Investigation Into Water Treatment Processes And Possible Bottleneck Affecting Water Distribution Network In Osogbo Osun State, Nigeria.

Adebara S.A and Afolayan .A
Department of Civil Engineering
The Federal Polytechnics Ede, P.M.B 231 Ede, Osun State, Nigeria.
E-mail: sadebara2006@yahoo.com, afolayanabayomi@yahoo.com

Abstract: This project work investigates factors affecting water distribution network and possible bottleneck encountered during distribution processes and suggest possible ways of ameliorating the problem for effective water distribution to Osogbo metropolis, Osun State. Six hundred (600) copies of questionnaires were distributed with visual observation and interview techniques employed. The data obtained shows that 36.5%, 11.6%, 32.4%, 13.1% and 6.4% of respondents have their water source from borehole, hand pump, public tap, well, and others respectively, more so, 23%, 22.1%, 3.3%, 4.3% and 47.2%, are percentage of typhoid, cholera, diarrhea dysentery and None. 33.4%, 36.7% and 29.9% belong to weekly, monthly and others on the basis of periodic water treatment, also, 63.7%, 15.9% and 20.4% are percentage of people who experience scarcity of water sometimes, Always and Never. Water supply are not evenly distributed to the community, people in Osogbo metropolis due to distribution network of pipes not properly maintain leading to rusting and corrosion of the pipes which causes disease to populace in osogbo area.

[Adebara S.A and Afolayan. A. **Investigation Into Water Treatment Processes And Possible Bottleneck Affecting Water Distribution Network In Osogbo Osun State, Nigeria.** *Researcher* 2015;7 (11):86-90]. (ISSN: 1553-9865). http://www.sciencepub.net/researcher. 12 doi: 10.7537/marsrsj071115.12.

Keywords: Distribution network, bottleneck, ameliorating, visual observation, metropolis, rusting, corrosion.

1. Introduction

Nigeria rank amongst the countries with the lowest level of potable water supply in the world despite the fact that Nigeria was a signatory to the international water decade (1981 – 1990). The status of urban and rural water supply are characterized by low level of coverage which could be as a result of weak political commitment, and lack of operation and maintenance culture for existing facilities, poor workmanship by contractors, etc.

Water sourced from the government is generally irregular or unreliable thus inadequate to meet the needs of the households. The type of treatment provided by a specific public water system varies depending on the size of the systems, whether they use ground water or surface water, and the quality of the source of the water. It was reported that about 1.1 billion people lack access to improved waters. This is due to population growth and rapid urbanization which may consequently increase in coming years unless serious massive investment in supply infrastructure are undertaken to stem the tide. Massive investments in supply infrastructure are required as well as reforms in the operation and maintenance of supply system to increase efficiency. The amount and type of treatment applied by a public water system varies with the source, type and quality. Many ground water systems can be applied without any treatment (Adepoju, 2009).

The process from rainwater to tap water is more complex than one might imagine. The water that comes out of tap has been through various processes that clean and change its original properties, physically and chemically. The importance of good drinking water in maintaining human health was recognized early in history. However, it took centuries before people understood that their senses alone were not adequate judges of water quality. The earliest water treatments were based on filtering and driven by the desire to remove the taste and appearance of particles in water. Filtration was established as an effective means of removing particle from water and widely adopted in Europe during the eighteen century (Environmental Protection Agency, 2004). Water is a limited resource with less than one per cent of the earth's water is fresh and can be utilized for human consumption. The amount of this water will never increase as the water cycle is a closed system. This seems hard to imagine when we have always been able to turn on a tap and outcomes as much water as we need.

The Australian Drinking Water Guidelines stated that: drinking water should be clear, colorless, and well aerated, with no unpalatable taste or odour, and it should contain no suspended matter, harmful chemical substances, or pathogenic microorganisms. Drinking water must not contain chemicals, organic substances or organisms that may be harmful to human health. Drinking water should also be at a reasonable

temperature and be free of unappealing odours, tastes and colour.

According to Environmental Protection Agency (2004), the different types of water treatment processes in water treatment includes: Collection of water from the dam or reservoir, Coagulantion (Alum and Lime are added), Flocculation Tank, Sedimentation Basin, Sludge Collection, Sludge Thickening, Storage of sludge, reuse and disposal, Filtration, Disinfection and Fluoridation, Water Storage and Water Distribution.

II Materials and Methodology

This research work employed the use of questionnaire survey, interviews and observations. A number of interviews were conducted with some of the inhabitant of Osogbo area to have a deeper knowledge of the water treatment process and supply of water to various household. Some of the respondents include farmer, educated person, non-educated and others, which are above 18years old. Six hundred (600) questionnaires were distributed into various places where only five hundred and seventy eight copies were retrieved. Basically, two types of methods were used to collect the study data namely: Primary and Secondary data. Personal interview were carried out to complement the questionnaire which involved oral interview on difficult area that needs further clarification on the problem the populace encounter about the water treatment and supply of water to the community. Oral interview was done at twelve communities in Osogbo metropolis. The community includes Dada estate, Ring road, Igbona, Alekuwodo, Ayetoro and Olaiya, Old Garage, Oke-Fia, Oja Oba, Oke Onitea, Ataoja Estate and Oke Baale where useful information were deduced.

Plate 1: Bust Pipes around Oke – Fia

Visual Observation which involved taking of photograph of some affected pipes, leakages of pipe to know the extent of damages to distribution network is as shown in Plate 1.

III Result and Discussion

The results on the questionnaire distributed to various respondents and hypothesis test on the source of water and periodic water distribution are presented in Table 1– 5 with the corresponding pie chart on gender, sources of water, water borne-diseases, water treatment periodic and water scarcity presented in Figure 1– 5 respectively.

Table 1, shows the sex distribution of the respondent, where 345 (59.7%) were males and 233 (40.3%) were females. This difference in population is an indication of more males than the female respondent in the study area (Osogbo). Table 2, present respondents based on water sources this indicate 211 (36.5%) uses bore hole, 67 (11.6%) hand pump, 187 (32.4%) public tap, 76 (13.1%) well and 6.4% to other source of water supply. This is an indication that majority of the respondents fetched from borehole, which reduces level of prone to diseases.

Table 3, present result in terms of water borne diseases, the results shows that 23.0% of the populace

has typhoid, 22.1% cholera, 4.3% dysentery, 3.3% diarrhea and 47.2% has none of this stated diseases. Table 4 indicate level and period of water treatment in the study area, which shows 36.7% monthly and 33.4% weekly which indicated a low level of pathogenic organisms occurrence in the treated water as compared to longer period of water treatment. It is also worth to note that 63.7% of the study area population experienced water scarcity which put a lot of pressure on the borehole and well since the availability of water from tap is not regular. This cause a lot of burden on the populace that make them look for alternative sources through water tanker services, which is not even regular.

Testing of Hypothesis

Chi-Square χ^2 statistical instrument at 5% level of significance was used to test the hypothesis of data collected for water bore diseases and water distribution. The result is as presented in table 6 and 7.

Chi-Square is denoted by χ^2

$$\chi^2_{calculated} = \frac{\Sigma(O_i - e_i)^2}{e_i}$$

$where,\ O_i = observed\ frequency$

$e_i = expected\ frequency$

$\chi^2_{tabulated} = \chi^2(df)$

$df = (r-1)(c-1)$

$r = number\ of\ rows,$

$c = number\ of\ columns$

Table 1: Percentage of Respondents Based on Gender

Sex		Frequency	Percent	Valid Percent	Cumulative Percent
	Male	345	59.7	59.7	59.7
	Female	233	40.3	40.3	100.0
	Total	578	100.0	100.0	

Table 2: Percentage of Respondents Based on Water Source

Water Source	Frequency	Percent	Valid Percent	Cumulative Percent
Bore Hole	211	36.5	36.5	36.5
Hand Pump	67	11.6	11.6	48.1
Public Tap	187	32.4	32.4	80.4
Well	76	13.1	13.1	93.6
Other	37	6.4	6.4	100.0
Total	578	100.0	100.0	

Table 3: Percentage of Respondents Based on Recorded Water Borne Diseases

Water Borne Disease		Frequency	Percent	Valid Percent	Cumulative Percent
	Typhoid	133	23.0	23.0	23.0
	Cholera	128	22.1	22.1	45.2
	Diarrhea	19	3.3	3.3	48.4
	Dysentery	25	4.3	4.3	52.8
	None	273	47.2	47.2	100.0
	Total	578	100.0	100.0	

Table 4: Percentage of Respondents Based on Periodic Water Treatment

Period		Frequency	Percent	Valid Percent	Cumulative Percent
	Weekly	193	33.4	33.4	33.4
	Monthly	212	36.7	36.7	70.1
	Others	173	29.9	29.9	100.0
	Total	578	100.0	100.0	

Table 5: Percentage of Respondents Based on Experienced of Water Scarcity

Water Scarcity	Frequency	Percent	Valid Percent	Cumulative Percent
Sometimes	368	63.7	63.7	63.7
Always	92	15.9	15.9	79.6
Never	118	20.4	20.4	100.0
Total	578	100.0	100.0	

Table 6: Result of Hypothesis Test on Source of Water

Source of water	Observed 0_i	Expected e_i	$(0_i - e_i)$	$(0_i - e_i)^2$
Bore hole	211	115.6	95.4	9101.16
Hand pump	67	115.6	-48.6	2361.96
Public tap	187	115.6	71.4	5097.96
Well	76	115.6	-39.6	1568.16
Other	37	115.6	-78.6	6177.96
Total				24307.2

$$\chi^2_{calculated} = \chi^2(df)$$
$$\chi^2_{calculated} = \frac{\Sigma(O_i - e_i)^2}{e_i}$$
$$\chi^2_{calculated} = \frac{24307.2}{115.6}$$
$$\chi^2_{calculated} = 210.2699$$
$$\chi^2_{tabulated} = \chi^2_{1-0.05}(5-1)(4-1)$$
$$\chi^2_{tabulated} = \chi^2_{0.95,12}$$
$$= 21.03$$

Since the 210.2699 > 21.03, we reject the claim that "the source of water is not the cause of waterborne disease" and hence concluded that "the source of water is the cause of waterborne disease".

Table 7: Hypothesis Test on Periodic Water Distribution

RESPONDENTS	Observed 0_i	EXPECTED e_i	$(0_i - e_i)$	$(0_i - e_i)^2$
Sometimes	368	192.67	175.33	30740.6
Always	92	192.67	-100.67	10134.45
Never	118	192.67	-74.67	5575.609
Total				46450.67

$$\chi^2_{calculated} = \chi^2(df)$$
$$\chi^2_{calculated} = \frac{\Sigma(O_i - e_i)^2}{e_i}$$
$$\chi^2_{calculated} = \frac{46450.67}{192.67}$$
$$\chi^2_{calculated} = 241.09$$
$$\chi^2_{tabulated} = \chi^2_{1-0.05}(3-1)(4-1)$$
$$\chi^2_{tabulated} = \chi^2_{0.95,6}$$
$$= 12.59$$

Since the 241.09 > 12.59, we reject the claim that "The water supply is evenly distributed in the community" and hence concluded that the water supply is not evenly distributed in the community.

IV Conclusion

The complex causes of the reduction in water supply in Osogbo metropolis suggest that water use effect reaches far beyond the urban areas. This is because the population explosion in the metropolis has a very strong effect on the rural areas which shares the same water plant with it. Many household have already invested substantial amount of capital in improving their water supply, hence they may have little or no need for private water connection.

The result of the study shows that the demand for improved water services is significantly related to the income of the household members. However, majority of the respondents are willing to pay for alternative water supply, particularly if the existing services are improved upon, in terms of the quality, quantity, reliability of supply and water services and with these household income and the connection charges to the alternative source. Therefore, private investment in the provision of potable water should be encouraged in supplying potable water to the community for human

livelihood and existence. The treatment process adopted for the purification of water being supplied to Osogbo metropolis lack effective and efficient operation, hence the water treatment processes need to be redefined, operated and managed effectively for provision of highly potable water, which is deficient of disease carry affinity to the populace of Osogbo metropolis. Sequel to the conclusion drawn, the following recommendations are made: Government should give financial support to water corporation scheme with provision of sophisticated equipments. The distribution network systems of water should be evenly installed at reasonable intervals in Osogbo metropolis. Water supply to the consumer should be properly treated to eradicate various coliform organisms present in water. Private organization should be encouraged to invest in water distribution to reduce the populace search for quality water.

References

1. Adepoju, A. A. and Omonona, B. T. (2009). *Determinant of Willingness to Pay for Improved Water Supply in Osogbo Metropolis; Osun State , Nigeria.* Research Journal of Social Sciences, Vol. 4, pp.1-6.
2. Laura Winkle (2004). *Water Treatment Plant.* www.google.com.pdf Retrieved 23rd April 2015.
3. Nemanja Trifunovic (2015). *Water Distribution.* www.google.com Retrieved 23rd April 2015.
4. Kay, C., John, C. and Leith, F. (2004). *Design and Operation of Distribution Network.* IWA Publication, London.
5. Webber NB (1971). *Fluid Mechanics for Civil Engineers.* Chapman and Hall London.
6. OFWAT (1990). *July Return- Reporting Requirements and Definition Manual*. Office of Water Service, Birmingham, UK.
7. AWWARF (2009). *Pathogens Intrusion into the Distribution System.* America Water Works Association Research Foundation, Denver, USA, 72.
8. Great Lakes Upper Mississippi (2012). *River Board of State upper mississippi and provincial Public Health and Environmental Manager*. Recommended Standard for Water Works 2012. Health Education Services, Albany, New York.

11/25/2015