

GLOBAL ENVIRONMENTAL PROBLEMS WITH IMPLICATIONS FOR BIOLOGY EDUCATION IN NIGERIA.

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Abstract

Although the Nigerian Biology curriculum is enriched with several environmental science topics yet it appears that many biology teachers are not knowledgeable on how to impart the knowledge, skills and values of such topics to the students. This article discussed the causes of global environmental problems, environmental and health effects of global warming, efforts at controlling global warming and implications of global environmental problems for biology education. Due to the disastrous effects of global warming, ozone layer depletion and climate change, there is urgent need to review the curricular objectives, contents, biology teaching methods (pedagogy), biology learning resources and biology evaluation techniques. Attempt was made to review these curricular components, particularly the use of problem-solving techniques, analogy and values clarification, and emphasis was laid on the need for training retraining of biology teachers in Nigerian schools through appropriate workshops, conferences (e.g S.T.A.N Conferences) and training programmes. Such experiences will likely enhance biology teachers' abilities to plan their instruction on environmental science topics, for instance, causes of global environmental problems and how to control them based on students' skills and knowledge acquisition, and inculcation of environmental ethics in the students for sustainable development in Nigeria.

.Introduction

Environment, according to Rana (2009) is the final analysis of everything (physical, chemical and biological.) present outside an individual's species. In other words, all the biotic and abiotic factors acting on an organism (plant or animal) make up its environment. Each organism has its own environment. Anido (2001) defined science as a systematic study of nature. Science is the

accumulation of knowledge on any subject and the method by which discoveries are made and recorded. Rana (2009) explained that since the beginning of human civilization, mankind had tried in a competitive relationship with nature. His relentless pursuit of progress, comfort and security has resulted in increased stress on the environment, particularly since the industrial revolution. Subsequently the life-

sustaining environment has been forced to transform more rapidly than ever before. Human tendency to exert a

negative influence on ecology has resulted into rapid increase in the green-house gases in the atmosphere, large scale deforestation, loss of biodiversity that is, extinct of some flora (plant species) and fauna (animal species); severe land degradation and environmental pollution such as air, land, water, noise, radioactive and thermal pollution. The effects of these problems are global, hence they are known as global environmental problems. The overall impact of these problems has been observed as climate changes, depletion of ozone layer, rise in sea level, changes in agricultural output and loss of biodiversity ultimately leading to an ecological crisis capable of affecting the entire life and life support systems existing in our planet (the earth).

Concept of Global Warming

Ezedum (2012) defined global warming as the unusually rapid increase in earth's surface temperature over the past 100 years primarily due to the greenhouse gases released by people burning fossil fuels; such burning of fossil fuels by human activities is referred to as anthropogenic activities. The anthropogenic activities, according to Horsefall and Spiff (2001) include the use of fossil fuels for heating and cooling, industrial energy conversion; incineration of various forms of industrial, commercial and domestic wastes; gas flaring in oil locations; clearing and burning of forests for agricultural and other purposes; commercial logging/deforestation construction works such as dams, roads,

mines and buildings.

The greenhouse gases include Carbon dioxide (CO_2), Sulphur dioxide (SO_2), Methane (CH_4), Nitrous oxide (N_2O), and chlorofluorocarbon (CFCS) among others. According to the Intergovernmental Panel on Climate Change (IPCC, 2007), different greenhouse gases have very different heat trapping abilities. Many of them even have greater heat-trapping potential than carbon dioxide but because their respective concentration in the atmosphere are much lower than carbon dioxide concentration, none of them adds as much warmth as carbon dioxide to the atmosphere. This is why carbon dioxide is seen as the major cause of global warming.

Another cause of global warming is the melting of the glacier and polar ice. According to Glacier and Ice Cap Facts (2011), there is a positive feedback mechanism between global warming and release of carbon dioxide. The ability of the sea to trap or retrieve and store carbon dioxide from the atmosphere is because of its possession of ice. When the ice melts, the sea's capability to absorb carbon dioxide diminishes and the sea discharges already absorbed carbon dioxide into the atmosphere. This increases warming of the global environment which in turn facilitates further melting of ice.

The National Geographic News (2007) captured the facts of global warming as follows:

- Average temperatures have 1.4 degrees Fahrenheit (0.8 degree Celsius) around the world since 1880.
- The rate of warming is increasing. The 20th century's last two decades were the hottest in 400 years and

possibly the warmest for several millennia, according to a number of climate studies.

- The Arctic is feeling the effects the most. Average temperature in Alaska, Western Canada and eastern Russia have risen at twice the global average, according to the multinational Arctic Climate Impact Assessment report compiled between 2000 and 2004.

Global warming is causing climate patterns to change. However, global warming itself represents only one aspect of climate change. Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among other effects, that occur over several decades or longer (United States Environmental Protection Agency; US EPA, 2012).

Many parts of the globe have witnessed change in rainfall, resulting in more floods, droughts, or intense rain, as well as more frequent and severe heat waves. The planet's oceans and glaciers have also experienced some big changes, oceans are warming and becoming more acidic, ice caps are melting, and sea levels are rising (US EPA, 2012). As the global warming-instigated climate changes continue to occur, they will certainly present some environmental and health challenges to the world including Nigeria.

Environmental and Health Challenges of Global Warming

Ezedum (2012) pointed out that global warming has certainly presented and

may continue to present a range of environmental and health challenges. The challenges touch on the natural systems, ecological systems, food security and health among others. Intergovernmental Panel on Climate Change (IPCC) (2007a), estimated that on the timescales of centuries to millennia, the melting of ice sheets could result in higher sea level rise. Partial deglaciation of the Greenland ice sheet, and possibly the west Antarctic ice sheet could contribute 4-6 meters (13 to 20ft) or more to sea level rise. This suggests a great risk of possible submerging of human settlements located on low lands and sea shores. Nigerian settlements are not exempted from this.

Global warming also suggests the possibility of more warming at high northern latitudes and least warming over the Southern Ocean and parts of the North Atlantic Ocean (IPCC, 2007b). According to IPCC, the frequency of hot extremes, heat waves, and heavy precipitation will very likely increase.

With regard to the ecosystem, the poleward and upward shift in plant and animal ranges have been linked to recent warming (IPCC, 2007b). Future global warming induced-climate change is expected to particularly affect certain ecosystem, including tundra, mangroves, and coral reefs (IPCC, 2007b). Overall, IPCC speculates that higher atmospheric carbon dioxide levels, combined with higher global temperatures, will result in the extinction of many species of plants (flora) and animals (fauna) and reduced diversity of ecosystems, (that is, loss of biodiversity).

On food security, Lobell, Burke and Mastrandrea (2008) pointed out that by

2030, maize production in South Africa could decrease by up to 30% while rice, millet and maize in South Asia could decrease by up to 10%. Following from this, it stands to reason that temperate crops stand to fail with increased temperature while even some tropical crops may also fail to withstand the increased warming. This portends great danger to global food security.

Regarding human health, many prevalent human infections, including malaria, dengue fever and cholera are climate sensitive. In some cases such as malaria and dengue fever that is in part because the disease is transmitted by mosquitoes which cannot survive if temperatures are too low. For others, climate restricts where an infection can occur because it limits distribution of other species that are required for disease transmission. It follows to reason therefore that increased global warming will encourage the spread of those infections whose vectors thrive better under warmer climatic conditions.

Children's health over the last century can be linked to improvements in adequate food, clean air and water and freedom from diseases. Fortunately, climate change puts all of these achievements at risk. According to the Centre for Health and the Global Environment (CHGE, 2012), because of the increased risk of heat waves, droughts, and floods, as well as sea level rise more greenhouse gases in the atmosphere make food shortages more likely, lessen air quality, diminish freshwater supplies, and may create conditions favourable for the spread of certain infections diseases.

Rana (2009) pointed out that researchers from Stockholm Environment Institute reported that all natural ecosystems can tolerate a rise by 0.1°C of temperature per decade. However, further rise in temperature has been calculated to pose serious environmental consequences namely:

1. Many species, particularly plants, would be unable to migrate to new and somewhat suitable habitats, leading to rapid loss of biological diversity and natural resources of economic importance.
2. The increase in temperature will cause more frequent storms to many part of the world, including regions that have experienced no such activity earlier.
3. Rainfall and monsoon patterns could shift dramatically as the planet warms. Some of the regions of the world could dry out while others could receive too much rains-flooding rivers and increasing soil erosion.
4. An increase in temperature will cause the oceans to expand. Rising sea-levels will flood many highly productive areas of the world like Bangladesh, Egypt, Indonesia, China and India.
5. Glaciers and ice-caps will melt contributing further in the rise of sea-level
6. Rise in sea-level is a threat to the very existence of several island countries in the Pacific, Indian Ocean and Caribbeans.
7. Global warming could seriously disrupt marine ecosystems. The flooding of many coastal wetlands would mean the loss of breeding grounds of fish, shrimps and birds.

8. Groundwater supplies in several parts of the world could become contaminated with seawater.

Reasons why climate varies:

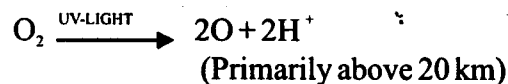
Rana(2009), emphasized that the complex problem of climate variation is the result of interaction amongst many external and internal processes of the earth's atmospheric system. The internal processes include air-ice interaction, heat exchange, wind stress, precipitation and evaporation. The external processes include changes in atmospheric compositions, changes of land features, topography, vegetation and albedo, changes in solar system radiation and change of ocean basin shapes and salinity.

Concept of Ozone Depletion

According to Rana (2009), Ozone (O_3) is a triatomic form of oxygen. It is found largely in the stratosphere that extends from about 6 km at the poles and 17 km at the equator to about 50 km above the earth's surface. It is present in traces (less than 1 ppm) in the atmosphere. It has a peak concentration (10 mg kg^{-1}) in the stratosphere. Ozone has been the most reactive form of molecular oxygen and the fourth most powerful oxidizing agent. It has a pleasant concentration at about 2 ppm or less, but higher concentration is irritating. It is used as a disinfectant and bleaching agent.

In nature, O_3 is formed in the stratosphere when ultraviolet light strikes an oxygen molecule. A photon splits the oxygen molecule into two highly reactive oxygen atoms (O). These atoms combine quickly with an oxygen molecule to form ozone. Ozone readily absorbs UV light and dissociated into its constituent

components.



Being a natural constituent of the stratosphere, O_3 is regularly formed and destroyed in a cyclic manner with solar radiation as the driving force. In the absence of any other disturbances, O_3 settles into a dynamic steady state in which the rate of its formation is equal to the rate of its destruction.

Ozone works like umbrella and protects the earth from the harmful UV radiations coming from cosmic rays. In spite of being a trace gas, it plays a major role in the maintenance of climate and biology of the earth. It filters out all the radiations below 3000 Å (UV-B radiations) that are biologically harmful and controls the heat budget of the earth.

According to Rana (2009) some of the health effects of ozone depletion and increased uv-B radiation are cataract-induced blindness, skin cancer, lung diseases, all the diseases that affect at a stage like measles, malaria, leishmaniasis, tuberculosis and leprosy are known to be caused by uv-B induced immune suppression, uv-B radiation will cause squamous cell of the eyes in cattle. Ozone depletion causes crop losses in potatoes, spinach, clover, alfalfa, beans etc.

Realization of the importance of the ozone layer and confirmation of holes in the ozone umbrella led to important accords/protocols, that is, Montreal protocol (1987), London conference (1989), Helsinki (1989) and Kyoto protocol (1997).

Processes Causing Ozone Depletion

The Ozone story began with Johnston's warming in the seventies of a possible depletion caused by nitric oxides as exhaust from supersonic aircrafts. However, it received little attention till the discovery of *Antarctic Ozone hole* by the British scientists from a single Dobson Instrument operating at Halley Bay. Data gathered by US NIMBUS-7 satellite further confirmed their observations. Further examination of balloon measurements made at the Japanese station Swoya showed the "hole" to be primarily at 15 to 20 km. The discovery prompted a number of special campaigns-the National Ozone Expedition-1 (NOZE-I) in 1986 and NOZE II in 1987. India participated in 1987 and subsequent campaign by launching a series of balloons carrying ozone measuring instruments over its base at Antarctica known as *Dakshin Gangotri*. These activities focused attention dramatically on the frail nature of the stratosphere and the role of ozone as a screen for biologically hazardous ultraviolet 'B' radiation.

Three processes cause the ozone depletion. Radiations from the sun create and destroy the ozone but at somewhat different wavelengths. There are a host of chemical reactions occurring between O_1 , O_2 and O_3 and a number of other molecules that have greenhouse effect. The key is the catalytic action by a number of radical species, viz. H, OH, NO, Cl or Br. In a catalytic process, a catalyzing atom or a molecule keeps converting ozone into molecular oxygen again and again without itself being destroyed (Rana, 2009).

Ozone Depletion and Global Warming

Rana (2009) pointed out that global warming is fallout of ozone depletion. Greenhouse gases and the global climatic changes are major problems. The earth's average temperature has not varied by more than 2°C in the past 10,000 year and during the last iceage, the earth probably was about 5°C colder than it is now. Some 5,000 to 7,000 years ago (the Holocene optimum), when the average temperature was perhaps 1°C warmer than it is now, climate then was substantially different from that of today. There was more rainfall in Indian areas and the Sahara was probably not a desert but a dry savannah. Yet if some of the principal green house molecules such as CO_2 , CH_4 and O_3 continue to increase at the present rate and if many of the current calculations are correct, then the global temperature can rise by 1.5 to 4.5°C in about 50 years.

Effort at Controlling Global Warming

Ezedum (2012) emphasized that these environmental challenges (climate change, ozone layer depletion and global warming) are serious threats to human existence in this planet earth. There have been a number of global, regional and national summits aimed at addressing the problems of global warming. One of the notable global summits is the United Nations Conference on Environment and Development (INCED) otherwise called the Earth Summit, where 150 countries pledged to confront the problem of greenhouse gases by signing the United Nations Framework Convention on Climate Change (UNFCCC). To date, more than 180 nations have ratified the UNFCCC, which commits nations to stabilizing greenhouse gas concentrations in the atmosphere at a

level that would avoid dangerous human interference with the climate (Confalonieri, Menne, Akhar, Ebi, Hauenuge, Kovas and Woodward, 2007.) This was followed by a meeting of 160 nations in Kyoto, Japan in 1997 which resulted in the Kyoto Protocol – an amendment to the UNFCCC. Many other meetings have since been held at various levels. So far, not much has been achieved in terms of concrete actions to stem the rate of carbon emissions into the atmosphere. The sooner such actions are taken the better.

Implications of Global Environmental Problems for Biology Education in Nigeria

Ajewole (1998) stated that Biology being the study of living organisms (plants and animals) in their environment aims at helping the student to acquire appropriate skills, abilities and competencies that would enable him/her contribute to the development of the society. According to Reynolds (1994) Ecology as an aspect of biology taught in schools deals with the interrelation among plants animals and their non-living environment. The study of ecology reveals the influence of human activities in altering normal ecological relationships: creating new habitat(s) or to degrade and destroy old ones, the biological consequences of pollution, waste disposals, and global environmental problems (global warming, greenhouse effect, ozone (O₃) depletion and climate change).

Literature review has revealed that the teaching and learning of ecology in Nigerian schools had experienced a lot of problems as Biology teachers and students find it difficult to teach and learn

ecology (Osisioma, 1994).

This might be due to the intrinsic nature of ecology which has been shown to involve relationships among concepts of widely disparate degrees of concreteness and abstractness (Waheed and Lucas, 1992). Therefore, the need arises to teach ecology in a way that reflects the nature of the subject basically through problems solving and other practical approaches based on the interaction between living things and their environments. This calls for biology curriculum review to re-orient the content area to its relevance to student's personal lives, and subsequent application to resolve environmental problems to their communities. Generally, this has implications for curriculum planners to review the curricular objectives and content, pedagogy (Biology teaching methods), learning resources and evaluation techniques adopted in biology. This will foster in students and biology teachers a greater depth of understanding of the content area and to inculcate in them appropriate environmental attitudes which can enhance their commitment or motivate them to apply inherent or acquired skills to solve related environmental problems. Through this they can work individually or collectively towards solution of current problems (for instance, biodiversity conservation) and prevention of more global environmental problems.

According to Olagunju (2002) there are several methods and approaches a biology teacher can use to present biological information and impart skills to students. Such methods frequently used are demonstration method, guided and unguided discovery method, discussion, project,

laboratory/investigative method, individualized learning method and fieldtrips. Moreover, several approaches and techniques have been recommended for use while adopting the various teaching methods. Examples of such approaches and techniques are: problem solving; concept mapping. Analogy, value clarification, pictorial, dramatization, use of resource persons among others.

Olagunju (2002) pointed out that two major types of learning resources in biology are human resources and material resources. Biology teachers should be exposed to appropriate environmental knowledge and skills through workshop and conference which they will impart to their students. Through the study of Ecology, biology teachers should expose students to such tasks as tree-planting, raising flowers, gathering materials for recycling, emptying bins, burning incinerators, poultry keeping, rabbitry, snailery, gardening or keeping school farms, sewage disposal among others.

According to Olagunju (2002), there are four major materials resources for effective teaching and learning of biology namely: Realia (real objects/specimens), Audio- visual aids, written or printed materials (biology textbooks/ science journals) and the physical biology laboratories.

Conclusion

The importance of clean environment cannot be over- emphasized because it promotes good health of people, prevents breeding of harmful insects and animals, ensures our security, for a aesthetics and ensures survival of bio-diversity. However, global environmental problems terribly affect human beings,

animals, plants and causes a lot of pollution (land, water, air, radioactive pollution, noise and thermal pollution). Therefore, there is need to review biology curriculum in Nigeria in order to teach students the disastrous effects of environmental degradation so that they will help to prevent it as well as proffer solutions to existing environmental problems in Nigeria.

Recommendations

The following recommendations were highlighted:

1. Biology teachers should be trained on how to use material resources available in their environment to foster adequate comprehension of Environmental Education (EE) topics/concepts through appropriate methods/approaches.
2. There is need to organize training workshop for biology teachers on how to use analogies, problem solving, value clarification, game simulations, pictorial dramatization among others for each EE concept.
3. Field-trips should be planned for biology students to visit polluted sites such as industries, factories, mines and quarries, reserve packs among others.
4. Efforts need to be intensified to organize students into various extra-curricular clubs such as conservation club, energy saving team, beautification club, water purification team, animals' conservers, plants' conservers among others. Such exposure will enable biology students to attain first hand experiences which can facilitate their critical and analytical thinking that can also be applied to find solutions to conservation problems.

5. Curriculum developers should organize forum for incorporating the environmental packages from research on biology concepts into the curriculum. Efforts should be extended to restructure the existing biology curriculum to include specific evaluation questions, field work or laboratories' activities and time allocation for both biology students and teachers.
6. Publication of EE (Environmental Education) textual materials, biology teachers' guide and biology project monitoring workbooks is highly recommended.
7. The need to train and retrain our biology teachers on how to impart appropriate environmental knowledge and skills in their students cannot be over-emphasized. During training biology teachers should be exposed to relevant fieldwork experience related to biodiversity conservation projects or activities which they can design for students. Such tasks can be executed either in small groups or a whole class and may be rotated on weekly basis. Examples of such tasks are: tree planting, raising flowers, gathering waste materials for recycling, emptying bins, burning incinerators, poultry keeping, rabbitery, snailery, gardening or keeping school farms, sewage disposal among others.

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