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Keywords: *access water, sanitation, population, index, disease, portable water, demand, supply, coverage.*

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Modelling Water-Sanitation Relationship in Edo State, Nigeria

Idogho P.O [α], Olotu Yahaya [σ] & Dagona A.G. [ρ]

Abstract- An effective understanding of water and sanitation supply in developing states such as Edo-state is a veritable tool in addressing uneven distribution of these utilities. This research study focuses on the evaluation of water and sanitation supply in the state using baseline and demand responsiveness approaches to capture data on water and sanitation supplies in all the 18 local government areas in the State. Variables such as coverage of access or no access to water and sanitation supply, sources of water and incidences of water-related diseases were captured and technically analysed. The output of the analysis revealed that 62% representing 1,346, 649, population could not access portable water, while 38% corresponding to 813,199 could fairly access portable water in 1993. However, coverage for safe drinking water between 1993 and 2002 in Edo-State is not significant at 95% confidence interval. In addition, 72% (2,009,566 population) did not have any access to sanitation; while 28% (777,210 population) had fair supply of sanitation. The regions with poor sanitation and water index are Etsako central, Etsako west, Esan west, Esan north-west, while Oredo, Akoko- Edo, Egor and Owan east have improved sanitation and water index. The results obtained also indicate widespread of water and sanitation related diseased in the State with the recorded highest cases of Schistosomaisis (134, 361:43%); Typhoid (81,981:27%); Cholera(62,191:20%) and Diarrhea (29,893:10%) respectively. Water harvesting is the major source of water supply in the Edo-state with 69.8% in Etsako West, 65.6% in Esan north East 65.5% in Etsako central while Oredo and Akoko-Edo had 5.9% and 4.3% respectively. Protected water supply from pipe borne water and borehole were noticeable in Oredo with 54.2%, 19.9% and Akoko-Edo with 5.2% and 6.0 respectively. The result on social sector expenditure shows that water and sanitation had least allocation of 18.4%, while Education, Health and Security had 23.5%, 37.0% and 21.1% allocation respectively. However, this research study concludes that serious attention should be given to water and sanitation sector for general growth, productivity and for the State to be on track with the attainment of meeting Millennium Development Goals on the sector by 2015.

Keywords: access water, sanitation, population, index, disease, portable water, demand, supply, coverage.

I. Introduction

Water is a natural resource of fundamental importance. It supports all forms of life and creates jobs and wealth in the water sector, tourism, recreation, fisheries (Ntengwe, 2005). However, water resources, like other natural resources are limited in supply. Without water life is as it exist on our planet is impossible (Olotu et al., 2009). 97.5% of water on the earth is salt water living only 2.5% as fresh water of which over two thirds is frozen in glaciers and polar ice caps. Water forms the largest part of most living matter. The number of people who rely on the earth's limited freshwater reserves is increasing everyday. In fact, a scarcity of clean, fresh water is one of the world's most pressing environmental problems (Arms, 2008). Water demand already exceeds supply in many parts of the world, and as world population continues to rise at an unprecedented rate, many more areas are expected to experience this imbalance in the near future (Waterkeyn, 2003).

Sanitation is the safe management of human excreta and includes both hardware (sanitation technologies, such as toilets and hygienic latrines) and 'software' (hygienic promotion, such as hand washing). Over the past several years, the international community has agreed to a number of water-and sanitations-related goals, including halving, by 2015, the proportion of people unable to reach or afford safe drinking water and the proportion of people without access to basic sanitation (Starkl, 2003). While, globally, the world is on track to meet the target on drinking water, specific regions lag significantly behind, chiefly sub-Saharan African, and especially in rural areas. Water Assessment Program, by 2050, 7 billion people in 60 countries may have to cope with water scarcity (Chenoweth, 2008). Progress on the sanitation goals is much further behind; little progress has been made almost anywhere in the developing world. At current rate of progress, sub-Saharan Africa will not meet the millennium development goals sanitation target until 2076 (Sullivan, 2001).

In Edo State and other Niger-Delta states of Nigeria are facing a great challenge towards the accessibility of safe drinking water and sanitation. This development has resulted to reduction in production and increase in a number of water and sanitation related diseases such as cholera, diarrhoea and typhoid across the state. Without accurate data we cannot have sustainable water and sanitation supply. Having considered the challenges brought by these problems, the research study is focused at evaluating the supply of water and sanitation wants and formulates holistic strategies of ensuring sufficient supply.

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II. Materials and Methods

a) Description of study area

Edo state region of Nigeria is among the deltas in the world. It constitutes the coastline area of Nigeria. It is bounded in the south by delta state in the West by Ondo state in the North and North East by Kogi state and in the East by Anambra state. Edo State covers an area of 19,744km2 and has a total population of 2,159,848 and population density of 109 (based on the 1991 census figure). The state has approximately between latitude 05o 44'N and 07o 34'N of the Equator and between latitude 06o 04o'E and 06o 43o'E. Edo State has annual mean rainfall of above 2,000mm, air temperature of 27oc and relative humidity of above 80%. Fig.1 shows the photograph map of Edo State indicating the study areas. Reconnaissance survey using baseline data extracting mechanism was applied to obtain information in all the visited of local government areas in Edo-State. Four places were visited in each local government area; comprising two rural and two urban settlements. A total of 72 villages and towns were visited in Edo state. In addition, Ministry of Water, Finance and Environment were visited.

Fig 1: Map of Edo-State showing the regions of study

A total of 600 technically designed questionnaires were constructively administered to all the sampled places in the state. Out of the numbers that were administered, 550 completed questionnaires were retrieved (representing 92 percent). The questionnaires were structured to capture the following water and sanitation components:

1. population access to safe drinking water;
2. sanitation coverage;
3. coverage access to safe drinking water;
4. incidences of water and sanitation related diseases;
5. social sector expenditure; and
6. sources of water. Retrieved questionnaires were well collated, sorted and subjected to statistical analysis using tools such as One-Sample Statistics, One-Sample-Test or T-TEST and some other statistical measures.

These analyses were carried out to determine the degree of population coverage to sanitation and safe drinking water, the relationship between coverage to water- sanitation and incidences of diseases such as cholera, diarrhoea, typhoid, cholera and schistosomiasis and the justification of the expenditure on the sector (water and sanitation) to the physical accessible projects in Edo state.

III. Results and Discussion

a) Coverage of safe drinking water

A survey of access to safe water and sanitation in 72 towns and cities in Edo state revealed that 38% of the population had access to safe water either from the borehole, pipe borne water and well constructed hand dug wells. However, 62% corresponding to 1,346,649 could not access portable water as shown in Table 1 and fig. 1 respectively. In addition, places like Etsako West and Etsako Central, are the most water stressed region, while Oredo, Owan West and East have fairly supply of potable water to their teeming population. This shows that the people at the urban areas could access safe drinking than the rural dwellers.

Table 1 : Population access to safe drinking water in Edo State

S/N	Local Govt.	Population	Indicator	Asw	Nasw	%Asw	%Nasw
1	AKOKO EDO	124,366	0.39	48,503	75,863	39	61
2	ESAN CENTRAL	66,169	0.31	20,512	45,657	31	69
3	IGUEBEN	62,342	0.32	19,949	42,393	32	68
4	ESAN SOUTH-EAST	88,358	0.34	30,042	58,316	34	66
5	ESAN NORTH-EAST	89,486	0.31	27,741	61,745	31	69
6	ESAN WEST	91,748	0.30	27,524	64,224	30	70
7	ETSAKO EAST	143,903	0.28	40,293	103,610	28	72
8	ETSAKO CENTRAL	43,263	0.27	11,681	31,582	27	73
9	ETSAKO WEST	87,663	0.27	23,669	63,994	27	73
10	OREDO	305,230	0.48	146,510	158,720	48	52
11	EGOR	212,485	0.42	89,244	123,241	42	58
12	IKPOBA OKHA	263,261	0.45	118,467	144,794	45	55

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13	OVIA NORTH-EAST	122,107	O.40	48,843	73,264	40	60
14	OVIA SOUTH-WEST	81,020	0.41	33,218	47,802	41	59
15	OWAN EAST	78,136	0.37	28,910	49,226	47	63
16	OWAN WEST	72,963	0.37	26,996	45,967	47	63
17	ORHIONMWON	118,054	0.30	35,416	82,638	30	70
18	UHUNWODE	109,294	0.31	33,881	75,413	31	69
	Total	2,159,848		813,199	1,346,649		

Source : Field study

Note:

Asw: Access to safe water

Nasw: No access to safe water

% Asw: % access to safe water

%Nasw: % No access to safe water

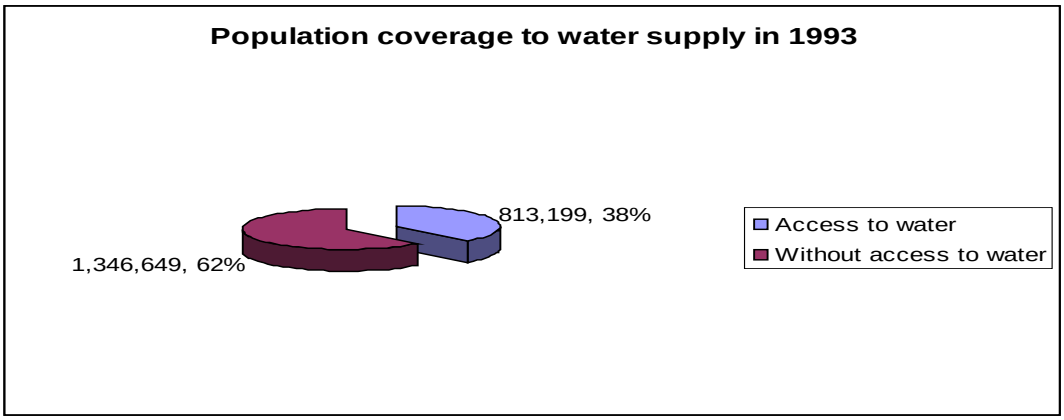

Fig. 1 : Population coverage to water supply

The result in Table 2 further shows the distribution of safe water coverage in Edo-state. The people with access to improved source of drinking water in 1993 were 813,199 out of 2,159,848 representing 38% of the total population as it shown in Fig.1. In 2002, the population with access were 1,268,607 out of 3,485,283 people representing 36.3% of the total population. Finding using T-test revealed that the distribution of portable water in Edo-State between 1993 to 2002 is not significant at 95% confidence interval as it is shown in Table 4. The calculated T-test values were 20.7 and 13.3, while the T-critical values at 95% confidence interval are 1080.16 and 3071.6 respectively. However, the population without access to water has not been improved. In 1993, 62.7% of the population could not access safe drinking water and 63.7% of the population could not in 2002. This result shows that there is no meaningful coverage of safe drinking water between 1993 and 2002 in Edo State.

Table 2 : Coverage access to safe drinking water in Edo State (1993-2002)

S/N	Year	Access to safe water	No access to safe water	Total population
1	1993	813,199	1,346,649	2,159,848
2	1994	883,299	1,597,081	2,480,380
3	1995	986,595	2,077,304	3,063,899
4	1996	1,046,756	2,092,307	3,139,063
5	1997	1,096,956	2,110,632	3,207,588
6	1998	1,141,318	2,138,780	3,280,098
7	1999	1,188,316	2,168,994	3,357,310
8	2000	1,226,966	2,195,178	3,422,144
9	2001	1,256,267	2,206,432	3,456,699
10	2002	1,268,607	2,216,676	3,485,283
	Average Total	1,027,827.9	2,015,033	3,105,231.2

Source : Field study

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Table 3 : One-Sample Statistics

	N	Mean	Std. Deviation	Std. Error Mean
Year	10	1997.5000	3.02765	.95743
Access to water	10	1080.1600	165.01502	52.18233
Total population	10	3071.6000	502.78694	158.99519

Table 4 : One-Sample Test

	Test Value = 0					
	T	Df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
	Lower	Upper	Lower	Upper	Lower	Upper
Year	2086.321	9	.000	1997.50000	1995.3341	1999.6659
Access to water	20.700	9	.000	1080.16000	962.1154	1198.2046
Total population	19.319	9	.000	3071.60000	2711.9279	3431.2721

b) Sanitation supply and coverage

2.5 billion People lack access to improved sanitation, including 1.2 billion people who have no facilities at all (Olotu et al., 2009). This observation corresponds to the output of the research study carried out in Edo-State as shown in Table 5. In 1993, a total of 715,377(33.3%) had access to sanitation, while the remaining population of 1,444,471(66.7%) could not access a comprehensive sanitation. The towns with poor sanitation index are Etsako central, Etsako West, Esan West, Esan North-East, while places like Oredo, Akoko-Edo, Egor, Ikpoba, Okha and Owan-East experience fairly distribution of sanitation supply. The situation in the state is worse because more population did not have access to safe excreta disposal facilities and more than 83% use pit latrines. Both solid and waste water are freely discharged to the environment without considering its adverse effect or health consequences. The result in Table 6 shows total coverage of sanitation in Edo-state for ten years. 72% of the population could not have access to good sanitation, while only 28% had access to good sanitation as shown in Fig 2. This shows that the Edo-state is off track of meeting MDG targets of 75% of population with improved water and 63% of improved sanitation facilities by year 2015.

Table 5 : Sanitation coverage in all Local Government Areas in Edo State in 1993

S/N	Local Govt.	Population	Indicator	Ass	Nss	%Ass	% Was
1	AKOKO EDO	124,366	0.35	43,528	80,838	35	65
2	ESAN CENTRAL	66,169	0.36	17,204	48,965	26	74
3	IGUEBEN	62,342	0.27	16,832	45,510	27	73
4	ESAN SOUTH-EAST	88,358	0.28	1.24,740	63,618	28	72
5	ESAN NORTH-EAST	89,486	0.28	25,056	64,430	28	72
6	ESAN WEST	91,748	0.26	23,854	67,894	26	74
7	ETSAKO EAST	143,903	0.32	46,049	97,854	32	68
8	ETSAKO CENTRAL	43,263	0.23	9,950	33,313	23	77
9	ETSAKO WEST	87,663	0.24	21,039	66,624	24	76
10	OREDO	305,230	0.41	125,144	180,087	41	59
11	EGOR	212,485	0.38	80,744	131,741	38	62
12	IKPOBA OKHA	263,261	0.40	105,304	157,957	40	60
13	OVIA NORTH-EAST	122,107	O.35	42,737	79,390	35	65

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14	OVIA SOUTH-WEST	81,020	0.34	27,547	5373	34	66
15	OWAN EAST	78,136	0.38	29,692	48,444	38	62
16	OWAN WEST	72,963	0.25	18,241	54,722	25	75
17	ORHIONMWON	118,054	0.25	29,512	88,541	25	75
18	UHUNWODE	109,294	0.26	28,416	80,878	26	74
	Total	**2,159,848**		**715,377**	**1,444,471**		

Source : Field study

Note:

Ass: Access to sanitation
Nss: No access to sanitation
%Ass: % Access to sanitation
%Was: % Without access to sanitation

Table 6 : Population coverage for sanitation in Edo state (1993-2002)

S/N	Year	Access to sanitation	No access to sanitation	Total population
1	1993	715,377	1,444,471	2,159,848
2	1994	740,377	1,644,481	2,384,858
3	1995	755,497	1,779,694	2,535,191
4	1996	767,823	1,905,205	2,673,028
5	1997	779,666	2,005,439	2,785,105
6	1998	787,167	2,111,619	2,898,786
7	1999	796,800	2,206,628	3,003,428
8	2000	809,278	2,290,064	3,099,342
9	2001	816,797	2,343,371	3,160,168
10	2002	823,321	2,364,687	3,188,008
	Average total	**777,210**	**2,009,566**	**2,788,776**

Source : Field study

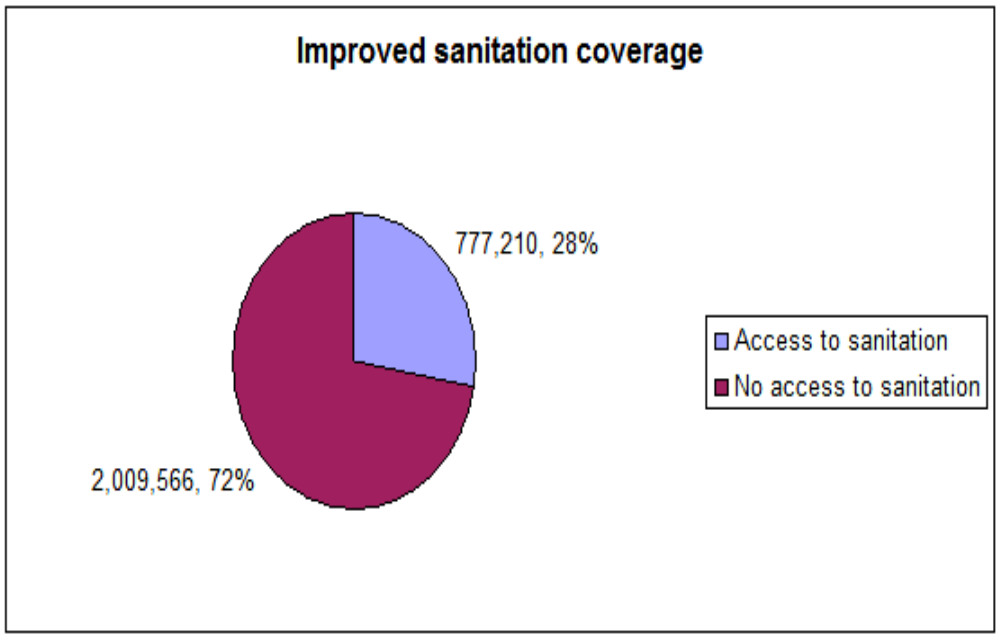

Fig. 2 : Improved sanitation coverage

c) Incidence of water and sanitation diseases

At any given time, half of the world's hospital beds are occupied with patients suffering from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene (Blum and Feachem, 1983). The result in Table 7 shows the summary of water and sanitation related diseases in Edo-State between 1993 and 2002. Highest cases of Schistosomaisis of 134,361 representing 43%, followed by Typhoid (81,981: 27%), Cholera (62,191: 20%) and

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Diarrhea (29,893: 10%) respectively as indicted in figure 3. These diseases endemic throughout Edo State are generally associated with unsatisfactory sanitation conditions and inadequate health education programmes in the State. Health implications of water supply deficiencies in Edo-state are enormous.

Table 7 : Incidences of water and sanitation related diseases in Edo state

S/N	Year	Diarrhea	Typhoid	Cholera	Schistosomiasis
1	1993	3,672	10,351	7,334	15,961
2	1994	3,491	9,806	7,181	15,314
3	1995	3,209	9,243	6,833	14,863
4	1996	3,097	8,821	6,516	14,412
5	1997	2,986	8,417	6,209	13,911
6	1998	2,856	7,972	6074	13,206
7	1999	2,742	7,511	5,896	12,845
8	2000	2,695	7,045	5,618	12,063
9	2001	2,604	6,683	5,349	11,434
10	2002	2,561	6,132	5,181	10,352

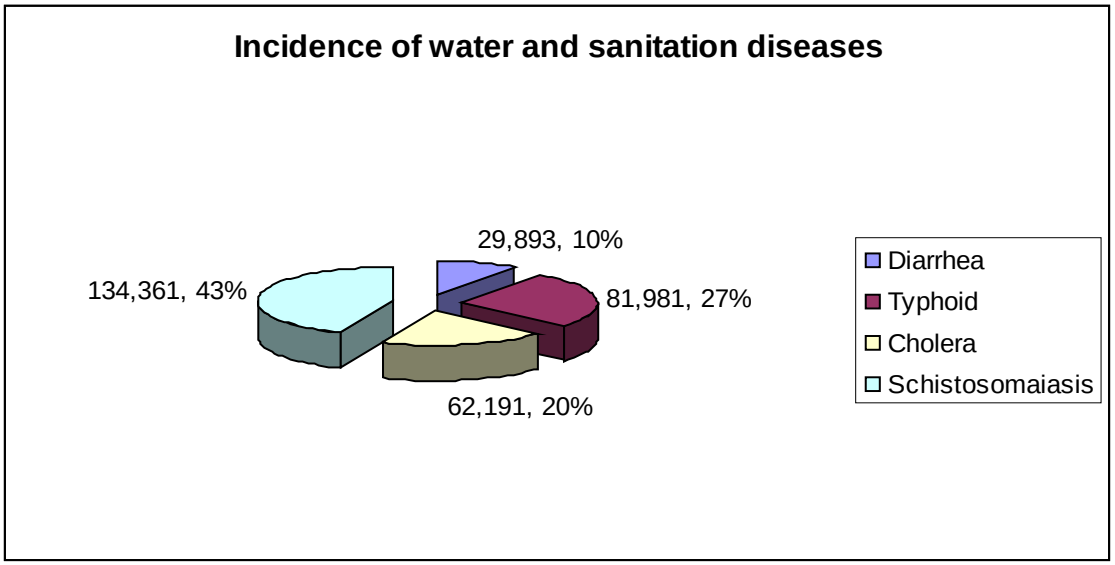

Fig. 3 : Incidence of water and sanitation diseases

The population of people with access to safe drinking water and needed sanitation in the state is low, the state is relatively densely populated and the direct health hazard it imposes is always underestimated. The outbreak of these diseases could be prevented by improving water, sanitation, hygiene and management of water resources. Such improvement reduces child mortality and improves health and nutritional status in a sustainable way.

d) Sources of water

Wide disparities in access to improved sources of drinking water exist among the visited local government areas in Edo-state. The findings reveal that water scarcity is very critical in the following regions: Etsako West, Etsako Central and Esan North East in the month of February to April and the scarcity reduces during the wet season. This is primarily because these regions depend solely on rain harvesting for the major source of their water supply. In addition, the finding indicated that 69.8% of the population has access to rain harvesting in Etsako West, 65.5% in Etsako Central, 5.9% in Oredo and 4.3% in Akoko Edo respectively. Due to the contamination of harvested rain water, it is regarded unsafe for drinking without adequate treatment.

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Table 8 : Sources of water distribution (%)

S/N	Local Govt. Area	Rain water harvesting	Pipe borne water	Bore hole
1	Akoko Edo	4.3	5.2	6.0
2	Oredo	5.9	54.2	19.9
3	Etsako West	69.8	3.7	6.0
4	Etsako Central	65.5	3.8	5.3
5	Esan North East	65.6	4.2	4.8

Source : Field study

In Etsako West about 6% had access to water from protected boreholes, 4.8% in Esan North East, 5.3% in Etsako Central, 6.0% in Akoko Edo and 19.9% in Oredo, while 54.2% used water from pipe borne water in Oredo 5.2% in Akoko Edo, 3.8% in Etsako Central, 4.2% in Esan North West and 6% in Etsako West respectively. From this result, it shows that Oredo has fairly distribution of safe drinking water in Edo state.

e) Social expenditure

Table 9 presents summary of expenditure for social institutions in Edo state in 2002. This table shows that highest expenditure of 582,189 million naira representing 37% was expended on health, followed by education with 330,132 million; 21.1% and the least capital was expended on water and sanitation value, 290,107 million naira; 18.4%. Having considered the variation on the general expenditure in Edo state, it clearly shows that water and sanitation sector has completely been neglected. This development brings about poor awareness in the area of water, sanitation and hygiene, development of existing dams or reservoir, water point and boreholes. Holistic integration of all these lapses resulted in the epidemic of water and sanitation related diseases such as cholera, diarrhea etc. across state as indicated in Table 7.

Table 9 : Social sector expenditure in Edo-State in 2002

S/N	Social Sector	Expenditure(millions)	Share of Expenditure (%)
1	Education	370,148	23.5
2	Health	582,189	37.0
3	Security	330,132	21.1
4	Sanitation and Water	290,107	18.4

Source : Field study

IV. Conclusions

The role of water and sanitation in modern society such as Edo state can never be under estimated. Water resources problems have the potential to constrain human well being, economic development, food security and healthy ecosystem. This research study evaluated the supply of water and sanitation in Edo State. It was deduced from the findings that Edo State is off the tract of meeting Millennium Development Goal (MDG) of 75% coverage for access to safe water and 63% for sanitation supplies by the year 2015. It has been observed that better access to potable water and sanitation can drastically reduce the total burden of diseases and improvement in public health cares.

Effective strategies require a particular participatory approach and this takes good marketing in the areas of water and sanitation development. Sanitation is perceived as personal and not important as a utility like water is. This thinking must completely be changed. Generally, Edo State Government should prioritize safe water and sanitation supplies in their budgetary allocation in order to increase the degree its coverage in the state.

V. Recommendations

Based on the findings, the following recommendations are drawn:

1. Bottom up approach mechanism must be introduced in designing and developing water and sanitation programmes;
2. Demand responsiveness approach must be introduced in establishing water and sanitation project in any of the local government areas in Edo State;
3. Government, both local and state in Edo state should match their political will with financial commitment to see that the allocation for water and sanitation sector is increased, and ensured that voted capital is appropriately spent/applied in the provision of water point, sanitation facilities such as public latrines, hygienic awareness programme/ education;
4. Community based effort must be introduced so that the people in the community see any of the water and sanitation project in their domain as theirs towards protecting and maintaining them; and

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5. Corporate organizations, international organizations and some private individuals should be encouraged to invest in water and sanitation sector in order to compliment governmental efforts.

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