Water Policy 20 (2018) 597–616

Rural water supply in Nigeria: policy gaps and future directions

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Abstract

The alarming state of safe water deprivation among the residents of rural communities in Nigeria is well recognized. Unfortunately, research that shows the policy gaps in the water supply sector of the country and measures to eliminate them in order to improve water supply sustainability in the country is lacking. This paper investigates the landscape of water service provision to rural communities in Nigeria using investigative and qualitative approaches due to the desire to explore the experience and opinions of previous workers/agencies in the region. Primary and secondary data were used in the study. Findings characterized the rural water supply landscape in the region. The community-based service providers are constrained by several policy gaps that negatively impact on the quality and sustainability of rural water supply in the country. Rural water interventions suffer from a high rate of failures due largely to weak institutional framework in the water supply sector. The paper recommends that for rural water supply sustainability to be improved in Nigeria all the stakeholders must work together to prioritize and address the policy gaps constraining service delivery simultaneously in the region. Working on one factor alone may not result in sustainable services.

Keywords: Future directions; Nigeria; Policy gaps; Rural communities; Rural water supply; Service providers; Sustainability

Introduction

Access to safe drinking water is required by all communities, regardless of the area, average income, average level of education, geographical region or race, ethnic or cultural background (Akpor & Muchie, 2011). For many rural communities in developing countries, unreliable access to safe drinking water remains a large and growing concern (Eva, 2015). The 2015 WHO and UNICEF report indicated that many countries, especially in Sub-Saharan Africa (SSA), have fallen short of the Millennium Development Goals (MDGs) target of reducing by half the proportion of people not having access to safe water supply by 2015 (WHO & UNICEF, 2015). The report indicated that in six developing regions of the world, namely, Sub-Saharan Africa, Oceania, Latin America, South East Asia, Southern Asia, and Northern Asia, a vast proportion of the rural population still lacks adequate access to safe water supplies.

doi: 10.2166/wp.2018.129

Citizens of these countries risk their health any time they use local water sources (particularly rivers and wells) because the quality is often degraded.

In SSA, sustainability of rural water supply systems (WSSs) is an acute problem mainly due to widespread water infrastructural decay and frequent system breakdowns (Adeleye *et al*., 2014). Many nations in SSA suffer from frequent WSS failures, and this and other related factors cause widespread water scarcity in the region (Metwaky *et al*., 2006). According to Satterthwaite (2016), 23 out of the 25 countries with the lowest proportion of their rural population having access to improved water sources are in SSA. In many rural communities, operational challenges such as poor service coverage, maintenance backlogs, and endless problems with service provisions have compelled water users to turn to unprotected water sources for their water needs (Nwankwoala, 2011; Eva, 2015).

Although the MDGs summit Report (1) indicates that appreciable progress has been made in attaining the MDG 7 target of reducing by half the proportion of people without sustainable access to safe drinking water by 2015 in many countries, recent findings clearly indicate that many countries in SSA still remain with limited access to potable water supplies, as 34 million people still lack access to safe drinking water (WHO & UNICEF, 2015). In Nigeria, for instance, water supplies are not only inadequate but dwindling (Ali, 2012). In fact, Ezenwaji *et al*. (2016) reported that millions of people in the country, particularly in the countryside, still depend on unimproved drinking water sources (shallow well, springs, rivers, ponds, canals, stored rainwater, etc.) for their water needs. This is in spite of the large array of institutions and agencies responsible for ensuring that government targets in the water supply sector are met in the region (Baguma *et al*., 2013).

Many rural water supply projects in Nigeria are characterized by poor performance. Adeleye *et al*. (2014) reported that, in Nigeria and Niger, many rural water supply schemes (RWSSs) have collapsed and that except for a few areas, most rural dwellers are facing serious and persistent challenges in meeting their water needs. The water need of the rural population in these countries has been on the increase due to an increase in the population and consumption rates (Adelana & MacDonald, 2008). The challenges of poor and unsustainable service delivery in the rural water sector are having an adverse impact on rural dwellers and on the rural economy in Nigeria (Ezenwaji *et al*., 2016). Unfortunately, governments and donor agencies have not been able to find a lasting solution to the challenges of poor and unsustainable service delivery in the rural water sector in the country (Allaire, 2009).

Previous studies on rural water supply in Nigeria, seeking to proffer a solution to water supply inadequacies, have looked at the subject mostly from the point of view of institutional strengthening of government water supply agencies (Baguma *et al*., 2013; Omole *et al*., 2015). Little attention has been given to the characterization of rural WSSs, the challenges faced by service providers, the existing policy gaps, and future steps needed to promote sustainable rural water services delivery in Nigerian rural communities. For instance, Akpomunje (2010) investigated the effectiveness of self-help as a strategy for improving access to rural water supplies in Nigeria without going into policy inadequacies constraining supply and other complex issues related to water projects developed in the informal sector. In addition, the data used in the study were very general and not specific to the rural community levels. The lack of relevant information on the challenges faced, existing policies, and future steps needed to promote sustainable use of water in Nigeria constrains effective decisions on the type and nature of interventions required and the target beneficiaries.

The rural people of Nigeria, like their counterparts in other regions of the world, deserve a society where water is available in adequate quantity and quality for present and future generations, serving to achieve sustainable development. It has become increasingly clear that the inadequate access to and the unsustainable nature of water services delivery are major challenges that need to be overcome if the rural economy of Nigeria is to be transformed. Achieving this requires extensive research in order to select policies and strategies that are

informed by clear scientific insight. Therefore, this research was undertaken to thoroughly characterize the rural water supply landscape in Nigeria, isolate the policy gaps that constrain the sustainability of rural water services provision in the region, and advance suggestions on how to overcome the problems.

Theoretical literature review

Water resource endowments of Nigeria

Nigeria has abundant natural surface water and groundwater resources, estimated at 226 billion cubic meters of surface water and about 40 billion m^2 of groundwater (Abaje *et al*., 2009). These abundant, diversified and unique surface water resources include over 9,670 miles of named rivers and streams, 1,323 named lakes, 390 flowages, and thousands of acres of wetland (Olaleye, 2010). The distribution of the streams in the country is uneven, with the southern parts having the most streams and lakes. The streams, lakes, and wetlands have plants and other resources essential for domestic consumption, commerce, and agriculture. The Niger River, after which the country is named, is the longest and largest surface water body in Nigeria. Apart from surface water, abundant groundwater resources that provide millions of gallons of water per day to over 78 million rural citizens and other users also exist in the country (Okoye, 2015). The majority of the people in rural communities in Nigeria have entrenched dependence on wells and boreholes for the provision of rural water supplies (Gbadegesin & Olorundemi, 2007). Many of the country's lakes, rivers, and streams receive wastewater discharges that create enormous environmental and public-health problems (Okoye, 2015). Several factors including nutrients, sediments, and other pollutants from point sources and non-point sources, airborne pollutants, contaminated sediments, and physical or habitat degradation are causing the impairment of Nigerian rivers, streams, and lakes (Metwaky *et al*., 2006). Many of the rivers receive huge quantities of untreated effluents and solid wastes that contain substances that are not only harmful to humans but also to aquatic biota (Babic *et al*., 2014). Institutional initiatives to identify and analyze water quality status and develop and implement plans to improve the surface water quality in the region are few and far between (Metwaky *et al*., 2006; Okoye, 2015).

Sustainability. The concept of sustainability took its root from the debate on sustainable development of the early 1970s; defined then as the development that meets the needs of the present generations without compromising the ability of future generations to meet their own needs (Tadesse *et al*., 2013). Currently, different organizations have their own version of definition to address their own intended objectives (Pretty, 1995). In the context of water supply projects, however, the concept is about whether service delivery in the rural water supply sector is carried out regularly and reliably over a long period of time. Close to half of all low- and middle-income countries of the world, including Nigeria, have not achieved rural water supply sustainability (WHO & UNICEF, 2014).

Area of study

Nigeria has an area of 927,339 km^2; it lies between longitudes 2 49E and 14 37E and latitudes 4 16N and 13 52N and is composed of 36 federating states (Figure 1). The climate is tropical with high temperatures and high humidity as well as marked wet and dry seasons, although there are variations between north and

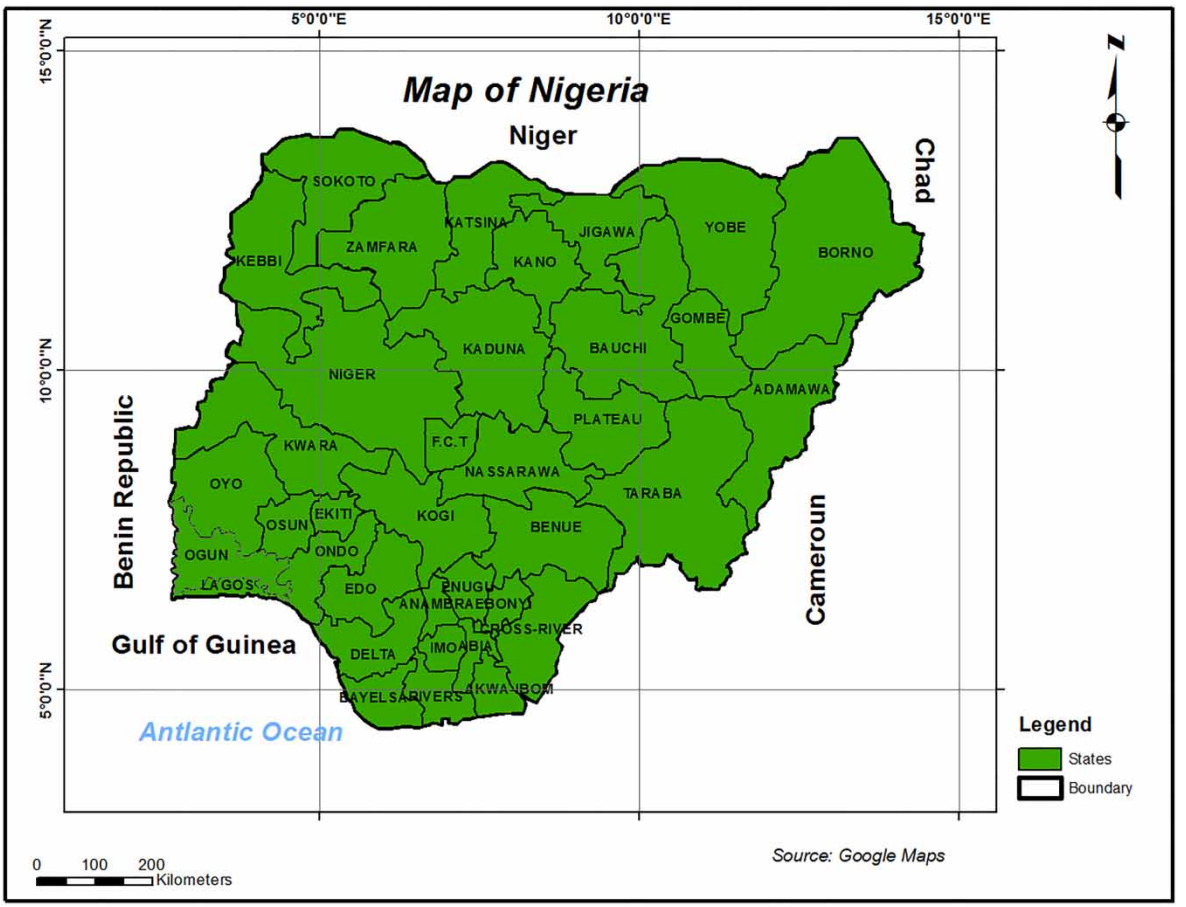

Fig. 1. Nigeria, showing the location and the 36 federating states. *Source:* Adapted from Google Map by the GIS Unit, University of Nigeria, Nsukka.

south (Ofomata, 2002). Precipitation varies widely in both time and space, ranging from less than 250 mm per annum in the extreme north to 2,250 mm at the coast (Adekalu *et al*., 2001). Some rural areas get little or almost no precipitation, while others, like those in the Niger Delta, are among the most water-rich areas in SSA (Chukwu, 2015). Almost every community in the Niger Delta experiences high precipitation levels, with some parts receiving heavy precipitation almost daily (Adekalu *et al*., 2001). This pattern, together with the seasonal variation of water availability combined with the phenomenal growth of the population, creates two important scenarios in the water use pattern (Awuah *et al*., 2009). First, direct collection and use of rainwater are more pronounced in the rainy season. Second, extraction of water from springs, streams, ponds, and wells, as well as water shortages are more common during the dry season. The high variability of precipitation is a significant characteristic of the nation's climate and is usually factored into water resource management in the country.

The country is drained by numerous rivers, principally the Niger, Benue and their numerous tributaries as well as by the Lake Chad basin and the rivers that discharge into it (Olaleye, 2010). Many of these streams, especially in the drier northern states, are seasonal. Although the country is blessed with abundant natural

water resources, water has been the most limiting factor to the development of Nigeria (Oyegun, 2001). The availability of perennial water sources largely accounts for the evolution and development of many communities in Nigeria. The vegetation of the country varies mainly with the rainfall and with topography. Natural vegetation is denser in the south and in the valleys, and sparse in the north and at the top of the highlands (Akpomunje, 2010). Water is traditionally utilized for two major purposes in most rural communities in Nigeria, namely, agriculture and domestic consumption. Sources of such water vary widely from direct rainfall to water from runoffs, rivers, streams, creek flow, and seepage (Olaleye, 2010). Underground water resources are harnessed and used to sustain the country's economic growth and ecological systems.

Methodology

Primary and secondary data were used for this study. Primary data collection in Nigeria was carried out between October 2015 and March 2016. We first selected six study states randomly, one each from the six geo-political zones in Nigeria (see Figure 2).

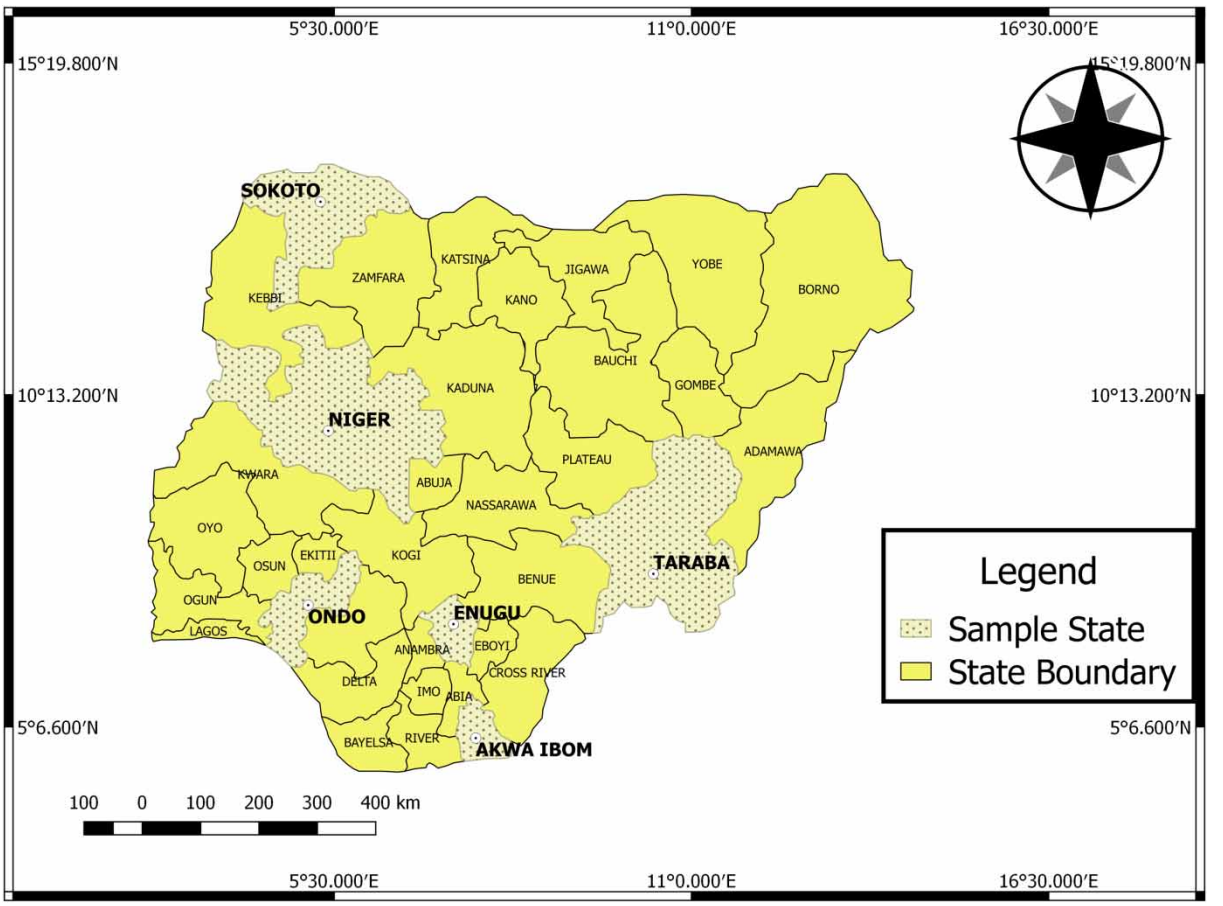

Fig. 2. Nigeria, showing the sampled states. *Source:* GIS Unit, University of Nigeria, Nsukka.

Table 1 further provides brief summary information on the sampled states and communities.

From the states, one local government area (LGA) was also drawn randomly for use in the study. Within the local government areas (LGAs), 10 rural communities were purposely selected for sampling. A total of 60 rural communities (see Table 2) were sampled. Sampling was limited to communities that are accessible, have both RWSSs and informal water services providers (IWSPs), and available for study. Based on these criteria, the communities shown in Table 2 were selected and used in the study.

Within each sampled community, 40 copies of a questionnaire were administered at random to households that participated in the study. The questionnaire was administered by two trained research assistants, who were indigenes of the state and postgraduate students of the Department of Geography, University of Nigeria, Nsukka. Research assistants spent one day in each community to complete all data collection activities. Consultations and discussions were also held with experts at the Statistics, Monitoring, Evaluation and Engineering Departments of the Federal Ministry of Water Resources, Abuja, as well as from the states' Water Corporations/Boards to fully understand the performance and challenges facing public RWSSs across the sampled states. Data were also collected through personal interviews with individuals (such as community members, women leaders, water committee representatives, zonal water engineers, Directors of Planning at district or LGAs level, etc.) and the coordinators of local non-governmental organizations (NGOs) and organizations involved in informal water service delivery in the sampled communities in Nigeria. Field observations of existing facilities provided additional information.

Secondary data collection

To obtain quality information on the trends, patterns, and institutional arrangements for water services delivery in the rural sector in Nigeria, we embarked on extensive desk research to source useful secondary data from published documents. Relevant data were obtained from document analysis, the internet,

Table 1. Characterization of sampled states.

S/No.	Sampled states	2016 Projected population[a]	Land area (km^2)[b]	Density (persons/km^2)	Rural/Urban ratio	Major economic activities in the sampled communities
1	Enugu	3,257,298	7,161	455	31/69	Agriculture, palm oil milling, trading, metal work, and sand mining
2	Niger	3,950,249	76,363	52	38/62	Agriculture, hide and skin, arts and crafts, sand mining and quarrying
3	Ondo	3,441,024	15,500	222	66/34	Farming, lumbering and sawmilling, fishing, and wood and metal work
4	Akwa-Ibom	3,920,417	7,081	554	70/30	Farming, fishing, wood and metal work, lumbering, local gin making
5	Taraba	2,300,736	54,473	42	24/76	Agriculture, quarrying, arts and crafts, rubber and latex
6	Sokoto	3,696,999	25,973	142	28/72	Agriculture, hide and skin, local cloth dyeing, mat making and other local crafts

[a]Projected from National Population Commission (NPC) (2006).
[b]Adebayo & Rashid (2011).

Table 2. States, local government areas, and communities used in the study.

S/No.	Geo-political zone	Name of sampled state and LGA	Name of sampled communities	Estimated no. of households	Available local water sources	Owners of available local water sources	Leading water source
1	South east zone	Enugu/Udenu	Amalla, Umundu, Igugu, Orba, Imilike, Ezimo, Ogbodu, Obollo Affor, Obollo Etiti, Ezimo Agu	8,645	Streams, lakes, wells, rivers, boreholes, vendors, ponds	Individuals, households, communities, states, vendors, schools, governments, NGOs	Vended water
2	North central zone	Niger/Lapai	Lappi, Esa, Esagi, Tashi, Tashibo, Ibba, Dum, Dume, Igaie, Igate	5,778	Streams, rainwater, wells, boreholes, vendors	Vendors, individuals, households, communities, churches, governments, NGOs	Vended water
3	South west zone	Ondo/Owo	Owo, Ayore, Ose, Ifon, Oka, Ikare, Ikaram, Iru, Owoni, Ibillo	6,628	Streams, lakes, wells, rivers, boreholes, vendors	Individuals, households, communities, states, vendors, governments, NGOs	Mixed[a]
4	South – south zone	Akwa Ibom/ Uruan	Uruan, Ururu, Iboni, Mbom, Igutu, Onne, Inii, Etian, Udim, Ekesi	6,898	Streams, lakes, wells, rivers, boreholes, vendors	Individuals, households, communities, vendors, governments, NGOs	Borehole/well water
5	North west zone	Sokoto/Bangi	Alami, Banjii, Dinya, Yadi, Mako, Kuiki, Ganbe, Bin, Bako, Jiera	2,747	Streams, lakes, wells, rivers, boreholes, vendors	Individuals, households, communities, states, vendors, schools, governments, NGOs	Vended water
6	North east zone	Taraba/Wukari	Wukari, Ginda, Diwaya, Fini, Kadi, Iddi, Raminkrsu, Asari, Mpar, Mkar	3,143	Streams, lakes, wells, rivers, boreholes, vendors	Individuals, households, communities, states, vendors, governments, NGOs	Well/borehole water

[a]Mixed = vendors, streams, stored rainwater and private wells. *Source:* Author's fieldwork, 2016.

project reports, mission reports of pilot studies relating to the externally supported water projects and from relevant records in Water Ministries at national and state levels. We collected additional data from relevant records at the Statistics, Monitoring, Evaluation and Engineering Departments of the Federal Ministry of Water Resources, Abuja, as well as from the states' Water Boards/Corporations.

Data analysis

The data collected from the sources described above were carefully analyzed. Descriptive statistics (totals, means, standard deviations, percentages, etc.) were used to analyze the data.

Results

Trends in approaches to community water supply in Nigeria

Water service providers in SSA have grappled with different approaches under different policy regimes to provide the rural population with potable water (Pavelic *et al*., 2012). During the pre-colonial periods, community leaders, village elders, and kingdoms' administrators successfully mobilized community members to participate in self-help projects such as road and water source development and maintenance (Harvey & Reed, 2004). Trust, unity, local rules, sanctions, and high levels of social cohesion characterized and motivated community members to support each other and their leaders (Majuru *et al*., 2011).

During the colonial era, the need for safe water provision became highly apparent, especially at administrative centers, and the colonial governments set up agencies to develop, operate, and manage a number of water sources such as community wells, rainwater storage facilities, and boreholes (Ayoade & Oyebande, 1983). No preconditions were set for communities to fulfill before the state provided them with water infrastructure (Aderogba, 2005). The colonial administration introduced local legislations and sanctions to protect the emergent water supply institutions, and water sources developed during this period can still be found in some villages in the region (Awopegba, 2001).

Independence and emergence of state governments' water institutions were not followed by radical reforms and interventions in the rural supply sector of rural communities in the country (Carter & Bevan, 2008). In fact, post-independent public water supply institutions in Nigeria inherited the demand-driven approach introduced by the colonial masters and institutionalized the same in their rural water supply sectors (Majuru *et al*., 2011). Governments provided water infrastructure and assumed the sole responsibility for water services' delivery to the rural population (MacDonald *et al*., 2005). No preconditions were set for communities to fulfill before being provided with water supply facilities. This model of direct state intervention in service delivery, which operated in most countries of SSA until the early 1990s, failed to ensure quality and sustainable water services delivery. The majority of the rural population lacked access to potable water within a reasonable time frame; service coverage was poor and water infrastructure suffered from maintenance backlog (Van Rooijen *et al*., 2007).

These inadequacies led to a policy shift to the community participation (CP) approach during the International Drinking Water and Sanitation Decade of the early 1990s (Bailur, 2007). In the CP

approach, water users were required to be fully involved in the planning, development, operation, and maintenance of water facilities. The aim was to promote a sense of ownership and sustainability of water service delivery (Cherlet & Venot, 2013). The reforms of the 1990s led to the creation of new infrastructure, improved access, and operation and maintenance (O&M) in some countries such as Rwanda, Zambia, South Africa, etc. (Chitonge, 2011; Eva, 2015). However, the sustainability of critical infrastructure in the Nigerian rural water supply sector remained an intractable problem. Countrywide, poor infrastructure posed a great challenge to service delivery, accounting for over 50% of non-functionality of water sources in many rural communities of the country (Van Rooijen *et al*., 2007). The current state of water deprivation among rural residents in Nigeria is still alarming (Satterthwaite, 2016).

The institutional arrangements for water supply in Nigeria

The provision of potable water to the rural populace in Nigeria is the constitutional responsibility of three tiers of government – federal, state, and local governments (Allaire, 2009; Chukwu, 2015). The federal government through its national water agency, known as the Federal Ministry of Water Resources, is charged with the responsibilities of policy advice and formulation, data collection, monitoring and coordination of water resources development at the national level (Okoye, 2015). This agency of the national government deals with water service provision matters at national level; it sets and implements water resource policies, norms and standards (Harvey & Reed, 2004; Eva, 2015). The national agency has no direct involvement in rural water supply services other than licensing and registering non-governmental agencies involved in public water supplies. In Ghana, Uganda, and Tanzania, such national water agencies also exist and assist in negotiating and obtaining loans on behalf of regional agencies and in determining the nature and conditions of such loans (Pavelic *et al*., 2012).

The state governments have their own executive and legislature. They are bound by the laws and policies passed at national level and can pass their own within a framework that suits their specific needs (Eva, 2015; Chukwu, 2015). They are authorized by law to design, build, operate, manage, and maintain a network of rural water supply networks and boreholes. All the 36 states in Nigeria have water agencies charged with responsibility to provide urban and rural water supplies in their states. In some states, such as Lagos, separate agencies exist for rural water supplies and for urban and semi-urban water supplies. Currently, all the states in Nigeria are actively involved in developing/rehabilitating RWSSs in order to provide adequate and sustainable water supply for household and community well-being (Nwankoala, 2011).

The local governments consist of the lowest tier of government in Nigeria (Chukwu, 2015). They are tasked with providing democratic and accountable government to local communities at the grassroots. They provide services to rural communities as well as promote social and economic development (Harvey & Reed, 2004; Eva, 2015). One of the objectives of local government according to the Constitution of Nigeria, just as in some SSA countries such as the Republics of South Africa, Kenya, Ethiopia, etc. is to ensure the provision of services, including provision of water, to communities in a sustainable manner (Van Rooijen *et al*., 2007). In Nigeria, they are responsible for delivering services on behalf of the government as a whole to the remotest parts of the countryside. According to the Constitution of the Republic of Nigeria, and even that of South Africa, local governments assume the responsibility for designing, financing, and maintaining the rural WSSs (Eva, 2015). They also compile priority lists of communities in need of water supply facilities and recommend the same to the federal/state governments and/or donor agencies.

NGOs and donor agencies also assist in the provision of affordable, economical, efficient, and sustainable water services in Nigeria, particularly to vulnerable groups, including children. They assist variously, but majorly in planning, infrastructure development, and rehabilitation and service delivery arrangements in order to improve access to quality and sustainable services delivery (WHO, 2006).

Water system failures in the sampled rural communities

Water system failures occur, constrain regular access, and cause water shortages in all the sampled communities. Field survey showed that most households (82.6%) lack access to piped drinking water sources; none of the sampled households has a functional (yard) tap in their residence and only a mere 14.3% get their water from public taps located outside their residence. The majority of the households depend on unprotected water sources – vendors, surface water, and wells (Table 2). The poor piped water services provision in the rural communities and the poor state of water infrastructure were highlighted in all the communities visited. This finding is not new; in fact, Adeleye *et al.* (2014) reported that, in Nigeria and Niger, many rural WSSs have collapsed and that except for a few areas, most rural dwellers were facing serious and persistent challenges in meeting their water needs and that many rural water users often returned to streams and rivers.

Findings revealed that the factors that occasion the massive failures in the rural WSSs vary in the sampled communities. Generally, however, the premature collapse of rural WSSs was normally attributed to water governance crises as well as to a range of institutional, managerial, technical, and social factors. A summary of the factors identified as being responsible for the failures of rural WSSs by the service providers is shown in Figure 3. It is worth noting that most of the faults are mainly technology-related; responses from the field indicate that the majority of the system components are old and unable to function as intended. Interviewees indicated that the non-replacement of old components led to

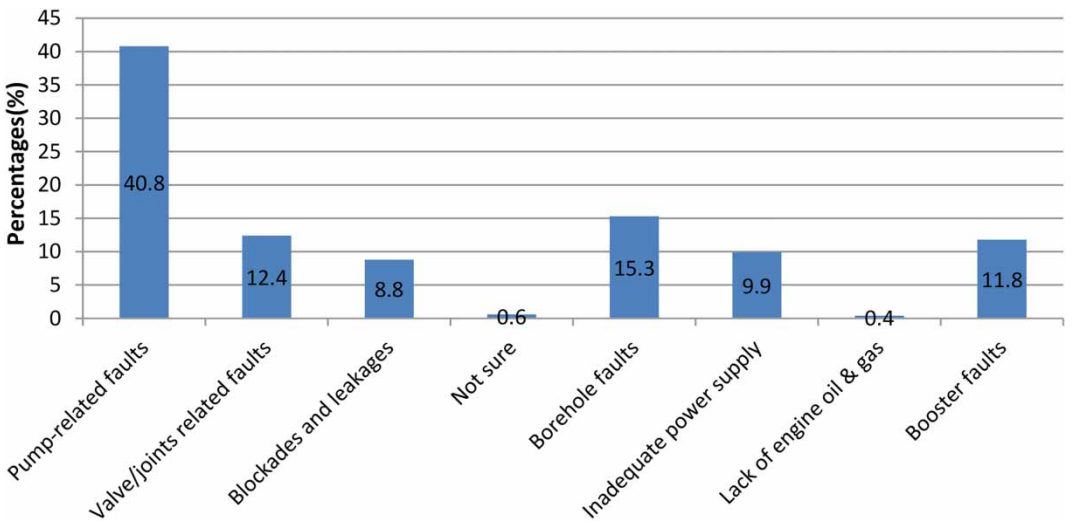

Fig. 3. Respondents identified causes of WSS failures in Nigeria (borehole faults included such faults as the collapse of borehole walls, etc.). *Source:* Author's fieldwork.

further deterioration of infrastructure and a downward spiral of escalating inefficiency in the rural water supply sector.

Literature evidence reveals that WSS failures also occur widely and exacerbate water scarcity in many other developing countries. For instance, Eva (2015) reported that failures in the WSSs occur frequently in South Africa and attributed the failures to the shrinking service providers' budgets, increased electricity tariffs, and increased wages based on agreements negotiated at national levels. He added that service provision in the country is also constrained by inadequate technical capacity required to implement a sustainable operational and maintenance system for their infrastructure. A study undertaken in 2006 by Van Rooijen *et al*. (2007) revealed that in South Africa an additional 1,100 municipal plumbers were needed countrywide in order to cope with O&M of water service infrastructure. Local municipalities were found to be operating with an average of two civil engineering professionals per 100,000 population, which is far below the prescribed five civil engineering professionals per 100,000 population.

System failures and deteriorating infrastructure in the rural water sector in Uganda, Ghana, and Burkina Faso were attributed to limited availability of spare parts for O&M, inadequate financial viability, policy inadequacies, and use of over-aged infrastructure (Baguma *et al*., 2013). In Mali, Chad, and Niger, Fotso *et al. (*2007) and Allaire (2009) observed that WSS failures are worsened by periodic droughts, especially in areas where moisture availability is critical. Droughts in these areas are often cyclic and land use practices exacerbate their effects.

In Kenya, Tanzania, and Ethiopia, lack of resources and capacity constrains preventive maintenance and exacerbates WSS failures (Carlsson *et al*., 2010). Service providers in these countries are struggling with critical deficiencies arising from the use of old and deteriorating infrastructure, weak institutional framework, poor governance structures, and a lack of capacity (including properly trained personnel and with the required skills) (Carlsson *et al*., 2010; Pavelic *et al*., 2012; Marks *et al*., 2013). The lack of resources and capacity often forces service providers to focus more on activities necessary to deliver immediate services, while preventive maintenance (Eva, 2015), which involves activities that may keep the system in long-term good operating condition, is neglected.

Pattern of access to public water sources in the sampled rural communities

Field survey revealed that despite the involvement of multiple agencies and several decades of water supply system development in the study communities, access to piped drinking water still remains critical. The majority of the sampled households (82.4%) sourced their drinking water from water vendors, unprotected wells, surface water (streams, ponds, canals), and stored rainwater. No sampled household had access to piped water on the premises. Strong disparity existed among the sampled households on the proportion of the households that depended on the various local water sources in the states. For instance, of the 23.6% that had access to piped water, 12.6% were from Ondo state alone, 5.8% from Akwa Ibom, and 2.2% from Enugu state, while all the sampled communities in Taraba, Niger, and Sokoto states shared (unequally) the remaining 3%. None of the sampled communities has a public piped water supply network and boreholes that are fully functional. Observed facilities were either malfunctioning or have completely broken down.

The situation of general poor access to piped drinking water in the sampled communities in Nigeria is typical of the prevailing situation across many other developing countries, especially in SSA. For instance, Table 3 illustrates the general poor access to piped drinking water in the SSA sub-region.

Table 3. Pattern of access to water sources in rural communities of SSA.

S/No.	Countries of SSA	% of rural population with access to improved water sources	% that depend on surface water	% that depend on groundwater	% piped water	% that depend on others (vended water and rain)	Rank on piped water
1	Botswana	96	2	2	74	22	1st
2	Burkina Faso	76	3	15	7	74	11th
3	Chad	57	3	46	6	45	12th
4	Congo DR	76	9	15	25	51	4th
5	Ethiopia	57	13	30	12	45	8th
6	Kenya	63	22	15	22	41	5th
7	Malawi	89	1	9	8	81	10th
8	Mali	77	1	22	16	61	7th
9	Mozambique	51	11	38	9	42	9th
10	Niger	58	9	39	2	49	14th
11	Nigeria	69	10	21	1	68	15th
12	Senegal	60	1	39	18	42	6th
13	South Africa	93	3	4	73	20	2nd
14	Uganda	79	8	13	5	74	13th
15	Zimbabwe	77	6	17	28	40	3rd
Mean		71.9	6.8	21.7	20.4	50.3	

Source: WHO & UNICEF (2015) Joint Monitoring Programme for Drinking Water and Sanitation Report, Annex.

As Table 3 shows, groundwater is the preferred and most widely used source of water for the majority of the rural population in Chad, Senegal, Niger, Mozambique, and Mali. Groundwater has the benefit of being naturally protected from bacterial contamination and is a reliable source during droughts. However, the high costs associated with drilling and the technical challenges in finding sources that are large enough to serve huge populations present challenges that limit the tapping of the resource (Harvey & Reed, 2004; Allaire, 2009).

As shown in Table 3, surface water sources are leading sources not only in Nigeria but also in many SSA countries such as Uganda and Ethiopia. Unfortunately, these sources are often highly polluted and water quality testing is not performed as often as is necessary to guide rural users in most developing countries (Awuah *et al*., 2009). Also, lack of education among the rural residents utilizing the water sources leads them to believe that as long as they are getting water from a stream, it is safe. Once a source of water is available, the quantity of water is often given more attention than the quality of water by the users (Awuah *et al*., 2009).

Policy gaps in the service delivery patterns by the service providers

Rural water policy provides guidance on the roles and responsibilities of all stakeholders involved in rural water project implementation, from communities to central bodies (WHO, 2006). It also incorporates set targets/aims such as to increase access to sustainable water supply for at least 70% of the rural population by, say, 2015, in line with MDG targets. Sustainability is always a high priority in the rural water supply policies of most countries and regions (Van Rooijen *et al*., 2007). Policies for the sustainable provision of potable water to rural dwellers in Nigeria are scantly enshrined in a number of different

pieces of legislation at both the state and national levels in Nigeria. Examples are the Nigerian Mineral Act of 1945, which became law in 1946, the 1963 Water Act in Nigeria, the Nigerian 1990 Water Act, and the National Water Supply and Sanitation Policy of 2000, which spelt out the institutional framework for rural and urban water supply and development in Nigeria (Adeoye *et al*., 2013; Adeleye *et al*., 2014).

The rural water supply policies at both the state and national levels in Nigeria have been reviewed severally since the International Decade for Rural Water Supply of the early 1990s based on a need to comply with international treaties (i.e. the MDGs) and in recognition of the inadequacies of the previous policies (Baguma *et al*., 2013; Chukwu, 2015). Yet, drinking water supply in all the sampled rural communities still remains critical; massive failures, frequent breakdowns in rural WSSs, and general underperformance of RWSSs characterize and constrain services delivery in all the sampled communities. Findings from sampled communities and from documents on water resources literature reveal the policy gaps that constrain water services delivery in Nigeria. The most critical include the following:

(1) Post-construction support (PCS) is not systematically applied as an integral part of community-based policy in the rural water supply sector of Nigeria. Although it is formulated as a role to be performed by the federal, state, and local government water agencies in Nigeria (just as in South Africa, Kenya, Tanzania, and Mozambique (Carter, 2010)), the water agencies do not have the dedicated resources or institutional arrangements to fulfill it. The National Water Acts of Nigeria, for instance, do not require service providers, service authorities, or end-users to provide post-construction support (Eva, 2015); do not identify sources of funding and/or set aside dedicated resources for preventive maintenance (Carter, 2010; Chukwu, 2015), or create a separate agency or sub-agencies, with a clearly defined mandate to undertake the maintenance of water supply facilities. This limits the capacity of service providers and service authorities to procure needed spare parts, and chemicals, and undertake essential repairs. As a result of this, many of the rural WSSs are dysfunctional and ill-maintained.
(2) The community-based management/participation policy, in which service providers are responsible for the actual O&M of systems and the administration of services (Marks & Davis, 2012), is ineffective towards achieving rural water supply sustainability in Nigeria. The policy provides that: governments would continue to develop rural WSSs (Lockwood & Smith, 2011); end-users must participate actively in the decision-making process (Lockwood, 2002); beneficiaries must participate in all water supply project phases as a way of ensuring sustainability of infrastructures (Marks *et al*., 2013); women should participate in all phases of the project cycle (Omole, 2015); type and level of service selected must suit the beneficiaries' capacity to pay, manage, and maintain the service, and that once completed and tested by a supervisor, the rural water project should be handed over to the community to be managed by a Village Water Committee (Omole *et al*., 2015). Findings from the 60 sampled communities (and even evidence in the literature) reveal that the local community members who are supposed to participate in and monitor water supply projects lack the capacity to do so. First, they lack contract information as well as the required technical knowledge and skills to operate and maintain water supply facilities or participate in their monitoring and evaluation. Worse still, there is no training undertaken to equip them for the roles they are expected to play. This undermines their ability to contribute to repairs and preventive maintenance. Second, women, often confined to gender-stereotype activities, are not consulted on matters concerning rural water supply, even though they bear a great burden of the works involved.

Marks *et al*. (2013) also discovered that community members are not allowed to initiate and/or take actions that are stimulated by their own thinking and deliberations that might show or suggest that the people are directing and controlling their own affairs.

(3) Another policy gap is the limited consideration or non-consideration of how settlement patterns and densities interact with different types of rural water projects. Many rural communities in Nigeria are characterized by scattered households, located in remote, inaccessible hillsides, forests, and/or on flood-prone floodplains or plateau surfaces. In Plateau and Cross River states, for instance, millions of rural residents live on mountainous, inhospitable, rugged, and largely inaccessible hill slopes. In the Niger Delta/coastal parts, settlements occur mostly in scattered patterns; in the northeastern and other parts also, settlements are widely dispersed in small villages, with many having fewer than 500 people, and over 500 rural villages living semi-nomadic lives (migrating between seasons in search of pasture for their animals or looking for conflict-free zones) (Okonkwo *et al*., 2011). This implies that governments *cannot provide ALL population groups* with potable water as enshrined in the Water Acts of states and national water agencies under the current settlement pattern. First, the *cost and skills* required to access/install, operate, and maintain piped WSSs in all rural communities are enormous. Second, the *maintenance requirements* per consumer will invariably be too high for scattered rural settlements. Third, the *quantity of water infrastructure* will equally be too high for scattered rural settlements. Therefore, governments need to pursue a policy of encouraging the widely dispersed settlements to form bigger clustered villages with others to serve them with RWSSs that best serve higher numbers of consumers living *in higher concentrations.* More people will thus be served with the same infrastructure leading to higher economies of scale.

(4) The non-recognition of IWSPs as key stakeholders in rural services delivery in Nigeria is another policy gap. Rural water users in Nigeria obtain water from both formal and informal sources to meet their water needs. Unfortunately, IWSPs are not legally recognized, regulated, or monitored by national water agencies within the country's institutional framework. Because of this, the health risks from using water from informal sources are neither known nor documented. Government failure to recognize these IWSPs and monitor the quality of water they provide to consumers in Nigeria is a big gap in government approach to rural supply in the region.

(5) Finally, public piped water networks and boreholes are generally dysfunctional in the sampled communities, while the privately owned ones are usually functional – serving users with speed and quantity. This shows that encouraging private-sector involvement or adopting some private-sector principles in the construction, operation, maintenance, provision of spare parts, choice of technology, research, etc. may impact positively on rural water service delivery in the country.

How the above policy gaps constrain rural water services delivery in Nigeria

In Nigeria, the primary responsibilities for public water supply development are vested in the local, state, and national government water agencies and non-government agencies such as UNDP (Chukwu, 2015). These government and non-government agencies carry out rural water development projects in an uncoordinated manner; quality services' delivery and projects' sustainability receive little emphasis. Water supply agencies tend to focus more on project development than on the functioning throughout the entire life cycle of water supply schemes. Findings show that rarely do the government water agencies set aside dedicated resources for the operation and maintenance of developed schemes

throughout their designed lifetime. Regrettably, users in the study communities tend to see water supply projects provided by governments as 'dividends of democracy' (free gift/reward from governments which they helped to install) and so object to contributions for the maintenance of the schemes. Without appropriate maintenance, the schemes quickly degrade and collapse. In all the states studied, quality control and assurances were downplayed by the states' water engineers. Emphasis was more on the number of communities covered rather than on water supply system efficiency. Sustainability issues relating to prompt provision of spare parts, other technical support and maintenance structure are not properly addressed at planning stages. Consequently, water supply projects' benefits are short-lived.

The reality is that the number of public functional piped water networks and boreholes in the sampled communities is very low (12.2%); massive failures, frequent breakdowns in the supply system, and general underperformance of RWSSs were reported in all the communities. Ordinarily, with the (high) number of public water supply schemes dotting the landscape of the study communities, one would expect that the majority of the rural residents should have adequate/regular access to safe water supplies, but findings showed that most of the residents (86.4%) depend on non-piped water sources, particularly private boreholes, water vendors, streams, etc.

Discussion

In Nigeria, rural water supply policies are poorly defined and the implementation of the existing ones by (states and national) water supply agencies is constrained by a number of policy gaps. The situation is exacerbating the level of water poverty and the functionality of WSSs in the rural communities. Currently, the provision of adequate and reliable water supplies to the rural population remains a matter of great concern. Sustainability of rural WSSs is an acute problem mainly due to widespread water infrastructural decay and frequent system breakdowns. Less than 12.2% of the inhabitants of the region have access to piped water supplies. Most of the sampled rural communities lack or have poor, non-functional water infrastructure. Many water schemes have fallen into disrepair or are not working to full capacity. The sustainability of installed WSSs is affected by numerous factors ranging from inadequate technical capacity, through low budgetary provisions, paucity of spare parts, corruption, low investment levels, lack of cost recovery, non-availability of spare parts, inadequate system maintenance, inadequate local resources' mobilization, ineffective community management models, to finance for operation and maintenance, to inadequate external support.

From Enugu to Akwa Ibom, Sokoto to Niger, and Taraba to Ondo states, the major problem facing the national or state-developed RWSSs is non-functionality. The non-functionality of many of the RWSSs imposes hardships on the people and handicaps economic activities throughout the study area. As a result of this situation, the majority of the people in the study communities take their drinking water directly from vendors, streams, and rivers. Apart from Owo and Ikare communities (where an oil firm assists in facility maintenance) in Ondo state, the RWSSs in the rest of the states are in no position to meet users' demand. Different types of system faults were identified. Water services' providers have, so far, not been able to increase the sustainability of water supply coverage and increase the quality of services. As a result, many water users in the region obtain water from informal sources to meet their water needs.

The low level of dependence on piped water supply in the sampled communities is not surprising. Many of the public RWSSs are old, dysfunctional, generally unreliable, erratic, and ill-maintained. With limited capacity, resources, access to spare parts, and skills, the benefiting communities are

generally unable to manage, operate, and maintain these systems efficiently. The rural households that many of the RWSSs are designed to serve are widely dispersed and/or sparsely distributed. The required trained personnel to carry out operation and maintenance activities (using government resources and technology) are not always available.

Previous workers have revealed similar findings in some other developing countries. For instance, Marks & Davis (2012) who worked in Ghana, and Eva (2015) who worked in South Africa, reported that even where governments have constructed rural water schemes and upgraded the capacity of water users so that the communities would be able to operate and maintain supply systems efficiently, many RWSSs still fall into disrepair or fail to work to full capacity.

In Ethiopia, Kenya and Tanzania, Tadesse *et al*. (2013) and Babic *et al*. (2014) reported that quality and reliability are not always assured; that vendors ensure some form of water access where the government has failed; that water supplies from public RWSSs are generally dysfunctional, unreliable, and erratic; and that the few functioning schemes do not function to their design capacity or last for their design period.

Future directions

For several decades Nigeria has experienced rural water supply shortages and poor quality water services' delivery. National and state public water supply agencies develop WSSs in rural communities and allow the critical water infrastructure to deteriorate, decay, and collapse. What follows is erratic/unreliable and inadequate water service delivery, and then water crisis – forcing the people to return to their traditional water sources – streams, wells, or to the water vendors. The massive failures of public WSSs in Nigeria, together with the challenges implicit in them, need, therefore, to be addressed. One way of confronting this issue is to close the policy gaps in the rural supply sector at the national and state levels through policy reforms. First, there is an urgent need to reform the principal legislations governing rural water supply in Nigeria in order to adequately address the present and future water needs of the rural populace. The critical issues that should guide the reform policy must be quality service delivery and sustainability of rural water supply services. The policy must address the issue of post-construction/external support to RWSSs and ensure that quality/sustainable rural water infrastructures are put in place to enhance the people's well-being and accelerate the pace of economic growth in the countryside. The legislations governing rural water provision in Nigeria should aim at attaining lasting services' provision in order to alleviate the suffering of the rural dwellers. Adequate provisions of post-construction support need to be the precondition for qualification for the establishment of rural water projects and service providers must have the capacity to rapidly respond to system failures. The states and federal governments should closely monitor service providers and enhance their capacity (through technology upgrading, etc.) to cope with the challenge implicit in providing quality services' delivery. Healthy living and socio-economic development in the region will be facilitated and/or accelerated by the presence of functional water infrastructure.

Second, the widely held view on, or trust in, the effectiveness of the CP policy needs to be revisited. The assertion that 'communities are always capable of managing their own water infrastructural facilities on their own' is largely a myth in the sampled communities. No evidence is available to show that sustainability of rural water services' provision is being achieved with the current model of CP policy in which benefiting communities receive little or no external support to sustain supply services. Cases where benefiting communities have successfully participated in the planning, development, and

choosing technology type are rare in the study communities. The factors constraining the effectiveness of this policy need to be addressed.

Third, introduction of measures to regulate the activities of IWSPs is both justified and highly desirable. Official recognition and integration of IWSPs, and assistance to IWSPs by governments in Nigeria may help to improve water supply service provision in the area. IWSPs have become important and even the preferred service providers in the sampled rural communities, where they are now ubiquitous and helping households to meet their water needs. They are capable of, and are already sharing, the task of delivering potable water to the rural communities. There are useful lessons that public-sector agencies can learn from the IWSPs to boost water service delivery to rural communities. Such lessons include: IWSPs operate, maintain, and extend water facilities with relative ease largely because of the traditions of prompt financing and effective management of facilities. Financial viability, and prompt and efficient management may help to revive many of the dysfunctional RWSSs in the study area. Governments can encourage and assist IWSPs through technology upgrading, training, marketing support and credits, to enable them to develop and deliver better services to the people. However, the activities of the IWSPs should be closely monitored and regulated to ensure that they deliver water of acceptable quality to the users.

Fourth, governments and donor agencies need to set strict rules for the selection of simple and affordable technologies for rural water services' delivery in Nigeria. The reason for this is largely technical. There is a need to choose the type of technology that rural residents can afford, operate, and maintain. In the light of the high poverty level in rural communities, and rapid growth and development in engineering technologies and their applicability to developing drinking water, such rules will be more and more urgently needed.

Finally, in choosing a water source to be developed, the adequacy of the source and the settlement pattern of the benefiting community should be considered. If several water sources are available or can be mixed, preference should be given to underground sources, which are more widely available in Nigeria, technically more feasible and more adaptable to the use of simpler technologies. Nigerian surface waters are extremity polluted (see Figure 4) and the technologies required to treat such polluted water are expensive.

Fig. 4. Effluent discharges and other pollutants in Orji River, Enugu state. Most rivers in Nigeria are extremely polluted.

Conclusion

A major problem facing the rural dwellers in Nigeria is the inadequate availability of potable water on a timely basis and in the quantity required (Marks *et al*., 2013). Evidence from this work indicates that this constraint is largely linked to the policy gaps in Nigeria's rural water supply sector. In Nigeria, weak institutional framework, inefficiencies in the management of state-owned RWSSs, lack of essential resources, and, sometimes, spatial dispersion of rural households are major constraints to the sustainability of rural WSSs. RWSSs are largely under state control; benefiting communities are rarely involved in, or are too weak to contribute to, both the design of water distribution systems and the maintenance of the network. As a result, access to potable water from RWSSs is low and this affects the quality of life of both men and women and their families. The current model of developing and managing rural RWSSs in the area needs to be improved through policy adjustments; recognition of and support to IWSPs may also improve access to safe water and make rural water supply service provision more sustainable.

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Received 21 September 2017; accepted in revised form 27 November 2017. Available online 30 January 2018