Impact Factor (SJIF): 6.126 E-ISSN: 2583-1615

International Journal of Research in Academic World

Received: 09/January/2025 **IJRAW:** 2025; 4(2):54-63 **Accepted:** 05/February/2025

Management Strategies for Sustainable Water Supply in Nigeria

[*1]ACC Ezeabasili, [2]NU Dim, [3]Chinwe Sussan Oguejiofor, [4]OKAFOR Ifeoma Pethronila and [5]Chikezie Godson Chukwuma

[*1]The School of Architecture, Building and Civil Engineering, Water, Engineering and Development Centre (WEDC), Loughborough University, United Kingdom.

[2]The School of Management Technology, Project Management Technology, Federal University of Technology Owerri, Nigeria.

[3]Department of Vocational Education, Chukwuemeka Odumegwu Ojukwu University, Igbariam, Nigeria.

[4]Department of Cooperative Economics & Management, Faculty of Management Sciences, Nnamdi Azikiwe University Awka, Anambra, Nigeria.

[5]Department of Public Health, Faculty of Health Science, Imo State University. Owerri, Imo, Nigeria.

Abstract

Nigeria is not on-track and has not yet achieved the Millennium Development Goals (MDG) target 7c of 2015 which intends to halve the population that does not have access to potable water and sanitation. The water-supply issues have taken a critical situation with the rapidly-increasing population, agricultural demands decreasing rainfall due to climate change, non-existence of potable surface water and pollution of water by wastes.

This study employed a qualitative approach method of investigation to examine water sustainability existing institutional framework, practices and present patterns of water use. This study will also demonstrate the value of water management plan in contribution to achieving sustainable water supply in Anambra state. Reviews, analyses of the situation of water and of its management practices in Anambra indicate that there is a glaring laxity and that challenges exist in policies related to water management strategies.

Keywords: Management, strategies, sustainability, framework, water supply.

1. Introduction

The (WHO/UNICEF 2000) [15] Programs for joint monitoring (JMP) for Water and Sanitation most recent update confirms that at present, the world is expected to exceed the MDGs target of bringing to half the portion of its population without sustainable access to potable water. Since capacity building, operation and maintenance are keys to sustainable le governance donor agencies. The communities have attached great importance on these components in planning, management and water supply monitoring projects (Davis & Brikke, 1995) [2].

According to (Nfor, B. N., *et al*, 2007) [7] Anamabra State is traversed by four geological formations from which groundwater is tapped in the state. The geologic formations include:- Ameki/Nanka formations (Outcrops mainly at Aguata. Orumba, Anaocha areas), Imo shale groups (parts of awka, Ayamelum, Orumba North), Lignite formation Ogwashi-Asaba formation is traversed Nnewi, Ekwusigo and parts of ihiala, and coastal Plain Sand formation is traversed Ogbaru and Anambra West. Groundwater is the current source of water supply in the state from the government and unorganized private sector in the urban, small towns and rural areas. All the small-town water schemes are borehole driven, and the borehole driven functional water schemes include, Nibo, Nise, Agulu-Aguinyi, Nimo-Enugu-Ukwu-Abagana, Awkuzu, Njikoka, Ozubulu, AzuigboAmichiukpor water schemes (Nfor, *et al*, 2007, Olugboye & Hayes, 2011) [7, 8].

Therefore, there are currently more than 3000 boreholes in the state. In areas where the groundwater resources are deeply seated, and out of reach in Aguata LGA, rain harvestation had been the main strategy for all year water supply. In the last two years the RUWASSA/UNICEF have drilled many boreholes which are spread the communities. And, with the rehabilitation of the Obizi streams at Uga, the Aguata area now has an alternative to borehole development (Olugboye & Hayes, 2011) [8]. Moreover, the increasing agricultural sector's need for water is greater than the amount available for use in the Imo shale areas. Many studies in the past had x-rayed the water situation and management strategies among stakeholders in Nigeria. Hence, they have significantly identified the policies and strategies for implementation. The existing problems according to Shiklomanov (2000) [10] which was highlighted by them are as follows:

- The danger of groundwater levels falling, making it difficult and costly to abstract.

***Corresponding Author:** ACC Ezeabasili

- The continuing reduction of rainwater and over-exploitation of existing groundwater in Nigeria.
- Limited public knowledge of water issues and also lack of stakeholder involvement in water issues.
- Poor Institutional and legal frameworks.
- Pollution from wastes.

More so, it was estimated that the demand for water in Anambra state in year 2005 was 213, 952m3 per day. This rose to 278, 313m3/day in 2015. The percentage of water available to the state or percentage of water supply against demand was 7.2%. This means that only 7.2% of safe water requirement was met in 2015 and this was very poor. Therefore, it requires extensive work to establish new water schemes, new sources and to rehabilitate old schemes to close up the demand gap. These problems will all have impact on the water situation in Anambra that will be visible in the future. This is for the fact that there is no one particular solution that makes water supply and management attain sustainability. Nevertheless, the solution would vary from region to region.

Furthermore, the demand responsive approach requires that managerial decisions about levels of service, location of facilities, cost recovery and should be achieved locally. (Deverill *et al*., 2002) [3] list four assessment techniques: investigating people coping strategies, demonstrations of demand, user participation in option development and contingent valuation. Affordability, based on an assumption that people would pay three to five per cent of the income on water services has been shown to be a poor guide to measuring. Despite the consensus that the affordability bases on income levels are required to assess demand "developing an understanding of people's economic status is useful for the development of poverty sensitive strategies" (Deverill *et al*., 2002) [3].

2. Literature Review

The management of community water supply system is normally carried out by a committee established by the community solely for this purpose. Existing community or organizations may also be effective in managing a new water supply project. Therefore, the establishment of a new committee requires careful (Davis and Brikké, 1995) [2]. Regardless of what name the committee has, there are common approaches to their establishment and operation (Davis and Brikké, 1995) [2]. The tasks of the committee and the roles and responsibilities need to be defined and understood, and the committee needs to establish policies governing the utilization of water facilities, maintenance plan and cost recovery procedures.

More so, Smout (2010) [12] recommended that an assessment of community skills and capacity should be carried out before finalizing a capacity building plan. Training for committee members on cost recovery should cover budgeting, tariff design, billing, revenue collection, recording income, expenses, monitoring and applying sanctions. Training for the caretakers should cover operation, maintenance and issues of cost recovery. The training should be suited to the capacity of the community members, should not be too long and should include women and men.

2.1. Present State of Water Supply in Anambra State

Good governance in WASH services requires participatory approached among stakeholders for development, efficient and sustainable use of resources, Efficient Water Governance is predicated on basic reform principles which address key areas of policy, legislation frame work, institutional frame work, decision-making mechanism and regulation which are lacking in Anambra State, hence causing the collapse of the system. There was no policy and no institutional arrangement to defines roles and duties. The government attracted the EU supported WSSSRP program in the state which it gave all the political and financial support by paying the mandatory counterpart fund which ushered in the reform processes. These reform elements include:-

i). New bottom-up, demand driven approach to water supply.
ii). Decision making to be developed to the lowest possible administrative level (WCA)
iii). Capital cost should be shared between 2 levels of government, state, local governments, and the benefiting communities
iv). Government to focus more on facilitating, coordinating, planning, financial capital projects and development, while services provision is to be done by appropriate agencies, bodies and the water service providers.
v). The water sector needs to be regulated to protect the consumers/providers and to ensure its long-term sustainability for service provision
vi). Private sector participation for efficiency and accountability
vii). Community involvement and ownership, Water Consumer Association (WCA) in small towns and WASCOM in rural areas. O&M is the hub of continued production of water supply as the strategy of cost recovery and willingness to pay.

- **Water Demand:** Anambra's per capital domestic water consumption is about 90 liters per day in comparism with the acceptance consumption rate of 170 litres approved by the World Health Organization (WHO). With Anambra population which is about 4.2 million GPD domestic and expected to be 7, 155, 799 per day by 2040, the demand of water for domestic purposes may increase by 50% in the period. The available water is been shared competitively by agriculture, industry and domestic use. Anambra state water corporation owns sixty-two (62) Water Schemes but only five (5) are functional. Baseline survey in 2016 indicates that the government owns 497 motorized boreholes, 72 hand pump boreholes and 7 surface water schemes. The total installed capacity was 30, 795m3/day. It is expected that demand for Municipal, Industrial Agriculture will increase leading to total water demand in future.
- The demand of water is increasing in the local sector due to increasing population which is expected to rise from 4.58 M in 2019 to about 7, 155, 799 in 2040 due to high birth rates.
- Industrial and Agricultural sector are growing at a reasonable rate.

2.2. Operation and Maintenance Systems

Maintenance activities can be preventative, reactive, or extend to major rehabilitation or replacement and the requirements vary considerably with technology types used and the capacity of the system. Harvey and Reed (2004) [6] provided details of the various types of maintenance models which fall into three categories as follows: Village Level Operation and Maintenance (VLOM), Public Private Operation and Maintenance (PPOM) and Private Ownership and

Maintenance (POOM). An O&M management system usually has the following key components: Operation and Maintenance (O&M) policy and objectives, O&M manuals, annual O&M plan, budget, work schedules and a monitoring plan (Skinner, 2011). The O&M system can be developed at a Program level countrywide, then trailed at a project level on new and existing schemes to test the feasibility of the system (Davis &Brikké, 1995) [2]. The potential users should be provided with comprehensive information about the ongoing maintenance requirements (Fonseca *et al*, 2011) [5]. Designing systems for ease of operation and standardization of designs are two key principles that can minimize operation and maintenance difficulties (Well, 1998) [14]. The first principle requires the selection of simple technology, which can be operated and maintained by the community taking into consideration the skills available and willingness to pay. The second principle requires the use of standardized designs within a range of technological options and alternative management approaches.

2.3. Monitoring and Evaluation

Danert and Narkevic, (2013) [1] proposed that robust, transparent monitoring and evaluation are essential to generate the up-to-date evidence which can lead to informed decision making, effective policies and better planning. Harvey and Reed, (2004) [6] explained the process of setting up an appropriate monitoring system which involves the following steps: selection of performance indicators, monitoring tool selection and design, monitoring scheduling, role allocation, staff training, evaluation, review, and information sharing, while, Danert and Narkevic (2013) [1] advocated the establishment of a country-led and country-wide performance management system which cover the whole service delivery chain and are added up within the existing national processes of national planning, budgeting, review and reporting.

Segone, (2010) [9] defined a country-led Monitoring and Evaluation methods as a procedure where the host country leads and owns the Monitoring and Evaluation process by determining:

- What is important to evaluate?
- What questions would be asked?
- What analytical approach would be undertaken?
- How will the findings be communicated?
- Ultimately, how would the finding be used?

As well as carrying out Monitoring and Evaluation duties at a local level to provide information about Program Performance, the users of a community water supply can monitor and evaluate their own system, with possible back-up from extension agents (Davis and Brikké, 1995) [2].

3. Methodology

Implementation of sustainable strategies in water supply management differ from country to country due to the uniqueness of experiences, nature of problems and maturity level of stakeholder in quality water management schemes. Successful water management implementations programs as reported in the existing literature were mainly in some developed nations such as the United State, and Western Europe, thus there is need to develop an implementation strategy that will be adaptive enough to the prevailing indigenous water management circumstances in Nigeria. Thus, it is important to review laws, existing policies, capacity building, operation maintenance issue and sustainability in Anambra State. The following should be looked at for sustainable water supply to be ensured:

- The relationship between the external donor, the Rural Water and Sanitation (RUWASAN) is expected to be further consolidated.
- It is estimated that the percentage of Water Supplies against demand was 7.2% in year 2015 and has widened in 2019. This means that it requires extension work to establish new water scheme, find new sources and rehabilitate old ones to close up the demand gap.

Therefore, the methodological approach in this study employed a qualitative method of investigation, and data are collected through published and unpublished literature, personal research using archival, historical sources, and interviews with the key personnel in the water sector sources to establish the current water supply situation within the area. About 21 items of interviews and discussions of one focus group of water users, professionals, observations, collection of documents from government officials, service providers were conducted. A face-to-face interview organized to investigate the functionality of existing water supply system in Anambra State, and the interview questions were developed and shared among water professionals and key stakeholders in water scheme. The selection criteria for the eventual stakeholders were based on management experience and number of participations in water development projects in the last five years in terms of their water use practice, attitudes, beliefs about paying for improved water services, water management, and barriers to sustainable water management strategy. And, the proposed research respondents encompass; agricultural water users, domestic water users, women, government head of agriculture, water contractor/consultancy, sanitation official, hydrogeologist, and environmental agency official. The answers provided by the respondents from the interviews and focus group discussions were noted down in standardized interview form.

3.1. Data Presentation and Analysis

The qualitative data collected were subjected to different measurement scales that were later analyzed with SPSS version 23 and Excel. The data collected and its analysis are shown below in tabular forms:

Table 1: Rating of Farmers Awareness on existing water policies in Anambra State.

Extent of Awareness of Water Policy	Mean weight	Std. Dev.	Decision
Maintenance policy	2.48	0.928	Not aware
Bottom top policy	4.24	0.889	Aware
Top-bottom policy	2.48	0.873	Not aware
Payment policy	2.43	0.870	Not aware
Water treatment policy	2.62	0.921	Not aware
Cluster mean	2.85		Not aware

Source: *Field Survey Data, April 2019.*

Table 2: Water Supply Strategies for Sustainability.

Stakeholders	Question	Response	Freq.	%
Agriculture/Irrigation water user	Do you agree the quantity of water taken from your well for irrigation should be limited to ensure sustainability of the supply?	Yes	12	57.1
		No	9	42.9
	Under what condition farmers should be allowed to extract water?	During dry season farming	15	71.4
		when there is need to control flood	4	19.0
		when the water does not contain heavy metals	6	28.6
		when it is safe for domestic use	13	61.9
	Do you think it is important for legislative reform to be made to ensure the sustainability of water supplies in Anambra State?	Yes	17	81.0
		No	4	19.0
	Do you think farmers should be involved in management issues?	Yes	21	100.0
		No	-	0
	In what way should farmers be involved in water management issues?	Farmers should decide on the right penalty they will pay when the policy is violated.	10	47.6
		Farmers should be used to police violators.	4	19.0
		Farmers should be trained to manage the water project themselves.	17	81.0
Domestic/Industrial User	Do you consider there should be controls which limit the misuse of water by users?	Yes	19	90.5
		No	2	9.5
	Which of the following control measures will you suggest?	Metering	9	42.9
		Legislation	3	14.3
		Penalty/fine	14	66.7
		Police arrest	7	33.3
	Do you agree the water suppliers should enforce the installation of water meters in properties to conserve water in the state?	Yes	15	71.4
		No	6	28.6
	If yes, which of the following considerations arise when identifying properties to install water meters?	Family Size	16	45.7
		Family Income	17	48.6
		Size of the House	2	5.7
		Garden Size	-	0

Source: *Field Survey Data. April 2019.*

Table 3: Functionality of the Existing Water Supply System

Stakeholder	Question	Response	Frequency	Percentage
Domestic/Industrial water users	What do you understand about the word Sustainability?	Continue supply of water without adverse effect.	11	52.4
		Inexhaustible	7	33.3
		Not clear with the meaning	3	14.3
	Are you aware of any guide or publicity relating to water users in relations to sustainability?	Yes	19	90.5
		No	2	9.5
	What informed your choice of selection of water facility?	Well is cheap to build and maintain.	9	42.9
		Close water depth	6	28.6
		Rain water is readily available.	1	4.8
		Inadequate professionals to drill to the required depth.	2	9.5
		Contractors sometimes cut corner which results to unclean water for consumption.	13	61.9
	Which type of borehole facility is preferred in your area?	Hand pump	12	57.1
		Motorized	2	9.5
		Solar powered	7	33.3
Mature house-wife	How do you compare the water use in your house in the past five years with the recent times?	We have more water and use more.	4	19.0
		Water usage has improved.	17	81.0

Source: *Field Survey Data. April 2019.*

Table 4: Best Practice to bring Improved Sustainability of Water Supply and Management.

Stakeholder	Question	Response	Freq.	%	Mean	Std. Dev.
Domestic/Industrial water user	To what level do you agree water polluters should pay remedial cost in Anambra State?	Strongly agreed	-	0		
		Agreed	13	61.9		
		Somewhat agreed	7	33.3		
		Disagreed	1	4.8		
		Strongly disagreed	-	0		
	Which of these represent your candid opinion on water usage?	Opinion	Yes	No No		
		Water suppliers should train water users on how to use water.	21	- 100.0		
		Water suppliers should demonstrate to water users on how to properly use water in properties.	21	- 100.0		
		Water suppliers should educate water users in using water in a sustainable manner.	18	3 85.7		
	Do you approve of setting up a rural community base operation and maintenance committee?	Yes	21	100.0		
		No	-	-		
	What are the work functions of O/M committee?	They maintain the borehole and may contract the contractors/suppliers of the water when need arises.	17		81.0	
		They liaise with the traditional rulers to mobilize funds where community effort is needed	12		57.1	
		They manage water supply for community members	2		9.5	
		They keep proper records of the water activities and financial transaction for the community water project.	1	4.8		
		They prepare schedule for water supply and monitor its implementation	5	23.8		
		They collect fee for the water suppliers.	7	33.3		
	Do you approve setting up a water user association for sustainability?	Yes	21	100.0		
		No	-	-		
	What will be the functions of the water user's association?	They regulate the activities of the operation and maintenance committee.	8	38.1		
		They use the money generated from users to maintain water breakdown.	11	52.4		
		They provide work tools for the O/M committee.	5	9.5		
		They keep record to monitor water breakdown.	15	71.4		
Matured house-wife	Do you think there is a need for legislative reform to ensure water supplies are sustainable in Anambra State?	Yes	21	100.0		
		No	-	0		
	What are the finest ways to ensure water is saved?	Metering	12	57.1		
		Legislation	7	33.3		
		Policing	2	9.5		
		Enforcing water user's association	10	47.6		
	How do you make people realize that water has value?	Metering	10	47.6		
		Price tag to use	17	81.0		
		Use of water user's association	5	23.8		
Water Engineers/Contractors	What will be the functions of O&M committee?	Maintain water facilities	2	33.3		
		Repair broken pipes	1	16.7		
		Report breakdown issues to water suppliers	3	50.0		
	How do you think water pollution will be prevented?	Policy enforcement	6	100.0		

Source: *Field Survey Data, April 2019.*

3.2. Transcript of Interviews and Focus Group Discussion with Women

Table 5: Focus group Discussion with Women

Question	Response
How do you compare the use of water in the past 10 years and the recent times?	P1; Women are now more prosperous and many a time water is available through taps and boreholes hence, water consumption is high.
	P2: High water consumption in every occasion or in the households. Women today don't suffer as much as in the past when one has to trek more than 10 kilometers for 30 liters of water in some instances.
	P3: I do not like people who waste water. I know how it was in the past and how costly water was to provide. Women use too much water in whatever they do and it is not a pleasant attitude.
	P4. Water is easier to access now and because women have no knowledge of the suffering of the past or they have forgotten water is highly misused.
What is the trend of water consumption by women presently?	P1: Presently the situation has improved as it is easier for women to access water for washing clothes and dishes.
	P2 Women used water more carefully before because it took plenty of time to get water.
	P3 Excessive water usage is experienced by women recently.
	P4. The awareness is conserving water and better usage is now lost with women.
	P5 Water is easily available and therefore the issue of excessive use is expected.
What are the best ways to ensure water is saved and to make people realize that water has value?	P1. If meters are used for water, it will have the required impact.
	P2: A tariff for water use should be introduced.
	P3: Maintenance culture should be taught to women to avoid waste and leakages.
	P4: Education on awareness of how to save water and management use effective must be a priority.
	P5: To avoid any leakages of pipes and taps should be guided and using drinking water for gardens and domestic work should be minimized.
What are the measures to implement in order to ensure water sustainability in Anambra State?	P1: Operation and Maintenance team should be constituted to ensure sustainability.
	P2: water users association should be formed.
	P3: Government should ensure water policies are adequately enforced.
	P4: households that waste water should be made to pay heavy fine
	P5: water should not be harvested from only one source in the state.
What will be the job of the Operation and Maintenance for water sustainability?	P1: they should be trained to repair broken pipes.
	P2: they should monitor the use of water by household members
	P3: they should report water breakdown to the government
	P4: during borehole construction, the team should ensure that water contractors use the right materials specification
	P5: the team should help to collect revenue from water users
Is re-cycled Water acceptable and what is the biggest problem you think water consumption poses?	P1: if the recycled water is safe and hygienic, there is no problem.
	P2. We have good quantity of good ground water and I don't agree it is good to use recycled water.
	P3. I think it will add to extra time and cost recycling water
	P4. There is good water everywhere and I think Chlorination and simple treatments surfaces
	P5. It is necessary to regulate water industry. We may not need to recycle water in the near future. Our problem is adequate management.

Table 6: Interview with Office of Ministry of Environment

Question	Response
Please explain what you understand by sustainability	**HODEV:** He said Anambra state has a large quantity and quality of water more, water would be in demand for farming and irrigation in future as investment in Agriculture increases with Government policy of diversification. It is important to manage water well and avoid unnecessary losses. Water resources must be protected and made safe.
Attitude and behaviors of water users	**HODEV:** population is increasing at a fast rate and the demand for water too. Water users must be educated about water consumption. For safety, water in the tank has to be covered, and water should not run freely within the streets
Identify problem of water and what do you support as the solution of excessive water drinking water.	**HODEV:** Education is needed to make water users understand that water can be scarce. We cannot live without water. Water misuse can be dangerous to the environment and a strategy is needed in its management. Misused water can be food for the environment where insects thrive. This can cause health challenges. Those who live uphill might have problem with water and pumping is required to get water uphill. Even, erosion of soils can be a problem.

Are you satisfied with both private and public water services provided by suppliers?	**HODEV:** I think we have sufficient water from boreholes and surface water for most of the communities. But I think better strategies are needed to ensure that water covers all areas both now and for the future with the increasing population both for agriculture and domestic uses.
What do you think about water tariffs and water meters being provided inside the properties?	**HODEV:** Water users should feel that water has value when this is widely implemented. Users should be educated on the benefit of paying for water use and sustainability
What do you know about groundwater depletion and increasing number of waters well in Anambra state?	**HODEV:** In urban areas with so many wells that are not regulated, it is obvious that due to pumping the groundwater is facing depletion. This is because the public 'water works' is virtually not available and therefore people are drilling individual water boreholes in virtually all the residential accommodation in the town

Table 7: Interview with Director of water and Sanitation/Operation & Maintenance

Question	Responds
What do you know about the term sustainability?	Sustainability is a requirement of civilization, and we must work to achieve sustainability in water. The amount of water we have is great but it is good to optimize the use and maintain regular supply, this is the concept of sustainability.
Are you aware of the problems that affect water sustainability?	There are a lot of problem that needed to be addressed in order to maintain the water network for ages. There are problems of lack of pump for water distribution, and there is illegal connection in some areas leading to deterioration of service provided by WSS to the residents. I am aware of the excessive misuse by the residents, and now they have started to get more liters per day instead of about 50 cubic liters.
Identify the problems of which you are aware.	Poor performance of the pipes for the water line to the main pumping station, the lines are corroded in most of its parts, as well as broken air valves and water losses. There is high cost of submersible pump for wells, and bad use of water by the resident. I am aware of the excessive misuse by the residents, and now more water is readily made available and they misuse more. There is negligence in maintenance.
Are you aware of water misuse by other property owners?	Yes. It is very clear from what we see on the street. Looking at the street you will see clear evidence of water misuse by people in Anambra state.
Can you suggest any solution to help prevent the misuse of waters?	To solve the problem, we need to introduce the water meter system, like in other countries to control our consumption and moreover leak detection and repair. The only way to control the misuse of water consumed is to introduce water meter system or the pay as you go system. To put tariff on whatever is used beyond a set limit of water allocated to a household. Education and training domestic water users are also very important.
Are you aware of any guidance or publicity relating to water users in relating to sustainability?	Education of water users is vital to implore water users to use wisely and to achieve that, community education should start at the school by incorporating into the school programs some topics about conservation of water.
Are you satisfied with the water services provided by the suppliers?	I am not satisfied with the service we provide for local residents. What I am not happy with is the system of water supply operation and its maintenance. Technical problems like miss-matched pressure of water that causes lack of water for some properties. The corporate side of water supply is corrupt, and that causes further technical problems with water supplies. The water corporation is non-functional. I am positive about water supply which is provided, while it is difficult to solve all existing problem with the lack of information about pipes not working and difficulties leak detection and repair, water user's behavior with water, this is just an example of existing barrier to sustain water.
What are the difficulties in the providing water services?	There is geographical problem with the locations of water network pipes. Reduction in water losses, leak detection and repair. Reducing the amount of used water in house and personal activities like washing machines, toilet, etc have impact in water sustainability.
Do you consider water suppliers should train, demonstrate and educate water users in using water in a sustainable manner?	Education of water users is an important element to convince water users to perceptively, but with a lack of highly qualified and capable personnel in water management, it makes it difficult to train water users. If domestic water users are educated and received the necessary training, it will help to achieve higher water use efficiency. Long term training for water users is needful for water conservation in Anambra state.
Water do you think will be the effect of O&M in providing sustainable water?	The good side of O&M in sustainable supply of water in Anambra state is that, their presence will help to ensure early detection and repair of broken water facilities. There will be a checkmating on water misuse.

4. Findings

4.1. Water Policy Review in Anambra State

Though, water policies exist in Anambra state, but this study wanted to ascertain; to what extent water users are aware of the policy existence. Thus, the researcher used mean threshold of 5-point Likert scale to capture and quantify the water user's awareness on water policy in Anambra State. The strength of their awareness was scaled from 1 – 5 as strongly not aware, not aware, somewhat aware, aware, and strongly aware respectively. This was later interpreted as greater than or equal to 3.0 as aware and less than 3.0 as not aware. Based on the five (5) items of water policy in Anambra state captured, only 1 had mean threshold of 3.0 while the remaining 4 had mean threshold less than 3.0. Thus, the users of both Agricultural/Irrigation, and Domestic/Industrial water users were only aware of Bottom top policy. The cluster mean of 2.85 suggest that the water users are not aware of most of the existing water policies in the state. The implication is that water misuse may continue hence the policies guiding water use for sustainability in the area is not known by the users.

4.2. Strategies and Law Document Relating to Water Supplies in Anambra State

The strategies adopted for water sustainability was presented in table 3.2 above. These strategies aimed at bringing about efficient utilization of water in Anambra State. The strategies adopted, if implemented will ensure water sustainability in the study area. Thus, below are some the strategies used by the study. Some of these strategies suggested by the users in the area as was discussed below were: limiting the amount of water taken, regulating the time of water abstraction, legislative reform, regulation of water usage in the farm, involvement of farmer on water management issues, and limiting the misuse of water.

- **Limiting the Amount of Water Taken from Well for Sustainability:** The project found out that greater number (57.1%) of the Agricultural/Irrigation water users suggested that the water in their farm should be regulated to ensure sustainability, while the remaining 42.9% said that water supply in their farm should not be regulated for sustainability's sake.
- **When to Allow for Water Extraction:** The Agricultural/Irrigation water users was allowed to record more than one response. Thus, it was found out that majority (71.4%) of the water users opined that farmers should be allowed to abstract water during dry season farming, while the remaining 61.9%, 28.6% and 19.0% assert that farmers should be allowed to abstract water when its safe for domestic consumption, when the water does not contain heavy metals, and when there is need to control flood respectively.
- **Conditions for Water Abstraction:** 90.5% of the water users said that farmers should only be allowed to extract water if they are going to use it efficiently, while the remaining 9.5% said farmers should not be allowed to extract water even when they prove to use it efficiently.
- **Need for Legislative Reform:** the results show that majority (81.0%) of the water users accepted necessity for a legislative reform to ensure the sustainability of water supplies in Anambra State, while the remaining 19.0% refuted the acceptance of a legislative reform to ensure sustainability of water supplies in Anambra State.
- **Regulation of Water Use in the Farm:** The researcher found out that majority (85.7%) of the farmers accepted the use of water on farm should be regulated for sustainable purpose, while the remaining 14.3% rejected the regulation farm water use.
- **Farmer's Participation in Water Management Issues:** Being the major stakeholders in water use issues in Anambra state, the importance of involving farmers for such a conservative management issues cannot be overemphasized. Thus, 100.0% of the farmers think that they take part in water management issues since they are the major users in need of water for food security.
- **Limiting Misuse of Water**: Controls to limit the misuse of water by users: majority (90.5%) of the domestic & industrial water users accepted that there should be control which limit the misuse of water by both domestic and industrial water user, while the remaining 9.5% refused the control measure which limit misuse of water by users in the area. The users therefore were allowed to suggest the appropriate control measure to regulate the use of water for sustainability. Thus, result showed that majority (66.7%) of the water users opined penalty/fine should be enforced as a water control measure in Anambra state. The remaining 42.9%, 33.3%, and 14.3% suggested metering, police arrest, and legislation as a control measure respectively.

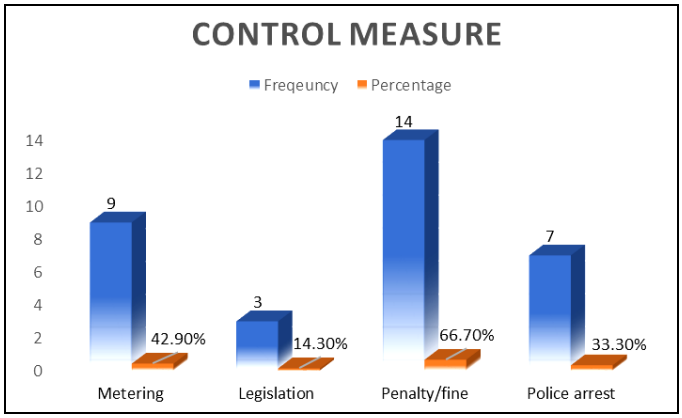

Fig 1: Control measure suggestion.

- **Installation of Water Meters in Properties in Anambra State Area to Conserve Water:** Majority (71.4%) of the water users agreed water suppliers should enforce the installation of water meters in properties in Anambra State to conserve water, while the remaining 28.6% refused that water suppliers should enforce installation of meters in properties in Anambra state.
- **Consideration Taken into Account When Identifying Properties to Install Water Meters:** The domestic user and industrial user allow to suggest what to put into consideration before installation of meters, finding showed that majority (48.6%) of the water users assert that family income should be taken into account when identifying properties to install water meters, while the remaining 45.7%, and 5.7% said family size, and size of house should be taken into account when identifying properties to install water meters in Anambra state respectively. none of the respondents opined consideration of garden size.

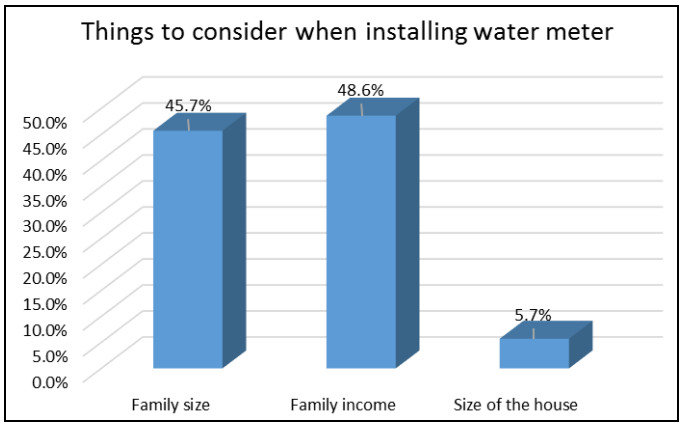

Fig 2: Consideration taken into account when identifying properties to install water meters.

4.3. Functionality of Existing Water Supply System

For effective functionality of water supply system in the study area, all the stakeholders need to be informed about water sustainability and they should be in consonance with all the guide relating to water sustainability in Anambra State. There is need to sustain water supplies system to meet future demands. Therefore, majority (52.4%) of the water users assert that sustainability is a continuous supply of water without adverse effect, 33.3% understands water sustainability as inexhaustibility of water, while 14.3% of the users are not clear with the meaning of water sustainability.

Thus, below are the functionalities of existing water supply system in Anambra state.

- **Awareness of Guide or Publicity Relating to Water Users in Relation to Sustainability**: The result is that majority (90.5%) of the respondents were aware of some guide or publicity relating to water users in relation to sustainability, while the remaining 9.5% were not aware of any guide or publicity relating to water use sustainability.
- **Issues of Constructing a Particular Water Facility in the Area:** water users were allowed to record multiple responses. Thus, finding indicated that majority (61.9%) of the water users asserted that contractors sometimes cut corners which resulted to unclean water for consumption. Despite the issue raised, the remaining 42.9%, 28.6%, 9.5%, and 4.8% said that well is cheap to construct and maintain, water depth, inadequate professionals to drill to the required depth, and rain water is readily available informed their choice of selection of water facility respectively.
- **Type of Borehole Facility Preferred in the Study Area:** Majority (57.1%) of the water users said that their area preferred hand pump borehole, the remaining 33.3% and 9.5% said the preferred borehole in their area is solar powered borehole and motorized borehole respectively. The preference of hand pumping borehole is associated with inadequate electric power supply in the study area. Furthermore, the majority (81.0%) of the mature house-wives interviewed suggested that water usage improved in recent time when compared to past five (5) years, while the remaining 19.0% asserted that they have more water now and uses more water now than in the past five (5) years. This therefore, implies that water supply is in the area functional depending on the particular scheme adopted by the stakeholders.

4.4. Identification of Best Practice to bring Improved Sustainability of Water Supply and Management

Information on best practice to bring improved sustainability of water supply and management was presented in table 3.4 above. Thus, the findings were discussed as follows:

- **Ways Farmers can be Involved in Water Management issues**: The farmers were allowed to select more than one way they could be involved in water management issues, the results showed that majority (81.0%) of the water users should be trained to manage the water project themselves, while the remaining 47.6% and 19.0% opined that farmers should decide on the right penalty to be meted out when the policy is violated, and farmers should be used to police violators respectively.
- **Remedial Cost by Water Polluter:** The researcher discovered that majority (61.9%) of the respondents accepted that water polluters should be made to pay remedial cost, 33.3% somewhat agreed that polluters should pay remedial cost while the remaining 4.8% strongly disagreed that farmers should be made to pay remedial cost for water pollution.
- **Understanding of the Word Sustainability:** majority (52.4%) of the domestic and industrial water users asserted that the word sustainability means continued supply of water without adverse effect, 33.3% asserted that sustainability means inexhaustibility of resource use. The remaining 14.3% are not clear with the meaning of sustainability. Both agricultural & irrigation water user have similar view with the domestic & industrial water user in the study area.
- **Suggested Solution to Help Prevents the Misuse of Water:** The domestic and industrial water users were allowed to suggest more than one solution; findings indicated that majority (76.2%) of the respondents suggested water users should be penalized for the case of water misuse in Anambra state. the remaining 57.1% and 33.3% suggested that solution to water misuse in Anambra state is regular repair and policing (enforcing the law and making sure offenders are punished) respectively are solution to help prevent the misuse of water in the state. The water users were allowed to suggest more than one opinion, and finding showed that 100.0% of the water users opined that water suppliers should train water user in using water, and demonstrate to water users on how to properly use water in properties. 85.7% of these users asserted that water suppliers should educate water users in using water in a sustainable manner, while the remaining 14.3% did not present their candid opinion on water usage in the state.
- **Approval on Setting up a Rural Community Base Operation and Maintenance Committee:** To cub the challenges of breakdown and vandalization issues in Anambra state, the study found out that 100.0% of the water users approves of setting up a rural community-based operation and maintenance committee. Equally, the water users were allowed to record multiple responses, the researcher, therefore found out that majority (81.0%) of the water users opined that the work function of the operation and management (O&M) committee will be to maintain the borehole and may contract the contractors/suppliers of the water when need arises, while the remaining 57.1%, 33.3%, 23.8%, 9.5%, and 4.8% of the water users asserted that the functions of the water user should include; liaise with the traditional rulers to mobilize fund where community effort is needed, collect fee for the water suppliers, prepare schedule for water supply and monitor its implementation, manage water supply to community members, and keep proper records of the water activities and financial transaction for the community water project respectively. This means that the domestic and industrial water users are perfectly informed with the work function of O&M team in Anambra State.
- **Approval to Setting up a Water Users Association (WUA) for Sustainability:** 100.0% of the domestic and industrial water users approves of setting up a water use0072 association in Anambra state. And, findings made showed that majority (71.4%) of the water users opined that the roles of the WUA will be to keep record to monitor water breakdown, the remaining 52.4%, 38.1% and 9.5% opined that the roles of WUA will include; using the money generated from users to maintain water breakdown, regulating the activities of the operation and maintenance committee, and providing work tools for the operation and maintenance committee respectively in Anambra state. More so, findings made showed that 100.0% of the respondents think there is a need for legislative reform to ensure water supplies are sustainable in Anambra State. And, 100.0% of the water users think that the existing water regulations in Anambra state is not adequate. Furthermore, response from the survey conducted on ‘’Mature House-Wife’’ about the best ways to ensure that water is saved indicate that majority (57.1%) opined that metering will save water in houses, while the

remaining 47.6%, 33.3%, and 9.5% opined that enforcing water user's association, legislation, and policing respectively will save water in Anambra state. Additionally, majority (81.0%) of the house-wife/women asserted that price tagging water will make people realize the value of water, while the remaining 47.6%, and 23.8% opined that metering and use of water user's association to monitor water will make people realize the value of water in Anambra state respectively. Moreover, findings made showed that 100.0% of the engineers/contractors interviewed approves of the state setting up Operation & Maintenance committees in rural area to help conserve and manage water facilities in Anambra state. And, majority (50.0%) of the engineer/contractors opined that O&M committees should report breakdown issues to water suppliers, while the remaining 33.3% and 16.7% asserted that O&M committee should undertake maintenance of water facility, and repair broken pipes respectively. Thus, the rural O&M teams should properly be trained to undertake such task. Finally, findings made showed that 100.0% of the contractors/consultants thinks that water pollution will be prevented through policy enforcement in Anambra state.

5. Conclusion

Conclusively, management strategies for sustainable water supply in Nigeria, with special reference to Anambra State is of great essence. As water is very vital for human existence, hence needs to be properly managed for its sustainability.

Installation of water meter is one of the strategies to be adopted in ensuring sustainability of water supply. They will be heavily billed for misuse this will in a long way minimize if not put to a total stop the misuse of water from the housewives and the community at large.

Operational and Maintenance committee has to be constituted in the rural areas of the state, to help in conserving, sustaining and managing the water facilities. Again, Operational and Maintenance (OM) committee should report any breakdown issues to the water suppliers for immediate repair.

Water user association can equally be set up to monitor any break down, keep records, use the fund generated from the water users to maintain water breakdown and regulate the activities of the operational and maintenance committee.

References

1. Danert K and Narkevic J. Country-led and Country-wide monitoring of rural and small towns water supplies. Presented at the Hague, Netherland, 2013.
2. Davis J & Brikké F. Making your water supply work. Operation and maintenance of small water supply systems, 1995.
3. Deverill P. Designing Water Supply and Sanitation Projects to Meet Demand in Rural and Peri-urban Communities: Concept, principles and practice. WEDC, Loughborough University, 2002.
4. Duru CR. An Investigation into the Nature and Variability of Climate Change-Induced Rainfall over Awka, Anambra State (Doctoral dissertation, Federal University of Technology, Owerri), 2016.
5. Fonseca C, Franceys, R., Batchelor, C., McIntyre, P., Klutse, A., Komives K & Potter A. Briefing Note 1a Life-cycle costs approach, 2011.
6. Harvey P & Reed B. Rural water supply in Africa: Building blocks for handpump sustainability. WEDC, Loughborough University, 2004, 85.
7. Nfor BN, Olobaniyi SB & Ogala JE. Extent and distribution of groundwater resources in parts of Anambra State, Southeastern, Nigeria. *Journal of Applied Sciences and Environmental Management*, 2007, 11(2).
8. Olugboye D & Hayes J. Review of PfWS technical support to Anambra State water supply and sanitation sector reform programme in Nigeria, 2011.
9. Segone M. From policies to results. Developing capacifies for country monitoring and evaluation systems, 2010.
10. Shiklomanov IA. Appraisal and assessment of world water resources. Water international. 2000; 25(1):11-32.
11. Skinner B. Water and Environmental Sanitation, Unpublished module notes, WEDC: Loughborough University, UK, 2009.
12. Smout I. (ed.). Management of Water and Sanitation, Unpublished module notes, WEDC: Loughborough University, UK, 2010.
13. WELL. Hygiene Promotion. Well Fact Sheet. WEDC, Loughborough University, UK. Downloaded on 3/7/2013 from http;//www.lboro.ac.uk/orgs/well/resources/fact-sheets/factsheets-htm/hp.htm, 2005.
14. WELL & Great Britain. Dept. for International Development. Guidance Manual on Water Supply and Sanitation Programmes. WEDC, Loughborough University, 1998.
15. WHO/UNICEF/WSSCC. Global water supply and sanitation assessment 2000 report. Geneva, Switzerland, 2000. Downloaded on 3/7/13 fromwww.who.int/water_sanitation_health/monitoring/jmp2000.pdf.