

WATER POLLUTION INNOVATIVE SOLUTIONS FOR MONITORING AND ENVIRONMENTAL COMPLIANCE AND ENFORCEMENT*

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***Lead Paper Presented at the 13th National Stakeholder's
Forum, organized by the National Environmental
Standards and Regulations Enforcement Agency (NESREA)***

***Environmental held at NICON Luxury Hotel Abuja, 2
9 -30th October, 2019***

Introduction

- **The paper Examines the law establishing the National Environmental Standards and Regulations Enforcement Agency(NESREA).**
- **Through the powers granted the Minister via NESREA, 33 Regulations governing all aspects of environmental challenges were enacted appropriately.**

Introduction

- Pollution control in the water sector is becoming complex and difficult because of increasing anthropogenic activities and climate change, the latter much beyond the capability of any government agency.**
- Also, the uncontrolled population growth would lead to water scarcity and environmental degradation to constitute major challenges in future.**

NESREA ACT 2007

The mandate of the Agency under Act, 2007 is clearly spelt out in Section 1(2a) as follows:

“ shall be the enforcement Agency for environmental standards, regulations, rules, laws, policies and guidelines” with its objectives and responsibility in Section (2) thus: “..have responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigeria's natural resources in general and environmental technology, including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines”

The functions of the Agency are quite elaborate (Items, a-m), enough for any organization to carry out its mandate and perform effectively.

The Agency shall have power under Section (7) to undertake a wide range of activities listed in the Act (a-s)

Importantly also is Section (k) which gives very wide power to the Minister *to approve proposals for the evolution and review of existing guidelines, regulations and standards on environment other than in the oil and gas sector including:*

The functions of the Agency

(i) atmospheric protection, (ii) air quality, (iii) ozone depleting substances, (iv) noise control, (v) effluent limitations, (vi) water quality, (vii) waste management and environmental sanitation, (viii) erosion and flood control, (ix) coastal zone management, (x) dams and reservoirs, (xi) watershed management, (xii) deforestation and bush burning, (xiii) other forms of pollution and sanitation, and (xiv) control of hazardous substances and removal control methods.

The above responsibilities it is believed have covered almost all environment protection activities. The power of enforcement and compliance and setting environmental standards, regulations and enforcements were granted earlier under section (f) which states that,

“subject to the provisions of the Constitution of the Federal Republic of Nigeria, 1999, and in collaboration with relevant judicial authorities establish mobile courts to expeditiously dispense cases of violation of environmental regulations”

The Act went on to further to specify appropriately, under Section (20), the protection of the

- **Atmosphere – control air pollution from gas emissions from vehicles, aircraft, factories etc**
- **Ozone layer protection Section (21)- the zone within the stratosphere and prescribes fines for violations by only corporate bodies . The ozone layer is responsible for cool temperature near the surface of the earth and warmer temperature at higher altitude, thus comfortable flight region for airplanes.**

- **Noise**: Also, under Section (22) is the control of noise pollution which prescribes fines for individual violators. However, one wonders whether anyone has ever been found guilty, fined and paid for noise violations despite the array of loudspeakers in almost all towns and villages across the country by merchants selling herbal medicines which the sellers claim could cure any ailments.

- **Water standards are covered under Section (24), while effluents limitations under Section (25).**
- **Sanitation was provided under Section (26). There is also under Section (27) protection of land resources and watershed quality and lastly, under Section (28) prohibition of discharge of hazardous materials into Nigerian waters and shorelines with appropriate penalties specified.**

Environmental Challenges facing Nigeria

Despite the elaborate and wide powers conferred on the Minister through NESREA Act 2007, however there are many environmental challenges beyond the control of the Agency.

The United Nations Development Programme, TACC(Territorial Approach to Climate Change) Project Document of 2010 gives an unsavory picture of environmental challenges facing Nigeria as follows:

Environmental Challenges facing Nigeria

- **The Sahara Desert to the north is advancing at a rate of 600 m/ year;**
- **Sea level rise (SLR) threatens low-lying delta regions in the south of the country;**
- **In 2005, Nigeria was identified to have the highest rate of deforestation in the world (losing 56 % of its primary forests over the period 2000 – 2005), and is listed in a worldwide assessment as having the third largest average annual net forest loss (-3.7 %) over the period 2000 – 2010;**

- **Oil pollution**: In 2006, an estimated 1.5 million tons of oil had spilled in the Niger Delta ecosystem over the past 50 years;
- **Between 1990 and 2000, Nigeria reportedly flared 75 % of the gas it produced;**
- **In 2005, 46 million tons CO₂ was released through flaring. Gas flaring releases methane and other GHGs into the atmosphere, which not only contributes to global warming, but also negatively impact on human health in surrounding areas, and reduces crop yield;**
- **Rapid urbanization contributes to environmental problems within Nigeria due to inadequate urban waste management.**

2.0 Climate Change

The impacts of climate change were observed apparent across Nigeria resulting in

- Increase in the mean annual temperature of 1.7 °C from 1901 - 2005;**
- Increase in coastal erosion in the states within the coastal areas due to SLR;**
- Increase in the variability in total annual rainfall;**
- Increase in flood events in the southern coastal states due to increased rainfall;**
- Increase in drought events and accompanying desertification in the northern states;**
- A mean SLR of 0.46 m was recorded between 1960 and 1970 in the coastal areas.**

- **Due to continued sea level rise, saltwater intrusion of the low-lying areas of the coastal areas has been observed, including a flooding of saltwater into the coastal plain covering an area of approximately 3,400 km² .**
- **SLR has led to saltwater intrusion into freshwater resources (both surface and groundwater sources), which has led to increasing salinity, and a reduction of freshwater resources for both agricultural and domestic purposes.**
- **This situation has impacted negatively on aquatic biodiversity, particularly important mangrove forests, by altering the salinity content of the estuarine waters.**

2.1 Climate change projections and predicted

Impacts in Nigeria

- **Increase in mean annual temperature of 3.2°C by 2050 under the high climate change estimate, based on the IPCC (Intergovernmental Panel on Climate Change) climate change assumptions, latest research findings and results of a consultation exercise in Nigeria, from 0.4-1.0 °C under the low climate change estimate;**

2.1 Climate change projections and predicted Impacts ***in Nigeria***

- **A rise in sea level of 0.3 m by 2020 and 1 m by 2050 under the high climate change estimate from 1990 sea level; and of 0.1 m and 0.2 m over the same time period, under the low estimate. A 1 m rise in sea level will result in the submergence of 75 % of the coastal areas;**
- **Increase in the frequency and intensity of extreme weather events floods, droughts and heat waves and**
- **Changes in rainfall pattern, both, timing and intensity, resulting in an increase in mean annual rainfall of 8 - 20%.**

3.0 Water Scarcity

- **The water sector will be impacted by both changes in rainfall pattern and an increase in saltwater intrusion in coastal areas.**
- **The amount of rainfall is predicted to increase in the southern region of the country, and rainfall events are likely to become more intense (i.e. leading to flooding) with potentially destructive consequences for communities, infrastructure and natural ecosystems.**

3.0 Water Scarcity

- **Due to the predicted saltwater intrusion into coastal surface and groundwater resources as a result of SLR and the expected decrease in rainfall in the northern region of the country, the supply of potable water is expected to decrease county-wide.**
- **Nigeria with an annual population growth rate of 2%, this population growth coupled with concomitant decrease in potable water supply is expected to create significant water shortage as to affect economic development in Nigeria in the future.**

Impact on the Water Resources

It may assist to give the challenges facing the water resources sector which may assist the Agency in formulating its policies and regulations appropriately. For, without adequate water supply, what regulation can be enforced?

Water-Food-Energy Security Relationship

It has been observed that there is interrelationship between the trio, water, food and energy as depicted in Fig.1 below

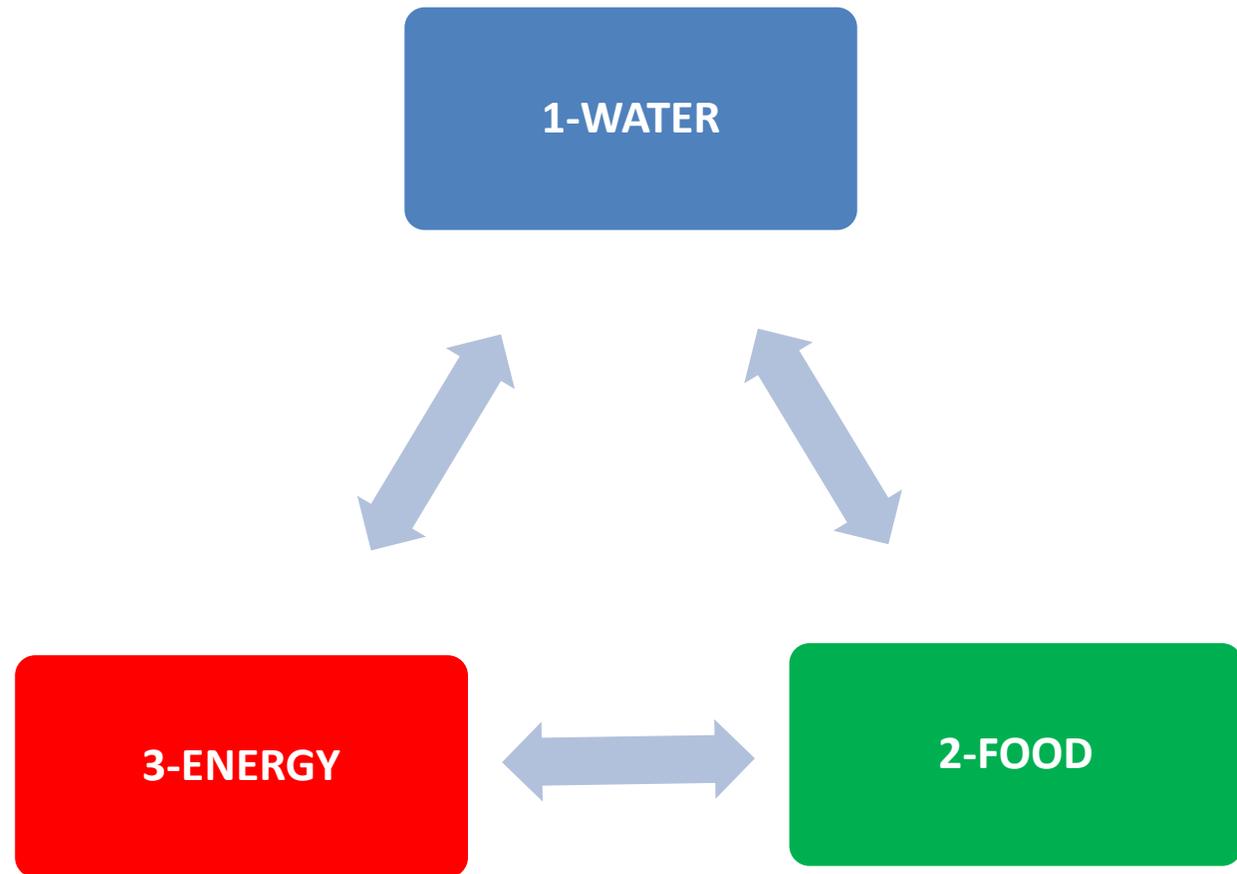


Fig.1 Relationship between water, food and energy

Energy to pump water: 3 → 1; Water produce energy - hydropower: 1 → 3

Water to produce food: 1 → 2; Food carry water footprint: 2 → 1

Energy process and produce food: 3 → 2; Food to produce energy - biomass: 2 → 3

Water Stress and Water Scarcity

Using Nigeria's population growth rate, put between 2%, projections were made on availability water towards meeting water demand up to 2050. The hydrologic definition of water stress and water scarcity were applied as follows:

- ***Water stress:*** when a country's or region's annual water supply is less than 1,700 cubic meters per person per year .
- ***Water scarcity:*** when a country or region's annual water supply is less than 1,000 cubic meters per person per year.

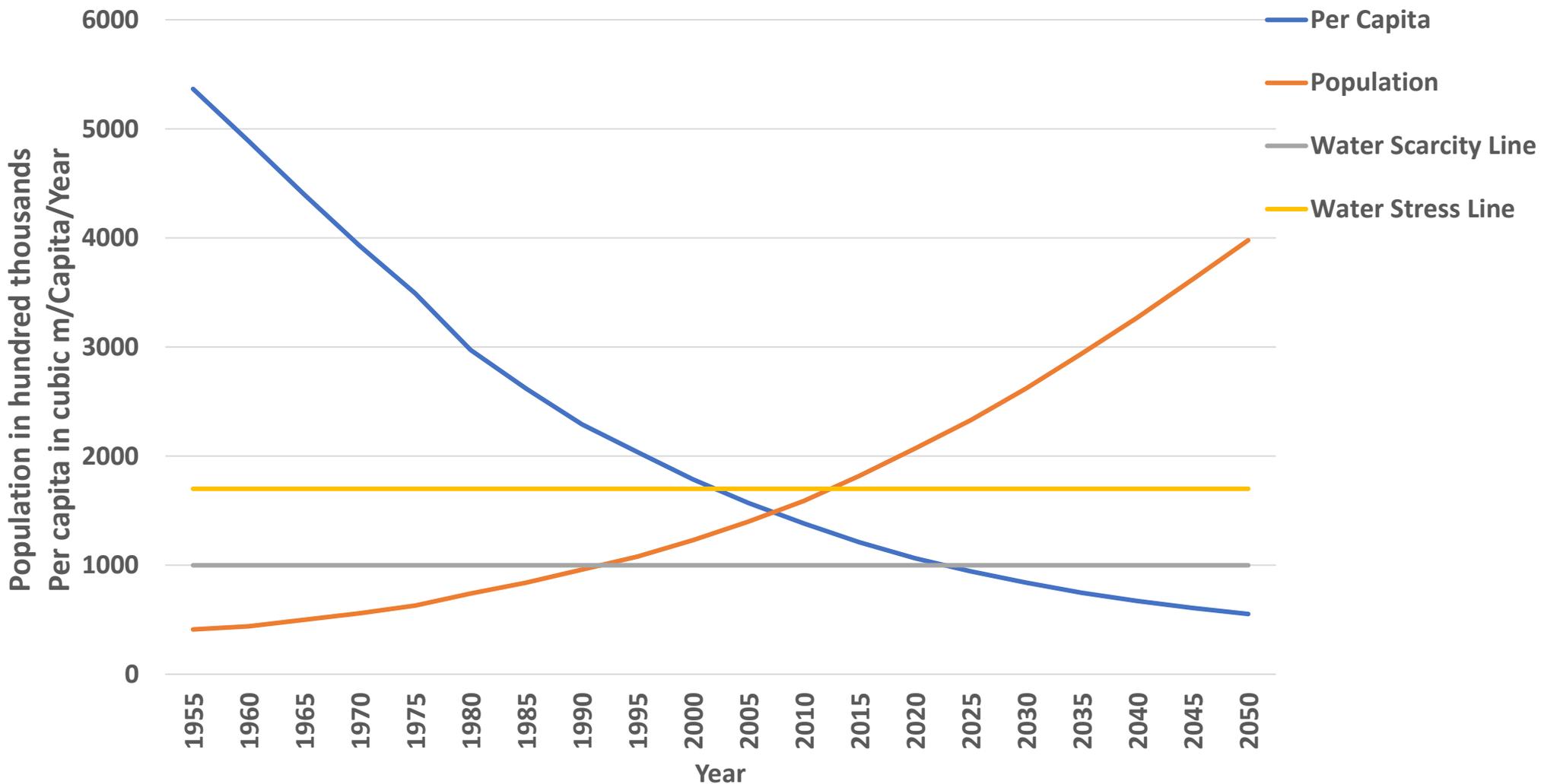
Water Stress and Water Scarcity

- In Table1 is shown projected population and per capita per year water demand from **2010-2050**.
- The results plotted and presented in Fig.2 clearly show that Nigeria is already under category of water stress country and by **2024**, fall under category of water scarcity.

Table 1 Projected Population and per capita renewable water in M³ /year from 2010-2050

Year	Projected Population	Per Capita/Year M ³	Year	Projected Population	Per Capita/Year M ³
2050	398	552.8	2005	140	1571.4
2045	362	607.7	2000	123	1788.6
2040	327	672.8	1955	108	2037.0
2035	294	748.3	1990	196	2291.7
2030	262	839.7	1985	84	2619.0
2025	233	944.2	1980	74	2973.0
2020	207	1062.8	1975	73	3492.1
2017	191	1151.8	1970	66	3928.6
2016	187	1176.5	1965	50	4400.0
2015	182	1208.8	1960	45	4888.9
2010	159	1383.6	1955	41	5365.9

Fig2. Showing Population and Per Capita Renewable Water Resources in Cubic Meters /Year



Causes of Water Stress and Scarcity

- Generally, there is distinction between physical and economic scarcity. In the case that water demand cannot be met with available supply, like in dry regions, then the region is considered facing **physical water scarcity**.
- On the other hand, where constraints are due to lack of investment, inadequate regulation or pricing, then this situation is considered **economic water scarcity**.
- This is the situation in most developing countries, including Nigeria.

Causes of Water Stress and Scarcity

In general, factors that cause water scarcity to result in conflicts and security challenges are many, but prominent ones are;

- shifting demographics,**
- population growth,**
- increasing urbanization and migration,**
- changing consumption patterns leading to increased demand for water,**
- changing hydrologic cycle, caused by anthropogenic activities,**
- climate change and increasing demand and competition for water resources for food, energy, industries etc.**

A brief description is presented on how some of these factors increase demand for water resources:

- **Increased Population Growth and Agricultural Production**

Water for agriculture water currently accounts for 70% of all water use and increase in population will lead to increased demand for water.

- **Changes in Diet**

Dietary habits change with increase in prosperity. People with **consume more foods with high water footprints like meat, vegetable oil. For example, compare one kilogram of beef requires 15,500 litres of water to produce, while the equivalent amount of wheat requires only 1,300 litres.**

- **Industrialization**

Globally, energy and industry account for approximately 20% of water use. Water is fundamental to industrialization and as a nation becomes more industrialized, it will require more water. In addition to increased demand for water, the available fresh water gets depleted as industries become major source of pollution, releasing heavy metals, solvents, toxic sludge and other wastes and contribute to water stress.

- **Inadequate Water Supply Infrastructure and Poor Management**

Ageing and poorly functioning water infrastructure with leakage rates often between **30-50%** , all these pose a challenge for agricultural and urban water supply.

The ageing of costly irrigation infrastructure is a serious problem in Nigeria, and this will increase in water scarcity and security. Other contributing factors are, inadequate knowledge of both surface and ground water budgets and unsatisfactory representation of value of water in economic development.

Addressing Challenges Caused by Increasing Water Demand

Thus, to deal effectively with increasing water demand leading to water scarcity and water security, multidisciplinary approaches are required, together with cross-sectoral policies to avoid tensions and conflicts.

Addressing Challenges Caused by Increasing Water Demand

1.0 Need for New and Better Technologies

New technologies will be required to increase water efficiency and reduce water pollution in the future water resources development. New and better tools are needed to support effective policy development and decision making and enable the effective and sustainable management of water resources. These include:

- **Developing water decision support systems for use in the optimization of water resource allocation and the simulation of the reliability of the balance between supply and demand and proper analysis of water needs and water use.**
- **The use of risk analysis and risk-based decision-making techniques, especially to address issues relating to the security and reliability of water supply, and the implications of uncertainty in developing sustainable water management plans.**

- **Technology will be expected to have significant impact on fresh water supply and demand in future, but changes are likely to be evolutionary, as assessed by many scientific studies.**
- **Also, changes are expected in salt-tolerant crops and point-of-use applications for the safe human consumption of untreated water.**

2.0 Developing New Sources

2.1 Water Recycling, Reuse and Rainwater Harvesting

There is scope for reuse and recycling of water in industrial and domestic settings. Harvested rainwater together with recycled water can be used for flushing toilets, and irrigation, dust control and firefighting.

2.0 Developing New Sources

2.2 Water Desalination

- **Membrane and other nanotechnology applications that dominate the current desalination and water-purification industries are likely to account for the biggest advances and effects on freshwater availability. Although desalination may be economically feasible for household and industrial water, it is not currently feasible for agriculture.**

2.0 Developing New Sources

2.2 Water Desalination

- **Because all desalination processes produce a saline concentrate, the environmental impact of using and disposing of this concentrate always constitute problems.**
- **For industry and households, water prices in developed countries vary from \$0.60/cubic meter to more than \$3/cubic meter; whereas, water for agriculture is priced at approximately \$0.10/cubic meter.**

2.0 Developing New Sources

2.2 Water Desalination

- **Desalination processes produce water at much higher costs: \$0.61/cubic meter for reverse osmosis, and \$0.72/cubic meter to \$0.89/cubic meter for thermal processes. Thus, water produced by desalination processes would be too costly for use in agriculture.**

3.0 Research in Water Treatment Process

Advances in large-scale drip-irrigation systems are the most likely means to address water shortages for agriculture. Research to develop drought resistant crops has been conducted for several years, but no break-through has been recorded for commercialization to date. During the coming years, selected crops could be developed that require less amount of water used by current crops, but widespread cultivation of such crops would still likely to pose some problems.

4.0 Water Efficiency in Agriculture

There is need for improved irrigation efficiency for more efficient use of water. New technologies like drip system of irrigation can be adopted. Also, there is need to adopt heat and drought resistant crop varieties while, improved irrigation practices and land leveling (to obtain an even distribution of water), are often the most convenient approach to meet increased demand from existing water supplies.

5.0 Water Efficiency in Industry

Water used by industries for cooling of plants is evaporated and not available for reuse in the basin. This water is non-consumptive and there is need for improving efficiency in the cooling process such as recycling to put the water to consumptive use.

6.0 Improved Policy Development by Engaging the Public

Awareness raising is a vital part of a participatory approach to water resources management. Information, education and communication support programmes must be an integral part of the development process. The current uncontrolled rate of population growth, combined with the growing pressure on available water resources, Nigeria will be among the water-deprived countries in the world in less than ten years, if the available resources are not judiciously and efficiently managed.

7.0 Integrated Water Resources Management

- **Water is a vital part of the environment and a home for many forms of life on which the well-being of humans ultimately depends.**
- **Disruption of flows has reduced the productivity of many such ecosystems, devastated fisheries, agriculture and grazing, and marginalized the rural communities which rely on these.**

7.0 Integrated Water Resources Management

- **Various kinds of pollution, including transboundary pollution, exacerbate these problems, degrade water supplies, require more expensive water treatment, destroy aquatic fauna, and deny recreation opportunities.**
- **Integrated management of river basins would provide the opportunity to safeguard aquatic ecosystems and make their benefits available to society on a sustainable basis.**

8.0 Capacity Building

- We should identify, as part of national development plans, training needs for water-resources assessment and management, and take steps internally and, if necessary, with technical co-operation agencies, to provide the required training, and working conditions to retain the trained personnel.**
- Governments at levels must develop the capacity of their water experts and equip them to implement the full range of activities for integrated water-resources management.**

Challenges in Water Supply and Sanitation

- In Nigeria, there are three tiers of government responsible for water development and management. Federal Ministry of Water resources collaborates with Ministry of Environment on water sanitation activities, sewage disposal, storm water drainages and water quality control.**
- At the state level, there are 37 SWAs (including FCT) responsible for developing and managing water resources. LGAs also participate in water development in their communities.**

Access to Water Supply and Sanitation

Recent assessment of access to water by USAID report showed the following population accessibility to water and sanitation in Nigeria in 2015.

Water Supply- Urban and Rural - 58% and MDG target by 2015-85%

Sanitation- Urban and rural – 32% and MDG target by 2015- 70%

Indeed, water experts projected that with sustained effort, the water supply target could be met in 2030 while it will be more than 150 years to reach sanitation target.

Government Initiative over the years

- Presidential Water Initiative (PWI) tagged **Water for People, Water for Life** was launched in 2013. The main objective of the exercise was, to increase access by all to water and sanitation with the following targets spelt out:
 - State capitals- 100%; Urban and semi-urban areas- 75%; Rural areas- 60%
 - There was no concrete effort to implement these ambitious targets after the launching and to date, the objective is far from being met.

Open defecation

- **A communiqué was issued after the 22nd National Council of Water Resources meeting held in Kaduna in 2013 stated the need for Nigeria to attain Open Defecation Free (ODF) status by 2015.**
- **States and local communities to provide funds to implement Community Led Total Sanitation(CLTS)projects.**

Open defecation

- **Under CLTS communities are to be mobilized to eliminate Open Defecation (OD) and transform them to Open Defecation Free (ODF). In addition to providing toilets, there is need to raise awareness of the dangers of OD to risks of spreading diseases namely, cholera, gastroenteritis, diarrhea, typhoid, etc.**
- **Communities should be encouraged to build toilets in their compounds and wash their hands after using toilet.**

Observations and Recommendations

- 1. The problems of water pollution would hinge on our ability to tackle three factors namely Climate change, uncontrolled population growth and water scarcity.**
- 2. The existing 33 regulations already enacted by the Ministry will be difficult to enforce mainly because of inadequate funding and dearth of well trained and dedicated personnel.**

Observations and Recommendations

- 3. Sophisticated equipment will be required to be installed in the field to ensure continuous monitoring since most pollution parameters are transient.**
- 4. There will be need to resort to prevention measures like enacting regulation on OD and enforcement of compliance using sanitary inspectors who could be recruited and deployed to all streets and corners of major cities in the country.**

Observations and Recommendations

- 5. There should be more emphasis on prevention than on penalties and fines.**
- 6. There is need to use emerging technologies like drones equipped with cameras, spectrophotometers, etc. to monitor pollution of water courses.**

Observations and Recommendations

7. There is need for **NESREA** with the assistance of **TETFUND** to sponsor practical research activities in our universities and polytechnics to produce prototype machines locally to recycle wastes.
8. Need to work with law enforcement agencies (police, civil defence, traffic wardens, etc.) to enforce environmental laws as they enforce traffic laws.

Observations and Recommendations

- 9. There is need to procure and deploy surveillance cameras in towns, cities, major highways and at lakes and river sides to monitor compliance with environmental regulations.**
- 10. The Agency should have access to all CCTV cameras mounted by all security outfits in public and private premises for the purpose of monitoring the environment.**

Observations and Recommendations

- 11. There is the need for **NESREA** to work closely with **FCT** to put an end to embarrassing sites of OD so that Abuja will be clean and serve as an example to all major towns in the country.**
- 12. There is need to create an annual event to competitively select the cleanest city in the country giving wide publicity. This will encourage tourism and good governance. Similarly, the dirties city could be selected.**

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THANK YOU

THE END