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Roles of Laboratory Science in Environmental Development in Nigeria

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Abstract:

Global warming and climate change are the most prominent issues of the current environmental scenario. These problems arise due to a higher concentration of greenhouse gases in the atmosphere which exerts a warming effect. Although much attention has been given to anthropogenic sources and impacts of these gases, the significance and implications of microorganisms have remained neglected. The present review brings to light this over looked aspect of the causes of climate change and how the laboratory has helped in mitigating the environmental issues being experienced in recent times. It was then found that the laboratory plays a major role in the attempt to cushion increasing environmental challenges. The paper revealed that the laboratories are responsible for the betterment of the health of many individuals, wildlife and the environment. With their technical data and analysis, they provide a brief solution to what to do next to preserve the well-being of the area. The laboratories also provide technical services in which they analyse samples. They provide a detailed analysis of elements, trace metals, total organic carbon and absorbable organic halides etc.

The laboratory science is a very broad and lengthy bridge making profession serves as a linkage between the various field of sciences and technologies (Prasanna et al., 2020). In the widest sense, science refers to any systematic knowledge or practise, a methodology for gaining information based on the scientific method, and the structured body of knowledge acquired through such inquiry. Thus, science is the acquisition of the knowledge of what to do or what scientists do, but technology is a very wide notion that encompasses a species' use and understanding of tools and crafts, as well as how it influences a species' capacity to regulate and adapt to its environment (Latshaw, 2016).

According to Adewole (2007), technology is a result of science and engineering in human civilization, but a number of technical advancements before the two ideas. The name 'technology' comes from the Greek 'techno logia', where 'techno' means 'craft' and 'logia' means'saying' Thus, technology translates to craft in Greek. Nonetheless, a precise definition is problematic (Alaku, 2007; Ijagbone, 2005). Technology can refer to material objects of use to humanity, such as machines, hardware, or implements, but it can also be applied generally or to specific areas; examples include construction technology, medical technology, environmental technology, metal technology, oceanic technology, etc., or cutting-edge technology (Adewoye, 2007; Ibitoye, 2006).

Effiong (2016) found that climate changes have created some effects on human and environmental systems, spanning water bodies such as rivers, lakes, etc., causing some issues for agricultural and food security, particularly in the irrigation and fisheries sectors. Impacts of climate change, such as unpredictability and change in seasonal weather patterns, etc., are reducing food yields and fish productivity. Introducing trees, herbs, and shrubs along the banks of water bodies, constructing more ponds, dams, or basins in order to collect and retain water,

utilising agro-ecological techniques, and collecting data on the parameters of environmental water bodies in order to determine, assess, and address the environmental impacts are likely ways to combat climate change.

Fairburn et al. (2019) argued that environmental protection is the most important issue of our time; explosive population growth, rapid progress in science and technology, massive industrial organisation and use of various chemicals in agriculture, and most importantly, human activities are the factors endangering life itself. Macro and micro element compounds contained in modest levels in plants such as vegetables and grains are not recognised nutrients, but they considerably protect against the development of several degenerative illnesses. In developing nations, environmental factors constitute the underlying cause of a high burden of sickness and death. In places such as sub-Saharan Africa, the ensuing effect is estimated to account for roughly 35% of mortality and illness. Consequently, all organisations, including labs, have a social duty to mitigate the damage caused by environmental changes. The labs are responsible for improving the health of many people, animals, and the environment. With their technical data and research, they propose a concise answer for preserving the area's well-being. However, the significance of labs in environmental development is now little understood.

Laboratories are responsible for dealing with poisons that are harmful to humans, animals, and the environment. Several disciplines, including as technology, chemistry, medications, infrastructure, and others, have changed since the industrial revolution. Nonetheless, this rapid growth has had a substantial effect on our ecology. In addition to affecting the ecosystem as a whole, it also impacts ourselves and our habitat, requiring prompt action. Consequently, assessing indoor air quality, contaminants, and other issues has become crucial. Environmental laboratories have contributed significantly to the environment. The scientific laboratory's major mission is to provide technical services to other divisions, laboratories, and institutions in the fields of elemental analysis, metals, organic carbon, and adsorbable organic halides, among others. Using modern technology, the laboratory conducts a number of projects and in-house research to assess the environmental quality of air and water based on analytical observations of various elements, trace metals, organic carbon, and organic halides.

Despite laboratory science's contribution to environmental progress, the laboratory has contributed to environmental deterioration. A typical research laboratory is expected to use more than three times as much energy as an office building (per square meter). This makes logical given that laboratory equipment may operate continuously for lengthy durations. Electronics, office equipment, and lights need a great deal of energy to operate, but the most energy-intensive equipment in the laboratory is the heating and cooling equipment. Since plug-load equipment is seldom switched off, it is a continual energy user. Additionally, the laboratory generates a tremendous quantity of (mostly plastic) garbage. According to estimates, a scientist in a bioscience laboratory creates less than one ton of plastic garbage every year. If we generalise this to a department of around 280 scientists, we would need approximately 5.7 million 2L plastic water bottles. It is against the foregoing that this paper sought to examine the role of laboratory science in environmental development. The paper is divided into four sections: introduction, conceptual clarifications, the role of laboratory science in environmental development and the conclusion.

Conceptual Clarifications

The Concept of Environment: The idea of "environment" has been defined in a variety of ways by various researchers and institutions/agencies. Regardless of how one interprets the word "environment," it simply describes what surrounds us. Environment, according to Desmet and Rossi-Hansberg (2015), is the "sum total of all circumstances that surround man at any given

moment on the earth's surface." Environment, as defined by Donadelli et al. (2017), is the collection of external variables that impact the life of an individual or population, especially the lives of humans and other animals on the earth's surface. The Federal Environmental Protection Agency (FEPA) Act of 1990, section 38 also provided a very clear definition of environment: "Environment includes water, air, land, and all plants and human beings and/or animals living there, as well as the interrelationships that exist between these and any of them." Environment is the natural and biological resources in an area.

The Concept of Environmental Laboratories: Environmental Laboratories are responsible for dealing with toxins that impact people, animals, and the environment (Perfect Pollucon Services, 2022). These facilities include cutting-edge technology and seasoned researchers. These scientists at an environmental laboratory create analytical data on biological, ecological, and physical sciences by conducting insightful tests on numerous components, such as water, soil, air, waste characterisation, pollutants, energies, and explosives, among others. To offer such services, however, requires skilled professionals who are adept at protocol formulation, sampling, and analysis.

For proper operation, the scientific laboratory depends solely on its staff of professionals. Typically, this team is comprised of lab specialists with specialised training in testing for toxins damaging the environment and life on Earth. These technicians have a variety of duties and designations, including environmental technician, environmental specialist, laboratory expert, and environmental health specialist. Environmental scientists and engineers oversee and assess the work of these personnel. Environmental Laboratories scientists and engineers are responsible for creating new processes for environmental remediation and suggesting new regulations. The following list of Environmental Laboratories' functions will provide you an overview of how the lab operates.

Environmental Development: Environmental development is economic and social development that takes into account environmental considerations (Donadelli *et al.,* 2017). The notion is also an environmentally conscious economic and social growth. Sustainable development seeks to establish feasible initiatives and harmonise the economic, social, and environmental elements of human activity; it is concerned with advancing in these areas without destroying the environment. It symbolises the observable improvements, advances, and transformations in the general circumstances of the environment, particularly in terms of reduced land, water, and air pollution, as well as less destruction of vegetation and threat to species. Environmental development also includes all positive changes brought about in a specific geographical area through people-centered political, economic, social, cultural, and even diplomatic efforts to make it a better place for everyone to live (https://www.igi-global.com/dictionary/environmental-development/86906).

The Role of Laboratory Science on Environmental Development

Laboratories are responsible for dealing with toxins that harm the environment, people, and animals. Since the industrial revolution, the globe has evolved in several fields, including technology, chemicals, medicines, infrastructure, and others. However, Prasanna *et al*. (2020) found that this fast increase has had a significant impact on our ecosystem. In addition to impacting the overall environment, it also affects human beings and our habitat, which need swift response. Consequently, it has become essential to assess indoor air quality, pollutants, and other factors. Environmental labs have made substantial contributions to the environment. The primary purpose of the scientific laboratory is to supply environmentalists with technical services about elemental analyses, metals, total organic carbon, and absorbable organic halides, etc. Using modern technology, the laboratory also conducts several projects and in-house research to evaluate the

environmental quality of air and water based on analytical observations of different elements, trace metals, organic carbon, and organic halides.

Environmental impact statement (EIS) is a written declaration of the effect of an existing or projected factory or development on the environment, or a scientific study conducted in order to create such a statement. In the Middle Ages, the process of adapting natural laws to human comprehension and ultimate uses of these laws to address man's day-to-day issues with the aid of science and engineering relied only on a series of laboratory experiments. However, with the advent of Nanoscience and Nanotechnology, which have recently had a significant impact on many facets of our society, through the production and innovation of computers and the internet, which makes it possible for virtual or stimulated and remote laboratories to exist, this is no longer the case (Adewole, 2007; Titi, 2007).

The EIS is a formal procedure used to anticipate the impact of a proposed development or legislation on natural resources such as water, air, land, and wildlife. Environmental impact statements were originally established in 1969 as a requirement of the National Environmental Policy Act in the United States. Since then, a growing number of nations have adopted the procedure by enacting laws and forming bodies tasked with its execution. EIS have been used mostly to individual projects and have spawned several branch methodologies, including health impact assessments, social impact assessments, cumulative impacts assessments, and strategic environmental assessments (environmental assessment of proposed policies, programmes plans). In some instances, social and economic effects are evaluated as part of Environmental Impact Statements. In order instances, they are evaluated independently.

According to Liggio *et al.* (2016), trash utilisation must be assessed and controlled. There are four levels of waste management:

1. pollution avoidance and source reduction;
2. reuse or redistribution of undesired, excess materials;
3. treatment, reclamation, and recycling of waste materials; and
4. disposal by incineration, treatment, or land burial.

The optimal method for handling laboratory waste is one that maximises safety while minimising environmental effect. These goals should be considered at the time of acquisition. No activity should commence until a strategy for the disposal of non-hazardous and hazardous waste has been prepared, according to the guiding principle for the careful management of laboratory waste. This basic approach assures compliance with the multiple state and federal regulatory requirements for waste management and prevents unanticipated complications, such as the production of a waste kind (e.g., chemical, radioactive, or biological) that the institution is not prepared to handle.

Laboratory single-use plastics are a key potential change target (Liggio *et al.,* 2016). Several businesses have been striving to produce polymers manufactured from renewable and biodegradable sources, albeit these are not yet generally accessible. The greatest influence that laboratories can have on plastic waste is to reduce the quantity of plastic used for experimentation. For instance, if suitable, scientists should utilise smaller flasks or tubes or purchase materials-efficient equipment. Researchers at two institutes of the Vienna BioCenter now utilise refillable boxes for their pipette filter tips rather than purchasing new boxes each time they need extra tips. Additionally, they use glass pipettes wherever practical. Under the new approach, researchers are able to replenish their pipette filter tip boxes from the stockroom (often referred to as stores in Europe). Scientists who want to limit their total plastic use may also choose suppliers with zero-waste production facilities and minimal packaging when delivering and creating items. For

instance, scientists may minimise the quantity of reagent bottles by purchasing chemicals in bulk and sharing them with other laboratories.

When it comes to reusing plastic in the laboratory, contamination is a huge obstacle. In many laboratories, particularly biological ones, preventing contamination and maintaining sterility are crucial. In some laboratories, however, where contamination is less of a concern, researchers may consider recycling equipment like as weighing boats and gloves. For instance, accuracy and contamination may be less of a concern in teaching laboratories. But Alaku (2007) also notes that, even in sterile processes, reusable objects might occasionally have equivalent performance to single-use products. His company has developed washing devices that can wash and disinfect single-use pipette tips so that they may be reused numerous times. The device is comparable to a programmable dishwashing for pipette tips. The user then specifies the cleaning chemical to employ, as well as whether the tips should undergo soaking, ultraviolet light irradiation, or sonication. Different users have developed pipette tip cleaning processes for various laboratory techniques, such as mass spectrometry or toxicology and immunology experiments. Researchers at the National Center for Advancing Translational Sciences of the National Institutes of Health discovered earlier this year that their cleaned pipettes produced the same results as fresh tips when producing small-interfering-RNA screening libraries.

To limit the amount of plastics in the environment, the laboratory recycles plastics, which is often a physical process (Ibitoye, 2006; Abbatt *et al.,* 2014). Recycling facilities clean plastics, shred them, and then remelt them to create new goods. Each recycling stream at these facilities must include just one kind of plastic; cross-contamination might be problematic. However, chemical or biological contamination complicates the recycling of laboratory plastics. Even the disposal of laboratory plastic trash necessitates addressing this contamination. Before transferring garbage to a landfill or a professional processing business that will incinerate it, it must sometimes be cleaned with chemicals or autoclaved (Abbatt et al., 2014). Even if the plastics are not contaminated, many local facilities and recycling contractors are unwilling to accept lab items for general recycling due to contamination concerns. Contamination concerns hinder scientists from reusing plastics in the laboratory.

Conclusion and Recommendations

Since people realised that their activities had a direct influence on the environment, laboratory sciences have played an essential role in protecting both human health and the ecosystem (Latshaw, 2016). They serve as a reliable resource for reference and emergency response, being in the forefront of developing strategies for new or novel pollutants. Environmental policies, legislation, and decisions at all levels need strong scientific facts. Laboratories continue to be a crucial instrument for producing these data; they considerably contribute to the data required to estimate pollution levels not only in our air, water, and soil, but also in persons. The data collected by these labs alleviates the difficulty of determining if environmental regulations are being broken, where environmental or public health measures are necessary, and how effective rehabilitation has been. Environmental authorities at the state level should explore collaborating with public labs. This policy would enhance a sustainable environmental management in Rivers State. Furthermore, special fund should be established to enhance effective establishment of laboratories for environmental research. This would enhance the effectiveness of government at both local and central levels in formulating policies to combat future environmental hazard in Rivers State.

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