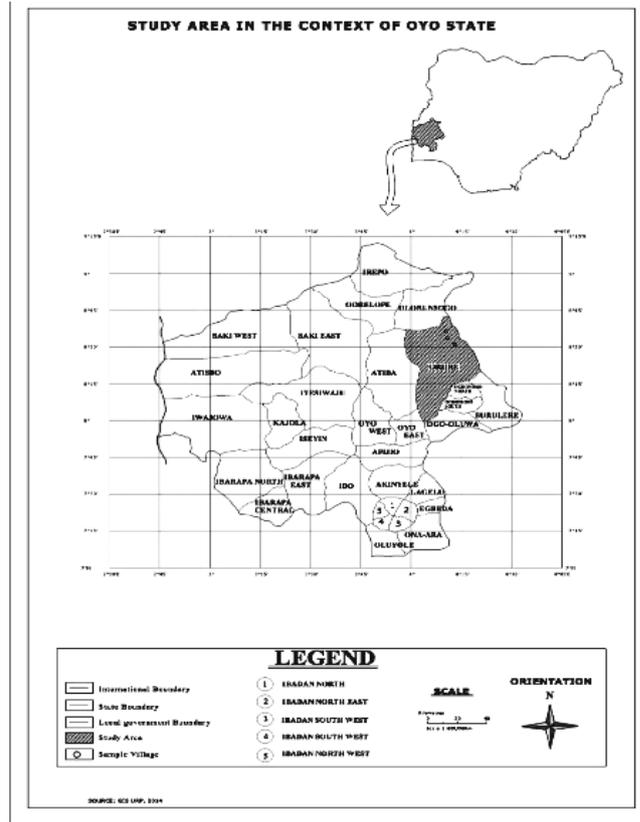


Figure 1: Map of Nigeria showing Oyo State and the Study Area

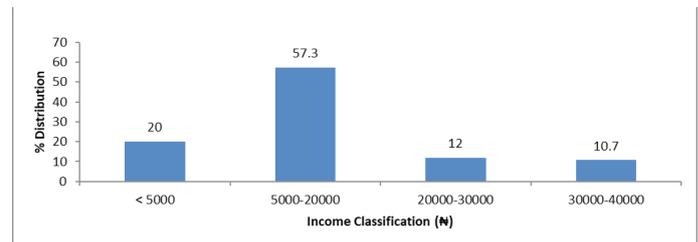


Figure 2: Income distributions of household heads

Technological Option

Availability of water in the Communities

Out of the 7 communities surveyed, there are only 9 sources of portable water, containing only 1 motorized borehole and 1 hand pump in each community except Obama with 3 and Elelu having none as shown in Table 2. Other alternative sources of water for the communities are also documented in Table 2

Table 2: Available Water Supply Scheme/Non Water Supply Scheme in different communities.

Location	well	Stream	Motorised borehole	Hand pump borehole
Obama (1)	4	1	0	3
Elelu (2)	9	2	1	0
Onila (3)	2	1	0	1
Atere (4)	4	4	0	1
Okusubu (5)	1	1	0	1
Idi Iroko (6)	2	1	0	1
Bosunla (7)	2	1	0	1
Total	24	11	1	8

Kruskal –Wallis Test

Applying Kruskal-Wallis test to the different locations to test if there would be any difference in the mean of the water sources data collected, the null-hypothesis H_0 and hypothesis H_1 is as stated.

$$H^0 : N_1 = N_2 = N_3 = N_4 = N_5 = N_6 = N_7$$

$$H^1 : N_1 \neq N_2 \neq N_3 \neq N_4 \neq N_5 \neq N_6 \neq N_7$$

H_0 signifies that all the locations are equal while H_1 signifies that the seven locations were different.

From Table 3, H_{cal} is greater than H_{tab} , hence we reject the hypothesis that there is no significant difference in the average available water supply in the 7 locations. This implies that, water supply in the seven locations were not evenly distributed as there is a significant difference in the availability of water in the communities.

Table 3: Decision Table of Available Water Supply Scheme/ Non Water Supply Scheme in Different Communities using Kruskal -Wallis Test

Group	Total	Mean	N	K	α -level	Df	H_{tab}	H_{cal}	Decision
1	8	2	28	7	0.05	6	12.59	29.99	Significant. Reject H_0 and retain H_1
2	12	3							
3	4	1							
4	9	2.25							
5	3	0.75							
6	4	1							
7	4	1							

Status of Available Water Supply Scheme

The available water schemes (portable water sources) were assessed and evaluated in the seven (7) communities. In Obama and Elelu 50% of the available water schemes are non-functional, while in Onila, Okusubu, Idi-Iroko and Bosunla, 100% of the available water supply schemes are currently

Physio-chemical Test on water samples

Table 5: Physio-Chemical test on water samples

Result Estimated	Sample 1	Sample 2	Sample 3	Sample 4	NSDWQ	WHO
pH	6.60	6.50	6.55	6.30	6.5-8.5	6.5-8.5
Total hardness (mg/l)	32.80	36.30	42.60	31.70	150	200
Dissolved oxygen (mg/l)	118.50	108.60	124.10	110.30	-	-
Turbidity (NTU)	6.90	10.40	10.80	8.50	5	5
Chloride ion (mg/l)	4.50	5.20	5.90	4.94	-	<250
Sulphate ion (mg/l)	32.90	40.90	43.80	38.90	450	500
Electrical conductivity (μ S/cm)	136.50	165.50	186.10	132.40	1000	1200
Chemical oxygen demand (Mg/l)	15.20	18.56	17.50	16.70	-	-
Nitrate ion(mg/l)	4.30	5.70	5.55	4.90	10	50
Total solids (mg/l)	30.20	42.620	46.50	36.70	-	-
Calcium ion (mg/l)	17.60	19.80	20.40	16.20	NS	NS
Total suspended solid (mg/l)	14.90	23.90	26.60	20.10	30	30

functioning. In Atere, only 29% of the schemes are not functioning. Most of the Okusubu villagers depend more on the stream than well. As shown in Figure 3 and Table 4, larger percentage of the functioning water sources are non-water scheme constructed and managed by the communities, while the non-functioning water sources, mostly schemes were constructed by government without proper plan for maintenance.

Respondents’ view on water quality

The views of respondents about the quality of water in their communities were examined. About 13% reported that the water quality is very good, 57.69% says the water is good while 29.48% reported that the water quality in their community is poor.

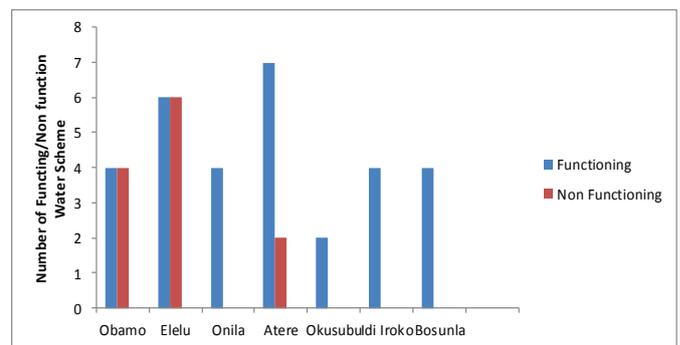


Figure 3: Level of Functionality of Water Supply Scheme/ Non Water Supply

Table 4: Sustainability of the Schemes/Non-Scheme in the Communities.

Source	Functioning water scheme	Non Functioning water scheme	Total
Stream	1	9	10
Well	11	7	18
Borehole	4	4	8

Table 5: Physio-Chemical test on water samples *-continued*

Result Estimated	Sample 1	Sample 2	Sample 3	Sample 4	NSDWQ	WHO
Total dissolved solid(mg/l)	15.30	18.70	19.90	16	500	1000
Magnesium ion (mg/l)	15.20	17.10	22.20	15.50	NS	NS
Biochemical oxygen demand (mg/l)	20.90	18.70	15.54	17.60	-	-
Total Alkalinity(mg/l)	14.80	13.00	14.10	15.40	-	-

Sample 1: Obamo stream water; Sample 2: Olode- Elelu stream water; Sample 3: Onila stream water; Sample 4: Okusubu stream water; NSDWQ: Nigerian Standard For Drinking Water Quality, WHO: World Health Organisation , NS: Not stated

pH and Turbidity

There is no health based guideline for pH, although a range of 6.5 to 8.5 is often suggested because aquatic life is negatively affected below pH of 6.0 (Mason, 1990). Additionally at low pH, the water is corrosive and can cause wear to equipment. All samples fall within acceptable range except sample 4 (slightly acidic). Also, Turbidity in drinking-water is caused by particulate matter that may be present from water source as a consequence of inadequate filtration. These particulates can protect microorganisms from the effects of disinfection and can stimulate bacterial growth (Hunter *et al.*, 2009). In all cases where water is disinfected, the turbidity must be low so that disinfection can be effective. Some forms of primary treatment like flocculation and coagulation therefore need to be carried out on this water sources before any disinfection treatment can be done, otherwise, high turbidity values will shield the pathogenic organisms from chemicals and render the treatment ineffective. No health-based guideline value for turbidity has been proposed; however, it should be below 0.1 NTU for effective disinfection (World Health Organisation, 2006; Katsi, *et al.*, 2007). The turbidity of all the samples were generally high and above standard.

Total Dissolved Solid (TDS) and Suspended Solid (SS)

There is no evidence of any epidemiological reaction at high level of TDS, but water becomes unpalatable and may lead to corrosion of containers (Kruawal *et al.*, 2005). Consequently, WHO, (2006) set the highest permissible values of 1000mg/L. The palatability of water with a TDS level of less than 600 mg/L is generally considered to be good. From Table 5, TDS of all the samples are less than 1000mg/l. Therefore, the TDS value is acceptable for the samples. High TDS could indicate soluble metals and ions present in the water. There is no particular values (are) stipulated for Suspended Solid by both WHO and NSWDQ. Its values in water samples should be checked whenever any treatment method is being contemplated (Birol *et al.*, 2006).

Total Hardness and Electrical Conductivity

Total hardness is determined by amount of calcium, magnesium and potassium in a particular water

sample. Their high concentrations are generally not a health concern but a guideline value of 200mg/l is set by WHO (2006). This may be due to an inverse relationship that exists between cardiovascular disease and water hardness, with increased risk occurring with Calcium concentrations less than 60 mg/L (Rietveld *et al.*, 2009). In large concentrations, they may also affect the taste of the water which also leads to soap wastage if the water is used for washing (Graciana, 2010). Total hardness of all the samples are less than recommended value. Electrical conductivity is the ease to which a substance allows free flow of electricity through the ions in electrolytes example of water sample, (Mwendera, 2006). The Nigerian Standard for Drinking Water Quality has set a maximum permissible level of the conductivity to be 1000 μ S/cm. Electrical conductivity of all the samples are less than recommended value.

Nitrate

Nitrate is a nitrogenous compound that when it is in excess in our drinking water can cause reduction of oxygen capacity of blood, shortness of breath and blueness of skin. The Nigerian Standard of Drinking Water Quality has set 10mg/L for Nitrate. It has a WHO guideline value of 50 mg/l and if exceeded it is regarded as one of the causes of methaemoglobinaemia (Blue Baby Syndrome) in infants (Rossiter *et al.*, 2010) as well as a potential risk of stomach cancer in adults (Mwendera, 2006). High concentration of nitrate in both surface and shallow groundwater can probably be due to poor sanitation and latrine construction, fertilizer and other agrochemical use. From Table 5, all the water samples, have their nitrate values lesser than WHO and NSDWQ, (2007) standards. High nitrates concentrations in drinking waters point often towards contamination (Riemann *et al.*, 2003). Therefore, water sources with high nitrate values need to be checked for bacteria contamination.

Calcium and Magnesium

Many fresh waters are naturally low in minerals and water softening and desalination technologies remove minerals from water. The possible contribution of drinking-water to total daily intake of calcium and

magnesium and the case that drinking-water could provide important health benefits, including reducing cardiovascular disease mortality (magnesium) and reducing osteoporosis (calcium), at least for many people whose dietary intake is deficient in either of those nutrients. According to WHO the maximum value of calcium and magnesium are not stated.

CONCLUSION

The study has shown that the income of the people in the communities is very low and many people cannot afford water supply facilities by themselves. Furthermore, people's income in rural settings whose occupation is predominantly agriculture tends to be seasonal.

While some villages in the study area solely depends on stream as their only source of water, majority of others have water supply schemes which were constructed by the local government while some were own by private individual.

At village level, there was no caretaker committee to take care of proper repairs and maintenance of water supply facilities and water consumption by the community members. The local government do not give room for repair and maintenance after construction. Generally, the institutions or government providing these water

schemes do not consider the communities in the planning, construction and maintenance of water supply facilities. This agrees with the earlier study by Oloruntade *et al*, (2014) who emphasized that the failures were most likely due to poor design and construction, hydrogeological factors and operational and maintenance failures. Poor sitting and scarcity of spare parts are other reasons for the failure of the hand pump fitted boreholes.

Acceptability aspects of drinking water quality such as pH, temperature, turbidity, TDS and total hardness were generally good. However, the presence of higher turbidity in all the sampled water points may affect their use. Also, the level of chloride, nitrate, and manganese was generally good within the WHO guidelines for health and aesthetic considerations. Based on the study, identified stream water in the various communities can be developed as part of the existing scheme to alleviate water supply problem in the study area. On the other hand, the Government should give room for proper planning and management of water supply facilities by conducting the study on decision support system development for rural water supply. In addition, the users of the facilities must be involved in the planning and management of water schemes so as to prolong the long-term effectiveness of the hand-pump and borehole water facility.

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