*IOSR Journal of Research & Method in Education (IOSR-JRME)*
*e-ISSN: 2320–7388,p-ISSN: 2320–737X Volume 7, Issue 2 Ver. II (Mar. - Apr. 2017), PP 30-34*
*www.iosrjournals.org*

# Environmental Education and the use of Incentives: Panacea for Sustainability of Biodiversity in Africa

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***Abstract:*** *Due to anthropogenic activities, environmental degradation such as the overexploitation of environmental resources – a situation that leads to great loss of biodiversity, is in alarming rate in Africa. Such activities as indiscriminate cutting down of trees for firewood, bush burning, hunting, overgrazing and intense crop production have been identified as common practices in the continent. To ensure its sustainability, the paper advocates effective environmental education and the use of incentives as measures for promoting it. Environmental education helps to achieve environmental literacy which has attitude and behavior components in addition to knowledge component while incentives motivate providers of biodiversity. The paper therefore recommended among others training of specialized students such as biologists, especially in the areas of ecology, taxonomy, genetics, etcetera that will assist in the conservation of biodiversity.*
***Keywords****: Biodiversity-Anthropogenic activities-Environmental education-Incentives- Panacea-Sustainability.*

## I. Introduction

Africa like most continents of the world is faced with the issue of environmental abuse and management. Environmental abuse is contamination of the environment as a result of anthropogenic activities (World Health Report, 1998). Stent (2006) stated that abuse of our environment arises from actions that cannot be sustained by nature. Environmental abuse such as the over-exploitation of the environment resources leads to great loss of biological diversity or biodiversity.

Australian Museum (2015) conceives biodiversity as the variety of all living things; the different plants, animals and microorganisms, the genetic information they contain, and the ecosystem diversity and the three levels work together to create the complexity of life on earth. Biodiversity also refers to the interrelatedness of genes, species, and ecosystems and in turn, their interactions with the environment (UNEP, 2015). So biodiversity can be seen as the collection of the diverse living organisms that constitute the planet Earth's biosphere, the composite of the genetic information, species and ecosystems that provide humans with natural wealth in the form of food, fibre, medicines and pharmaceutical preparations, and inputs into diverse industrial processes; besides it supplies the raw materials that may assist human communities to adapt to future and unforeseen environmental stresses (World Bank, 1992). So biodiversity is important in that it has enriched our planet and given us a wide variety of species that are vital sources of food for man and animals and raw materials for industries (Dike and Herbert, 2005). Tobey (1995) further asserted that biodiversity facilitates ecosystem functions – gaseous exchange, surface and ground shed flows, protection, and enrichment of soils, regulation of surface temperatures and local climate; aesthetic, scientific and cultural values are intangible and monetary benefits of biodiversity in Africa are universalized. Biodiversity is essential to sustainable agriculture without which the people of Africa cannot survive. Plant breeders need biodiversity as a basis for the creation of new, richer, high yielding, better adapted and more disease resistant varieties of crops and useful plants. While allowing for improvement of existing varieties of crops and livestock as well as developing new ones, biodiversity provides a wide range recreational uses.

Yet catastrophic loss of these rich species diversity is in alarming rate in Africa particularly in tropical Africa. Mayhew (2009) opined that since the beginning of 1980s, there has occurred extensive deforestation, increasing atmospheric $CO_2$ concentration, etc which suggests that the ecological crisis was no longer just a hypothesis but in fact, a reality. It has been indicated (UNEP, 2015) that species are becoming extinct and species are heading towards extinction at a rate of about one every 20 minutes; one figure frequently cited is that rapid loss of species today is estimated to be between 1000 and 10000 times higher than the natural extinction rate. This process of genetic erosion is likely to continue at an even greater speed in the future. Ayensu (1981) observed that apart from Zaire, where the population pressure on the forests is slight, and Gabon where extensive oil, manganese and uranium deposits present little incentive to forest exploitation, much of Africa's forest diversity may have even been destroyed forever. Mayhew (2009) further observed that as a result of ecological crisis – this state of human – induced ecological disorder could lead to the destruction of planet Earth's ecosystem to the extent that human life will at least be seriously impaired for generations, if not completely destroyed.

**Causes of Biodiversity Loss**

Several reasons are advanced for the loss of biodiversity which according to UNEP (2015) include:

1. **Habitat loss and destruction:** This is one of the greatest threats to biodiversity. Habitat loss is directly linked to human induced pressures on land, for instance, where land is scarce, over cultivation involving mixed cropping or continuous cropping is adopted. Any of these cropping patterns involves land clearing that leads to destruction of ecosystem and loss of biodiversity. Sometimes where bush burning is adopted because of lack of labour, the heated surface layer of soil is denied the required moisture content, organic matter, and soil microorganisms that facilitate soil fertility. Apart from loss of habitat of some organisms, over cultivation of land using fertilizers and herbicides is stressful.
2. **Alterations in Ecosystem Composition:** Assemblages of species and their interactions with their ecosystems is critical for not only saving the species, but also for their successful future evolution. In the event of alterations, either within species groups or within the environment, the entire ecosystems can begin to change. Alterations to ecosystems are a critical factor contributing to species and habitat loss.
3. **Invasive Alien Species:** The introduction of exotic species that replace local and native species is cited as the second largest cause of biodiversity loss. Alien invasive species replace, and often result in the extinction of native species. The annual economic damage caused by invasive plant and animal species is estimated to be in the region of $1.4 trillion.
4. **Over-Exploitation:** Over-hunting, over-fishing, over-grazing or over-collecting of a species can quickly lead to its decline. Changing consumption patterns of humans for example is often cited as the key reason for this unsustainable exploitation of natural resources.
5. **Pollutants and Contamination:** Ecosystems are polluted with variety of pollutants such as refuse, fertilizers, herbicides, chemicals etc. Biological systems respond slowly to changes in their surrounding environment. Pollution and contamination cause irreversible damage to species.
6. **Global Climate Change:** Climate variability and climate change due to felling of trees not only expose soil to erosion and desertification but also decrease the carbon dioxide content of the atmospheres; which cause biodiversity loss. Species and populations may be lost permanently if they are not provided with enough time to adapt to changing climatic conditions.

In addition to the above, Okigbo (1993) stated that non-agricultural side effects of modernization also contribute to biodiversity loss. These include population growth and its increased pressure on resources, disruption of ecosystem by constructions particularly multipurpose dams, the high priority given to industrialization, mining practices, war and civil strife. Natural factors such as insect pests, fires, flooding, earthquakes etc. also lead to biodiversity loss to a certain extent.

**Implications of Biodiversity Loss**

Adams (1992) citing Palumbi (2001) pointed out that rising human demands on the biosphere involving continuous annexation of biological processes to attempt to improve productivity has had adverse impacts on biodiversity, while at the same time creating evolutionary trajectories in the species.

A severe scarcity of biodiversity particularly of forest resources from which these natural resources are derived will have important consequences considering the recent available information on it. UNEP (2015) indicated that species are becoming extinct at the fastest rate known in geological history and most of these extinctions are tied to human activity. According to the source, some conservation organizations estimate species are heading towards extinction at a rate of about one every 20 minutes; experts calculate that between 0.01 and 0.1 percent of all species will continue to become extinct each year, if we carry on with business as usual. According to International Union for Conservation of Nature (2009), of the 47,677 species assessed, 17,291 are deemed to be at serious risk; the list reveals that 21 percent of all known mammals, 30 percent of amphibians, 12 percent of birds, 28 percent of reptiles, 37 percent of fresh water fishes, 70% of plants and 35 percent of invertebrates are under threat.

Deforestation of tropical forests is almost 1 percent annually (UNEP, 2002).This rate of deforestation going on in the African forests may result in their total elimination. Deforestation exposes the top soil to forces of wind or rain which results in erosion or leaching of the soil, and there will be poor nutrients to support plant life. Threatened water fishes also imply fewer fish in the sea. Many scientists contend that ecosystems undergo an irreversible collapse when a certain 'threshold' of damage is reached (Tobey, 1996). In the long term, biodiversity loss results in fewer opportunities for livelihoods and less income, better health, education, and better life for the poor in the society that depend solely on biodiversity for survival. So already beset with food crisis, continued loss of biodiversity in Africa will further threaten nutritional well-being, political stability and availability of raw materials for industries such as medicinal plants in the continent.

**Concept of Sustainability**

Sustainability is the study of how natural systems function, remain diverse and produce everything it needs for the ecology to remain in balance; it takes into account how we might live in harmony with the natural world around us, protecting it from damage and destruction (Environmental Science, 2015). The global concept

of sustainability is articulated in the Bruntland Report (WCED, 1987) and Agenda 21 of the UN conference on Environment and Development in 1992. The Brutland Commission defined "sustainable development as development that meets the needs of the present without compromising the ability of future needs". Dzidonu (2010) related environmental sustainability to a pattern of resource use that aims to meet human needs while preserving the environment so that these needs can be met not only in the present but also for future generation. Sustainable development is a process that envisions a desirable future state for human societies in which living conditions and resource-use continue to meet human needs without undermining the "integrity, stability and beauty" of the natural biotic system (Sachs, 2015). The concept emerged in response to a growing realization of the need to balance economic and social progress with concern for the environment and the stewardship of natural resources which James *et al*. (2015) agreed was the practical consideration for everyone concerned about sustainable development. Sustainable socio-economic growth relates to finding the right balance, ensuring we can continue to improve the quality of life of all citizens without harming our environment.

According to International Sustainable Report (2011-2012), an unsustainable situation occurs when natural capital (the sum total of nature's resources) is used up faster than it can be replenished. As it is estimated that we use about 40% more resources every year than we can put back, the situation needs to change; efforts have to be made to find lasting solutions to this unsustainable living. Strategies for promoting sustainability of biodiversity in Africa can be achieved through Environmental Education and the use of incentives.

**Environmental Education**

In addition to calling for the conservation of biodiversity for the sustainable use of its components and the fair and equitable sharing of the benefits arising from the utilization of genetic resources by Agenda 21, the role of education in pursuing the kind of development that would respect and nurture the environment was also emphasized. It focused on the process of orienting and reorienting education in order to foster values and attitudes of respect for the environment and envisaged ways and means of doing so. Chapter 36 of Agenda 21 emphasized that education is critical for promoting sustainable development and improving the capacity of the people to address environmental and developmental issues. Furthermore, Onaolapo (2016) citing Nwaebuni (2015) observed that in September 2015, the 193 global leaders agreed on a new agenda for United Nations eight Millennium Development Goals (MDGs) launched in 2000 which was code-named Sustainable Development Goals (SDGs). This pronouncement is a 17-point agenda, expected to serve as catalyst to government of the world and key stakeholders to embark on a 15-year development marathon race to destination 2030 starting by January 2016. The SDGs are also crafted to balance the three crucial dimension of human existence namely: the economic, the social and the environment. The fourth goal of SDG is centred on quality education. This goal and that of Agenda 21bring into focus the importance of environmental education in tackling environmental issues such as rapid global biodiversity loss particularly in the tropics.

Environmental Education (EE) is a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, 1977). Adeniyi (1999) also defines EE as a form of education that plays a key role in promoting the development of values, attitudes, and belief that are conducive to the enhancement of the quality of environment.

Therefore the components of EE are:

- awareness and sensitivity to the environment and environmental challenges;
- knowledge and understanding of the environment and environmental challenges;
- attitudes of concern for the environment and motivation to improve or maintain environmental quality;
- skills to identify and help resolve environmental challenges; and
- participation in activities that lead to the resolution of environmental challenges (UNESCO, 1978).

Shenpam (2005) citing Obi (1993) stated that among formal objectives of EE are the desires to:

1. enlighten the citizenry on the components of the environment;
2. inform about our dependence on environmental resources;
3. enlighten about the change that have taken place in the environment over the years;
4. create concern for environmental quality and conservation as well as foster understanding of man's relationship and interactions with the ecosphere;
5. alert about the consequences of human actions on the environment including their toll on other forms of life;
6. develop personal, community and national sanitation and conservation ethics that will emphasize caring for nature;
7. kindle a sense of responsibility that will motivate the ordinary citizen to seek and acquire more knowledge about the environment and its problems, and propagate such knowledge to others in the community; and
8. awaken appreciation of the aesthetic quality of nature in order to encourage its use for recreation.

The objectives as stated above provide the framework for selecting and organizing EE themes, concepts, ideas and skills such as biodiversity in both formal and non-formal environmental pedagogical approach that are capable of bringing about the achievement of EE goals and resolution of the problems affecting the environment.

Aspect of the objective such as conservation (in this case of biodiversity) can be achieved through formal training programs which can be carried out in two areas. The first should aim at training of biologists especially in the area of ecology, taxonomists and genetics, to mention but a few. Indigenous tropical biologists will reduce the situation where there are more taxonomists on African plants and animals outside than inside Africa. The tertiary institutions such as universities and governmental organizations should assist in any training programs through support for B.Sc., M.Sc., and Ph.D. courses. International Research Organizations such as UNESCO have been making efforts in the promotion of research and training in biological fields which are of importance to the African countries (Tobey, 1996).

The second training effort should focus on germ plasm conservation. This involves using seed to conserve the resources of tropical trees. First, large number can be obtained; secondly, spare seeds can be stored and thirdly, variation is retained in succeeding generations. Though Hanson (1995) observed that many diverse tasks are involved in conserving germ plasm in the best possible way, it is necessary to safeguard the supply of seeds of desirable genetic quality for future use.

Kola-Olusanya (2000) opined that EE at all levels for all people is crucial; the more the knowledge the public has about the environment, the better, the more and the more effective decision makers can be, and will be; furthermore it is the cornerstone of long-term environment strategies for prevailing environmental problems, solving those which arise or have occurred and assuring environmentally sound, sustainable development.

**The Use of Incentives for Sustainability of Biodiversity**

The second strategy for promoting biodiversity is by the use of incentives. Tobey (1996) suggested that use of economic incentive and the measures can be directed at three main target groups. The first are people whose behaviour enhances biodiversity-related goods and services and tend to bear the cost of conservation, such as farmers and other land owners. The second are people who benefit directly from biodiversity – related goods and services and who attach significant value to biodiversity such as people who enjoy the natural landscape or diversity in farm product. The third are people whose behaviour diminish or harm biodiversity-related goods and services such as urban developers or the operators of industrial plant.

Groups or individuals who damage biological resources as the third group should pay the cost of preventing and repairing the damage. Likewise, the users such as the second group should pay for the benefits they receive from biodiversity – derived goods and services. Both could be seen as maintenance cost. On the other hand, compensation should be paid to farmers and other land owners/first group from the revenues generated from the maintenance charges for additional costs associated with the delivery of biodiversity. This can be regarded as payments to providers of biodiversity. Such compensation should include making the current booming informal market in the developing African countries which has evolved but lacking the replanting mechanism, sustainable. This can be made sustainable by developing a bigger market in wood which would encourage people with land to cultivate trees as a cash crop. As observed by Wright and Nebel (2004), when have to pay for fuel wood, trees become an important resource that can be put under the stewardship of local communities or private landowners, and a sustainable use of forests can result. Then all of the other benefits of goods and services provided by forests are preserved and restored. Tobey (1996) ascertained that in Sweden, farmers are compensated for maintaining traditional farming practices that sustain and improve the biodiversity of their country.

## II. Conclusions And Recommendations

The environmental side effects of anthropogenic activities are numerous and include biodiversity loss. Biologically, one of the consequences of continued loss of biodiversity in tropical Africa is the rapid rate of erosion of the rich and varied resources of species which have evolved over the years and if time is not taken, may lead to their extinction. These abundant biodiversity should not be allowed to go into extinction and hence the different strategies as discussed – Environmental Education, and the use of incentives should be utilized to prevent it. To this end, it is recommended that:

1. The Environmental Education include both formal and informal education to focus on training of specialized students such as biologists especially in the areas of Ecology, Taxonomy, Genetics, etc that will assist in the conservation of the biodiversity gene plant and awareness campaigns to promote it.
2. A well-monitored poverty alleviation programme should be set up in the African countries concerned to reduce the level of dependence on their immediate natural environment for survival.
3. A bigger market in wood should be developed in these countries to encourage both planned afforestation and deforestation.

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