



An Analysis Of Bayelsa State Water Challenges On The Rise And Its Possible Solutions

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Abstract

The adoption of the United Nations Sustainable Development Goals (SDGs) in 2015 marked a new level of political recognition of the importance of water to development. For the first time, this included a target to ensure access to affordable, reliable and sustainable water for all – collectively known as Sustainable Development Goal 5. Interestingly, the fundamental starting point for food and life is water and its scarcity are a critical global issue. Over the past century, the quest for development has spurred the desire to explore the possibilities of harnessing all resources to advantage including water, which is 75% human made water content, while the whole earth is 70% water. These efforts were such that cogniscance has not been given to the environment where the entire processes take place. Consequently, around the world over a billion people lack access to adequate supplies of water and close to two billion people suffer from the consequences of poor sanitation. Millions of people, especially children, die each year from contaminated water and about 95% of deadly diseases in human body is associated with the consumption of liquid content, while over 25 million Nigerians are diagonized to die from highly chemicalized products. In many areas, lack of water, not land is the main constraint to agriculture. Recognizing that water is critical to sustainable development, many aid organisation's have tried to solve water problems by creating water-focused programmes. It concludes that there is an urgent need for increased awareness among leaders so that adequate strategies can be made for development under conditions of severe water scarcity and that there is absolute need for team work between national governments, multilateral bonds, UN agencies, professional associations, the private sectors and development partners (NGOs) etc., if we are to develop and manage our water sustainably. Government should take up the responsibility of providing potable water. Furthermore, there is need for strong policy, legal and regulatory frameworks, more effective implementing organizations and appropriate instruments. This can be achieved principally through strengthening the capacity of relevant institutions and ministries/agencies to be more pro-active in monitoring and compliance. More importantly, as water scarcity intensifies, we must remember that without water, there is no food, and without food, there is no security. However, technological advancement has created a sense that no problem is too big for our collective innovation potential if we invest appropriately in research and development. But we must not ignore or diminish the need for collective action to solve structural and often systemic problems. We also must not underestimate the urgency of the challenge. The cost of inaction can quickly destabilize communities when water is at stake. This is especially important if Nigeria hopes to achieve her developmental priorities of poverty reduction and re-creation of wealthy prosperity for her citizens as envisioned in the "Seven-point Agenda", "Vision 20 2025" and SDGs.

Keywords: Water Crisis; Teamwork; Partnership; Sustainability; Increased Awareness; Multilateral Bonds; Regulatory Framework; Monitoring

Introduction

Polarization of the Nigerian society with an estimated population ranging from 198 to 201 million people, growing at the rate of 3.2% per annum, into a large rural sector and a small urban component provides a basis for the inadequate and indiscriminate attacks on water and sanitation infrastructure and has become a complex emergencies, both in the urban and rural areas and can be a violation of international humanitarian law. For instance, over 65% of Nigerian population who live in the urban slums and rural areas are most neglected and deprived of basic services as well as other modern infrastructural necessities that are essential to the maintenance and promotion of good health. Hence the deliberate, intentional and arbitrary denial of services vital to communities can also be a violation and its supply is a major factor for consideration in the health of any community [1].

As a resource, water is an asset; As a flood, it is a threat; As it becomes scarce, it causes Drought. Man can survive for 5 weeks without food but maximum of 5 days without water. It is the most important raw materials for mankind called "Liquid Gold". It is mainly because of the magical substance only that earth's temperature is maintained reasonably uniform at an average of 16°C. Man needs about 150 to 300 liters of water every day for domestic purposes such as drinking, cooking, washing utensils, bathing, flushing toilet, air-cooling, gardening etc [1-5]. Water has a number of properties to life that are of critical importance to life and the environment [6]. Water is the only inorganic liquid that occurs naturally. It is also the only chemicalized products on this planet that occurs naturally in all three states of matter viz: solid, liquid and gaseous [6,7].

The world is running out of clean, fresh water to feed and nourish a growing global population, ensure sustainable human development, and maintain the health of our planet. Approximately 2.4 billion people, more than one-third of the global population currently live in water scarce regions, and projections indicate that by 2050 over one-half of the world's population could be at risk due to water stress [8]. Competition for water among its many users including food and agriculture production, the environment, energy, industry, and individual consumers is going to intensify. Increased competition over highly stressed, shared water sources, combined with weak governance and increased weather variability, can lead to migration and even violence. Failure to treat water as a strategic, valuable, and limited resource will accelerate water insecurity, even for historically water-secure populations, and may threaten the economic and political security of nations, including the United States [9]. Interestingly, water touches every aspect of our lives: food, health, environment, industry, and leisure. The competition

for water resources is increasing between people and the natural environment as well as between cities and rural areas. By 2050 the global population is expected to increase to 9.8 billion, with 86 percent living in less developed countries and 70 percent living in rapidly growing urban areas [8]. Hence, global demand for water is generally projected to increase by 30 to 50 percent by 2050 [9].

Water is one of the most abundant compounds found in nature, covering approximately three – fourths of the surface of the earth. In spite of this apparent abundance, several factors serve to limit the amount of water available for human use. As shown in table 1.1 over 97 percent of the total water supply is contained in the ocean and other saline bodies of water and is not readily usable for most purposes. Of the remaining 3%, a little over 2% is tied up in ice caps and glaciers and along with atmospheric and soil moisture, is inaccessible. Thus, for their general livelihood and the support of their varied technical and agricultural activities, human must depend upon the remaining 0.62% found in fresh-water lakes, rivers and groundwater supplies. Water is mostly used for industrial and municipal purposes [3,5]. In order to ensure the right quality, it is extremely important to monitor water supply throughout taking all the aspects [10].

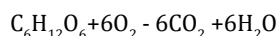
Location	Volume, 10 ¹² m ³	% of Total
Land Areas		
Fresh water lakes	125	0.009
Saline lakes and Inland Seas	104	0.008
Rivers (average instantaneous volume)	1.25	0.0001
Soil Moisture	67	0.005
Ground Water (above depth of 400m)	8350	0.61
Ice caps and glaciers	29,200	2.14
Total Land Area (rounded)	37,800	2.8
Atmosphere (water vapor)	13	0.001
Oceans	1,320,000	97.3
Total all locations (rounded)	1,360,000	100

Table 1: World Water Distributions. Adapted from Khitoliya, 2004

Water is distributed in nature in different forms, such as rain-water, river water, spring water and mineral water. Rainwater is the purest form of naturally occurring water. It evaporates from sea as a result of extensive heat. The water vapors thus arising from the surface are designed by the winds onwards [3,10].

Water and the living environment

The origin of water preceded the evolution of life. In fact, the reactions that make up life, such as the synthesis of proteins and nucleotides, occurred in the aqueous medium. It is for this reason that water forms a part of biological structures. For example, water plays an important role in maintaining protein structure. Water molecules are bound to the protein chains at varied locations through hydrogen bonding. These hold up the proteins in their peculiar folded conformations. Without the folded conformations, the proteins would have been unable to perform their specific functions [7]. An adult human has a water content of 65-75%. Table 2 shows that a normal adult person consumes two and a half liters of water every day and loses an equal amount. The daily gain of 350ml water, due to glucose oxidation, result from the reaction.



This reaction liberates about 8000KJ of energy which utilized by the body for performing essential work. Had this energy been dissipated as heat, the body temperature would have risen by 26 degrees and would have resulted in death [7].

Gain (ml)	Loss (ml)
Drinks: 1300	Respiration: 400
Food: 850	Evaporation: 500
Glucose Oxidation: 350	Excretion: 1600
Total: 2500	Total: 2500

Table 2: Daily balance sheet of water of an adult.

Plants derive their energy from the reverse reaction, this is,
 $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

Carbon dioxide and water combine to form glucose and oxygen in photosynthesis. This process takes place in the presence of solar energy. The levels of carbon dioxide and water in the biosphere are maintained by reaction. The large surface tension of water (73 dynes cm⁻¹ at 293K) and its ability to wet surfaces are the basis for the capillary action, which carries water to the leaves of plants and trees. Water has a maximum density at 277K, a little above its freezing point. Thus, lower density is attributed to ice than liquid water [11]. It, therefore, floats on the water surface and freezing of aquatic systems occurs from surface downwards. Unlike, the solid state of other substances is denser than the liquid state [12]. Had water behaved in this manner, the aquatic systems would have frozen from bottom up. As a result, the aquatic life in oceans, rivers or lakes would have perished in the winters [7].

Water and the non-living environment

Water covers 71% of Earth’s surface. Most of it is salt water. Only 2.5% of it is fresh water. And, only 1.2% of that fresh water is in rivers and lakes. The rest of Earth’s fresh water is trapped as ice in polar caps and glaciers (68.8%) or underground (30.0%). Water plays a role in climate and weather. It is the most abundant greenhouse gas in the atmosphere, accounting for 40–70% of Earth’s retention of heat. In addition, water is complex and anomalous and called the universal solvent because it dissolves a wide variety of substances. Water is polar, so it readily dissolves charged or polar solutes. Water also dissolves some molecules that have nonpolar character, such as aromatics and surfactants. However, water is not a good solvent for nonpolar molecules such as hydrocarbons (oils). This is the basis for the expression that “oil and water don’t mix”. Water is more cohesive than materials made of molecules of equivalent size and shape. Water molecules associate with each other relatively tightly. Therefore, H₂O has relatively high values of surface tension, melting point, and boiling point. And, water has density anomalies that are manifested in various ways [13].

Water has a high heat capacity per unit weight. This means that it can absorb relatively large quantities of heat without large changes in temperature. Thus, during summers a large body of water, such as a lake or an ocean, absorbs more heat from the air than the land. An area in the vicinity of the water body, therefore, would have a lower temperature than a distant region. During winters, the temperature of the air drops below that of the water and the aquatic system gives up its stored energy as heat. This effect tends to warm up the air. As a result, the areas surrounding a lake, or an ocean have milder winters. Moreover, the high heat capacity of water enables the oceans to store considerable quantities of thermal energy. The oceans are thus able to act as large thermostats from which heat energy is carried to the cooler regions by waves or currents [7].

Water has a very low coefficient of compressibility (5pa⁻¹) at ordinary temperatures and pressures. However, if water would have been completely incompressible, then the level of the sea would be higher by 40 meters, reducing the inhabitable area by 5%. The high dielectric constant of water makes it an excellent solvent; it is often referred to as the universal solvent. As a result, natural water is never pure, but a solution of substances which come into contact with it. When the number and or concentration of the chemicals entering an aquatic body become so large that the natural qualities of water are altered, we say that the water has become polluted [3]. The dissolved impurities are not the only ones which make the water stained. The suspended matter is also hazardous. When the

aquatic system becomes polluted it becomes mandatory to purify water, so that its natural qualities are restored. However, before water can be purified, the type and nature of the pollutants must be identified [3-5,7].

Conflicts over water

Water, as you know, is the most important resource of a society, since no life is possible without water. A society can survive without other resources like minerals, fuels, forests, live-stock, etc. but cannot survive without water [11]. So long as sufficient and plentiful of water remains available to fulfill the present and future needs of the society's population, there shall occur no conflict among the populace; but if the available water becomes or likely to become scarce or deficient, then naturally, quarrels and conflicts among its shareholders are bound to arise. Up to a few decades ago, water was generally available comparatively much easily, as compared to its availability in today's times. The basic reason for this shortage is the increasing demand of water due to increasing population, changing life styles, and excessive use in irrigation. So much so that the present annual global withdrawal of water (2005) is about 4500Bm³, which is about 21/2 times the withdrawal of the year 1950. Due to increasing demand, the scarcity of water is becoming more and more apparent, particularly in water short countries. So much so that, at present, about one billion people of the world have no access to clean water, and to many more, the water supplies are highly insufficient and unreliable. It has further been estimated that more than 30 countries of the world are already facing severe water shortages, while this number is likely to increase to more than 50 by the year 2025. The U.N. has estimated that by the year 2025, about 4 billion people will be seriously affected by shortage of water. This may lead to multiple conflicts between countries over the sharing of water. As a matter of fact, there are about 100 countries that share the waters of 13 large rivers and lakes. The upstream countries may create scarcity conditions for the downstream nations, leading to conflicts and water wars [14].

Africa, by far, is the most potential continent for such flare ups during the next 25 years, as countries may fight for access to scarce water resources, potential water wars are likely to occur in areas, where rivers and lakes are shared by more than one country. The possible flash points are the Nile, Niger, Volta and Zambezi river basins [15]. Ethiopia for example is already in great tension with Egypt. Ethiopia, in fact, is situated upstream of the Nile river, while Egypt, located downstream, is highly dependent on water of Nile river. The Ethiopian government was pondering over the construction of dams on the Nile to utilize its water for itself. This led to severe opposition from Egypt. In the dying years of the previous

Ethiopian government, the tension between Ethiopia and Egypt has increased so much, that a water war looked imminent. There is another possibility of a water war between Botswana, Namibia, and Angola. The river possesses a great potential for a water conflict between these neighboring countries, who are the authorized shareholders of this river.

As far as India is concerned, it shares Ganga river with downstream Bangladesh; the Indus river with downstream Pakistan; and Brahmaputra with upstream located China. Moreover, just after the Partition, had entered into a conflict with Pakistan on sharing of Indus waters; but the problem was sorted out with Indians magnanimity by international arbitration on the basis of Indus Commission Report, leading to signing of Indus water Treaty in 1961 (to be effective wef 1.4.1990). According to this treaty, the water of Sutlej, Beas and Ravi (all tributaries of River Indus) were allocated to India for unrestricted use; while the waters of Indus, Jhelum and Chenab (other tributaries of Indus) were allocated to Pakistan. The India was allowed to use the existing irrigation facilities and to develop an additional 0.28Mha from these three rivers, but on payment of a huge cost amounting to 62.6 million Pounds to Pakistan. India has, similarly, entered into an agreement with Bangladesh on sharing of the water of Ganga river at Farakka on 05.11.1977. However, prior to signing of this agreement, a lot of tension and bad blood had been generated with that country (i.e., East Pakistan at that time) on the issue of construction of Farakka barrage.

Signing of such international agreements is absolutely necessary for reducing the possibility of water wars between different nations. As in some other countries, there also exist some disputes between certain States of India on sharing of river waters passing through the beneficiary States. The continuing conflict between Karnataka and Tamil Nadu on sharing of Cauvery waters is one of the most prominent of such Inter-state river water disputes in the country. This dispute continues as Karnataka due to its own compulsions and necessities, sometimes fails to release enough water into Cauvery river to quench the thirst of the downstream located Tamil Nadu, leading to political mud-slinging and conflicts. All such conflicts and in-fightings have a great potential to convert into bloodsheds due to internal riots, battles, and wars. Another prominent example of such continuing inter-state river water disputes of India is the conflict between Haryana and Punjab on the issue of the construction of 201km long Sutlej-Yamuna Link Canal (SYL Canal), which shall divert waters of river Beas (after it outfalls into Sutlej) to Yamuna, so as to enable Haryana to utilize its share in the Beas waters as awarded to it by the Ravi-Beas Water Disputes Tribunal (also called the Eradi Tribunal). This link canal, as

you may know, is lying incomplete since long, as the State of Punjab has not allowed the construction of 121km long portion of this canal through its territory, due to its own compulsions. The terrorists during the days of military in Punjab in 187-1993, actually, made SYL an issue and opposed its construction on the plea that SYL will cause immense and irreparable harm to the farmers of the Punjab State, as they will be deprived of their precious water [14].

International water disputes

River	Countries in Dispute	Issues
Lake Chad	Nigeria, Chad	Dam
Okavango	Namibia, Angola, Botswana	Water diversion
Nile	Egypt, Ethiopia, Sudan	Siltation, flooding, water flow/diversion
Euphrates, Tigris	Iraq, Syria, Turkey	Reduced water flow, salinization/International quotas, Salinity level
Jordan, Yarmuk, Litani, West Bank aquifer	Israel, Jordan, Syria, Lebanon	International quotas/ Water flow/diversion
Indus, Sutlej	India, Pakistan	Irrigation
Ganges-Brahmaputra	Bangladesh, India	Siltation, flooding, water flow
Salween	Myanmar, China	Siltation, flooding
Mekong	Cambodia, Laos, Thailand, Vietnam	Water flow, flooding
Parana	Argentina, Brazil	Dam, Land Inundation
Lauca	Bolivia, Chile	Dam, Salinization
Cenepa	Ecuador, Peru	Water allocation
Rio Grande, Colorado	Mexico, United States	Salinisation, waterflow, agrochemical pollution
Rhine	France, Netherlands, Switzerland, Germany	Industrial Pollution
Maas, Schelde	Belgium, Netherlands	Salinization, Industrial Pollution
Elbe	Czechoslovakia, Germany	Industrial Pollution
Danube	Hungary, Slovak Republic	Industrial Pollution
Tagus	Spain, Portugal	Water allocation
Szamos (Somas)	Hungary, Romania	Industrial Pollution/ Water allocation

Table 3
Adapted from Carla [16].

Global water crisis

Humans faced both social and natural crises including the water crises, which are the one that lies at the heart of our survival and that of the planet. No region will be spared from the impact of this crises, which touches every facet of life, from children health to the ability of nations to secure food for their populace. Water supplies are falling while demand is dramatically growing at an unsustainable rate [5,16]. With a global population of 26 billion, 19.45% lack access to safe drinking water and 50% live under unsanitary or unhygienic condition.

Faced with the inertia at the leadership level, the global water crises will reach unprecedented levels in the years ahead with growing per capita scarcity in many parts of the world. For now, some 2.2 million people still lose the battle of life each year by succumbing to diseases associated with poor water and sanitation, with 6,000 children dying daily from diseases that can be prevented simply through improved water and sanitation [1].

About 40% of the world population currently lives in areas with moderate to high water stress and it is estimated that two thirds of the world’s population (about 7billion) will likely live in areas facing such water stress, ironically, as the worlds fresh water system get severely degraded through pollution, water use worldwide has increased six fold over the last 100 years, a figure which more than doubles the already precarious rate of population growth. The extent of pollution of water can be better imagined when it is considered that 90% of sewage and 70% of industrial wastes are discharged untreated, often polluting the useable water supply. Consequently, patients suffering from water-borne diseases occupy more than half of the world’s hospital beds [5,17].

Globally, the current water supply picture has been alarming despite the unprecedented advances in the last decades. Fresh water supply is facing intense and unsustainable demand from users of all sorts including farmers, which have to compete for water with urban dwellers and industries. A situation of total lack of water, which may prompt a country to go to war to acquire streams or rivers, is not very far in sight. In the Sahelian region and drought prone areas of the globe, there is a strong association between water availability and foods production [18].

It is an undeniable fact that poverty undermines provision of good water supply [1]. Moreover, the failure to extend the fundamental benefit of hygiene, sanitation, and water to all people remains a hurdle to development, and a root cause of persistent poverty [1]. If good water is synonymous with developed societies,

then little or lack of it or poor quality is associated with poverty and deprivation, which is the bane of the third world countries [1]. That is why most of the world's poor are frequently sick from unwholesome water and poor hygiene [17]. Since life expectancy is a cumulative event in an environment, the sheer sustained frequency of childhood diseases and afflictions occasioned by malnutrition, poor physical and mental growth and early death stem from poor hygiene and contaminated water [1,5,17,18].

In many developing countries, i.e. Nigeria (Abuja, Borno, Yobe, Niger, Adamawa, Kano, Bauchi, Sokoto, Gombe, Zafara etc.) women and children are seen roaming many miles in search of water, sapping their energy, and dissipating their time. About one third of the world still lives in squalid environments, smell and disease at the doorstep and being imprisoned by hygiene related illness and ignorance [1]. These are also countries of high population growth rates. Economically, the poor are still spending more on hygiene-related and water-borne diseases, weakening more ill economic indices and perpetrating continuous poverty. It is expected that more funds be committed to water development projects particularly in the third world countries and the importance of water resources as a weapon in the war against global poverty should be more effectively highlighted [18].

Analysis of the nature of the water crisis and its paradox

While the Nigerian state is joining other African countries in popularizing the African Water Vision on the one hand, its approach to natural resources governance and surplus accumulation are precipitating water crisis and rural poverty; its water crisis, therefore, poses a major public policy challenge for policy makers, scholars, development practitioners and development partners i.e. (NGOs) [19]. With a predominantly rural population, water crisis is linked with land crisis, because the rural livelihoods are tied to land, the ownership of which is also vested in the Nigerian state [19]. The water crisis is known to be historically rooted in the Nigerian state and the colonial legacy. It is the contradiction engendered by state's capitalist development in natural resources and service delivery [20].

As a natural resource, the state conceptualizes water to a great extent as an asset to be exploited to create capital and other open merchandise, with next to zero thought for its sustainability and restoration [20]. In fact, scholars like Hardin had contended that, as a common resource, water lacked proprietary character and that accounted for its tragedy [21]. Hardin's critics like Bromley and Cernea had portrayed his metaphor as not only simplistic socially and culturally, yet generally false [22]. It was Okoth-Ogendo,

who contended that, Hardin was insensible of the standard laws, traditions and customs of Africa; and that, the African tragedy goes beyond its non-exclusive characters to incorporate the appropriation, suppression and subversion of the African commons by the colonists. Common resources such as water had a proprietary character, in light of the fact that there were different traditional institutions, social hierarchies, and indigenous knowledge for the organization, governance, conservation and renewal, as indicated by the necessities of the general population and the network. It was colonial capitalism and its policy that conferred on the state, the sole ownership, rights and access to water asset on the state, which has been proceeded with in the post-frontier period [19].

Besides, water resources are intricately linked to land over which the state likewise practices sole ownership and control under the Land Use Decree of 1978, which was extracted from the 1914 Mineral Act. The 1978 Land Use Decree has turned land into the swamps, creeks, lakes, and wetlands of the Niger Delta, where oil is being explored, produced, transported, and stored in a minefield, and the general population who live there as squatters in their ancestral land. The 1993 Water Decree also entrusted the sole ownership of water, both essential and optional water, surface and underground, on the Nigerian state, and empowered it to adequate waters for the development of hydropower and the construction of river basins but did so largely to the advantage of private interests [19].

Poor governance of water infrastructure and sanitation facilities, resulted in water crisis, inadequacy and scarcity, giving rise to attendant ill health and other hazards for the rural and urban poor. As a service offered socially, the philosophy of the state has continued in the step of its predecessor in the area of urban-based development, accounting for the provision of water schemes mostly within States and few semi-urban centers like Imirringi, Kiama, Ogbia, neglecting the composed rural areas. Around the state capital, an estimated 20 liters of water is consumed per head per day for top government officials including State House of Assembly members and commissioners which is against the recommended 70 liters per head per day. However, water consumption is put at 5 liters per capita in the rural areas, as creeks, rivers and swamps remain the chief sources of water with very limited water schemes [1,5]. Surface and aquifers water contamination by oil companies operating in the Niger Delta resulted in soluble iron and manganese in water and has contributed to water insecurity in most Niger Delta states [3-5]. In fact, water crisis is has become a nationwide problem in Nigeria, as only 40 percent of the national water coverage is for the major cities like Lagos, Ibadan and Abuja, with a miserable 5 percent in few local government areas [19].

Governance crisis has been attributed to water crisis in most States in Nigeria and It represents a larger crisis profoundly established in the sort of capitalist development in natural resources being advanced by the Nigerian state and foreign capital. Practically, the political leadership of the state cuts across the oligarchies, the bureaucracy, fronts of local and foreign private capitals, with the legislature of the day filling in as the ground where the governmental issues of the constituents and battles for progressing parochial interests are happened in concrete terms [19]. Oppression and violence have become an outcome of the distorted manner in which the Nigeria state is constituted, and this explains why state actors and political elites are unwilling to democratize natural resource governance and development issues in general [23]. Democratizing water resource management therefore involves disputes over ownership, rights, power, and interest rationalization, violence, fighting, with very clear implications for political competition, democratization, and development. To this end, the authority in Spain set up the Water Court in Valencia in 1831 to resolve water disputes and the Water Court still meets in the same place to date. The Nigerian state, however, refuses to rethink a new approach to the development of water resources [19].

Reactions and responses to water crisis

Water Resources Governance and Democratization

Most importantly, to have an idea of the political economy of the protracted agitations in the state and across other oil-rich communities in the Niger Delta in order to determine whether they are really concerned with the democratization of the governance of natural resources inclusive of water resource and land [19]. Understanding the political underpinnings of the protests will also give greater insight into the extent to which the people, who bear the brunt of the water crisis and rural poverty, are mobilized for the struggles; the alternatives strategies they are developing for survival and the Ijaws for whom Bayelsa state was created, have mounted persistent agitations for self-determination, social justice and equity, ownership and control of natural resources, and fiscal federalism since the late 1950s. Since the late 1980s, when the negative consequences of environmental pollution by the state oil companies have fully unfolded, the state had had and still has the highest incidents of taking oil workers hostage, especially as most oil locations are offshore [19].

Moreover, in terms of water security and promotion of rural development not much success has been recorded. Rather, the state and the oil companies still pollute the environmental resources thereby deepening the trend of rural poverty. However, there are

no indications that water insecurity will be reversed, largely because of inadequate problematization of the crisis itself by the agitators. The majority of those involved in the struggles do not really have an indebt understanding of water crisis perpetuated by the state; indeed, a governance crisis, and that a fraction of the political elites who empathize with the agitations even lack the strong commitment and political will to enforce the re-distribution of rights over natural resource to the people. In part, because they are not politically oriented to embrace democratization, and that they are in opposition only to mediate their access to the state's political power and resources to advance their narrow political, social and economic interests, but not to halt the accentuation of water crisis. As the author has explained above, the Nigerian political elites are not oriented towards the democratization of the governance of land around which water crisis revolves. For, some of the architects, who helped re-awaken the agitation for resource control in the year 2000, notably, the governors of Akwa Ibom, Bayelsa, Delta and Edo, have presented it as the political project of the governors of the south-south geopolitical zone, where about 97 percent of the country's oil is produced. They are able to sustain the struggle, using their political positions in the interim, because resource control is not being internalized in the various communities, groups and organizations participating in the agitations across the Delta region [19,20]. Worse still, democratizing the governance of natural resources is not an agenda of the ruling People's Democratic Party (PDP) which they all belong nor All Progressive Party (APC) and pressure group of the Niger Delta extraction, and in the country at large, committed to resource governance and recruiting the rural poor and peasants for right-based development and pro-poor governance of natural resources. All this portends great risk for the sustenance of the struggle, because as soon as the current crop of politicians ceases to be governors, or excluded from the state's political power, the struggles might lose its tempo and relevance [19].

Regarding rural poverty, particularly for the peoples whose predominant occupations are fishing and farming (Odubo., *et al.* 2019 in print), there are no clear indications that the water crisis in Bayelsa state is abating. Coupled with the fact that, the water crisis is governance crisis and indeed, crisis of the Nigerian state, it cannot be effectively dealt with by the state government alone. For, there are other powers outside of Bayelsa State and even the federal government and like the local private capitals and foreign oil capitals that would want to maintain the status quo to operate with utmost recklessness in the Niger Delta. Herein lies an aspect of the internationalization of the water crisis and rural poverty in the oil-rich Bayelsa state [19].

More importantly, the environmental resources, particularly land, water, oil and gas, forestry resources have characteristics, which make their governance problematic. It links the local to the national and international, raising issues that can foster poverty reduction, participation, accountability, transparency and inclusiveness at all levels of governance. In particular, water resources are slowly growing, offering various values to different people and providing long-term repository of value to the people and society. But these environmental resources are being easily destroyed with unsustainable exploitative policy and framework for their selfish interest as evident in the path the state took to resource exploitation. Neither can an adequate monetary value be ascribed to them; nor can appropriate financial value be given to the kind of poverty that is being precipitated following the destruction of these resources by the state and oil companies. Because the state conceives of the oil-producing areas as minefields, the operations of the state and oil companies even annihilate indigenous resource governance methods, which are better, suited than the western-driven conservation policies and projects for managing bio-diversity, conservation and protected areas [20]. Positioned in this framework, is difficult to promote Indigenous growth. With the wetlands such as swamps, creeks and rivers also biologically dead due to constant environmental pollution, coupled with the killing of fishes and planktons, fishing, being a predominant occupation in the coastal areas of the state, has been declining steadily [3,4]. The pollution in the continental shelf and oil locations in the Deepwater has destroyed the hydrological regimes of the rivers thereby blocking the renewal process of the aquatic organisms. Land scarcity and landlessness in the hinterlands, where farming is the major occupation, has compelled the rural farmers to till the wetlands i.e. swamps and the extension of the frontier has precipitated massive flooding during the raining season (Odubo, *et al.* 2019 in print). Little wonders the establishment of the Niger Delta River Basin Authority [NDRBA] in 1981, among other such organizations, purportedly to harness water in the Delta region was a monumental failure. For, it was created without putting in place, appropriate mechanisms and strategies for halting gas flaring, oil spillages and other forms of environmental pollution [3,4].

Food gathering such as rural water and forestry resources like snails, water snails, periwinkles etc. among the rural Bayelsan is not barbaric but constituted a viable poverty reduction strategy for the rural dwellers. This was the situation until the oil companies began operations in the Niger Delta. As a result, food gathering is no longer protected as a local livelihood strategy, particularly as the rural resources have, under gas flaring and oil spillages and indiscriminate dumping of untreated drilling water-based wastes on land and into the wetlands i.e. swamps, been constantly destroyed. In fact, the poor governance of water resources has become the focus of the impoverishment of the rural people [5,17]. Yet, few of the

local non-governmental organizations like the Chicoco Movement, Environmental Rights Action, the Center for Democracy and Development have been engaged in the study and advocacy for the Niger Delta region, have hardly developed programmes and projects dealing with the core issues of rural development. The members of the international community like the UK Department of International Development, United Nations Development Programme, UNESCO and USAID, which have demonstrated interests on rural development and provided minimal funding, have equally not really shown concern for the origin, nature and dynamics of rural poverty and helping the development partners i.e. NGOs to strategize for its reversal. It is in order to examine the responses of the state and other development partners and agencies to water crisis in the context of current scenario.

Water schemes and politics

As an infrastructure, water is a public good and service. The process of getting water to the people depends on many factors including feasibility studies, sample analysis, planning, implementation and renewal, the depth of the boreholes, right facilities-ranging from the pumps and their capacity, to water treatment plants and alum, chlorine and other consumables, overhead tanks, pipes conveying the water to the end users, restoring link between prices and quality of water services, the right manpower/skill, building the capacity of local authorities, improving monitoring and benchmarking of the water, staff quarters and vehicles. In addition, Bayelsa state government, federal government agencies, oil companies, and development partners i.e. donor agencies have been involved in providing safe water in most states in Nigeria as part of corporate social responsibility or creating shared value [19].

State Level (A focus on Bayelsa)

Although, the government of Bayelsa state has made tremendous efforts to deal with water crisis in the state, as evident in its plans to refine the fresh water. More than N4billion has been spent in providing drinkable water to the people since 1999. Yet, the persistence of water crisis and in part, at this level of government, the production and delivery of portable water have been politicized that they lacked transparency, accountability and have nourished poverty. It is a governance crisis: The Bayelsa Water Board is a statutory public corporation created to produce and supply water in urban and rural areas across the state, but the Water Board hardly performs its statutory functions. Rather, it operates a water scheme built by the Ministry of Public Utilities and Rural Development. The process of getting safe water to the people in rural and urban areas is still a mirage and yet to be democratized [19].

The Ministry, for instance, performs both policy-making functions and the executive duties. Without consultation with the three (3) major departments under the Ministry, namely, Water, Electric-

ity and Rural Development, the executive branch awards all contracts for water schemes to Hydro Construction and Engineering Company. The tendering process is limited to the company, which provides the water pumps, overhead tanks, treatment plants and consumables, installation of transformer. After the water scheme is built, the Ministry then instructs the Water Board to operate it. One of the constraints of the Water Board is that, it is forced to operate a water scheme that it does not know the capacity of the water pumps, where they are made, capacity of the tanks, the population it is meant to serve, no maintenance budget etc. As a result, whereas more water schemes are being built in the state, the production of water remains grossly inadequate and gradually becoming non-existence [19].

Urban water scheme - yenagoa

The Yenagoa water scheme is one of the oldest of all schemes in the state, dating back to when Yenagoa was once a UAC depot in the colonial period, to when it became the headquarters of the local government [19]. The water scheme produces 600,000 gallons in 18 hours, given constant electricity supply, which is hardly guaranteed, as the state is yet to be connected to the national grid system. Conservatively, this translates into 2.3 million liters of water every 18 hours, approximately a day [19]. There are other water schemes within Yenagoa such as the Swale water scheme. It is installed with 6 water pumps of 150 cubic meters each, totaling 900 cubic meters, and this translates into 900,000 liters of water. Therefore, daily water supply for Yenagoa is 2.3 million plus 900,000 liters, totaling 3.2 million liters of water [19]. But, Yenagoa total estimated population is 1,992,000 (2010 projected population) with a land mass of 11,007Km² and given the estimate of 70 liters daily need/person, this will translate into about 105 million liters of water per day, against the total daily production of 3.2 million liters/day, with an average of 20 liters/person. This is just an aspect of the magnitude of water crisis in urban water supply. Even with the 20 liters/person water supply, the places fully supplied include: Ovum area, which includes Government House, House of Assembly Quarters, and Commissioners Quarters [19].

Other water schemes within Yenagoa, which were still projects at the time the study was conducted, included: Etegwé water scheme, Egebgwu water scheme, Igbogini and Kpansia water projects, with each project planned to redress the scarcity of drinkable water in the various quarters within the state which form part of the politics of water crisis. But, water delivery within the state capital is still grossly inadequate despite increasing private boreholes, as the main source of water, which is not treated, in spite of the heavy presence of iron and manganese in the water [3-5]. Water vendors sell the 25 liters gallon of water at an average of N50.00. The hand-dug well and the stream are still the major source of water for the majority of the urban dwellers [5]. The DSP Water Initiative in 1999, which the government refuted of having anything to do with the governor, but a private initiative for water distribu-

tion project, was aimed at selling water to the residents of Yenagoa and its immediate environs. It began with 10 tankers of 3000 litres capacity. Lacked funds for maintaining the tankers and grounded most of them. It folded up in 2004 and not much has been done till date [19].

Public and private semi-urban and rural water schemes

These are water schemes outside of Yenagoa located in semi-urban and rural communities. All 8 LGAs and 24 Development centers in the state have one form of public or private water scheme, but not all of them are equipped with water treatment plants. These water schemes are still in various stages of development, with some of them nearing completion, and others still being test-run, under construction and old ones being rehabilitated. One of the implications of this is that, safe drinking water is still very scarce and inadequate in the rural areas [19]. Firstly, the functioning public water schemes, including the Kolo water scheme producing about 3000 liters for 8000 people and those of Oruma under Ogbia LGA and Odi town producing skeletal, and those about to be completed are in the Southern Ijaw LGA (Opomowei), located in Perembiri, Amasoma, Eseomi, Otuan and Lobia. Secondly, the category of water schemes being test-run including the schemes located in communities under the Sagbama LGA, namely, Essozui, Ogolobiri and Tomibiri expected to produce 6000 liters. The water scheme in Sagbama town has a water treatment plant and produces about 5000 liters of water [19].

Third, are schemes being rehabilitated and one of them is the Okolobiri water scheme. Fourth, are water schemes that are still largely projects. They include Kiama Water Project under Kiama LGA, Agbobini and Otueke water schemes under the Ogbia LGA; Peretorugbene and Anyalobiri water projects under Ekeremo LGA. The fifth category includes public-private partnership water schemes. Under this, is the Brass water work, which is the only scheme refining the salty water, produces about 10,000 liters of water for about 9000 people per day. Initially, it was the project of the Rivers State Government and AGIP, because the company's oil terminal is located in the city of Brass. However, when the state was split into two, Bayelsa and Rivers, the scheme came under the management of the Bayelsa State Water Board. Agip funds the water scheme, while the Bayelsa Water Board provides the technical staff, who operate the scheme [19,20].

The sixth category of water schemes can be regarded as the responses of the state and oil companies to the protracted agitations of inhabitants and groups over the underdevelopment of the oil-producing communities. As agency of the state such as the Niger Delta Development Community (NDDC), Ministry of Niger Delta etc. has been charged to provide basic social and physical infrastructures in the Niger Delta, and portable water was one of its priority projects. However, as a microcosm of the state, its projects are

largely bedeviled with corrupt practices with shoddy work done. An example is the Bilogo water project, which was commissioned, but now idles away due to lack of funds to maintain it. Another example is the Ametolo Water project, Southern Ijaw LGA. Started first, by Shell, NDDC, OMPADEC and finally, UNDP. Yet, the project was abandoned. However, Shell's water project in Imirringi 10,000 liters of water for about 9000 people per day, is functioning. But it was built to calm the nerves of the agitated host communities; yet, the company still flares gas day and night for the past 50 years, thereby polluting the environment [19].

Lastly, the efforts made by the international community to redress water crisis. The UNICEF showed interest in educating the rural people on water and sanitation, collaborated with the state in providing water and sanitation programmes and projects and it is still dialoguing. The World Bank has trained personnel/built and strengthening capacity for the Water Board to manage secondary water projects in the state commercially, especially in a state that is badly hit with water crisis. Started in 1998, the Bank provided the funds for the construction of the current building housing the Water Board in Yenegoa, provided computers and other technical assistance, all inherited by Alemeseyia in 1999. Yet, nothing has been done, largely because it was difficult public policy on water to implement in a state ridden with water crisis. The European Union and Shell have promised to construct water treatment plants, but they are yet to do so [19]. The various water schemes itemized above represent considerable efforts towards redressing the inadequate production of safe water and its poor delivery in Bayelsa State and its environs. The reality of the situation is that, water crisis is biting harder.

Solution to water crises

Build partnerships

This is a "shared challenge," Jason Morrison CEO of the Water Mandate said, which was echoed throughout the Forum and reflected in the multidisciplinary panels and discussions. We have to get out of our silos and borders, Greg Koch Director of Global Water Stewardship at Coca Cola said respect each other's priorities. And these take trust [25]. Robust and coordinated action is needed by all affected states, donors, the private sector, academia and research organizations to strengthen responses and prevent the unbearable loss of productive time and life. States and partners should work together to embrace the current global momentum around sustainable water access to all and raise additional financial resources for water programmes.

Include farmers

It seems so obvious. Since farmers use 70 percent of the water used in the world, they must have a prominent seat at the table. Steve Peterson, Director of Sourcing Sustainability at General Mills, one of the world's largest consumer food companies, (and farmer) said "Since 13 percent of (farmers) produce 80 percent of the food supply, therefore, there aren't that many people you need to get in the room".

Include communities, especially women

Water is used by people, and people are in communities, and increasingly in urban areas. Marcia Brewster of Nautilus Development Corp. reminded us that women are key to driving community awareness and action. Interestingly, Deputy under Secretary of Agriculture, Dr. Ann Bartuska said that there's been a significant increase in the number of women farmers in the U.S., based on the recent Census. Recent studies have shown that women play a central role in the provision, management, and safeguarding of water, which is one of the four internationally accepted principles of water management. This principle is especially important for the developing world particularly Nigeria where millions of women lack access to water for their basic needs.

Measure water

Leaders say "what gets measured gets managed" and water is no exception. Data crystallizes and validates a challenge, spurs action, and helps us see improvements and trends.

Put a realistic price on water

We charge so little for it, yet it costs so much to manage, that there's little motivation to address the pressing needs of the aging water infrastructure. Since the necessary infrastructure was lacking in most developing countries and an upward trend in water prices without improvement in service quality will result in strong consumer dissatisfaction. Therefore, restoring the link between prices and quality of water services.

Waste less food

The USDA statistics are remarkable: in 2010, about 133 billion pounds of food was wasted from U.S. retail food stores, restaurants and homes, meaning about \$161 billion worth of food was wasted - while many people go hungry. The DC Central Kitchen is tackling this issue in the DC area and with the national Campus Kitchen initiatives nationwide.

Integrate water into trade policy

International trade is driven by economic and political forces rather than by water scarcity. There is a need to integrate water and development issues, including their environmental effects, in trade and development policy. We must integrate water management, conservation and sanitation into trade policy [25].

Upgrade the infrastructure

Infrastructure investments, including rural roads, cell phone towers, markets, cold chains, and processing facilities should be expanded in partnership with the private sector. The American Society of Civil Engineers gives the U.S. water infrastructure a grade of "D." The D.C. area's water infrastructure is between 77 and 100 years old, for example. Yet, as Steven Stockton, Director of Civil Works at the Army Corps of Engineers pointed out at the Forum, the return on investment is about 450:1 in preventing floods and increasing resilience. Really making these investments requires long-term thinking and getting out of living from crisis to crisis, as Stockton described it. I vote for the Infrastructure Bank.

Choose your words carefully

We need to reach people in culturally appropriate ways to build trust and language matters. For example, the word "sustainability" doesn't resonate with farmers, as the Gentleman Farmer from General Mills reminded us, adding that the word "stewardship" works for farmers. "They'll walk out of the room if they hear the word sustainability." And, we need to leverage technologies to bridge distances, such as apps that help farmers sell more and waste less.

Protect the poor

The less fortunate among us use "every drop of water available," so when they have even a little bit less, the impact is huge. Without a seat at the table, because they lack political influence, everyone must look out for them. They are the most vulnerable to shortages and climate change disasters, with the weakest infrastructure and least resilience.

Citizen advocacy/educate to change consumption and lifestyles

In the end, changing the face of this crisis involves education/citizen advocacy to motivate new behaviors. Coping with the coming era of water scarcity will require major overhaul of all forms of consumption, from individual use to the supply chains of major corporations, like GE. Some regions led by India, Australia and the Southwest U.S., are already facing the water crisis. The most critical task is making sure the problem is much better understood globally [25].

Invent new water conservation technologies

In areas where aquifers are drying up and rainwater is increasingly unpredictable, innovation is needed. But as we attempt to cope with freshwater scarcity and develop conservation technologies, energy consumption is an important consideration.

Recycle waste water

Recycling more water will help us to reduce water waste and increase supplies. In March, World Water Day panelists urged a new mindset for wastewater treatment. Some countries, like Singapore, are trying to recycle to cut water imports and become more self-sufficient. The rich East Asian republic is a leader in developing advanced technology that cleanses wastewater for other uses, including drinking.

Improve irrigation and agricultural practices

Some 70 percent of the world's freshwater is used for agriculture. Improving irrigation can help close supply and demand gaps. In certain cases, profligate irrigation practices meant for an earlier era has weakened the ability of farmers to provide food and fiber to a growing world. Examples include the Murray-Darling basin in Australia, Central Asia's Aral Sea, and the American Southwest. Although new technology has become an appealing solution, global water experts like Peter Gleick note that in some cases, such as the agricultural systems in California, success stories can happen by improving what's already in place [25].

Appropriately price water

Water pricing and rights go hand in hand, with consumers questioning the benefit of higher prices. According to experts from the Organization for Economic Co-operation and Development (OECD), an international economic forum of 31 of the world's richest countries, raising prices will help lower waste and pollution. But Circle of Blue's May investigation into water pricing systems in major U.S. cities, show current utility pricing systems are obsolete, send the wrong signals, and need reform.

Promote research/develop energy efficient desalination plants

Research promotion that will allow us to use solar energy to desalinate water for increasing supplies and to purify the water we use. To date, desalination has been an energy-intensive solution to water scarcity. Typically, the Middle East has capitalized on its large energy reserves to build desalination plants. But Saudi Arabia could be fostering a new kind of desalination with its recent announcement to use solar-powered plants. Britain has taken a dif-

ferent approach with small-scale facilities for agriculture. But these innovations bring to light another needed resource the capital for technological experimentation [25].

Improve water catchment and harvesting

Water catchment systems are essential for areas with no other reliable water sources. Pakistan and India-two countries that contend with some of the worst effects of climate change are overhauling rainwater harvesting systems. These efforts provide independent control of water resources.

Community-based governance and partnerships

Community organizations elevate the experiences of those whose voices merit more influence. In April, for instance, indigenous groups met at the alternative climate change conference in Bolivia, a gathering meant to foster international partnerships among underrepresented groups. Ensuring more effective governance at the grassroots-level gives communities stature and can lead to effective policy changes on a national scale [25]. Also, building the capacity of the local authorities to oversee the water interventions and improving the monitoring and benchmarking of the water providers by the Ministry of water resources and strengthening the institutional capacity of the Water Regulatory Authority.

Develop and enact better policies and regulations

As water scarcity complicates food security and pollution, governments need to redefine their role. The U.S. government is considering expanding the Clean Water Act to ensure more protections. In Russia, meanwhile, Prime Minister Vladimir Putin has approved waste discharges in Lake Baikal, one of the world's largest bodies of freshwater. Regardless of what path elected leaders take the Circle of Blue/Globe Scan Water views survey indicates they are considering multiple approaches the survey also found that most people say it is up to the government to ensure communities have access to clean and sustainable water.

Preserving biodiversity/holistically manage ecosystems

Preserving biodiversity by avoiding disruption of aquatic systems and their bordering terrestrial system as a key factor in maintaining water suppliers and water quality. Simply put, holistic management applies to a practical, common-sense approach to overseeing natural resources that considers economic, cultural, and ecological goals. In essence, the whole is greater than the sum of its parts, and each facet is related to and influences the others. Good examples of holistic management are communities that operate sewage treatment plants while pursuing partnerships with

clean energy producers to use wastewater to fertilize algae and other biofuel crops. The crops, in turn, soak up nutrients and purify wastewater, significantly reducing pumping and treatment costs.

Improve distribution infrastructure

Poor infrastructure is devastating to health and the economy. It wastes resources, adds costs, diminishes the quality of life, and allows preventable water-borne diseases to spread among vulnerable populations, especially children. The problem is not confined to the developing world alone. Pipes burst on a regular basis in the U.S., prompting boil alerts. Sewage treatment systems regularly overflow and malfunction, causing beach closures.

Shrink corporate water footprints

Industrial water use accounts for approximately 22 percent of global consumption and the corporate footprint includes water that is directly and indirectly consumed when goods are produced. As sustainable manufacturing becomes more important, given the increasing severity of water scarcity.

Build international frameworks and institutional cooperation

Binding international accords for natural resource issues are hard to achieve. The 2009 United Nations Climate Change Conference in Copenhagen is evidence of that point. And that's not just because the freshwater crisis, arguably the most visible and dire of the climate change risks, was ignored. Regional agreements regarding transboundary or shared water bodies such as the Great Lakes Compact in the U.S., and Nile River basin agreement in Africa are just as difficult to ratify. But policymakers and advocates need to keep trying. Humanitarian-oriented treaties, such as the U.N.'s drinking water Sustainable Development Goals, indicate that comprehensive global strategies are possible.

Address pollution

Water pollution affects human health, economic development, and the environment. It leads to increased competition among water users for the shrinking supplies of unpolluted water. Pollutants can be both human-induced (e.g., microbiological contamination, eutrophication and excess nutrients, acidification, metal pollutants, toxic wastes, saltwater contamination, thermal pollution, and increases in total suspended solids) and natural (e.g., salinization, arsenic, and fluoride). Water pollution reduces agricultural production and increasingly constrains agricultural and economic development [26]. Hence, measuring and monitoring water quality is essential to human health and biodiversity [4]. This monumental issue rears its head in many forms and can be addressed in just

as many ways. While securing the quality of drinking water at the local level, it's essential to build international bridges to solutions [3].

Public common resources/equitable access

One of the key United Nations Sustainable Development Goals (SDGs) is ensuring access to drinking water. While the steps to achieve this goal are debated, the thesis that water is a basic right comes into play. As countries such as Chile attempt to reform water rights [25].

Innovation/systemic thinking

Access to water in a water-scarce world will become a much higher priority in business decisions. Communities are likely to pursue public-private partnerships that draw on the innovative capacities of companies. One example, city that operates sewage treatment plants are likely to pursue partnerships with clean energy producers to fertilize algae and other biofuel crops with wastewater.

Transfer of technology on water projects in developing countries

Climate change and water scarcity are producing the most dramatic consequences in developing regions, such as northwest India and Sub-Saharan Africa. One proposed solution is to transfer water conservation technologies to these dry areas. Doing so is tricky because economies are weak and there are gaps in skills that often compel government and business authorities to impose these changes on local citizens.

Climate change mitigation

Climate change and water scarcity go hand-in-hand to cause some of the biggest contemporary challenges to the human race. These issues have a reciprocal relationship, identified by the Intergovernmental Panel on Climate Change (IPCC), in which, "water management policies and measures can have an influence on greenhouse gas (GHG) emissions." As renewable energy options are pursued, the water consumption of these mitigation tactics must be considered in producing alternatives ranging from bio-energy crops to hydropower and solar power plants [25].

Population growth control

Controlling human population growth is fundamental to using water resources more sustainably and efficiently while maintaining water quality. Because of the explosion rate in global population, parts of the world could experience a supply-demand gap

of up to 65 percent in water resources by 2030. Currently, more than one billion people don't have access to clean water. And with 70 percent of the world's freshwater used for agriculture, water's critical role in food production must be considered as climate and resource conditions change [25].

Creation of a databank for baseline information

There is paucity of information to help planning and management of water supply. For instance, any information given for per capita consumption of water will be misleading as water supplied to all parts are not the same? A lot of information is needed for effective decision-making during planning and management of water supply. One basic step to effective planning and management of water supply and availability to ensure that accurate information is available to the planners and managers of water supply.

Needs assessment and prioritization of actions

Since the sources, quantity and quality of water available to each community are different as well as the population of the residents requiring water, there is therefore the need to ascertain the actual need of the people from one community to another. This will generate needed baseline data for effective planning and management of water supply. To ensure water availability and need assessment should be done.

Effective institutional arrangement is necessary

A clearly defined institutional framework must be put in place. This will check overlap of responsibilities and therefore ensure that there is no role conflict that will result in neglect or dereliction. Effective institutional framework for sustainable water supply and management will imply that the institution is vested with this responsibility and no other institution/agency is expected to perform the same responsibility to avoid role-conflict. Moreover, in view of the enormity of the responsibility, for sustainable water availability, supply and management. The state government agency should be strengthened in terms of manpower and financial resources to be able to perform creditably well. Regular training and capacity building of personnel to be able to cope with the responsibilities will also constitute an effective institutional strengthening for sustainable water availability, supply and management [27-37].

Conclusion

Global demand for water is generally projected to increase by 30 to 50 percent by 2050 and rising global population, income, and urbanization are causing strong growth in food and water demand and intensified competition for water. More than one-third of the

global population approximately 2.4 billion people already live in water scarce counties, or river basins with annual water withdrawals greater than 40 percent of total renewable water. Hence, water is a vital resource that is becoming increasingly scarce and threatens to undermine the progress that has been made on global food and nutrition security. With the potential for severe economic, political, and humanitarian consequences across low and high income countries, water scarcity is a critical global issue that demands immediate action to improve water productivity and management. The challenges are daunting and will only become more difficult if not addressed.

Despite the challenge that water scarcity poses around the country, few states have succeeded in moving closer to water access to its citizen. Given its strong association with poverty, water scarcity is a litmus test for the achievement of the global ambition of "Sustainable Development Goals". Robust and coordinated action is therefore needed by all affected states, donors, private sector, academia and research organizations to strengthen responses and prevent the unbearable loss of productive time and life. States and development partners should work together to embrace the current global momentum around sustainable water access to all and raise additional financial resources for water programmes. To achieve the water-specific targets of the Sustainable Development Goals, water scarcity states and development partners need to take concerted action to reduce water crisis related deaths. Reaching all affected states and communities with water interventions requires strong political commitment and a significant expansion of international and domestic financial resources. Hence, there is an urgent need for increased awareness among Nigerian leaders so that adequate strategies can be made for development under conditions of severe water scarcity. The time to act on fundamental reform of water policies is now. Successful, sustainable water management is imperative to achieve the goals of a rapidly growing, urbanizing world. Several strategies can be used to address the challenges posed by increasing water scarcity. These include:

- Improving overall water resource governance through institutions that are transparent, accountable, efficient, responsive, sustainable, and geographically contextualized. Also, allocating water more efficiently through water rights, regulations and quotas, water pricing, water trading, and subsidy reform etc.
- Democratization of the Nigerian State and its constituents should be a priority. For, in its present composition, the Nigerian state is repressive; and given its actions and politics,

the state has become the major clog to the democratization of the governance of natural resources inclusive of water resources [19]. Part of the strategy of democratizing the state is to re-orient the political class away from its narrow perception of politics as a means to wealth, to catering for the common goods for all, with the enhanced material condition of the people as its centerpiece. In fact, the essence of politics is about the empowerment of the people and improving their material condition, which can be achieved by re-distributing rights over natural resources to the people, but necessarily denying the state its power over resources [19].

- Natural resources governance should be democratized. The aim of the democratization of the governance of natural resources is to empower the people to exercise their rights to own, exploit and control natural resources currently usurped by the state. It is concerned with the re-distribution of power over natural resources away from the state to the people [19]. That way, the resultant inequity and social injustice and other confusions and ambiguities that have characterized the path the state took to the production of natural resources, which have benefited a few, while the majority of Nigerians wallow in nourishing poverty while this would have been overcome. One of the advantages of the strategy for the democratization of the governance of the natural resources is that, repression, intimidation, killings, tortures and maiming that have come to characterize the state's responses to the agitations in the oil-producing communities, would gradually be phased out. However, the militarization of the Niger Delta region is increasing, rather than reducing, heightened the siege across the Niger Delta, creating security threat for most of the foreign oil companies and members of the local communities [19].
- Sustainable governance of water resources should be brought to heart of Nation's development policy. Unlike in the management of water resources, which may not necessarily deal with the issues of rights, ownership, transparency and accountability etc, governance provides larger space to redress these and other related issues. As a source of life, this means that the location of power and authority over water resources are not really secured over clearly defined rules, but are struggled over between the state, oil capital, community and community-based organizations, and the people [19,20].
- Strengthen the environment for cooperation and communication between water development and other stakeholders; leverage on expert influence to improve water resources gov-

ernance and sustainability including easing the challenges that could hinder greater private sector investment to expand sustainable water development.

- Community-based budgeting on resource extraction and infrastructure. As part of the strategy to democratize development matters, power over the kind of development including infrastructures will reside with people, who, together, with the community-based organizations, and the state, decide the size of the water scheme, among other social services, they want and have it allocated; rather than a situation they have a substandard water project imposed on them by the state. The people are likely to own such infrastructure, because it is seen as their own [19].
- Need for a forum for the representatives of state government and Stakeholders of Water Resources in the state demanding that both humanitarian and development organizations collaborate from the start to establish systems that will remain resilient. At such gathering, there will be audit on water resources, success made, constraints noted and resolved [19]. This will provide a rigorous basis for the government, development partners (NGOs), community-based organizations, private capitals, donor agencies to develop public-private partnership in water resources and delivery of water service and sanitation facilities [19].
- Pro-poor land policy. Its basic objective should be the restoration of the peoples' title of ownership to land and its content and the recognition of the proprietary character of common resources. Women access to the same rights and resources as men is critical to improving productivity along with food and nutritional security. This is because, a people-oriented land policy would help reverse the state's appropriation of the people's rights to own, empowering them to exploit and control their lands, all of which would amount to the engaging the people in the development process [19]. A pro-poor land policy would compel the Nigerian state to rethink its preferred dependence to self-reliance in the manner in which land is governed in the country.
- Failure to treat water as a strategic, valuable and limited resources will accelerate water crisis and will hinder the achievement of sustainable water for all particularly in a rapidly growing and urbanizing society. Without skepticism, the implementation of the above prescriptions would lead to water security and promotion of rural development in Nigeria. Moreover, it will be mistaken that, they will not be resisted by the state government [19].

Bibliography

1. Raimi MO, *et al.* "The Sources of Water Supply, Sanitation Facilities and Hygiene Practices in an Island Community: Amasoma, Bayelsa State, Nigeria". *Public Health Open Access* 3.1 (2019): 000134.
2. Siddiqui NA and Akbar Z. "Natural Resources and Environmental Management Systems, Khanna Publishers". Nai Sarak, Delhi India. (2008).
3. Morufu Raimi and Clinton Ezekwe. "Assessment of Trace Elements in Surface and Ground Water Quality". Lambert Academic Publishing (2017).
4. Raimi Morufu Olalekan and Sabinus CE. "An Assessment of Trace Elements in Surface and Ground Water Quality in the Ebocha-Obrikom Oil and Gas Producing Area of Rivers State, Nigeria". *International Journal for Scientific and Engineering Research (Ijser)*: 8.6 (2017): ISSN: 2229-5518.
5. Olalekan R M., *et al.* "The sources of water supply, sanitation facilities and hygiene practices in oil producing communities in central senatorial district of Bayelsa state, Nigeria". *MOJ Public Health* 7.6 (2018): 337-345.
6. Olalekan RM., *et al.* "Health Risk Assessment on Heavy Metals Ingestion through Groundwater Drinking Pathway for Residents in an Oil and Gas Producing Area of Rivers State, Nigeria". *Open Journal of Yangtze Gas and Oil* 3 (2018): 191-206.
7. Sodhi GS. "Fundamental Concepts of Environmental Chemistry". Second edition, Narosa Publishing House Ltd. (2005).
8. Ringler C., *et al.*, "Role of Water Security for Agricultural and Economic Development - Concepts and Global Scenarios". in *Handbook on Water Security*, ed. Claudia Pahl-Wostl, Anik Bhaduri, and Joyeeta Gupta (Cheltenham, UK: Edward Elgar Publishing Limited, n.d.), (2010):183-200.
9. Wada Y., *et al.* "Modelling Global Water Stress of the Recent Past: On the Relative Importance of Trends in Water Demand and Climate Variability". *Hydrology and Earth System Sciences* 15.12 (2011): 3785-3808.
10. Khitoliya RK. *Environmental Pollution, Management and Control for Sustainable Development*, S.Chand and company ltd, New Delhi (2004).
11. Yamaguchi Ayami., *et al.* "Two Novel Heat-Soluble Protein Families Abundantly Expressed in an Anhydrobiotic Tardigrade". *PLoS ONE* 7.8 (2012): e44209.
12. www.course.lumenlearning.com

13. Emiliano Brini., *et al.* "How Water's Properties Are Encoded in Its Molecular Structure and Energies Chemical". *Reviews* 117 (2017): 12385-12414.
14. Garg SK and Rannjini G. *Environmental Studies and Green Technologies*, Khanna Publishers, Delhi. (2008).
15. www.news.bbc.co.uk/2/hi/africa
16. Henry O Sawyerr., *et al.* "Bacteriological Assessment of Selected Hand Dug Wells in Students' Residential Area: A Case Study of Osun State College of Health Technology, Ilesa, Nigeria". *Global Scientific Journal* 7.1 (2019).
17. Raimi MO., *et al.* "Water-Related Problems and Health Conditions in the Oil Producing Communities in Central Senatorial District of Bayelsa State". *Imperial Journal of Interdisciplinary Research (IJIR)* 3.6 (2017).
18. Augustine OE., *et al.* "The Sanitarian and His Work". A Practical Guide to Environmental Health Practice first edition, Juainchrist Printers. (2009).
19. Omoweh DA. "The Paradox of Water Crisis and Rural Poverty in the Niger Delta of Nigeria: The Case of Bayelsa State". In Ayebe, H., and Ruf, T. (Eds.), *Eaux, pauvreté et crises sociales*. IRD Éditions. (2009).
20. Daniel A Omoweh. "Shell Petroleum Development Company, the State and Underdevelopment of Nigeria's Niger Delta: A Study in Environmental Degradation" Trenton (2005): 300.
21. Garret Hardin. "Tragedy of the Commons". *Science* (1968).
22. Bromley and Cernia. "The management of common property/ Natural resources: Some Conceptual and Operational Fallacies". *World Bank Discussion paper* (1989): 57.
23. Daniel A Omoweh. "Resources, Governance and Democratization in Africa". *The International Journal of African Studies* 5.1 (2005).
24. Daniel A Omoweh and Dirk van de Boom. "Blocked Democracy in Africa". *Experiment with Democratization in Nigeria* (2005): 1999-2003.
25. www.circleofblue.org/2010
26. Mark W Rosegrant., *et al.* "Water for Agriculture: Maintaining Food Security Under Growing Scarcity". *Annual Review of Environment and Resources* 34 (2009): 205-222.
27. Carla WM. *Environmental Geology*, seventh edition, McGraw Hill Higher Education. (2006).
28. Daniel A Omoweh. *Political Economy of the Operation of Shell Petroleum Development Company in the Oloibiri Area of Nigeria*, Report of Study submitted to the Bread for the World, Stuggart, Germany (1998).
29. Iloje J. "Geography of Nigeria". *Lagos* (1974).
30. National Population Commission Abuja Nigeria. "2006 Housing population Census: Population on distribution by age and sex: State and Local Government Area". *Priority able* 4 (2010): (54-58).
31. Omoweh Daniel A. *Shell Petroleum Development Company, the State and Underdevelopment of Nigeria's Niger Delta: A Study in Environmental Degradation*, Trenton, NJ: AWP (2005). 300.
32. Omoweh Daniel A. "Resources, Governance and Democratization in Africa". *The International Journal of African Studies* 5.1 (2005).
33. Okot-Ogendo. "The Tragic of the Commons: A century of Expropriation, Suppression and Subversion", *Proceeding of the African Public Interest law and Community-Based Property Rights Workshop*, Arusha, Tanzania (2000): 1-4.
34. Raimi Morufu Olalekan., *et al.* "Environmental Health and Climate Change in Nigeria. World Congress on Global Warming". *Valencia, Spain* (2018).
35. Raimi Morufu Olalekan., *et al.* "A Survey of Hand Washing Behavior and Awareness among Health Care Workers in Health Care Facilities in Kubwa District of Bwari Area Council, F.C.T. Abuja, Nigeria". *Annals of Ecology and Environmental Science* 2.2 (2018): 1-18.
36. Rao PV. "Textbook of Environmental Engineering, Eastern Economy Edition". PHI Learning Private Limited, New Delhi. (2010).
37. https://www.huffpost.com/entry/solutions-to-the-global-w_b_5348386

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