

## The future of environmental management in a developing country (Nigeria)

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### ABSTRACT

Nigeria is faced with many environmental issues such as poor waste management, gas flaring and oil spillages, desertification and others. These have severely polluted the environment, increased biodiversity loss and as well impacted the health of the people negatively. Hence, the importance of environmental management becomes a topical solution. Environmental management which is a process; a trans-disciplinary and inter-disciplinary field is growing to curb and manage the environmental menace in the country. Consequently, various laws, regulations and policies have been created but the effects of remain unabated. Similarly, many institutional – state and non-state actors - have grown in the country to curb environmental menace especially as it affects human health but little or no result has been shown, thereby, the effects continue growing steadily. This is related to divergence between economic development and environmental protection, institutional incapacity, poor monitoring and enforcement of existing laws, societal behaviours and technological incapacity. Effective legislation – laws, standards and regulations – without strong institutional capacity to implement, monitor and enforce them will not produce tangible transformation. Accordingly, the need for balance between economic development and environmental preservation; improved environmental education in academic institutions, strong collaboration between various stakeholders, and development of technological capacity. Our paper supports the importance of strong institution capacity -state and non-state actors- in driving environmental actions considering that vested interest of governments in some economic activities, for example, oil production weakens their regulation and control of activities such as gas flaring; and change in administration often results to changes in policies and agenda. Community participation in the process of environmental management provides benefits. It informs state actors and institutions of the needs of the people, creating suitable policies.

### KEYWORDS

Environmental management;  
sustainability; development;  
institutional capacity;  
environment education;  
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### INTRODUCTION

Quality environment is important to sustenance and productivity of life, including humans. Earth has undergone many geologic and climatic changes. However, various human activities in pursuit of satisfying wants and needs have adversely impacted the environment. Presently, environmental issues are one of the most important challenges facing the globe. Various anthropogenic activities impacting the environment include population growth and its associated land uses, energy production from fossil fuels, unsustainable resource extraction, poor waste management, etc. These have negative multiplier effects on environmental quality, health and socioeconomics.

For example, [1,2] showed that accelerated use of fossil fuel increased atmospheric carbon dioxide (CO<sub>2</sub>) concentration from 288 part per million (ppm) in 1880s to 415ppm, in 2019. This has resulted to climate change and global warming which has led to rise in sea level, debilitating climatic conditions which also have physiologic implications such as heat stroke. Poor land use practices have resulted to loss of flora and fauna (biodiversity), deforestation, desertification, erosion, flooding, water, air and noise pollution. Humans consume earth's natural capital at 1.2 times the speed at which they are renewed; accordingly, exceeding the biological capacity of earth. By 2020, human population is expected to surpass 9 billion. [3].

Starting with the United Nations Conference on Human Environment, Stockholm (1972), and Rio de Janeiro Conference on Environment and Development (also referred to as Earth Summit) in 1992, these problems were expressed to support transformation. The conferences did not only indicate the rising environmental problems worldwide, but also illustrated the associations between ecological sustainability and development. The increased concern was also demonstrated by the 1997 Kyoto protocol and the United Nations Conference on Climate Change (UNFCCC) which aims at addressing ozone layer depletion and greenhouse gases (GHGs) emissions, especially by the developed countries of the world [3]. Similarly, the World Commission on Environment and Development report of 1987 themed "Our Common Future," strongly focused on contemporary issues such as population, energy, effective and sustainable management of ecological resources, human settlement, human settlement, etc.

Until late 1980s, Nigeria was largely indifferent to environment protection, though there was existence of few environmental safety statues. The laws/statues/regulations were not product of any integrated public policy initiative. Accordingly, they were not prepared for comprehensive protection of the environment. In 1988, illegal dump of toxic waste was discovered at Koko in Delta State. The hazardous consignment of 4000 tons was shipped from Italy under an arrangement between an Italian businessman and a Nigerian, for a fee of \$100 a month. The event roused Nigeria from indifference towards environmental protection. Accordingly, the federal government of Nigeria arranged an international seminar that finally resulted to the publication of the National Policy on Environment (NEP) in 1989. NEP obligated Nigeria to sustainable development. Furthermore, Federal Environmental Protection Agency act (FEPA Act) was formed in 1988, creating Nigeria's foremost agency in charge of protection and management of the environment. The FEPA act was repealed and succeeded by the National Environmental Standards and Regulations Enforcement Agency (Establishment) (NESREA) Act in 2007. The NESREA act and other environmental directives are the framework of Nigeria's environmental law, which function together with constitutional requirements [4,5]. The Federal Ministry of Environment (FME) oversees and put into force environmental laws in Nigeria. It took control of this task from the defunct FEPA in 1999, at Nigeria's return to democratic governance.

The pursuit of environmental sustainability has given rise to environmental management. Environmental management has been described as a process, and interdisciplinary and trans-disciplinary field. [6] Defined environmental management "as a multi-layered process associated with the interaction of state and non-state environmental managers with the environment and with each other." Environmental management is a process and involves different actors. State actors include government agencies such as National Environmental Standards and Regulations Agency (NESREA) and others; while non-state actors are non-governmental organizations, international corporations. As an inter-disciplinary field, various branches of professional or experts are involved. Therefore, environmental management is a practice not limited only to large and global environmental actors, but also include wide collection of mostly local environmental actors. With this approach, this paper converges different factors very relevant for adequate environmental management in the country. They are (i) legislative framework; (ii) environmental management education, (iii) institutions (state and non-state) vested with environmental concerns, policies and agendas geared towards protecting, preserving and managing of environmental safety and quality and (iv) technological capacity. These factors support sustainable development or sustainability [5,6,7,8,9,10].

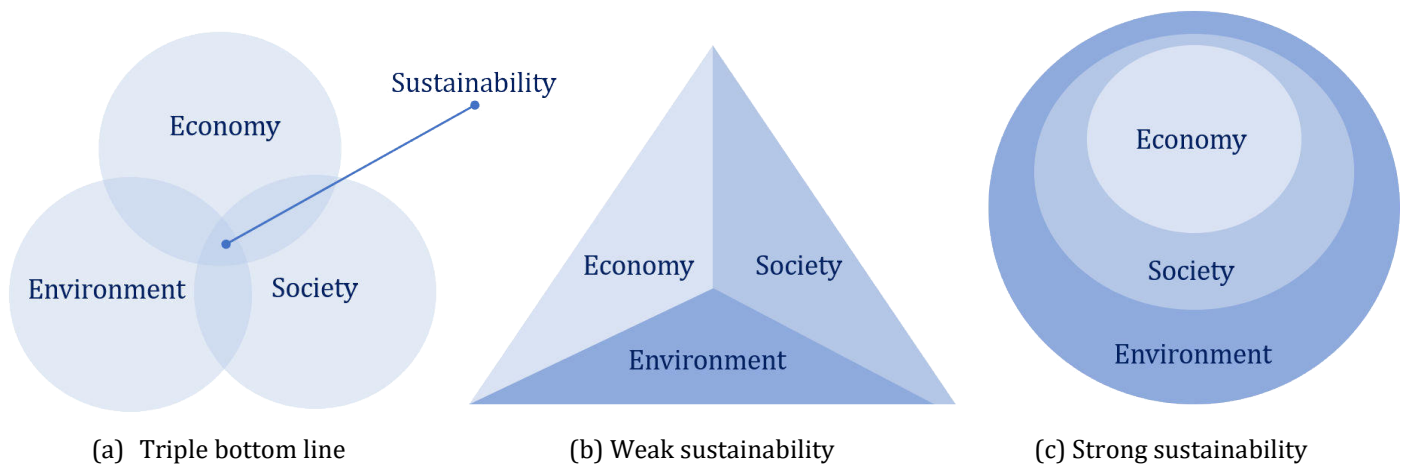
In the first section of the paper, general introduction and overview of sustainable development and sustainability are discussed. In the second section, general introduction and the concept of sustainable development and sustainability are discussed. In the second section, future directions towards improving environmental management in Nigeria are discussed.

## SUSTAINABLE DEVELOPMENT AND SUSTAINABILITY

Human activities (anthropogenic), especially in the past few centuries, have greatly changed the biosphere. Many evidences which include global climate change, biodiversity loss and municipal pollution – show that our planet is on an unsustainable course. To assure the safety, security and welfare of the present and future generation, functional operation of the model sustainability has grown to be the most critical challenge of this era. Indicators for assessment and monitoring of ecological settings have been utilized for more than fifty years. However, indicators for evaluating sustainable development have a comparatively recent history. Its foremost advancement began with the United Nations Conference on Earth and Development (Rio de Janeiro Earth Summit) in 1992. The Summit proposed the basic standard and the course of action for realizing sustainable development. Particularly, the Summit identified the need for the development of sustainability indicators with its Agenda 21, an action plan approved by more than 170 national governments. The subsequent Earth Summit of 2002 organized by the UN and which held in South Africa strongly reiterated the UN's support to the Rio principles and entire realization of Agenda 21. Accordingly, numerous global organizations, governmental organizations, NGOs, municipal groups and enterprises, and academic scholars have committed considerable effort to conceive, devise and achieve indicators that measures the condition and course of environmental state and socioeconomic development [3].

Sustainability and sustainable development, is at the center of protection and utilization (or exploitation) of natural resources. The two terms – sustainability and sustainable development - were made up in the early 1970s. Since then, it has covered a large number of definitions. The most commonly cited definition is the one given in the UN World Commission on Environment and Development (WCED) or Brundtland report of 1987. The broad definition described sustainable development as development that “meets the needs of the present without compromising the ability of future generations to meet their own needs” [3,11]. The definition calls for intra and inter-generational equity. Therefore, sustainability is related to our capacity to preserve a connected human-nature system at a pleasing condition for many generations, even with human-made and ecological disturbances, changes and instability.

Sustainable development concept developed from the Triple bottom line (TBL) structure. TBL emphasizes the equilibrium between the three supports of sustainability – environmental, social and economic sustainability. Figure1 shows different dimensions of sustainability.



**FIGURE 1:** Sustainability dimensions [3]

Environmental sustainability centers on preserving the quality of the environment. The environment is essential to undertaking of economic activities, well-being and safety of people. Social sustainability endeavors to make certain human rights and equality, conservation of cultural uniqueness, deference for cultural diversity, race and religious belief of people are maintained. Economic sustainability supports maintenance of natural, social and human capital which is essential for income and improvement in standard of living. Inclusive sustainable development is achieved through a balance between all these pillars.

On the other hand, it is not always easy to achieve, since in the process of realizing sustainability goals, each pillar of the tripod has to address the concerns of the other two pillars so as not to create imbalance. Hence, realization of sustainable development (for example, in economics), may produce un-sustainable development in the environmental and/ or social settings [12]. However, [3,12] argues that ecological sustainability is the base which support and ensures the sustainability of the other two pillars – social and economic sustainability. This is premised on ecosystem services – provisioning services, regulating services, supporting services and cultural services - which supply sustenance of human life and economic activities. Accordingly, without environmental system – biodiversity and ecosystem services, economic or social development cannot be sustained. Economic advancement is dependent on social and environmental capital, while equally social and economic activities pressures environmental state of the environment. “Weak” sustainability allows mutual substitutability among the three factors, while “strong” sustainability does not. Growing depletion of natural resources, increasing human population and its associated pressure on the environment has situated the environmental element as a primary foundation for sustainability.

Recognizing the interdependencies and/ or inter-relationships in and between ecosystems, it is very crucial to adopt a substantial change in present human actions – government, technology, production, consumption, etc. As a result, many instruments and tools related to environmental management has increased and are still emerging. They include; environmental management accounting (EMA), environmental management system (EMS), environmental impact assessment (EIA) and others.

### **FUTURE DIRECTIONS AND POLICY IMPLICATION**

Whether sustainability is considered a tripod consisting of three dimensions or as a twofold relationship between humans and the ecosystem they live in, there is a convergence that provision of clean air, potable and safe water, quality biosphere is necessary for a dependable socioeconomic system. The importance of legal framework, strong institutions and academia – research and development – to pursuit of sustainability, environmental preservation and protection cannot be over-emphasized. The inter-relationships between the three actors or players are strong. For example, legislation, regulation and policies have strongly supported the evolving “green” economic models such as circular economy, energy transition. Institutions have been advocating for such a move. For example, Ellen MacArthur Foundation, which comprises of industry players, academics and R&D. Similarly, early conferences such as World Commission on Environment and Development report of 1987, 1997 Kyoto protocol, Stockholm conference of 1972, and Rio de Janeiro Earth Summit of 1992, and the United Nations Conference on Climate Change (UNFCCC) – have all been championed by institutions – governmental, NGOs, corporations, and research institutes. Accordingly, the effective and strong influence of the summits have championed and achieved the ban of chlorofluorocarbon and other ozone depleting substances. This supports the importance and urgency of strong institutions for Nigeria.

Satisfactory implementation of sustainability indicators - which is at the center of environmental management - is an increasingly growing development and learning process. It therefore requires widespread input and strong involvement of various stakeholders [3]. Effective and evidence-based policy is the driver of successful program and ecological management. It should be holistic and integrates all the relevant actors and principles. Government solely cannot be relied on to promote increased environmental management in Nigeria because of three reasons, viz:

- (1) The vested interest of government in some unsustainable economic activities, weakens resolve of the government and position to control it. A strong example is gas flaring by oil companies. It is commonly assumed that strong environmental regulations limit economic growth. Since economic growth is one of the major goals of governments, the tendency to be lax in environmental protection is strong. This is even prominent for developing and emerging economies where environmental consideration is rarely considered in pursuit of industrialization;
- (2) Change in administration often results to change in policies and agenda. For example, US was at the forefront of 2015 Paris agreement goals. However, there has been extensive opposition of US commitments to the Agreement under current US administration. This is especially more serious for Nigeria, where continuity in government program is very poor;

(3) Increasing positioning of non-state actors and their growing strength in various areas of society.

The perception of high corruption in Nigerian and governments may be a great limitation to the ability of government and its institutions to foster trust and commitment to any of its environmental programmes. Therefore, non-state actors should hold governments and sanctioned economic enterprises accountable for their ecological-adverse policy. It includes judicial intervention, involvement of international and regional organizations, and even massive mobilization of society to environmental injustice.

Apart from legislation and institutions, one other factor that has enabled accelerated realization of some green ecological is technological advancement. For example, the growing energy transition is ushering in the age of renewable [13]. The development is strengthened by technological advancement which enables harnessing of the Resources. Currently, renewable energy is cost-competitive relative to fossil fuel. Energy insecurity and economics is also factors motivating the shift. However, ecological concerns – GHG emissions, climate change, global warming, rise in sea level, and various other associated issues – are the major factor. Similarly, technological development is supporting the growing circular economy model, starting from production process, recovery and re-utilization of recovered materials for open-loop or closed-loop production. A proactive policy is required if effective environmental management should be achieved in the country. This is opposite to reactive policies prevalent in the country now. For example, the United Nations Environmental Program reported that it will take about thirty years and more than \$1 billion to clean up oil spill impacts in Ogoniland. According to [14], NGOs are unique body with vital proficiency and resources relevant to the process of international environmental support. Instead of weakening state sovereignty, dynamic NGO involvement improves the capacity of state to conform globally. NGOs commonness in international environmental institutions demonstrates the growth, not the decline, of the state in dealing with global ecological problems. Another major policy directive which is crucial to effective environmental management is emergence of public-private partnership (PPP). For example, waste management and forestry management, offers a suitable platform for the model. It will foster the integration of circular economy model in circularity of “wastes,” as private enterprises recover and reprocesses the “wastes” for use in future production. Similarly, PPP if properly regulated will foster a business model of regenerative forestry utilization.

As reported in [7], the major task of the foremost environmental agency in Nigeria is preventing pollution and damage to the environment. It is not tasked with remedying damages that have taken place in the environment. Recognizing that environmental degradation is taken place at a significant rate, it is therefore important that “proactive” measures be taken to curtail it. Accordingly, to foster adequate environmental management in Nigeria, four critical and interrelated issues should be addressed. They are: (i) ensuring a balance between economic growth and environmental protection; (ii) improved environmental education across our educational system; (iii) strong collaboration between various stakeholders; and (iv) development of technological capacity.

- **Balance between economic development and environmental protection**

The triple bottom line of sustainability – environmental, economic and social – and their dynamics has important implications for a developing country such as Nigeria, which strives to achieve industrialization and economic development. Environmental issues are highly relegated to the background in industrial and policy decisions and actions. For example, the issue of gas flaring and land uses. According to [3], the only alternative to sustainable development is unsustainable development. Even with the establishment of environmental agencies and their affiliates after 1987 Koko incidents, Nigeria still has very poor environmental management. The issue is greatly enhanced with the divergence between protection of earth’s natural resources and economic development, which requires utilization of the natural resources. Though the country has an Environmental Impact Assessment (EIA) instrument, which aims at a balance between economic development and environmental protection, political influence, drive for industrialization and weak institutional capacity has largely negated the purpose of EIA objective in Nigeria. Hence, Environmental sustainability index (ESI) study conducted to 122 countries show that Nigeria ranks among the least, at 117. The ESI comprised of 22 major indicators and 67 variables [15].

The environmental problems have grown to be very demanding, complicated and costly to manage. Current environmental degradation in Nigeria is highly associated with human activities, in pursuit of satisfaction of want and needs. A sustainable earth demands a balance between economic growth and environmental sustainability, but from ecological perspective.

Though environmental degradation has been highly associated with economic development – resource extraction and utilization, there is no doubt that it is also highly associated with poverty. Poor people in Nigeria earn about \$2 per day, and largely depend extensively on the environment to provide for their needs. Consequently, their over-dependence on environmental resources degrades the environment furthermore. For example, substantial number (more than 70%) of rural Nigerians relies on firewood / fuel wood for their different energy needs. Nigerians accounts for 10.1% of global fuel wood consumption [16]. With a desertification rate of 0.6 km<sup>2</sup> per year, Nigeria has lost more than 351,000km<sup>2</sup> of its land to desertification [7,17]. The high deforestation rate associated with poverty has multiplier effects such as growing desertification in the North, erosion in the south, climatic change implications and others. The inter-dependency between poverty and environmental degradation therefore result to a cyclical phenomenon, as further deterioration of the environment additionally leads to increased poverty. Therefore, to strongly pursue appropriate environmental management, it is imperative that policies and programs to reduce poverty level in the country be systematically addressed so as to achieve a balance between the two factors.

The most important policy directive that will support quality environmental management and also offer new and sustained economic growth is regenerative economic model. They are circular economy (CE) and renewable energy (RE). The two models which complements each other and are therefore related, decouples economic growth from environmental degradation and resource inefficiency. For example, associated gas (AG) flaring is highly associated with oil production; therefore, increase in oil production equally increases AG flaring. Decoupling AG flaring from oil production entails adoption of co-heat power (CHP) generation, which will greatly improve power supply to the country and also significantly reduce greenhouse emissions. Advanced technologies have highly accelerated the efficiency of the application and its carbon footprint. Another decoupling – circular economy – will greatly reduce the amount of waste going to dumpsites in Nigeria. For example, greater amount of wastes generated in the country are organics -73% [18]– which can be composted or used for biofuel production. Effective waste management which involves collection and recovery is required to achieve better environmental management. Presently, Nigeria has a very poor waste management, and disposal to dumpsite seems to be the only role of waste management agency. Therefore, there are needs for a rethinking in waste management in Nigeria. Advancement in “green” technologies, methodologies and models is quickly accelerating adoption of regenerative economic application such as waste-to-energy and waste-to-wealth path, etc.

Environmental management which is multi-disciplinary and requires collaborative approach associated with a more comprehensive knowledge of the paths by which we depend on nature and the ways nature are impacted by humans, therefore bringing about evaluation and advancement. The collaboration will require appropriate participants (institutions – NGOs, governmental, community), the general society and decision makers (legislators, administrators, governments), in order to suitably identify the environmental challenges, and sustain societal support towards realization of coordinated, multi-disciplinary and comprehensive response essential for authentic transformation. The transformation involves improvement, modifications of industrial processes and innovative environment plans. Environmental management calls for an agreement between science, technology, management and the public. It identifies the significance of all the factors and provides symbiosis or unity making it possible to achieve positive outcomes.

It has often been argued by Nigerians that “Nigeria has one of the good laws in the world.” But the difference between laws and effective implementation are strong political will and independent institutions. That is one of the clear differences between developed countries and developing countries. Strong institutional capacity fosters independence of regulatory establishments, judiciary, from political interferences. Also, strong institution promotes transparency and accountability; and is a safeguard against corruption which is high in Nigeria.

For example, even though gas flaring has been prohibited in the country, poor political will and vested interest, and weak institutional capacity has made the regulation seem redundant. Therefore, Nigeria, must as a matter of necessity establish an effective legal and regulatory support system that promotes national capability to counter the issues of sustainable development. The policies and regulations should be appropriate to the unique factors in Nigeria, and must drive accelerated transformation of the country's ecological and development policies measures. Instead of the current fragmented method, approach of comprehensive integration of regulations, laws and standards should be adequately pursued. NESREA act and many regulations enforced by the agency affects almost all the sectors of Nigerian life is a good trend. However, they should be sustained by suitable institutional instruments and capacity, so as to adequately monitor and enforce the laws. For example, EIA act implementation and monitoring should be strengthen and enhanced to cover other economic activities beyond oil and gas, infrastructure construction. The non-state actors should be educated and empowered so as to foster their active participation in this regard. The importance of institution – especially non-state actors such as environmental and social NGOS – is very important. Most times, in pursuit of economic motives, state actors may be complicit in overriding public (or community) interests because of political pressure, etc.

- **Improved environmental education in Nigeria academic institutions**

Teaching and learning about the environment and their inter-relationship could be regarded as environmental education. Considering that about 61% [19] and 49% [20] of the related age group enrolls into primary schools and secondary school, respectively, it can be safely argued that effective and practical teaching of environmental education will result to a massive national orientation towards environmental protection. Elements of sanitation, global warming and climate change, water cycle, pollution, cleanliness and personal hygiene are part of primary and secondary school subjects such as Primary Science, Health Education, Basic Science, and so on, but there is a need to articulate proper environment-related subject matters and offer it as a subject to secondary school students. Similarly, first year university takes compulsory General Studies course as recommended by Nigerian Universities Commission, and which include an aspect of environmental education. But the scope and depth is highly limited as it is an integral of a course module. This should apply also to other tertiary institutions such as polytechnics and colleges of education. It should be offered a general mandatory course, with emphasis on contemporary and practical issues. For example, there is a need, and an urgent one at that to introduce basic components of environmental management instructions – subjects, modules, and courses – across the whole education sector. Important topics such as sustainability and their nexus – economic, environmental and social -should be integrated. Other topics such as waste hierarchy, circular economy and regenerative economic model, system thinking in environmental interactions, climate change science and others should be scaled up. The environmental subject should integrate practical and theoretical topics such as waste minimization principles of reuse, reduce, recycle; the nexus between energy efficiency and greenhouse gas emissions abatement; basic environmental chemistry; importance of forestry and vegetation as means of sequestering carbon; the carbon footprint of energy-intensive appliances such as incandescent bulb which is very common in Nigerian households, and also eco-friendly practices such as carbon footprint reduction in activities.

These will foster and promote practical attitudinal changes, and as well reinforce the scientific understanding of the students, as regards human-environment interaction. It calls for reformation and re-development of school curriculum. It may be argued that some elements of these principles, theories and methods already exist in some of the subjects offered by students. However, creating a special subject, promoting interest in its teaching and learning, with appropriate teaching aids will foster transformation in perception and attitudinal change. It is in regard with this approach, that the federal government of Nigeria instituted technical education, which includes formal academic program and technical specialty. Therefore, there is need for special environmental education for every level of schooling in Nigeria, and it should address our critical problems.

Communicating science is a critical factor that orientates the general public in the direction of sustainable development. Schools – secondary and tertiary institutions - are charged with creation and diffusion of knowledge. Therefore, they are important for development of socioeconomic and environmental transformation.

Since the UN Stockholm Conference in 1972, education – teaching and learning - has been assigned a major responsibility for supporting environmental management. Accordingly, at the 57<sup>th</sup> session in 2002, the UN General Assembly declared the years 2005 to 2014 as the United Nations Decade of Education for Sustainable Development (DESD). The aim is to promote the important function of education in advancing a more sustainable earth. However, challenges such as uncoordinated organizational support and curriculum, time constraint and poor financial resources has largely limited the effectiveness of educational institutions in advancing knowledge related to sustainability and development [21]. This is more critical for a developing country like Nigeria, where national decay in funding of education, high level of poverty and standard of living has highly crippled the educational sector.

A review conducted by American Association for Advancement of Science reveals that poor or deficient knowledge weakens public support for science as an institution, encourages resistance or disagreement to actions designed to deal with environmental issues such as climate change. Furthermore, it promotes suspicion and unease about scientific progress and new technologies. Accordingly, the importance of science to empower public behavioural change cannot be over-emphasized. Science is concerned with finding out, understanding, explaining and predicting models in natural observations, creating more accurate clarification of how nature functions without consideration of their possible applications. It is premised on critical inquiry which is geared towards the search for knowledge sake. Largely, science uses experimental method and frequently entails testing researchable hypotheses, generally with data and experimentation [22]. Attending to the numerous environmental challenges facing Nigeria calls for examining pertinent researches, considering our unique social and environmental factors, incorporating various verifiable data, and participation of the public in order to address issue(s) or formulate policy.

Employing communication will produce more positive and suitable result, as transformation of knowledge into change requires considerable effort. Therefore, beyond just scientific research, there is a practical need for a new type of proficient people, who can utilize science-produced results, and convey understanding to the public through education, co-operation and communication. This will result to support of science and assist in solving various difficult and policy problems related to environmental protection, sustainability and management. The educated or trained – researchers, graduates and even secondary students - will deploy acquired knowledge produced by science. Therefore, closing the gap between science and the general public [22,23].

The importance of higher education in scaling sustainability in society is strong. Higher education is largely neutral and trusted actors in the society. This affords them the opportunity to promote dialogues and ecosystem for partnership between diverse stakeholders and advance certain issues and ideas devoid of corporate or political manipulation. Universities and higher education institutions (HEI) are traditionally creators and disseminators of knowledge. Innovation and creative solutions are at the core of functional educational institutions. Furthermore, present and upcoming policy analyst, decision makers, etcetera are trained in HEI, and therefore they can establish meaningful collaborations [8]. State actors (Government) only, cannot be depended on to create appropriate decisions. Involvement of all stakeholders and educated, informed and committed citizens will support the transformation towards a better environmental management. Furthermore, higher education institutions as centers of innovation should be structured in accordance to sustainability principles. These include green campuses, recycling and renewable energy use, etc [8].

- **Strong collaboration between various stakeholders**

The United Nations 2030 Agenda for Sustainable Development identified combination of economic development, environmental sustainability and social inclusion. There is a need for strong partnership between various stakeholders – state and non-state actors; between different government institutions and also linkages among NGOs and legislative framework. No single actors can effectively address the various ecological problems. For example, while legislative framework creates rules, regulations, laws and guidelines that are in tune with preserving and protecting our environment, strong institutional actors are the drivers – monitoring, enforcement and compliance – of the regulations. Non-state actors (NSA) encompass all those actors that are not of state, but operate at all levels, which are also critical to international relations. Basically, there are five NSA – intergovernmental actors, NGOs, corporate interest groups and transnational corporations, epistemic community and others (professional associations, churches, etcetera) [10].



Non-state actors play a major role by serving as “watchdog” to ensure that state institutional actors strongly discharge their duties. Furthermore, they lobby, advocate or pressure legislatives, governments to pursue adequate environmental management practices where such gaps exist. Environmentally informed and committed society or general public possess a tremendous tool in driving ecological-friendly decisions, through their personal/ household attitudes and practices, voting power to support and demand for environmental justice and quality environmental policies.

Besides other avenues, educational system has a critical role to play in educating and communicating science and environmental solutions to the society. Therefore, the need to integrate environmental education across all the levels of schools in the country is paramount. Beyond post-secondary schooling, universities which is a center of research, has to innovatively re-imagine and rethink Nigeria’s unique ecological problems in association with the drivers of degradation (anthropogenic activities) which include resource extraction, materials use and production processes, and their end-of-life products. Similarly, other human activities include unsustainable land use practices. This supports inter and trans-disciplinary collaboration between science, psychology, economics engineering and technology. Furthermore, collaboration between academia and industry – manufacturers and goods and services providers – will assure massive inflow of funds which is critical to R&D, while the enterprises benefits from the research output. This is largely contrary to what is obtained in contemporary Nigeria higher education system, where government is the major funder (for government universities), and student’s payments, for private universities.

Consequently, this paper advocates for creation of a national environmental management programme (NEMP). The center should function as a critical hub independent of governmental control, but collaborating with state actors such as Federal ministry of environment, NESREA and judiciary, research centers and universities, and NGOs. They should aim to strengthen policy and legislative initiatives devoid of political and or vested commercial interests, which most often weakens our environmental laws. This paper conceptualizes a model incorporating actors and inter-relationships within our proposed National Environmental Management Programme in Figure 2.

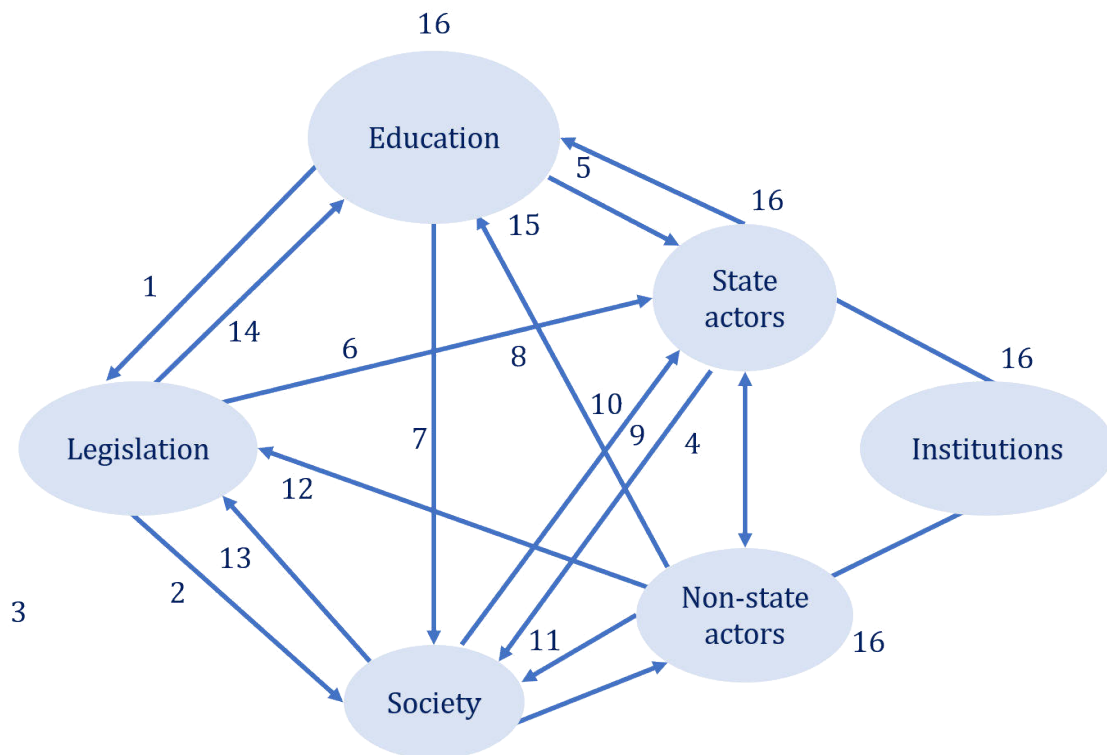


FIGURE 2: Inter-relationships among actors

## Legends

- |   |   |
|---|---|
| 1. Evidence-based science legislation   | 9. Monitoring, enforcement, funding, community-based environment protection         |
| 2. Laws, Regulations, Fund community efforts                                  | 10. Requests, judiciary applications, protest through peaceful action, voting power |
| 3. Collaboration, Pressure, Complaint   | 11. Sensitization, communication, develop foster eco-friendly practices             |
| 4. Pressure group, partnership  | 12. Lobbying, Advocacy, collaboration, fact, finding missions                       |
| 5. Funding, partnership – R&D, Endowment, Ecological Programs                 | 13. Petition, Pressure group, voting power  |
| 6. Empowerment, Laws  | 14. Appropriation, Grants, Support R&D  |
| 7. Communicate R&D, technological, solutions, education, consultancy services | 15. Midwife policy, science communication   |
| 8. Partnership, endowment, Funding  | 16. International/ regional cooperation, capacity building, funding                 |

From the above, increasing participation of stakeholders is very important – both state and non-state actors. In recognition of the global inter-relationship between ecosystem inter-relationship, collaboration between the “center” and relevant international agencies such as World Wild Foundation (WWF), UNESCO, UNEP and other relevant actors such as grant and R&D organizations will foster capacity building in technological development, innovative environmental solutions, effective advocacy and best practices, to solve Nigeria’s environmental challenges. Collaboration between stakeholders and international community of state and non-state actors is required. It should be noted that in the context of this paper, state actors such as judiciary and legislature which checks the excessiveness of the executive and vice versa are very much relevant, to proper environmental management in Nigeria. Furthermore, their independence will guarantee protection of the rights of people suffering “environmental injustice.” Other state actors such as federal ministry of environment, NESREA, NOSDRA, and others have the responsibility to monitor, enforce and ensure compliance to environmental laws. They can charge an enterprise to court for non-compliance. Similarly, the general populace on their own or through non-state actors such as NGO, or even through state actors as aforementioned, can bring to court enterprises, activities that degrades the environment and does not comply with environmental laws.

The existence of laws does not in itself constitute a transformation in behaviour of the public. The continual use of media, education and social institutions to bring about a change in thinking and actions consistent with the requirements of a healthy environment will make simple the functions of environment institutions. The society which comprises of the community or the people is very critical to any meaningful environmental protection. This is because they are the custodian of their local geophysical settings, and also their actions directly affect positively or negatively the environment. The same is true in a global scale. For example, Nigeria is reported to have the highest deforestation in the world, at a rate of 2.6% per annum. Deforestation is associated with loss of biodiversity. Nigeria’s forestry biodiversity includes about 899 species of birds, 154 reptiles, 53 amphibians, 274 mammals and 4,715 species of higher plants. There are also various non-timber products [24]. Obviously, state actors such as forestry department have a major role to play in ensuring the conservation of the resources. However, it is the people of the area that has much vested interest in the sustainability of the forest and biodiversity. Successfully making the people to understand this will go a long way to conserve the resources. Hence, the need to address poverty and formation of strong community-based environmental management partnership such as community forest protection emerges. Environmental education, sensitization, financing and reformation of land tenure system will go a long way to address the issues. The same model of community involvement will foster good attitude as regards solid waste management, and other environmental issues.

Industrial-academic mutual relationship is the usual standard for universities in developed countries. Considering Nigeria's emerging market system, integration of this innovative system together with the traditional model of government financing will accelerate research financing, while industry benefits from the research output. This model will go a long way to fix the stasis in Nigeria education, which has massively led to drain of faculty. For example, [25] showed that between 1988 and 1990, more than 1,000 lecturers left the federal university system. Also, universities as creators and disseminators of knowledge have a very important role to play in shaping environmental legislation. Another collaboration which will foster improvement and adoption of international best practices is global engagement or partnership of both the state and non-state actors – institutions, legislatives and academics. [26] showed that even though environmental laws and institutions has improved above pre-1987 era, however field observations show that environmental degradation is increasing at a rate greater than that of the era. Solution to the issues requires a tremendous change in legislation and institutions, including academia (R&D) and societal behaviors and practices. Among state actors, there is need for effective inter-agency co-operation. It includes exchanging information and data, and also among other agencies with related directive or overlapping roles.

- **Technological capacity**

Like every other development, technology is a critical enabler for environmental management. Technological capacity development cut across the other three factors – environmental education, balance between economic growth and environmental protection and legislative framework. Deployment of adequate and proper technology will drastically improve the environmental issues in Nigeria. For example, effective adoption of waste-to-energy technology will go a long way to harness energy from wastes, considering the high organic composition of Nigeria's waste stream. This will solve the negative implications of the country's poor waste management problems. The same applies to other environmental issues such as gas flaring, oil spillage, sanitation, energy generation, deforestation, environmental –air, water and noise – pollution, population growth control and others. Environmental-friendly technologies do not only foster solutions to ecological problems, but it is also accelerating economic growth. It is associated with resource-efficiency, which considerably reduces environmental degradation, and also increases industrial efficiency, quality environment, and human well-being [9,13]. Technological innovation in environmental issues requires a strong collaboration between different stakeholders and actors. For example, accelerated separation of waste (waste characterization) at source will improve recovery for either material and/ or waste production. Also, as at present, there is no engineered landfill operating in Nigeria [13,27, which is appropriate for suitable methane from wastes.

However, like many other development issues, Nigeria seriously lacks basic environmental technology. Accordingly, a very vital characteristic of global technological advancement should include transfer of technology from developed to developing countries. Motivations are required if these capital demanding developments are to substitute the poor efficient ones in Nigeria. To achieve deployment of technologies for ecologically and sustainable development, successful national and multi-lateral economic strategies and management plans geared towards sustainability objectives are required. The major step therefore is to develop local technological capability, and it involves knowledge and technical development – academic (R&D) and institutional actors, for example waste management agencies, and private (or non-state) actors such as entrepreneurs, interested in green enterprises [9]. Even though governments have an important function in achieving environmental sustainability, established capacities and flexibility of private sectors, especially as regards technological innovation and transfer situates the importance of private enterprises in fostering eco-technological development. The right environment such as tax rebates or waivers, funding, grants should therefore be accelerated and enshrined in legislative directives, so as to scale this. There is no doubt that market for eco-friendly technologies and processes exist in Nigeria, framework to encourage and deepen it is needed. State actors and non-state actors therefore have a critical role to play in this regard.

Collaboration between our advocated National Environmental Management Center, with international R&D agencies, industrial actors, and also local universities R&D will improve technology development indigenous to the country. This is necessary considering factors unique to Nigeria –technological incapacity, level of economic growth, poor education system, and weak institutional capacity, divergence between industrialization and environmental concern and improper waste management.

## CONCLUSION

Nigeria, a developing country has complex environmental problems. The environmental issues are caused by the conflict between economic development and protection of environment and resources. Hence, the need for environmental management emerges. Environmental management has gained momentum since the UN World Commission on Environment and Development (WCED) report of 1987. Environmental management is a process and also an interdisciplinary and multidisciplinary field. Many environmental institutions, especially state actors, have grown in the country. Still, the environmental degradation in the country continues to grow steadily. This is attributed to weak institutional capacity, poor monitoring and enforcement of existing laws; poor societal attitudes towards the environment, and technological incapacity. Effective legislation – laws, standards and regulations – without strong institutional capacity for implementation will not produce tangible transformation. Similarly, legislation that is not premised on evidence and appropriate science may not address the ecological issues. Accordingly, the importance of synergy between the factors – balance between economic development and environmental protection, improved environmental education in Nigeria academic institutions, strong collaboration between various stakeholders, and development of technological capacity. The paper argues the importance of strong institution capacity - state and non-state actors - in driving environmental actions, considering that vested interest of governments in some economic activities, such as oil companies has weakened their regulation and control of activities such as gas flaring; and change in administration often results to change in policies and agenda. Environmental protection should be tailored to reflect prevailing circumstances in the country, while still adopting and adhering to international treaties and best practices. The conception should recognize seemingly variation across ecological zone of the country. For example, in Niger Delta, gas flaring and oil spillage; in southeastern and southwestern Nigeria, it is unplanned urbanization with high settlement density, deforestation/ de-vegetation, erosion and flooding, poor waste management, while in the North, it is mainly desertification. Environmental education should be included in primary, secondary curriculum. Also basic course on environmental management should be offered as a compulsory to tertiary students, especially in first year and subsequent years for science majors. These will foster effective and adequate environmental management for sustainable Nigeria.

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