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Michael A. Nwachukwu

Environmental Education & Awareness Manual

With Wall Chart

General Knowledge about Environmental Education and Sustainability

LAP LAMBERT Academic Publishing

This manual put together all earth environmental issues and challenges, making environmental education easy to all people. Global awareness of natural resources conservation, environmental protection and sustainability is obvious. The UN programs to minimize degradation of the earth environments have made initial impact on member nations lacking environmental education. This manual and its wall chart will make grass-root impact in these regions because they contain every bit of environmental - sustainability information to make students and the public environmentally responsible. Some of UN agencies and their roles known to privileged few and important test questions are contained in this manual, making it a treasure for all. The author who was endemic to malaria cum typhoid at frequency of one every three months spent six years in the USA without having a fever for one day. This he attributed to the great difference in environmental quality between Nigeria and USA and concluded that *Environment is Life'*. He pledged to spend the rest of his life addressing issues that will improve environmental quality in Africa, which this manual and its wall chart is projecting.

Huan Feng, Ph.D.
Professor, *Department of Earth and Environmental Studies,*
College of Science and Mathematics, Montclair State University
Montclair, New Jersey U.S.A.

Dr. M. A. Nwachukwu is a Geoscientist/Environmentalist, a lecturer at Federal University of Technology Owerri Nigeria. He obtained a Ph.D degree in Environmental Management from Montclair State University U.S.A. Per his excellence, he advocates for more consolidated programs in environmental education to improve environmental quality world wide.

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Michael A. Nwachukwu

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Brief Contents

Photographs

Figures

Table

Preface

Environmental education and public awareness towards sustainable development are linked to virtually all areas in Agenda 21 of the United Nations. Positive and negative transitions of development around the world call for global implementation of environmental education in schools to save our planet earth from increasing degradation. Lack of environmental education in schools is significant to poor knowledge of both regional and global environmental issues by school levers in many developing countries. This is identified to have some negative impact on the students that gain access to read environmental education in higher institutions. The absence of environmental education in some countries is responsible for the poor environmental quality in homes in those countries. This general observation is critical to making this manual and its wall chart version.

This manual and its wall chart will provide environmental knowledge to be acquired in the classroom and public places, encouraging students and parents to bring environmental education into their homes. Thirty environmental issues and ten sustainability keywords presented in the wall chart are discussed in this manual in simple English, making the manual a treasure for all to read and understand. Few of these environmental issues are socio-environmental challenges, few are of natural effects and many are due to human activities. Many of these issues are global ones while few are regional challenges facing humanity on earth. Human activities such as inequitable and unsustainable production and consumption of earth resources cause most of these *environmental problems*. The wall chart will be displayed at public places such as schools, hotels, libraries, banks, hospitals, airports, rail stations and offices, as a practical tool for environmental education to the public. The thirty issues presented in this manual have caused environmental degradation which threatens the earth by changing its natural landscape, reducing its resources, and decreasing its competence to serve our future generations.

A general knowledge of the earth environmental problems, their effects and applicable solutions summarized in this manual are vital to all people across the nations. It is in doubt if the earth will be livable at the end of this 21st century if awareness of the environmental problems identified is not created with control measures justified. This manual and its wall chart (100 x 120 cm) provide the basic material for environmental education in Nigeria and other African countries.

Chapter 9 highlights selected UN programs directed to address challenges related to environmental degradation and sustainable development. Chapter 10 completes the book with 50 environmental test questions.

These two teaching materials will be useful for a one semester mandatory environmental education course proposed for all students of higher institutions in Africa. No excuse is justified to deny delivering this important knowledge to students from K6 to K12 in this 21st century. In the presence of inadequate well trained environmental teachers as in many African countries, science and social science teachers could teach the students using this manual and its wall chart. This book is also designed to enable teachers introduce environmental science in a wider scope. It is helpful in subject areas like: Land degradation and planning; Environmental geology; Geo-environmental hazards; Pollution (air, soil and water); Waste management; Environmental Sociology and Sustainability studies. The manual and its wall chart satisfy the definition of environmental education as early education, education for all and for sustainable development. The two materials present innovation in the way education is often practiced today.

Help Me Improve This Book

Let me know how you think this book and its wall chart could be improved. If you find any errors, bias or confusing explanations, please e-mail them to me at:

Futo.essg@hotmail.com

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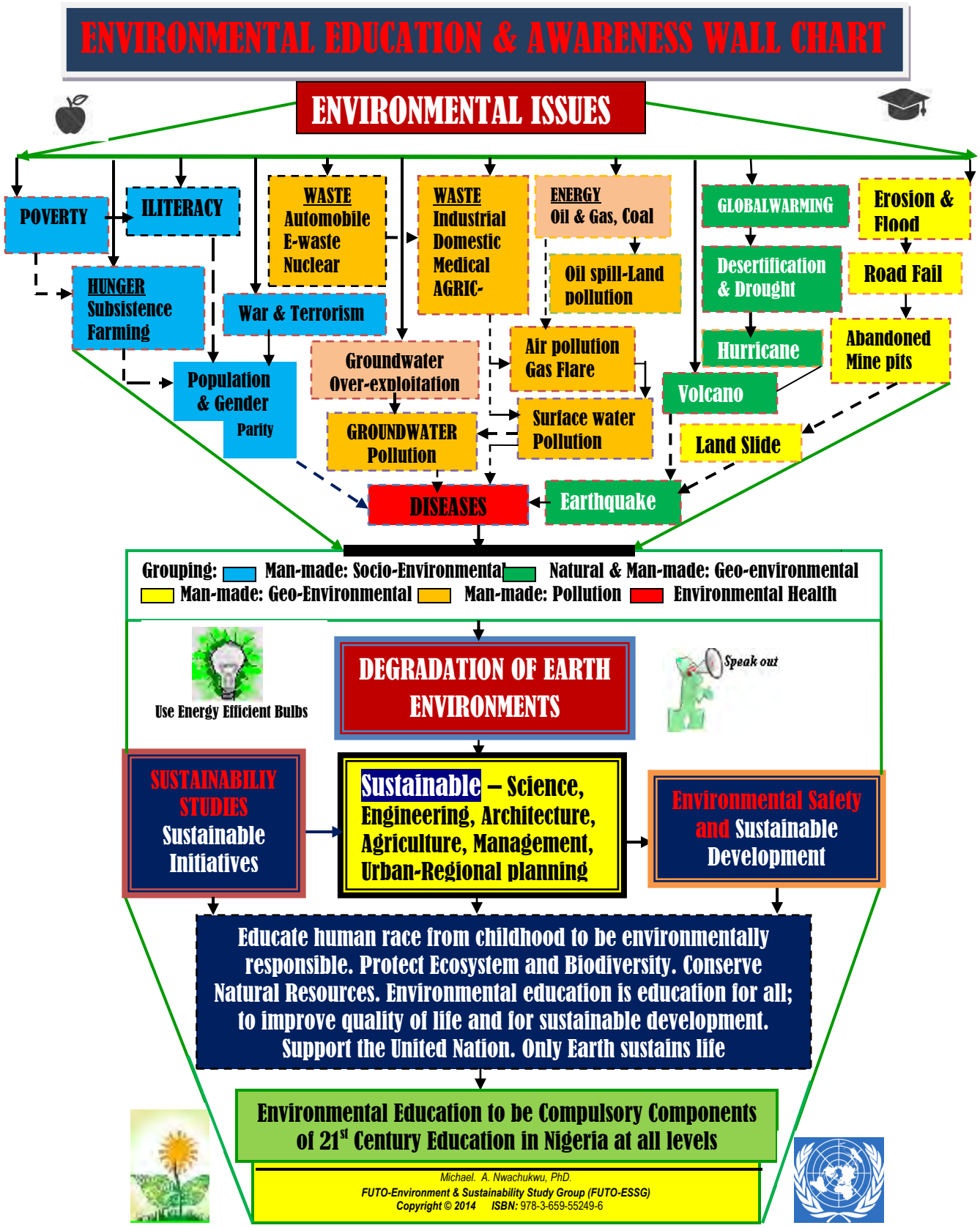
Acknowledgement

The author is grateful to members of the Federal University of Technology Owerri-Environment and Sustainability Study Group (FUTO-ESSG) and to the 2013/2014 Post-graduate diploma students many of who are teachers, for their assistance. The author is grateful to the following facilitators: Mr. Peter Celestine Itubochi, the General Secretary of Science Teachers Association of Nigeria; Mr. Godwin Urueme; former Director in the Imo state Universal Basic Education Board, for all your assistance in promoting this manual and its wall chart. The assistance of my wife Mrs. Ijeoma M. Nwachukwu who is my nearest research associate is deeply appreciated. The contribution of my other research associates such as Dr. J. I. Alinnor is similarly appreciated. The assistance of staff of GEOPROBE Int'l Consultants Ltd Owerri in making the wall chart is much appreciated. I am grateful to Professor Huan Feng for writing the Foreword. Thanks to Sophie Scampbel- the acquisition editor who worked relentlessly within a short period to achieve publication of this important book. I remain grateful to Dr. A. P. Uzoije for his wonderful role in the final review process of this book. I thank all of you.

I sincerely dedicate this book and its wall chart to humanity; those concerned with sustainable development of the planet earth.


ENVIRONMENTAL EDUCATION & AWARENESS WALL CHART
ENVIRONMENTAL ISSUES
POVERTY
ILITERACY
WASTE Automobile E-waste Nuclear
WASTE Industrial Domestic Medical AGRIC-
ENERGY Oil & Gas, Coal
GLOBALWARMING
Erosion & Flood
HUNGER Subsistence Farming
War & Terrorism
Oil spill-Land pollution
Desertification & Drought
Road Fail
Hurricane
Abandoned Mine pits
Air pollution Gas Flare
Groundwater Over-exploitation
Population & Gender Parity
Volcano
Surface water Pollution
GROUNDWATER Pollution
Land Slide
DISEASES
Earthquake
Grouping: Man-made: Socio-Environmental Natural & Man-made: Geo-environmental
Man-made: Geo-Environmental Man-made: Pollution Environmental Health
Use Energy Efficient Bulbs
DEGRADATION OF EARTH ENVIRONMENTS
Speak out
SUSTAINABILIY STUDIES Sustainable Initiatives
Sustainable – Science, Engineering, Architecture, Agriculture, Management, Urban-Regional planning
Environmental Safety and Sustainable Development
Educate human race from childhood to be environmentally responsible. Protect Ecosystem and Biodiversity. Conserve Natural Resources. Environmental education is education for all; to improve quality of life and for sustainable development. Support the United Nation. Only Earth sustains life
Environmental Education to be Compulsory Components of 21st Century Education in Nigeria at all levels
Michael. A. Nwachukwu, PhD.
FUTO-Environment & Sustainability Study Group (FUTO-ESSG)
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1. Introduction

Definition of Environmental Education and Awareness

Environmental Education promotes environmental literacy and develops the skills needed to be environmentally responsible. Environmental Education refers to education efforts that increase public awareness, concern, and knowledge about environmental issues and provides the critical thinking, problem-solving and decision-making skills needed to make responsible decisions about the environment. In secondary school, environmental education should be a focused subject within the sciences. At the undergraduate and graduate level, it can be considered its own field within education, environmental studies, environmental science and engineering. Environmental education is not restricted to in-class lesson plans. There are many ways children can learn about the environment in which they live. From lessons in the school to reading environmental posters and wall charts, and taking field trips to national parks, as well as participating in school wide sustainability projects. Environmental education is a subject which is readily and easily accessible. This manual and its wall chart have been identified as effective environmental education teaching tools. It is important to adopt sustainable practices in the classroom and public places and encourage students and parents to bring environmental education into their homes.

A population concerned with earth environmental problems, which has the knowledge and commitment to solving the problems and preventing new ones is well educated. Environmental education can be acquired under different names depends on which name the teacher prefers. Names like *Environmental science, Environmental studies, and Environmental management* at advance level, are commonly used. Occasionally, names such as Environmental engineering and Environmental technology are also adopted. Environmental education cuts across all branches of natural and applied sciences. Social science and engineering also have stake in environmental education. Several definitions have been recorded about environmental education. As far back as 1969, Dr. William B. Sharp and others, presented environmental education as a subject aimed at producing a citizenry that is knowledgeable about the biophysical environment and its associated problems. Such citizens will be motivated to help in providing solution to the environmental problems.

Environmental education stakeholders in Alberta Canada defined environmental education as –Education that helps children and adults develop knowledge, values, skill and behaviors that help them meet present-day needs without compromising the well-being of future generations". Their definition saw environmental education as

education for sustainable development. In their second definition, they saw environmental education as learning that:

- Increases peoples‘ knowledge and awareness about the environment and associated challenges;
- Develops the necessary skills and expertise to address these challenges, including critical thinking skills; and
- Fosters attitudes, motivation, and commitment to make informed decisions and take responsible action about the environment”

Stockholm Declaration of the United Nations Conference (1972) on the Human Environment described environmental education as organized efforts to teach about how natural environments function. How human beings can manage their behavior and ecosystems to live sustainably. At this conference, it was declared that environmental education must be used as a tool to address global environmental problems. The terms "sustainability" burst into the environmental literature in the 1980s as people became aware of the global problem of overpopulation. Since then, sustainability has become the golden tool of environmental management. Sustainability issues are largely concerned with how to preserve the earth environments and conserve its resources for future generations. Sustainable living and development therefore has emerged as a global watch word, and the target of this generation. To achieve this goal in the 21st century motivated the making of this wall chart and it‘s manual.

Global State of Environmental Education and Sustainability

In his recent systematic studies of the environmental movement in Ghana, Osuteye (2013) revealed a clear disconnection between environmentally focused civil society organizations and local academia. This disconnection has implications on both the study of the social dimension of environmental issues and sustainability, and the lack of academic literature on the subjects. He maintained that bridging this gap has potential benefits for both civil society and the development of environmental study that could bring sustainable development.

World Association of University Presidents or Vice Chancellors report and declaration at an international conference in Talloires, France (1990) associated university leaders with sustainable future. Therefore, universities bear great responsibilities to increase the awareness, knowledge, technologies, and tools to create an environmentally sustainable future. This is the first official statement made by university presidents, chancellors, and rectors, for a commitment to environmental sustainability in higher education. The Talloires Declaration (TD) is a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research

and outreach in colleges and universities. It has been signed by over 400 university leaders in more than 50 countries.

Shevgaonkar (2011) could not hesitate to respond to the decision reached by India government that environmental science will be a mandatory subject at graduation level in all Indian universities. He stated there was an immediate need to spread awareness about environmental conservation. He continued –There is a clear lack of awareness among students about the issues that we are facing today; issues of climate change and depletion of natural resources and its effects on the human life are important. According to *El-Ahraf* (1981) universities can contribute to environmental education by addressing theoretical considerations and by developing practical applications. This wall chart produced is a considerable practical model for the teaching of environmental education in line with *El-Ahraf's philosophy*.

A recent survey by Wambua (2012) revealed that there are no adequate resources for teaching environmental education in the four Kenya primary teacher colleges sampled. Most of the tutors were not even aware of what environmental education was all about. Consequently, field studies were not being effectively used and hence it could be concluded that environmental education has not properly taken off in Primary Teachers Colleges in Kenya. This study can be generalized to say that other thirteen Teachers Colleges not covered have not started environmental education.

According to Alnewashi (2003), formal educators and awareness program leaders in developing countries require more educational resources and environmental education training programs. This wall chart and its manual comply with this requirement of educating the educators, teachers, government officials, program leaders and the public. A recent survey conducted by Turan (2014) on the views of prospective primary school teachers regarding environmental education in Turkey revealed greater need of visual teaching aids. According to Turan, these teaching aids could be computer assisted wall charts and posters projected to the wall or printed, placed on the wall.

Gitile Naituli of Multimedia University in Kenya talked about Mainstreaming Environment and Sustainability into African (MESA) universities. He stressed the need to set up lateral links with secondary and primary schools for greater impact. Today, only South Africa can be assessed with such links and early commitment to environment and sustainability studies. MESA universities partnership suggested the re-orientation of African universities. According to him, this will enable them respond more effectively to equity, poverty alleviation and environmental degradation. This process would require the creative effort of African intellectuals. This wall chart and its manual are examples of such creative effort.

Review of environmental education surveys in Nigeria such as that conducted by Akinnuoye and Abd Rahim (2011), Akomolafe (2011) and recent studies revealed that more than 70% of the schools in Nigeria do not have any environmental education teaching materials. Neither of the schools have any form of environmental education books, wall chart or posters particularly the government schools. In Nigeria, facilities and resource-persons to teach environmental education are respectively inadequate and not up-to-task. Most government schools visited in the eastern Nigeria declined teaching environmental education as a subject. Information obtained from these schools reveal that some environmental education topics are found in geography, biology and chemistry subjects which the teachers may skip.

Environment and sustainability study group of the Federal University of Technology Owerri, Nigeria usually interview fresh students about their knowledge of environmental education during orientation. Revelation from the interview is that teachers usually skip the environmental education topics to the disadvantage of the students. Teachers interviewed attributed the difficulty in teaching the environmental topics and implementing environmental education to lack of books and absence of the subject in the school curriculum. The non inclusion of environmental education in the West African Exam Council (WAEC) and General Certificate of Education (GCE) Exams, as well as total lack of teaching materials and trained teachers contributed to the difficulty.

The state education ministries agreed that there are major problems in implementing environmental education program in Nigeria particularly the lack of inspiring materials and qualified teachers. On this note therefore effort is made in this manual to put in the hands of teachers, a book that has simplified environmental education and will make the teaching of environmental education come alive in schools. Personal environmental awareness, knowledge and attitude were identified as key factors affecting environmental knowledge and practice between the schools and the society. Experience and qualification affected the opinions of teachers on the infusion of environmental education in Nigerian school curriculum.

A survey of the availability of wall charts and adequate environmental education teaching books in schools in different parts of Nigeria brought negative result. This revelation specifically motivated the making of this wall chart and it‘s manual. It is important that a holistic approach be used to start teaching environmental education in colleges, secondary and primary schools in Nigeria. Similar approach is due for informal environmental education of the public due to their early denial of this aspect of knowledge. Its content should not only reflect the immediate challenges of regional environment, but a broad view of global environmental issues, with emphasis on sustainability. It is on this dual purpose that this wall chart and its manual will excel.

2.0 How to use this Manual and the Wall Chart

In public places: Hung the wall chart on the wall where it will be conspicuous with proper illumination. Preserve the manual in a closet as a reference material that can be provided on demand. In the case of offices and public libraries, place the manual on a stool or a table beside the wall chart.

In Primary schools: Environmental education shall be a subject for primary grade five or six. The wall chart shall be displayed at appropriate wall location in each classroom of the concerned grade. Each classroom of the concerned grade shall have the manual preserved by the teacher. The teacher will read the manual and become familiar with the various environmental issues identified. The teacher shall introduce two of the environmental issues each week, projecting the concept of sustainable development. References should be made to global changes such as increasing population and global warming. It is expected that the teacher will explain important keywords such as domestic waste management; proper disposal of human and animal wastes, waste sorting at homes and the health effects of waste picking at dump sites by scavengers. At this level, the children will be well informed about materials for recycling and the importance. Primary school levers must know about climate change, environmental degradation and conservation of natural resources for sustainability. Teachers are encouraged to compose recitations or poems to improve perception of earth environmental degradation by the pupils. Sample poems and recitations are provided in this manual.

In Secondary schools: Teachers of Environmental Science, Geography and other science teachers can teach environmental education as Environmental studies, Environmental education or as Environmental science. This subject shall be taught in junior secondary or middle school and continued in senior secondary as a subject of its own even now, to prepare for its inclusion in the West African School Certificate and GCE examinations. There is no doubt about including environmental education in all school certificate examinations very soon. Preparation and commencement of teaching is very important prior to enlisting the subject in the certificate examinations. Already, a number of schools including private schools across the country have commenced teaching of environmental education in readiness for its inclusion in the certificate examinations.

At junior secondary, the teacher will endeavor to give simplified notes to the students per topic, based on the content of this manual. The teacher prepares short explanatory notes for each of the environmental issues presented.

At senior secondary, each student opting for environmental education is required to have a copy of this manual. The teacher similarly, will prepare explanatory notes with local examples, and add vital keywords such as *Sustainability and Sustainable Development.* Students will be given additional notes with local case examples to explain *Ecosystem, Biodiversity protection and Conservation of natural resources.* All discussions and notes will be prepared to capture the concept of sustainability and sustainable development as presented in this manual. At this level, the teacher will explain to students the concepts of sustainability studies with respect to: *Science, Engineering, Architecture, Agriculture, Management and Urban and Regional planning as contained in this manual.* Teachers are encouraged to organize field trips or excursions to selected sites including recycling plants, waste dumps, erosion sites, abandoned mine pits, oil spill, gas flaring and degraded waterways. Students will learn about waste management options such as the use of engineered sanitary landfill as against open waste dumping currently practiced in many developing countries. Students should be informed about environmental pollution and public health effects of open waste dumping including littering of animal and human wastes.

Recyclable materials such as used engine oil, paper, plastics, bottles and recycling methods will be emphasized. Environmental hazards and public health effects associated with burning of fossil fuel in automobile engines and electric generators will be discussed. Environmental health hazards associated with electrical and electronic wastes (E-wastes) and surface dropping of cattle and human waste will be discussed. Emphasis will be placed on the environmental consequences of continuous emission of green house gases such as Chlorofluorocarbons (CFCs), Carbon dioxide (CO_2), Sulfur oxide (SO_2), Nitrogen oxide (NO_2) and Methane (CH_4). The 50 test questions provided in the last chapter can be used in the continuous assessment.

In Higher institutions: The wall chart speaks for itself when strategically displayed in lecture theatres, hostels, offices, laboratories, studios and campus restaurants. Most people here will appreciate and understand the wall chart even without using the manual. Here the wall chart/manual will be useful to all students taking the proposed mandatory 200 level environmental education and awareness course in universities, polytechnics and colleges in Africa, as practiced in other regions world wide. The manual provides the fundamental knowledge in the following subject areas: **Socio-Environmental Studies *Geo-Environmental Hazards*Pollution (Air, Water, Soil) *Environmental Geology *Waste Management *Ecosystem/Biodiversity and *Sustainability.*

Sample Poems - Recitations of Environmental Awareness K-6 to K-12

(a) Planet Earth-Planet Earth
The only planet of life
Why under destruction?
By unending human activities
We rise against your destruction
For interest of future generations
Who wish to see your beauty and
Enjoy your abundant air of life
Enjoy your abundant water of life
Enjoy your abundant land
Enjoy your abundant vegetation
Enjoy your abundant mineral deposits
We must preserve your beautiful environment
We love you Planet Earth.

(b) Planet Earth, you are the greatest
Because you house man and all animals
You are the strongest planet
Because you withstand all human activities
You are the only livable and comfortable planet
Because of your abundant Air, Water and Land
You are the richest
Because of your abundant mineral resources
Diamond, Gold, Silver, Iron, Aluminum, Zinc,
Copper, Sand, Uranium, Chromium, Nickel
Potassium, Manganese, Magnesium, Calcite,
Fluorite; A total of about 2720 different minerals
In addition to fuel minerals; Coal, Oil and Gas
Planet Earth what consumption rate per generation
do you approve of your resources?
Take ≤ 1%
Woo! We have exceeded by about 25%
We are sorry Planet Earth
Pardon us, while we reduce and conserve.

(c) Do you know about Global Change?

Yes, Planet Earth system comprising the land, oceans, climate, poles, human population and biodiversity, natural cycles and resources, earth processes and human society all face large-scale changes, affecting one another.

Do you know earth temperature is changing?

Yes, earth temperature is rising, known as global warming at as much as $0.76^{o}C$ between 1850 and 2005.

Do you know about desert encroachments in Nigeria?

Yes Northern Nigeria stands to be wiped off, due to encroachment of the Sahara desert. The country is presently losing about 350,000 square meters of its land mass to desert encroachment, which is advancing southwardly at an estimated rate of 0.6 kilometers a year.

Does it mean that Sokoto, Kebbi, Jigawa, Katsina, and Zamfara states are in danger?

Yes, but Borno, Yobe, Kano, Adamawa, Gombe and Bauchi are not left out. These states may be wiped off in no distant time if adequate control measure is not put in place. *You don't mean it!* Watch out for the next 100 years.

Do you also know about Gully Erosion?

Research has confirmed over 65% of soil on earth has displayed degradation phenomena as a result of soil erosion. Most states in Nigeria have one form of erosion or the other. The states in the southeast namely Imo, Abia and Anambra are most devastated by gully erosion. Greater of arable land in these states may be wiped off in no distant time if adequate control measure is not put in place. *Don't tell me this!* Watch out for the next 100 years.

Do you know about Sea level rising?

Yes, it is the outcome of ice melt in the polar region due to global warming. Global sea level has raised along our coastline about 7 inches (17.8 cm) during the 20th century, and recent satellite data shows that the rate of sea-level rise is accelerating. If allowed, places like Victoria Island, parts of lower Niger delta small and mega islands all over the world may be submerged. *Woo oh!*

What then do we do to save our country and the planet earth?

Control all vices of environmental degradation

Provide environmental education and awareness to policy makers, law makers and the public. Teach environmental education in primary, secondary and in tertiary institutions. Study environmental management; insist on sustainable development programs and initiatives.

3.0 Structure of the Wall Chart and Manual

Environmental Issues: A total of thirty environmental issues and ten sustainability keywords listed in the wall chart are briefly discussed in this manual. A wall chart is a type of large poster often displaying information for educational use or entertainment. This chart measuring 100 x 120 cm is the first of its type practical guide to environmental education. It will be displayed at public places such as schools, libraries, hotels, hospitals, airports, rail stations and offices. The wall chart and manual will be used for teaching environmental education. In writing this manual, effort was made to use simple and common terms that could be easily understood by the general public. Degradation associated with each environmental issue is briefly discussed. Environmental degradations so identified can be classified according to their primary causes as follows:

- Natural forces: *Earthquake, Hurricane and Volcano.*
- Combination of natural and human activity: *Global warming, desertification and drought.*
- Social forces: *Poverty, Illiteracy, Hunger, Population, Gender parity, War and Terrorism*
- Human activities: *All types of waste, Oil spill, Air pollution, Gas flaring, Energy, Abandoned mine pits, Land slide, Erosion and flood, Road failure, Surface and Groundwater pollution, Groundwater Over-exploitation and Diseases.*

Sustainability Issues: Sustainability keywords presented in the wall chart and discussed in the manual are: *Degradation, Sustainability studies, Sustainable initiatives, Sustainable development, Ecosystem, Biodiversity and Resources conservation.* Sustainability adaptations in the areas of Engineering, Management, Science, Agriculture, Urban and Regional planning and Architecture are briefly explained.

Many of the problems identified are related, and as such share the same mode of environmental degradation. The much related environmental issues are linked in the chart with broken line. The wall chart will be printed on heavy-duty flex with a large-format high-resolution color print**.** The final output is fantastic and attractive when displayed in public places. The author has the original copyright to mass produce and distribute the chart. Different grades of paper with or without cloth-baking are used in making wall charts used in lecture rooms and in public places but in this case, quality fabric is used to allow for durability and its flexibility.

All environmental and sustainability issues captured in the wall chart are explained in the manual, making the model a pleasure for all to read and understand. Citations made are presented at the end of the book as reference list.

Symbols on the Wall Chart

Apple: The apple became the symbol of education in the 1700s, when poor farming students rewarded their teachers with food in Denmark and Sweden. In Christian religious beliefs, Eve convinced Adam and both ate the forbidden apple to become as knowledgeable as God. As a result, the apple has become a symbol of knowledge. The ***Cap*** is a universal symbol of education fulfillment. The two symbols imply that environmental education provides the knowledge for education fulfillment. The glowing ***Electric bulb shaded with green leaves*** indicates energy efficiency or energy conservation. Reduce burning of fossil fuel; oil gas and coal, and insist on environmentally friendly energy sources. The cartoon of a ***Man carrying megaphone*** is in line with the global call to voice out environmental issues in all regions of the world. Alert the public about the degraded state of the earth environment. Public education concerning the impact of human activities on earth environment, its ecosystem and biodiversity need a holistic approach. Environmentally literate individuals or teachers may be equipped with megaphone like salesmen to infuse environmental education and awareness to the public in developing countries.

The ***green environment*** at the bottom left has the sun as the cleanest source of energy. The sun powers the water cycle that nourishes the earth vegetation, enables green environment, sustain biodiversity and ecosystem. *Solar radiation* and its resultant energy on the earth should remain at its natural equilibrium. Increased solar radiation on earth has caused gradual increases in earth temperature called global warming. ***The United Nations logo*** at the bottom right end of the wall chart is significant. The United Nations is at the forefront of planning and executing programs to save the planet earth by setting up over fifty agencies and programs across the world. Many of these agencies and programs are explained in chapter 6 of this manual. The manual is started with an *Introduction* containing worldwide public opinion that formed the bases and motivation to making the wall chart model. The last chapter of this book contains test questions; trial and general quiz totaling 50. The test questions are necessary in measuring individual knowledge and understanding of environmental education.

4.0 The Earth Environments

The goal of environmental education is to develop a world population that is aware of and concerned about the state of earth environments; the atmosphere, the water and the land (Figure 1), including plants, animals and all classes of organisms therein.

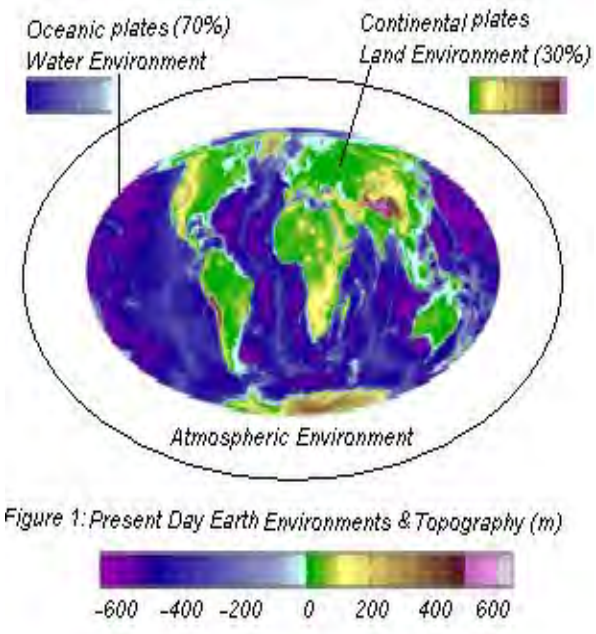


Figure 1: Present Day Earth Environments & Topography (m)

The Land: The land environment to different near surface depths is the area of most concern to environmentalists. This includes all the earth surface physical features; the ocean, vegetation, forests, mountains, valleys, hills, rivers, lakes and swamps. The land environment can be classified into three, based on predominant rock types as Sedimentary, Igneous and Metamorphic environments. In each of these environments can be found specific types of rock exposures called outcrops and characteristic vegetation. The most wide spread is the environment where sedimentary rocks are formed called the sedimentary environment. Every environment has a characteristic combination of internal and external geologic processes and circumstances.

Sedimentary environment

The setting in which a sedimentary rock forms is called the sedimentary environment. The type of sediment that is deposited is not only dependent on the material that is transported to a place, but also on the transport system and environment itself.

A sedimentary rock formed on the land has a continental sedimentary environment. Examples of continental environments are lagoons, lakes, swamps, floodplains and alluvial fans. In the quiet water of swamps, lakes and lagoons, fine sediment is deposited, mingled with organic material from dead plants and animals. In rivers, the energy of the water is much higher and the transported material consists of clastic sediment. Besides transport by water, sediment can in continental environments also be transported by wind or glaciers. Sediment transported by wind is called Aeolian and is always very fine and well sorted, while sediment transported by a glacier is called glacial till and is characterized by very poor sorting.

A marine environment means sea or ocean. Often, a distinction is made between deep and shallow marine environments. Deep marine usually refers to environments more than 200 m below the water surface. Shallow marine environments exist adjacent to coastlines and can extend out to the boundaries of the continental shelf. The water in such environments has a generally higher energy than that in deep marine environments, because of wave activity. This means coarser sediment particles can be transported and the deposited sediment can be coarser than in deep marine environments. Warm shallow marine environments also are ideal environments for coral reefs, where the sediment consists mainly of the calcareous skeletons of larger organisms.

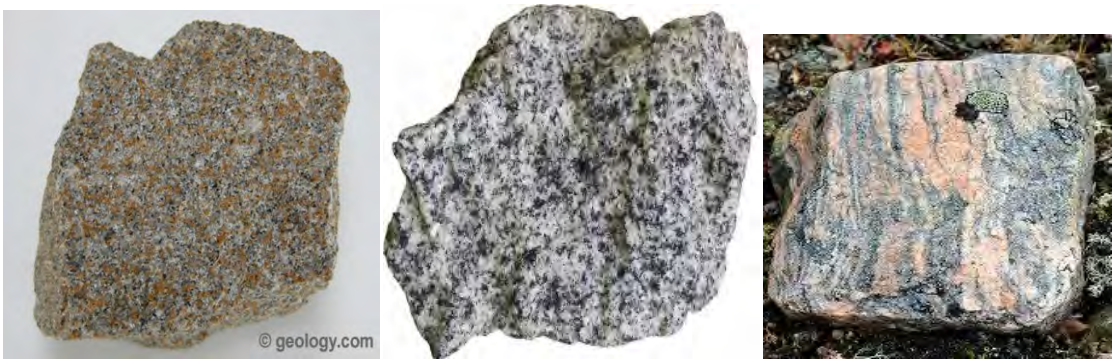
The coast is an environment dominated by wave action. At the beach, dominantly coarse sediment like sand or gravel is deposited, often mingled with shell fragments. Tidal flats and shoals are places that sometimes dry out because of the tide. They are often cross-cut by gullies, where the current is strong and the grain size of the deposited sediment is larger. Where along a coast (either the coast of a sea or a lake) rivers enter the body of water, deltas can form. These are large accumulations of sediment transported from the continent to places in front of the mouth of the river. Deltas are dominantly composed of clastic sediments. Sedimentary rocks can be subdivided into compositional groups based on their mineral composition: Sandstone is a clastic sedimentary rock composed mainly of sand-sized minerals or rock grains (Photo ia). It is a sedimentary rock formed by the consolidation and compaction of sand and held together by natural cement, such as silica, carbonate or iron.

Classification of sedimentary rocks:

- Siliciclastic sedimentary rocks, as described above, are dominantly composed of silicate minerals. The sediment that makes up these rocks was produced by weathering process and transported as bed load, suspended load, or sediment

gravity flows. Siliciclastic sedimentary rocks are subdivided into conglomerates and breccias, sandstone, and mudstone.

- Carbonate sedimentary rocks are composed of calcite (rhombohedral $CaCO_3$), aragonite (orthorhombic $CaCO_3$), dolomite [$CaMg(CO_3)2$], and other carbonate minerals based on the CO_{2-3} ion. Common examples include limestone and dolomite.
- Evaporite sedimentary rocks are composed of minerals formed from the evaporation of water. The most common evaporite minerals are carbonates (calcite and others based on CO_{2-3}), chlorides (halite and others built on Cl^-), and sulfates (gypsum and others built on SO_{2-4}). Evaporite rocks commonly include abundant halite (rock salt), gypsum, and anhydrite.
- Organic-rich sedimentary rocks have significant amounts of organic material, generally in excess of 3% total organic carbon. Common examples include coal, oil shale as well as source rocks for oil and natural gas.
- Siliceous sedimentary rocks are almost entirely composed of silica (SiO_2), typically as chert, opal, chalcedony or other microcrystalline forms.
- Iron-rich sedimentary rocks are composed of >15% iron; the most common forms are banded iron formations and ironstones – Hematite, Magnetite
- Phosphatic sedimentary rocks are composed of phosphate minerals and contain more than 6.5% phosphorus; examples include deposits of phosphate nodules, bone beds, and phosphate mud rocks.



(a) *(b)* *(c)*

Photo i: Rock samples (a) Sedimentary rock: Sandstone widely available
(b) Igneous rock; diorite common in Nigeria Benue Trough
(c)Metamorphic rock: Gneiss showing alternating bands of minerals

Igneous Environment

Igneous environment could be active: with frequent volcanic eruption, mountain building and earthquakes. They are usually within active plate boundaries. Passive igneous environment were active in the past, but now does not record any volcanic activity. The area falls within passive plate boundaries. The African plate was active in the past when it separated from South American and when Italy separated from the African plate. Spectacular volcanic eruptions show that rocks can get hot enough to melt deep in the Earth. Molten rock is called magma; rocks formed from magma are called igneous rocks. When magma erupts to the Earth's surface, it is known as lava. Rocks formed from cooled lava at surface, such as basalt, are called volcanic or extrusive rocks. Volcanoes are named after Vulcan, the Roman god of fire. Most magma solidifies slowly below the Earth‘s surface. Rocks formed in this way, such as granite, are plutonic or intrusive rocks. As magma cools, crystals form within the rock. The size of crystals in rocks depends mainly on the rate of cooling. Slow cooling plutonic rocks have larger crystals than volcanic rocks, which cool much faster.

The type of igneous rocks that form from magma is a function of three factors: the chemical composition of the magma; temperature of solidification; and the rate of cooling which influences the crystallization process. Magma can vary chemically in its composition. For example, the amount of silica (SiO_2) found in magma can vary from 75% to less than 45%. The temperature of cooling determines which types of minerals are found dominating the rock's composition. Rocks that begin their cooling at low temperatures tend to be rich in minerals composed of silica, potassium, and aluminum. High-temperature igneous rocks are dominated by minerals with higher quantities of calcium, sodium, iron, and magnesium. Based on their chemistry, geologists have classified igneous rocks into four basic types: felsic, intermediate, mafic, and ultramafic.

Diorite is a grey to dark-grey intermediate intrusive igneous rock composed principally of plagioclase feldspar, biotite, hornblende, and/or pyroxene. It may contain small amounts of quartz, microcline, and olivine (Photo ib). Igneous rocks derived from felsic magma contain relatively high quantities of sodium, aluminum, and potassium and are composed of more than 65% silica. Rocks formed from felsic magma include *granite, granodiorite, dacite,* and *rhyolite*. All of these rock types are light in color because of the dominance of quartz, potassium and sodium feldspars, and plagioclase feldspar minerals. *Dacite* and *granodiorite* contain slightly more biotite and amphibole minerals than granite and rhyolite. *Rhyolite* and dacite are produced from continental lava flows that solidify quickly. The quick solidification causes the mineral crystals in these rocks to be fine grained. *Granite* and *granodiorite* are common intrusive igneous rocks that are restricted to the Earth's continents.

Metamorphic Environment

Within the Earth, rocks can be changed by heat, pressure or both. Minerals in the rocks break down and reform in different combinations, altering the appearance and properties of the original rocks. This process of change from the original rock is called metamorphism. There are two types of metamorphism, contact and regional. Rocks surrounding a mass of magma can become as hot as they are ‗cooked' and new minerals form. This process is called contact metamorphism. When continents collide, great thicknesses of rocks are buried, compressed and heated. The resulting change affecting large volumes of rocks is called regional metamorphism. For example, the original rock of Quartzite is sandstone; the original rock of *Slate* is shale, the original rock of Schist could be shale, while the original rock of gneiss (Photo ic) is granite.

The Atmosphere: This is a mixture of different gases, particles and aerosols collectively known as air which envelops the earth. The atmosphere (Figure 1) provides various functions, not excluding the ability to sustain life. The atmosphere protects us by filtering out deadly cosmic rays, powerful ultraviolet (UV) radiation from the Sun, and even meteorites on collision course with earth. Although traces of atmospheric gases have been detected well out into space, 99% of the mass of the atmosphere lies below about 25 to 30 km altitude. The Earth's atmosphere consists, from the ground up: the troposphere (which includes the planetary boundary layer or peplosphere as lowest layer), stratosphere (which includes the ozone layer), mesosphere, thermosphere (which contains the ionosphere), exosphere and also the magnetosphere. Each of the layers has a different lapse rate, defining the rate of change (decrease) in temperature with height.

Three quarters of the atmospheric mass resides within the troposphere, and the depth of this layer varies between 17 km at the equator and 7 km at the poles. The ozone layer, which absorbs ultraviolet energy from the Sun, is located primarily in the stratosphere, at altitudes of 15 to 35 km. The Kármán line, located within the thermosphere at an altitude of 100 km, is commonly used to define the boundary between the Earth's atmosphere and outer space. However, the exosphere can extend from 500 up to 1,000 km above the surface, where it interacts with the planet's magnetosphere.

The Water: is widely distributed on Earth as freshwater and salt water in the oceans. The Earth is often referred to as the "blue planet" because when viewed from space it appears blue. About 71 percent of the Earth's surface is water-covered, and the oceans hold about 96.5 percent of all Earth's water.

Water exists in the air as water vapor, in rivers and lakes, in icecaps and glaciers, in the ground as soil moisture and in aquifers as groundwater. Our planet's water is in motion in different forms, making the water cycle. Things would get pretty stale without the water cycle! The vast majority of water on the Earth's surface, over 96 percent is saline water in the oceans. The freshwater resources, such as water falling from the skies and moving into streams, rivers, lakes, and groundwater, provide people with the water they need every day to live. Water sitting on the surface of the Earth is easy to visualize, and your view of the water cycle might be that rainfall fills up the rivers and lakes. The unseen water below our feet is critically important to life.

Where is Earth's water located?

For a detailed explanation of where Earth's water is, look at the data (Table 1) below. The *total* volume of *water* on Earth is estimated at 1.386 billion km³ about 332.5 million mi^3. Over 96 percent is in the ocean and salty (Figure 2). Out of the total freshwater, over 68 percent is in ice and glaciers. Another 30 percent of freshwater is in the ground. Rivers are the source of most of the fresh surface water people use, but they only constitute about 1,250 km^3 of total water.

Table 1: Amount and location of earth water

Water source	Water volume, (Km^3)	Percent of freshwater	Percent of total water
Oceans, Seas, & Bays	1,338,000,000	--	96.54
Ice caps, Glaciers, & Snow	24,064,000	68.7	1.74
Groundwater	23,400,000	--	1.69
Fresh	10,530,000	30.1	0.76
Saline	12,870,000	--	0.93
Soil Moisture	16,500	0.05	0.001
Ground Ice & Permafrost	300,000	0.86	0.022
Lakes	176,400	--	0.013
Fresh	91,000	0.26	0.007
Saline	85,400	--	0.006
Atmosphere	12,900	0.04	0.001
Swamp Water	11,470	0.03	0.0008
Rivers	2,120	0.006	0.0002
Biological Water	1,120	0.003	0.0001

Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, Water in Crisis: A Guide to the World's Fresh Water Resources (Oxford University Press, New York).

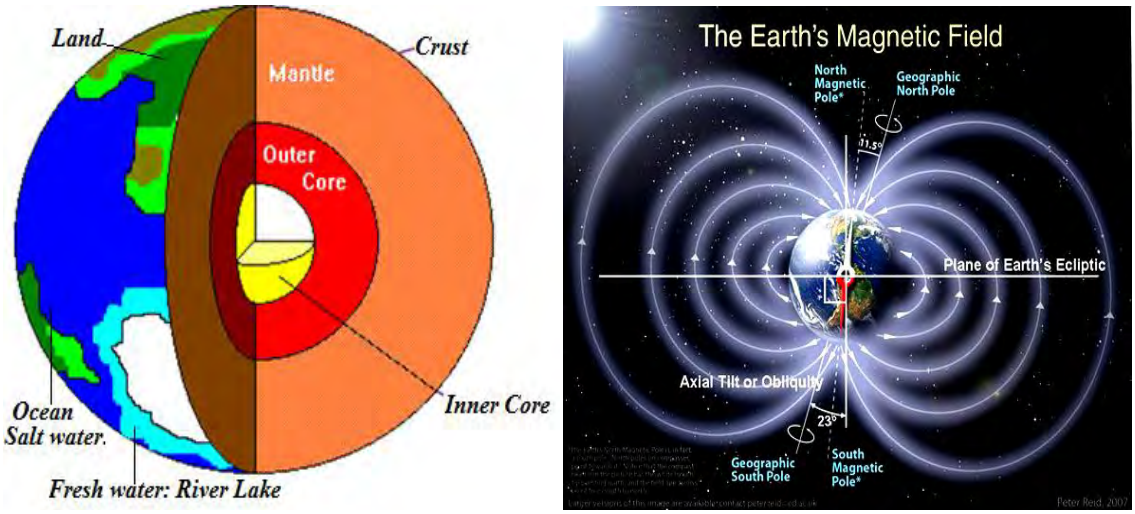


Figure 2: (a) Structure of the earth surface and interior (b) Earth Magnetic Field

Atmosphere: 1/1,000,000 of Earth's mass. Oceans: 2/10,000 of Earth's mass.
Crust: 1/250 of Earth's mass. Mantle: 2/3 of Earth's mass, 5/6 of Earth's volume.

The internal structure of the Earth (Figure 2a) is in spherical shells, like an onion. The outermost shell is the very thin crust, consisting of silicate materials, predominantly sand. This is followed by the mantle, then a liquid outer core that is much less viscous than the mantle, and a solid inner core consisting of high density metallic elements. Study of Earth's internal structure is based on observing volcanic activity and seismic waves in seismic stations by seismologists.

Gravity and Magnetic Fields of the Earth

The magnetic and the gravitational fields of the Earth are two different things. The magnetic field (Figure 2b) differentiates north from south, while gravitational field keep us on earth‘s surface, pulling us towards the centre of the earth. The main Earth‘s magnetic field is generated by flows of liquid iron in the outer core, and protects us from cosmic radiation particles. This flow of liquid iron caused by earth spin produce a continuous geo-dynamo effect that go on to create magnetic field. The magnetic processes in the outer core have influence on gravity. Unlike gravity, magnetism can pull two objects together or push them apart. Magnetic and gravity effects on objects get weaker as the objects get farther apart. Magnetic declination is the angle between magnetic north and geographic north. It is positive east of true north and negative when west. Magnetic declination changes over time and with location. Earth magnetic field is measured with magnetometer, while gravity field is measured with gravimeter.

5.0 Environmental Degradation and Related Challenges

5.1 Socio-Environmental Issues

Poverty

The word poverty is not only about economy, but a major player in environmental management. The environmental condition of a nation or state could be assessed by the percentage of its annual budget voted for environmental management. Similarly, the economy of a household affects the level of environmental sanitation maintained. Generally, dirty or degraded environment stands as a symbol of poverty, and sustainability study is inevitable. While other researchers may look at poverty from the economic point of view, environmentalists address poverty from the environmental point of view. Improved environmental quality will reduce poverty, being the new trend in poverty alleviation. For example, dirty environment increases environmental related diseases which affect household economy, increases poverty. Environmental related diseases incapacitate man from normal daily functions, affecting household and state economy, increasing poverty. To reduce poverty, living environment of air, water and land must be clean; free of pollution and degradation.

Illiteracy

Lack of education or illiteracy has its strongest hold on environmental education in developing countries. Probably, not up to one percent Nigerians has some sort of environmental education. Lack of Environmental education has been identified as a major cause of poor sanitation leading to degradation of air, soil, water, and public health. Environmental education should be seen as sustainable education and education for good living. Universities should intensify sustainability study in environmental education to reduce environmental degradation and their impacts to human and biodiversity existence on earth. Impart the students; to impart the society, for better environment and good living. This is education for a purpose which John Dewey (1859-1952) described as vital for society. According to Neil et al. (2005), a society grows great when old people plant trees whose shade they shall never sit in.

Early environmental education produces environmentally responsible adults and better environmental quality. To improve local, regional and global environmental quality, illiteracy therefore must be wiped out. Illiteracy with lack of environmental education can be linked to the Niger delta environmental crises and the high rate of environmental related diseases in Nigeria. The only solution to this is to eradicate illiteracy, infuse environmental education into the school system. Education without environmental education is incomplete, not designed for sustainable development.

Hunger

Global climate change leads to an increased number of weather-related disasters such as floods and droughts, which cause food shortages and famine. However, agriculture not only suffers from environmental problems, it also contributes to them, through pollution, overgrazing, and release of greenhouse gases**.** Land degradation, low and declining agricultural productivity, and poverty are severe and interrelated environmental issues. Declining soil fertility, which limits crop yields, is a particularly serious and widespread problem. Land management and land use policies and practices can plan an important role in alleviating hunger and poverty, while increasing agricultural productivity and the sustainable use of land resources reduces hunger and poverty. Effective policies are particularly needed to tackle the land degradation problems, which is one of the greatest challenges to the modernization of agriculture in many African countries. Modern and sustainable agriculture is the sure way to increase agricultural productivity in developing countries and to reduce hunger and poverty (Photo ii). The decline of emphasis on rural farming to the non existing white collar jobs in cities magnifies problem of hunger, dirty environment and diseases.

Photo (ii): Poverty and Hunger across nations

Remarks: *A hungry man pays little or no attention to sanitation of his environmental. Poverty, hunger and diseases strive in dirty environment. At present, the earth's total food supply can feed all people adequately but uneven distribution of resources leaves some people hungry. 1 in 5 people and 1 in 4 children worldwide suffer from hunger. One person dies every 2 seconds due to hunger following a WHO report.*

Human Population

The State of the World, 1999 Report from the World watch Institute suggests that the global economy could be seriously affected by environmental problems such as the lack of access to enough resources to meet population explosion across the world (Photo iii). Environmental degradation can contribute to social and political instability, which can lead to security issues. Human impact on the environment is a function of population size, per capita consumption and the environmental damage caused by the technology used to produce what is consumed. Changes in population size, rate of growth and distribution have a far-reaching impact on the environment and on development prospects. The largest population increases and the most fragile environmental conditions are usually found in poor countries, which typically have limited financial means and least adequate political and managerial resources to address the challenges. This threatens sustainable development and produces further deterioration in living standards and quality of life. People in developed countries have the greatest impact on the global environment. The first two Laws of Sustainability points out that in any society, population growth cannot be sustained, and that the larger the population, the more difficult it will be for the society to achieve sustainability. As at October 2011, the global population has reached 7 billion people now largely contributing to global environmental degradation and stress.

Photo (iii): Global population explosion

Gender parity, also known as ***gender equality*****,** refers to the view where the women are not discriminated against the men. This is a situation where women are given equal opportunity with the men in activities such as education, employment, business and in social functions. Women should receive equal treatment, and should not be discriminated against based on gender, unless there is a sound biological

reason for different treatment. Reason based on religion or culture is disputable as such practice does not give room for sound human development and improvement of environmental quality. This is the objective of the United Nations Universal Declaration of Human Rights, which seeks to create equality in law and in social situations, such as in democratic activities and securing equal pay for equal work. By ensuring gender equality, women's rights can be upheld, and realizing that women play a crucial role in the development of society, many underlying issues which lead to conflict and problems can be tackled more effectively. Better care, education and rights for women mean that children and environment would also benefit. This can eventually allow a society to enjoy more rights and the society can be enriched. Religion, culture and social background are very important factors causing discrimination against women that stands to be lifted this millennium.

Terrorism

Recent advances on terrorism are not all about politics, war and loss of lives. It borders largely on environmental degradation. There is destruction of property and structures causing environmental degradation or change in urban esthetics. There is incessant use of explosives and burning, causing emission of green house gases. Shelter displaced citizens are subjected to poor environmental health and sanitation. There is urgent need for greater investments on the control of terrorism in Nigeria and worldwide. Major terrorist groups identified by the U.S. department of state are mainly Religious-Political: Abu Nidal organization (ANO)- Libya, Abu Sayyaf Group (ASG)- South Philippines, Alex Boncayao Brigade (ABB)- Manila, Armed Islamic Group (GIA) – Algeria Chukaku-Ha – Japan**,** Democratic Front for the Liberation of Palestine (DFLP) -Syria, Lebanon, The Harakat ul-Ansar (HUA)- Pakistan, Kurdistan Workers' Party (PKK)- Turkey, Europe, Asia.

Others are the Liberation Tigers of Tamil Eelam (LTTE) -northern and eastern coastal areas of Sri Lanka; Manuel Rodriguez Patriotic Front (FPMR) – Chile, Aum Shinrikyo (Japanese); Klu Klux Klan (U.S.); Al Qaeda (Afghanistan); Egyptian Islamic Jihad; Hamas (Palestinian); Hezbollah (Lebanese), Boko Haram (Nigeria) etc. Boko Haram became active since 2002. Their primary ideologies are: Salafist Jihadism, Islamic fundamentalism, Islamism, Anti Western; Anti Christian. Leader: Abubakar Shekaw

Photo (iv): Boko Haram; suicide bombing, killing, burning and abduction

In one of the attacks by gunmen of Boko Haram, at least 52 persons including a soldier were reportedly killed and over 300 houses burnt in Kawuri Village 70 km off Maiduguri the Borno State capital (Photo iv) in Nigeria.

Remarks on Photo set (iv): *Call it terrorism or insurgence, the evil act is a global issue that causes loss of life and environmental degradation. The world must rise against it where ever it takes place. Nigerians are now living in fears of bomb attack, killing, burning and kidnapping, under the deadly hands of the Boko Haram Islamic group.*

5.2 Wastes Management Issues

Automobile waste

The unprecedented increase in transfer of used vehicles, junk engines and transmissions from industrialized to developing nations of the world like Nigeria may be reciprocated by more automobile junk markets (AJMs), and mechanic villages (MVs). There is increasing volume of automobile gas emission, discharge of spent engine and transmission oil, spent electrolyte and spills on the ground in MVs and AJMs. Topsoil within and around AJMs and MVs become heavily contaminated by toxic trace metals in many parts of Nigeria (Nwachukwu et al., 2010a, 2010b). This may lead to larger environmental degradation this 21st century, affecting land use planning, soil and water quality, and public health. Storm water from these urban infrastructures get into the waterways untreated, and there is no protection to both surface and groundwater. The overall outcome is environmental degradation that demands intensive sustainability study. If all automobile repair works and junk yards in different cities be confined to environmentally friendly mechanic villages, collection, preservation, recycling and reuse of spent oil will become effective. This will stop the habit of disposing spent automobile oil on the ground. This habit coupled with corrosion of abandoned end of life vehicles in junk yards cause pollution

of topsoil and insecurity of food products in the affected areas. Beside environmental quality, business and employment opportunities will improve. Small-scale refining or reprocessing of used oil in mechanic villages is lucrative and recycling plants are affordable and available (Nwachukwu et al. 2012)

Photo v: Abandoned auto body in junk yards; Piles of end of life vehicles waiting recycling; Spill of waste engine and transmission oil in mechanic villages.

Proper management or recycling of end of life vehicles must be guaranteed this 21st century to improve environmental quality. There is need for extended producer responsibility (EPR) in the recycling of spent auto oil and end of life vehicles Nwachukwu et al. 2010a)

Waste electrical and electronic equipment

Waste electrical and electronic equipment (WEEE), also known as *e-waste* has been defined as any electrically powered appliance that has reached the end of its life. Or that no longer satisfies the current owner for its original purpose. Importation of WEEE of all grades into Nigeria for crude recycling and reuse and consequent littering of their scrap casings and other hazardous components is not a sustainable international trade development. Subsequent to the continuous development and innovation of electronic technology, e-waste will undoubtedly represent one of the most serious environmental issues of this century in many developing countries. A comprehensive waste management strategy should be established and implemented. Sustainability study is necessary to continuously investigate and address the problems of e-waste in Nigeria. It appears that developed countries have put in place some kind of management plans for up to 70-75% of WEEE without a proper account for the remaining 25-30%. This remaining 25-30% is largely exported to developing countries, and about 5-10% stocked in junk yards and in building basements.

Developing countries import these wastes because of their poor economy and the relatively cheap cost (Nwachukwu and Feng, 2011).

Photo vi

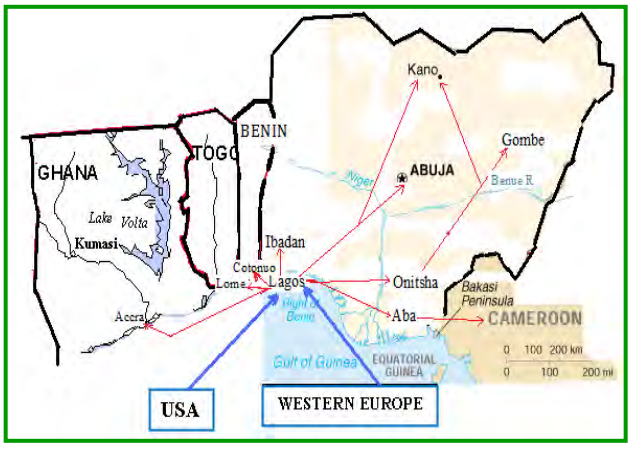


Figure 3

Photo vi: Electrical–electronic waste dumping along the Atlantic coast of West Africa is a common practice. This must stop to reduce marine pollution and threat to aquatic life. E-waste dumping in Nigeria is traced to U.S.A. and Western Europe (Figure 3).

Industrial and Domestic Waste Dumping

Improper management of industrial, domestic, medical and agricultural wastes are often seen as indiscriminate waste discharge or dumping in different parts of the world. This is a major cause of environmental degradation leading to poor environmental health and diseases. It causes hazards through physical, microbiological, or chemical agents of disease. Some domestic wastes that pose environmental issue in many developing countries are human and animal feces, food and market wastes, sewage, and industrial and agricultural wastes. Improper disposal of solid wastes and the absence of engineered sanitary landfill in Nigeria could cause direct health risks to people living around the waste dumped. Human beings need to be protected as much as possible from contact with waste. Specific risks are found in handling hospitals wastes and animal wastes. The most obvious environmental damage caused by municipal solid wastes is poor aesthetic, street littering, and urban degradation causing surface to groundwater pollution. Waste burning at dump sites often result in bush burning causing pollution. Waste burning at open dumps is still practiced today in many countries; this is a major source of toxic gas emissions such as dioxins and furans, causing serious air pollution.

Photo vii: Waste burning cause pollution

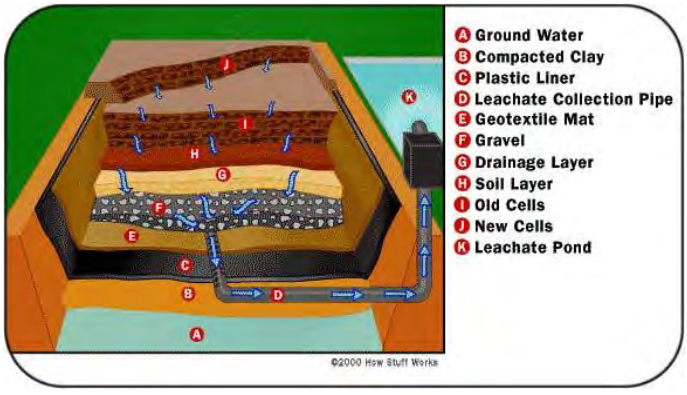
Photo vii: *Waste burning at dump sites (open waste burning) must stop to reduce air pollution, stop emission of CO_2 and other obnoxious gases.*

Agricultural Wastes

Agricultural wastes resulting from fertilizer input constitute major sources of surface water pollution. Rainfall wash away the fertilizer applied to farm land rich in phosphate and nitrite thus increasing nutrient level in streams which in turn increases growth of water weed on stream water. Bush burning being part of subsistence farming contributes largely to carbon dioxide emission into the atmosphere in different parts of Nigeria and Africa. It is important to stop bush burning and regulate the use and application of fertilizer on farm land.

Waste Disposal and Landfill Technology

Photo vii



(Figure 4)

Photo vii: Open waste dumping often at riverside cause water, soil, air pollution
Figure 4: The basic parts of a sanitary engineered landfill against waste dumping

- ***Bottom liner system*** - separates trash and subsequent leachate from groundwater
- ***Cells (old and new)*** - where the trash is stored within the landfill
- ***Storm water drainage system*** - collects rain water that falls on the landfill
- ***Leachate collection system*** - collects water that has percolated through the landfill itself and contains contaminating substances ***(leachate)***
- ***Methane collection system*** - collects methane gas that is formed during the breakdown of trash
- ***Covering or cap*** - seals off the top of the landfill

Groundwater Monitoring: At many points surrounding the landfill shall be placed groundwater monitoring stations. These are shallow wells that are sunk into the groundwater so water can be sampled and tested at regular intervals for the presence of leachate chemicals. The temperature of the groundwater is measured. Because the temperature rises when solid waste decomposes. An increase in groundwater temperature could indicate that leachate is seeping into the groundwater. Also, if the pH of the groundwater becomes acidic, that could indicate seeping leachate. Given current technology and disposal patterns, landfills are and will remain a necessary and important component of waste management.

Sanitary landfills are well-engineered, well controlled land disposal sites for solid, non-hazardous waste in which delivered wastes are spread and compacted in layers a few feet thick. At least the wastes are covered with a layer of earth at end of the day to prevent odor. Open dumps are often nothing more than valleys or quarries or mines whose owners abandoned, allowing people to dump trash. Along with solid wastes, into these open dumps are all kinds of household and commercial hazardous wastes and industrial materials. The open dump is hazardous because of its potential for producing leachate, becoming a rodent and insect breeding ground, and its general health dangers. Waste dumping currently practiced in Nigeria and in many developing countries must stop, replaced by landfill technology. What makes a dump different from a landfill is the absence of the following requirements:

- Preventing odor and deter pests
- Groundwater monitoring well-- checking to see if groundwater has become contaminated due to the waste dumping
- A restriction on location -- a dump is any where residents or past municipalities have found space to deposit garbage without plan.

- Use of liners -- landfills have liners in the bottom of their waste holes to prevent leakage of leachate from the waste, thereby protecting groundwater
- Capture of leachate from waste, pump leachate to surface treatment tank, treat leachate to become good water.
- Harvest emitted gases for commercial use.

Stop indiscriminate dumping of wastes, classify wastes. Isolate recyclable waste such as paper, bottles, cans and plastics (Photo ix) from other wastes in homes and offices to make money (Waste to Wealth). Indiscriminate waste dumping pollutes surface water which in turn, pollutes groundwater. Home sorting of wastes is most appropriate to stop scavengers who go to waste dumps to pick recyclable materials thereby endangering their health. Waste littering is a serious offence; polyethylene bags including that of sachet water fall under plastics that hardly decompose. Dispose your domestic wastes weekly by taking them to collection points or bring them outside your home for waste collectors to pick them.

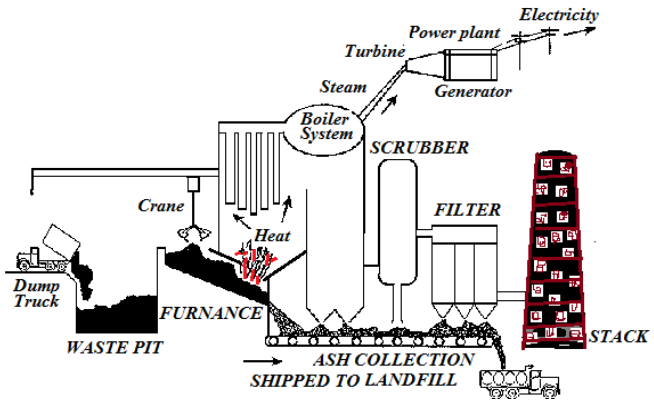
Photo ix: Plastic type containers for sorting wastes in homes and offices prior to disposal, as household efforts to support Recycling.

Incineration

This is waste destruction in a furnace by controlled burning at high temperatures. However, it is a highly contentious method because incomplete incineration can produce carbon monoxide gas, gaseous dioxins, and other harmful substances. Incineration is a waste treatment technology, which includes the combustion of waste to produce energy. It is a high temperature waste treatment. During the process, the waste material is converted to gases, particles and heat, used for generation of electricity.

The gases, flue gases are first treated for eradication of pollutants before going in to atmosphere. A major problem of incineration is in the disposal of the ash residue. This means that incineration however, does not replace the need for landfill but it reduced the amount to be thrown in it. Among waste-to-energy technologies, incineration is most effective. Other technologies are gasification, anaerobic digestion and Pyrolysis. Sometimes Incineration is conducted without energy production. In the past, incineration was conducted without separating materials thus causing harm to environment.

Photo x



(Figure 5)

Photo x: SYSAV incineration plant in Malmö, Sweden, capable of handling 25 metric tons (28 short tons) per hour of household waste. Figure 5: Simple design of an energy production incinerator.

Usage of incinerators for waste management is divisive. Despite the provision of emission control systems in modern incineration plants, arguments against the use of incinerator outweigh arguments in support of the use.

Recycling

This is a process to change waste materials into new products, thereby changing waste to wealth, and reducing the consumption of fresh raw materials. Recycling reduces air pollution from incinerator and water pollution from landfill. It reduces the need for "conventional" waste disposal, and lower greenhouse gas emissions. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse and Recycle" (RRR) waste hierarchy.

There are some international standard organization (ISO) standards related to recycling such as ISO 15270:2008 for plastic wastes and ISO 14001:2004 for environmental management control of recycling practice. Recyclable materials include used oil, glass, paper, metal, plastic, textiles, automobile and electronics. The composting or other reuse of biodegradable waste such as food or garden waste is also considered recycling. Materials to be recycled are either brought to a collection center or picked up from homes as against picking from waste dumps. These materials are then cleaned thoroughly and reprocessed into new materials. For example, used office paper would be converted into new office paper, and plastics can easily be recycled to produce fuel oil (Figure 6).

a b

Figure 6 a: Waste plastic recycled to fuel oil (b) The Universal Recycling Symbol

5.3 Pollution (Land, Water Air,)

Oil Spill

Oil spill worldwide causes environmental degradation with chain reactions. The Niger-delta region of Nigeria has continued to attract scholarly attention in view of devastation of its environment and people due to failure to manage the negative consequences of oil exploitation and poor development of the oil rich region. The Niger Delta is one of the world's most important wetland and coastal marine ecosystems. It is home to some 10 million people by the 1991 census, estimated to over 28 million by 2006. Due to its rich natural resource base, environmental exploitation is rife and pollution affects the people in unprecedented ways. Oil has been extracted in the Niger Delta by the national and multinational oil companies since 1958. Oil pollution caused by oil spills and gas flaring by the oil industry devastates farmland, rivers, villages and the air. Oil pollution kills fish and their food sources; it damages agricultural land causing soil infertility and negatively impacts agricultural productivity (Egberongbe et al. 2006).

In Niger delta, groundwater may have variable levels of pollution due to oil and gas spills. Another major pollution issue of the Niger delta region of Nigeria is the saline intrusion to aquifer. Presently, there is no significant research effort towards in-situ treatment of groundwater in this region. A prospect design recommended for treating groundwater polluted by oil or gas in the Niger delta is air sparging (Figure7).

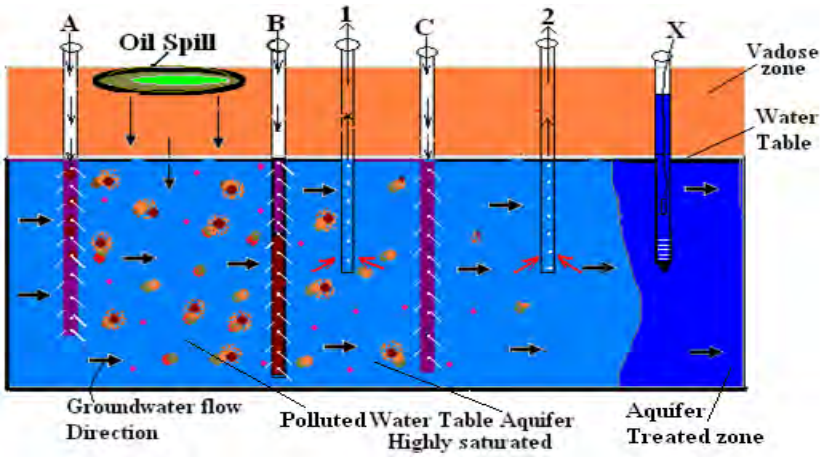


Figure 7: Air sparging field technique prospective for treating oil polluted areas of Niger delta where the vadose and the shallow aquifer consists of coastal plain sands (Nwachukwu, 2014)

Surface water Pollution

Environmental degradation due to no storm water management (SWM) in many countries is significant to soil and surface water pollution. SWM is cheap because infiltration and detention basins are simple structures. Storm water or runoff from market squares, mechanic villages, construction sites etc. deserve treatment before it is allowed to join the urban water way. Safety means sustainability across our value chain worldwide to protect our environment and communities. Protecting our natural environment is critical to surface water quality, health and prosperity of our communities. Surface water pollution occurs when hazardous substances are either dissolve or physically mix with the water.

Because of the close relationship between sediments and surface water, contaminated sediments are often considered part of surface water contamination. Sediments include the sand and soils at the bottom of an ocean, lake, or stream. Surface water can also be contaminated when it interacts with contaminated groundwater. The best approach to clean polluted surface water is to stop further discharges into it and enable natural biological, chemical, and physical processes to break down the existing pollutants. Harmful pollutants: Arsenic (As); Fecal Coliform; Lead (Pb); pH; Sulfate (SO_4) etc., could reach surface water from point source e.g. saline spring, or non point (wide spread) source e.g. nitrate from farm fertilizer input.

Groundwater pollution

Greater of groundwater pollution comes from surface infiltration. Pollutants from domestic waste dumps, animal wastes, industrial discharges and agricultural wastes constitute the pollutants. These pollutants easily migrate to groundwater through infiltration (Figure 8). Rate of migration specifically depends on the nature of the subsurface. For example, sandy subsurface allows transport of pollutants faster than clay. Other subsurface properties that affect transport of pollutants are porosity: the degree of pore spaces or fracture openings within the transport medium. Several sources of groundwater pollution exist particularly in the urban and semi-urban areas.

Potential Sources of Groundwater Contamination

Storage Tanks: Underground tanks may contain gasoline, oil, chemicals, or other types of liquids. There are so many of such tanks buried in gas stations of which some are abandoned. All over the world are such buried tanks, and over time the tanks can corrode, crack and develop leaks. If the contaminants leak out and get into the groundwater particularly where water table is near surface, serious contamination of groundwater can occur. Buried tanks such as in gas stations require cathodic protection to check corrosion. This practice is probably not enforced as a regulation in different parts of the world to check groundwater contamination.

Septic Systems: Onsite wastewater disposal systems used in homes, offices or other buildings not connected to a city sewer system is the practice in many developing countries. Septic systems are designed to slowly drain away human waste underground at a slow, harmless rate. An improperly designed, located, constructed, or maintained septic system can leak bacteria, viruses, household chemicals, and other contaminants into the groundwater causing serious health consequences.

***Uncontrolled Hazardous Waste*:** Poorly designed hazardous waste disposal sites can cause groundwater contamination if barrels or other containers filled with hazardous materials are disposed in them. If there is a leak, these contaminants can eventually make their way through infiltration down through the soil and into the groundwater.

Landfills: Landfills are the grave where our garbage is taken to be buried. Landfills are supposed to have a protective bottom layer to prevent contaminants from getting into the water. However, if there is no protective bottom lining, or it is cracked, or ineffective, contaminants from the landfill (car battery acid, paint, household cleaners, etc.) can make their way down into the groundwater.

Chemicals and Road Salts: The widespread use of chemicals and road salts is another source of potential groundwater contamination. Chemicals include products used on lawns and farm fields to kill weeds and insects and to fertilize plants, and other products used in homes and businesses. When it rains, these chemicals can seep into the ground and eventually into the water. Road salts are used in the wintertime to put melt ice on roads to keep cars from sliding around. When the ice melts, the salt gets washed off the roads and eventually ends up in the water.

Atmospheric Contaminants: Since groundwater is part of the hydrologic cycle, contaminants in other parts of the cycle, such as the atmosphere or bodies of surface water, can eventually be transferred into our groundwater supplies through infiltration and base flow.

Saline Intrusion: Fresh groundwater can be contaminated as a result of saline intrusion from the sea. Sea water is salty, and when in close proximity to a fresh water aquifer system could migrate by osmotic process to contaminate the aquifer.

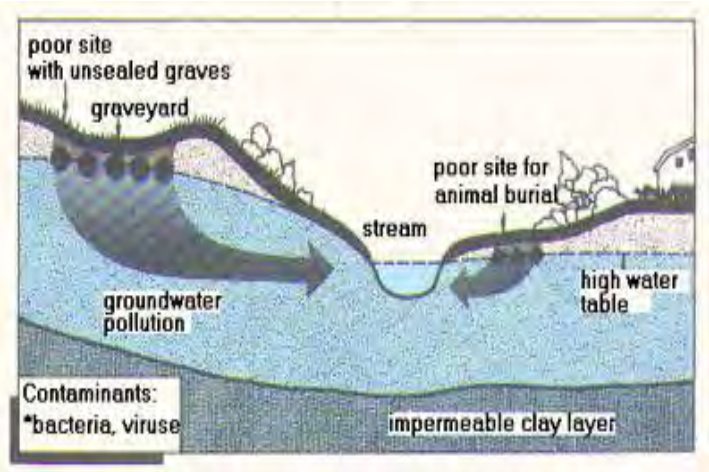


Figure 8: Groundwater pollution by Surface infiltration

Air pollution

Air pollution is the introduction of particulates, biological materials, or other harmful materials into the Earth's atmosphere, possibly causing disease, death to humans, damage to other living organisms and food crops, or the natural or built environment. An air pollutant is a substance in the air that can have adverse effects on humans and the ecosystem. The substance can be solid particles, liquid droplets, or gases. A pollutant can be of natural origin or man-made. Pollutants are classified as primary or secondary.

Primary pollutants are usually produced from a process, such as ash from a volcanic eruption. Other examples include carbon monoxide gas from motor vehicle exhaust (Photo xi), or the sulfur dioxide released from factories. Secondary pollutants are not emitted directly. Rather, they form in the air when primary pollutants react or interact. Ground level ozone is a prominent example of a secondary pollutant. Some pollutants may be both primary and secondary: they are both emitted directly and formed from other primary pollutants.

Primary air pollutants are emitted directly into the air from sources. Major primary pollutants produced by human activity include:

- Sulfur dioxide (SO_2); a gas formed when sulfur is exposed to oxygen at high temperatures during fossil fuel combustion, oil refining, volcanoes, or metal smelting. SO_2 is toxic at high concentrations, but its principal air pollution effects are associated with the formation of acid rain and aerosols. SO_2 dissolves in cloud droplets and oxidizes to form sulfuric acid (H_2SO_4), which can fall to Earth as acid rain or snow or form sulfate aerosol particles in the atmosphere.

- Nitrogen oxides (NO and NO_2, referred together as NO_x) are highly reactive gases formed when oxygen and nitrogen react at high temperatures during combustion or lightning strikes. Nitrogen present in fuel can also be emitted as NO_x during combustion. Nitrogen dioxide is a chemical compound with the formula NO_2. It is one of several nitrogen oxides. One of the most prominent air pollutants, this reddish-brown toxic gas has a characteristic sharp, biting odor.

- Carbon monoxide $(CO)^-$ CO is a colorless, odorless, toxic yet non-irritating gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Industrial fumes and vehicular exhaust are major sources of carbon monoxide emission into the atmosphere (Photo xi). Motor vehicle emissions contribute to air pollution and are a major ingredient in the creation of smog in some large cities. A study group from Massachusetts Institute of Technology led by Gaiazo in 2013 indicates that 53,000 early deaths occur per year in the United States alone because of vehicle emissions. According to another study from the same university, traffic fumes alone cause the death of 5000 people every year just in the United Kingdom.

- There is no study yet on number of death resulting from emissions from automobiles and the excessive use of private electric generators in Nigeria and Africa. On daily bases, people die, following inhalation of CO fumes from generators positioned close to their sleeping area.

- Carbon dioxide (CO_2) - a colorless, odorless, non-toxic greenhouse gas also associated with ocean acidification, emitted from sources such as combustion, cement production, and respiration. It is otherwise recycled in the atmosphere in the carbon cycle.

- Volatile organic compounds - VOCs are a well-known outdoor air pollutant. They are categorized as either methane (CH_4) or non-methane (NMVOCs).

Methane is an extremely efficient greenhouse gas which contributes to enhance global warming. Other hydrocarbon VOCs are also significant greenhouse gases because of their role in creating ozone and prolonging the life of methane in the atmosphere. This effect varies depending on local air quality. The aromatic NMVOCs benzene, toluene and xylene are suspected carcinogens and may lead to leukemia with prolonged exposure. 1, 3-butadiene is another dangerous compound often associated with industrial use. Particulates, alternatively referred as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to combined particles and gas. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols.

Averaged worldwide, anthropogenic aerosols those made by human activities currently account for approximately 10 percent of our atmosphere. Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer. Toxic metals, such as lead and mercury, especially their compounds are in this group. Chlorofluorocarbons (CFCs) are harmful to the ozone layer; emitted from products currently banned from use. These are gases which are released from air conditioners, refrigerators, aerosol sprays, etc. CFC's on being released into the air rises to stratosphere. Here they come in contact with other gases and damage the ozone layer. This allows harmful ultraviolet rays to reach the earth's surface. This can lead to skin cancer, disease to eye and can even cause damage to plants.

- Ammonia (NH_3) - emitted from agricultural processes. Ammonia is a compound with the formula NH_3. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers. Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals. Although in wide use, ammonia is both caustic and hazardous.
- Odors such as from garbage, sewage, and industrial processes

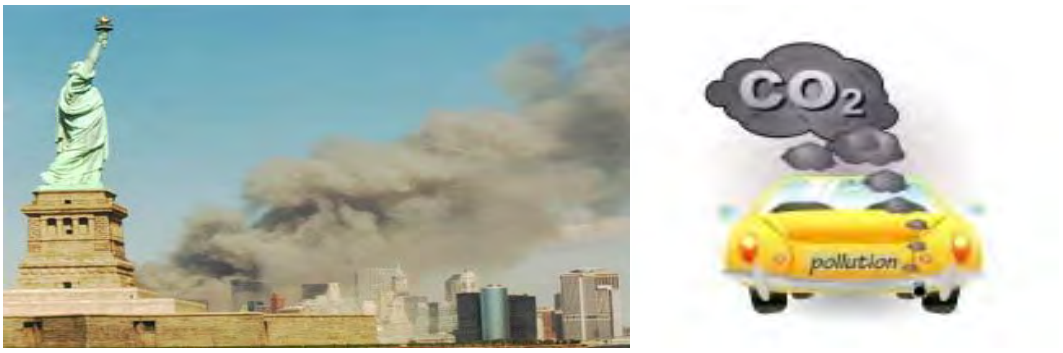


Photo xi: Industrial fumes and smoke from automobile exhaust pipe pollute air

- Radioactive pollutants - produced by nuclear explosions, nuclear events, war explosives, and natural processes such as the radioactive decay of radon.

Secondary pollutants: Secondary air pollutants are produced in the air by the interaction of two or more primary pollutants or by reaction with normal atmospheric constituents, with or without photo activation. Examples of secondary air pollutants are Ozone, Formaldehyde, PAN (peroxy acetyl nitrate), Smog (photochemical or smoke induced), Acid mist. (a) Modern smog does not usually come from coal but from vehicular and industrial emissions that are acted on in the atmosphere by ultraviolet light from the sun to form secondary pollutants that also combine with the primary emissions to form photochemical smog. (b) Ground level ozone (O_3) formed from NO_2 and VOCs. Ozone (O_3) is a key constituent of the troposphere. It is also an important constituent of certain regions of the stratosphere commonly known as the Ozone layer.

What Is the Difference between Primary and Secondary Pollutants?

A primary pollutant is an air pollutant emitted directly from a source. A secondary pollutant is not directly emitted but forms when other pollutants (primary pollutants) react in the atmosphere. These two constitute air pollution which is the introduction of chemicals, particulate matter, or biological materials into the atmosphere.

Minor air pollutants: A large number of minor hazardous air pollutants. Air pollution that comes from obvious sources, such as car exhausts and industrial emissions, is easy to identify. Most people are aware that these are sources of pollution. However, other smaller sources pollute the air every day. By itself, any one of these sources might be insignificant, but individual smaller sources combine to create a significant amount of air pollution.

Gas Flaring

A gas flare (Photo xii), alternatively known as a flare stack, is a gas combustion device used in industrial plants such as petroleum refineries, chemical plants, natural gas processing plants as well as at oil or gas production sites having oil wells, gas wells, offshore oil and gas rigs and landfills. Despite long standing laws against gas flaring - the burning of natural gas during oil extraction in Nigeria, and shifting deadlines to end the practice, the activity continues, with serious health consequences for people living nearby. In the Niger Delta, where most of the flaring takes place, residents living near gas flares complain of respiratory problems, skin rashes and eye irritations, as well as damage to agriculture due to acid rain. They are also forced to live with constant noise, heat and light that can lead to sleep deprivation which can degenerate into systemic insomnia. Since flaring involves carbon dioxide and sulfur outputs, in the longer term the heart and lungs can be affected.

–Extreme long-term exposure can predispose one to, or cause, skin cancer supported by a 2011 report by Environmental Rights Action (ERA), the Nigerian chapter of Friends of the Earth International. World gas flaring at the end of 2011, were (in declining order): Russia (27%), Nigeria (11%), Iran (8%), Iraq (7%), USA (5%), Algeria (4%), Kazakhstan (3%), Angola (3%), Saudi Arabia (3%) and Venezuela (3%) from World Bank report. The report says these pollutants can affect communities within 30km of the flares.

While gas flaring has technically been illegal in Nigeria since 1984, the government sometimes grants exemptions to oil companies, and fines for flaring are criticized as being too light to act as a deterrent.

An oil worker in Nigeria, who spoke to IRIN on condition of anonymity, described the fines as ―so low that it doesn‘t justify much investment" to stop flaring. Publicly, oil firms say they are working to reduce flaring. However, Ben Amunwa, a researcher with international human rights NGO Platform, pointed to Shell‘s most recent Sustainability Report which says the oil firm‘s flaring increased 32 percent from 2009 to 2010.

Photo xi: Gas flaring pollutes air

While Shell‘s report also says overall from 2002 to 2010 ―flaring from SPDC facilities has fallen by over 50 percent," it says this was partially due to a decrease in oil extraction owing to militant activities. In the same manner, it recognized that the 2010 increase in flaring from 2009 was because oil extraction rose following a drop in violence in the region. Militant activity in the Delta mainly attacks on oil installations and oil workers by youths protesting against environmental degradation caused by oil extraction peaked in 2008, but declined following a 2009 government amnesty program. Some oil companies have claimed up to 30 percent reduction in recent years, but the reality on the ground has not backed up such claims. NGOs have previously said the failure to enforce environmentally sound practices has been due to weak government institutions and over-reliance on oil revenues.

For example, Shell is yet to comply with a 2005 high court order to end gas flaring in the Iwherekan community, Delta State. Friends of the Earth Netherlands reported in 2011 that there were about 100 continuously burning gas flares in the Niger Delta and just offshore, some of which have been burning since the early 1960s. Nigeria has the second highest level of flaring in the world, after Russia; in most countries the excess gas is collected and used to generate power.

A 2004 World Bank report said the value of gas flared annually in Nigeria was between US$500 million and $2.5 billion.
Remarks: *Control industrial fumes and stop gas flaring to reduce air pollution. Industrial or chemical processes involving volatile liquids and emission of fumes require fume control practices in place. These practices help eliminate or lower human exposure to hazardous fumes*.

Energy Wastes: Oil and Gas, Coal, Nuclear wastes

Energy in Nigeria is about electricity from oil and gas production, consumption and export. Nigeria is a member of the Organization of the Petroleum Exporting Countries (OPEC). Nigeria has oil reserves about 35 billion barrels (5.6×10^9 m^3), 10th highest, and gas reserves about 5 trillion cubic meters, 9th highest. The Niger delta is one of the most polluted regions in the world. Oil is spilled more each year than in the Gulf of Mexico as at 2010. Nigerian government reports more than 7,000 spills between 1970 and 2000 and 2,000 major spillage sites. Pollution and environmental degradation by the oil industry has serious impact on people living in the Niger Delta. The environment laws are poorly enforced. Government agencies responsible for the enforcement are ineffective and in some cases, compromised by conflicts of interest. Communities in the Niger Delta frequently had no access to vital information about the impact of the oil industry on their lives. There is no control to the emission of green house gases in the petrochemical industries (Photo xiii).

Photo xiii: Petrochemical power plant

Coal, oil, and gas consist largely of carbon and hydrogen. The process that we call "burning" actually is chemical reactions with oxygen in the air. For the most part, the carbon combines with oxygen to form carbon dioxide (CO_2), and the hydrogen combines with oxygen to form water vapor (H_20). In both of these chemical reactions a substantial amount of energy is released as heat.

Since heat is what is needed to instigate these chemical reactions, we have a chain reaction: reactions cause heat, which causes reactions, which cause heat, and so on. Once started the process continues until nearly all of the fuel has gone through the process. The carbon dioxide that is released is the cause of the greenhouse effect causing the world largest share of environmental degradation. According to NNPC report (2010), a large proportion (about 63%) of the gas produced in Nigeria is being flared. By 2002 and 2003, gas flared remained as high as 45.4% and 42.7% while gas used was 54.6% and 57.3%, respectively. The economic costs in terms of lost incomes, air pollution, higher ambient temperature and reduction in the standard of living and health are expected to be excessive. Globally, over 150 billion cubic meters (or 5.3 trillion cubic feet) of natural gas are being flared and vented annually.

Coal: A large coal-burning plant annually burns 3 million tons of coal to produce 11 million tons of carbon dioxide. The water vapor released presents no problems, since the amount in the atmosphere is determined by evaporation from the sea. In addition to combining carbon and hydrogen from the fuel with oxygen from the air to produce carbon dioxide and water vapor, burning fossil fuels involves other processes. Coal and oil contain small amounts of sulfur, typically 0.5% to 3% by weight. In the combustion process, sulfur combines with oxygen in the air to produce sulfur dioxide, which is the most important contributor to acid rain water. The greenhouse effect causes only economic disruption and acid rain kills only fish and trees, whereas air pollution kills people and causes human suffering. Top coal burning countries are: China, USA, India, Germany, Russia, Japan, South Africa, Poland, Australia, and South Korea.

Nuclear Energy: Nuclear energy relies on the fact that some elements can be split (in a process called fission) and will release part of their energy as heat. Because it fissions easily, uranium-235 (U-235) is one of the elements most commonly used to produce nuclear energy. It is generally used in a mixture with Uranium-238, and produces Plutonium-239 (Pu-239) as waste in the process. All the steps in the complex process of creating nuclear energy entail environmental hazards. The mining of uranium, as well as its refining and enrichment, and the production of plutonium produce radioactive isotopes that contaminate the surrounding area, including the groundwater, air, land, plants, and equipments. As a result, humans and the entire ecosystem are adversely and profoundly affected. Some of these radioactive isotopes are extraordinarily long-lived, remaining toxic for hundreds of thousands of years. Presently, we are only beginning to observe and experience the consequences of producing nuclear energy as unsustainable due to accident risks.

Photo xiv: Nuclear power plant

Remarks on Photo set (xiii-xiv): *Fumes, gaseous emissions from petrochemical and Nuclear power plants. Nuclear power plants by country: USA (104); France (58);Japan (50); Russia (33); China (17, 32 under construction);*

5.4 Geo-Environmental Issues

Groundwater Over-exploitation

Over allocation and overuse of groundwater is often seen as a problem that can result when surface water is scarce. However, it is not an infinite problem, which means we must take care to use both groundwater and surface water supplies sustainably. Over extraction can cause groundwater resource depletion and saltwater intrusion, and disturb the balanced interaction between surface water and groundwater. Because of a historical lack of understanding and a shortfall in groundwater resource management, too many licenses have been issued (i.e. over allocated) in some areas. In some cases, this has led to the unsustainable extraction of groundwater (i.e. overuse). Poor management practice has been exacerbated by:

+ Failure to meter licensed groundwater usage in many parts of the world.
+ Groundwater being provided free or under priced
+ Management failure to recognize the connectivity of ground and surface water.

Increasing demand: Demand on groundwater resources continues to increase all over the world. This is due to development and population growth pressures. The perceived need to diversify water resources to complement existing supply and frequent drought increases pressure on surface water resources. Through the deep circulation of groundwater and the intrusion of molten magma into the earth‘s crust to depths of about 1-5 km, heat is brought closer to the earth‘s surface. The hot molten rock heats the surrounding groundwater, which is forced to the surface in certain areas in the form of hot steam or water (e.g. hot springs and geysers).

The heat energy close to, or at the earth‘s surface can be utilized as a source of energy, namely geothermal energy. This use produces lot of stress to groundwater, and this may cause over-exploitation in the applicable areas.

Global warming

The earth's average temperature increased by 0.7° Celsius (1.3° Fahrenheit) in the 20th century often attributed to the effects of industrial revolution. Greenhouse gases emission to the atmosphere mainly carbon dioxide (72%), methane (18%), nitrous oxide (9%), and chlorofluorocarbons has caused depletion of Ozone in the Stratosphere. Depletion of stratospheric ozone led to the formation of holes in the thin ozone layer. The ozone holes make way for ultraviolent rays of the sun that would otherwise be absorbed by the ozone layer to now pass onto the earth surface causing gradual rise of the earth surface temperature (Figure 9).

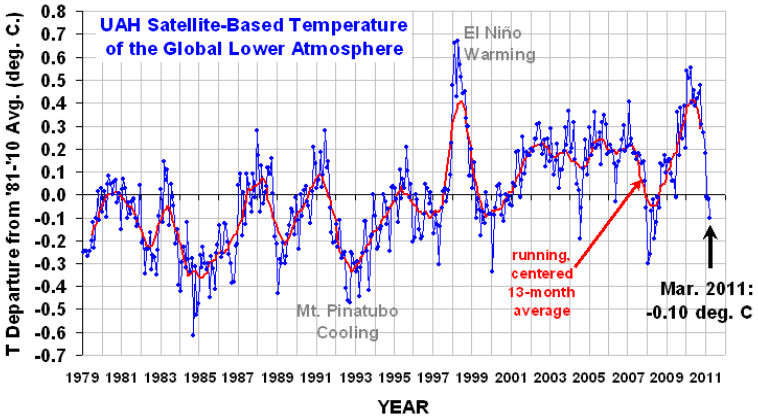


Figure 9: Gradual rising world temperature (1979-2011)

Rising earth temperature due to solar radiation through the Antarctic ozone hole (Figure 11) causes global warming-Climate change. Yet people and plants live with both helpful and harmful effects of ultraviolet (UV) radiation from the sun.
Causes and effects of air pollution: (1) greenhouse effect, (2) particulate contamination, (3) increased UV radiation, (4) acid rain, (5) increased ground level ozone concentration, (6) increased levels of nitrogen oxides.

Sun radiation often erupts in a terrible blast at surface of the sun (Photo xv) with increasing ultraviolet B rays on the earth surface. Electromagnetic radiation exists in a range of wavelengths, which are delineated into major divisions for our convenience.

Ultraviolet B radiation, harmful to living organisms, represents a small portion of the spectrum, from 290 to 320 nanometer wavelengths (Figure 10).

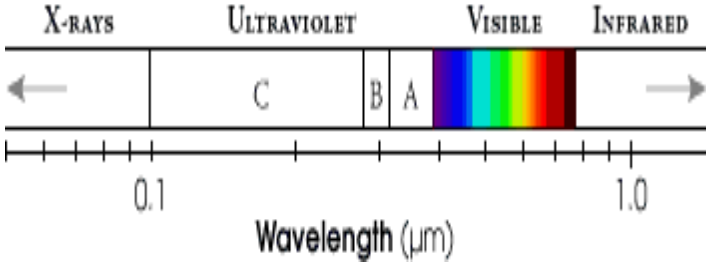


Figure 10: Solar electromagnetic spectrum

Increase of ultraviolet radiation and sun blast (Photo xv) on the earth surface is most allowed following depletion of the stratospheric ozone layer in the Antarctic region largely by human emission of green house gases into the atmosphere.
This has caused notable rise in the earth surface temperature and skin diseases, including cancer.

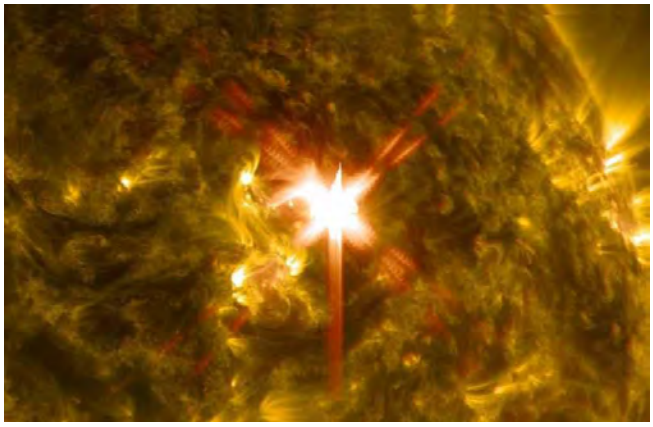


Photo (xv): NASA solar radiation eruption or blast

This development is the primary cause of global warming (Roy Spencer, 2011). Gas flaring, burning fossil fuels, bush - wood and human industrial and agricultural practices contribute to this global warming. Emission of CO_2 has been dramatically increased within the last 50 years and is still increasing by almost 3 percent each year. To this effect, effort must be made to reduce smoking vehicles, check automobile emission, bush burning and stop gas flaring to mitigate environmental degradation.

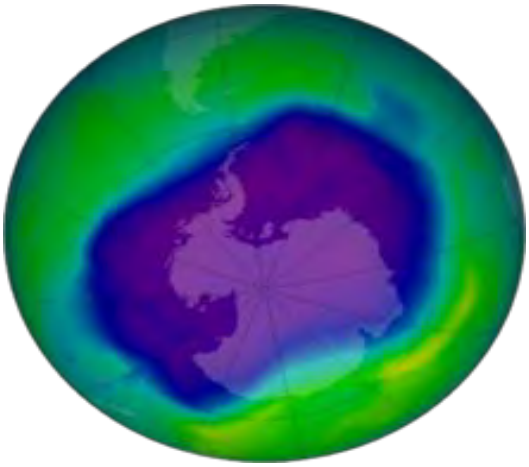


Figure (11) Antarctic Ozone Hole (2006)

Particulates

Alternatively referred to as particulate matter (PM), atmospheric particulate matter, or fine particles, are tiny particles of solid or liquid suspended in a gas. In contrast, aerosol refers to particles and the gas together. Sources of particulates can be manmade or natural. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, living vegetation, and sea spray. Human activities, such as the burning of fossil fuels in vehicles, power plants and various industrial processes also generate significant amounts of aerosols.

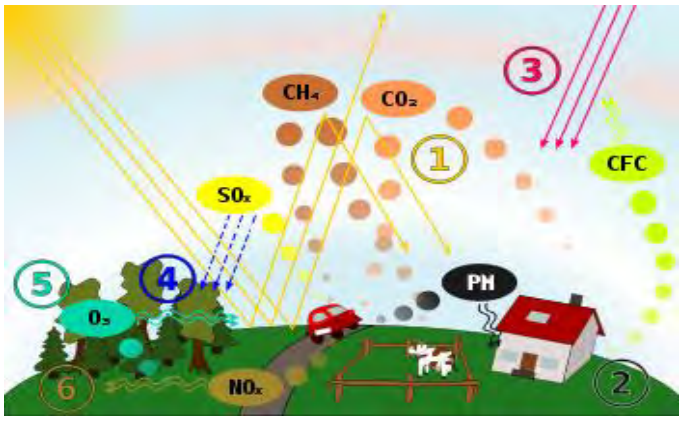


Figure 12: Emission of primary pollutants into the atmosphere

Averaged over the globe, anthropogenic aerosols produced currently account for about 10 percent of the total amount of aerosols in our atmosphere.

Thus various gases including CH_4, CO_2, CFCs, SOx, O_2, NOx, and pH are produced daily from human activities (Figure 12). Increased levels of fine particles in the air are linked to health hazards such as heart disease, altered lung function and lung cancer.

- Persistent free radicals connected to airborne fine particles could cause cardiopulmonary disease.
- Toxic metals, such as lead, cadmium and copper.
- Chlorofluorocarbons (CFCs) - harmful to the ozone layer emitted from products currently banned from use.
- Ammonia (NH_3) - emitted from agricultural processes. Ammonia is a compound with the formula NH_3. It is normally encountered as a gas with a characteristic pungent odor. Ammonia contributes significantly to the nutritional needs of terrestrial organisms by serving as a precursor to foodstuffs and fertilizers.
- Ammonia, either directly or indirectly, is also a building block for the synthesis of many pharmaceuticals.
- Although in wide use, ammonia is both caustic and hazardous.
- Odors — such as from garbage, sewage, and industrial processes
- Radioactive pollutants - produced by nuclear explosions, nuclear events, war explosives, and natural processes such as the radioactive decay of radon.

Indoor Air

The most widely quoted statistic about air quality is indoor air: The US Environmental Protection Agency (EPA) estimates that indoor air can be two- to five-times more polluted than the air outdoors. And while the US EPA is responsible for cracking down on *outdoor* pollution - the smog, ozone and other chemicals that spew from tailpipes and smokestacks -protecting the air *indoors* is largely the responsibility of homeowners. And while many sources of indoor air are fairly obvious and well-known, second-hand smoke, carbon monoxide and radon, to name the most prominent are deadly. There are more insidious, secret sources of pollution that any concerned homeowner or parent should consider.

Use these 25 indoor air quality tips from the American Lung Association to help reduce the risk factors for asthma and other lung illness in your home. The Environmental Protection Agency estimates that people spend 90% of their time indoors, but that indoor air quality can be two to five times more polluted than outdoor air.

Indoor air pollution can threaten the health and the lives of everyone in your family. The single most effective way to keep the air in your home healthy is to keep things out of your home that cause air pollution, including cigarette smoke, excess moisture and chemicals. The second most important strategy is to ventilate to pull dangerous pollutants out of the house. Run the exhaust fans in your bathroom and kitchen. Open your windows. Make sure you have a good exhaust system in place for appliances and stoves.

Pollution doesn't exist solely outside your door. Inside your home, mold, mildew, dust, and odors can cause itchy eyes, scratchy throats, and headaches. According to the Indoor Air Quality Scientific Findings Resource Bank, mold is responsible for 4.6 million current cases of asthma and about 20 percent of other common respiratory infections. Use spot ventilation systems in wet and enclosed areas. When taking showers or washing laundry, turn on ceiling or stand-alone fans to keep bathrooms, basements, and laundry rooms dry. While frying foods or boiling water, turn on kitchen fans that exhaust to the outside to remove odors and humidity. Finally, on those sunny days when the weather is warm and dry, open the windows. Letting the breeze circulate through your home lowers indoor humidity and removes stale smells.

Earthquake

Earthquake is the world largest cause of environmental degradation seconded by flood. It is caused by excessive accumulation of seismic waves (Figure 13) beyond the elastic limits of rocks in the affecting area. Regions situated between continental plate boundaries are most seismically active to experience earthquakes (Plate xvi). Forecasting a probable timing, location, magnitude and other important features of a forthcoming seismic event is called earthquake prediction. Various attempts have been made by environmental seismologists and others to create effective systems for precise earthquake predictions, including the VAN method. Most seismologists do not believe that a system to provide timely warnings for individual earthquakes has yet been developed, and many believe that such a system would be unlikely to give significant warning of impending seismic events. However, sustainability study, involving more general forecasts routinely predict seismic hazard. Such sustainability study estimates the probability of an earthquake of a particular size affecting a particular location within a particular time-span.

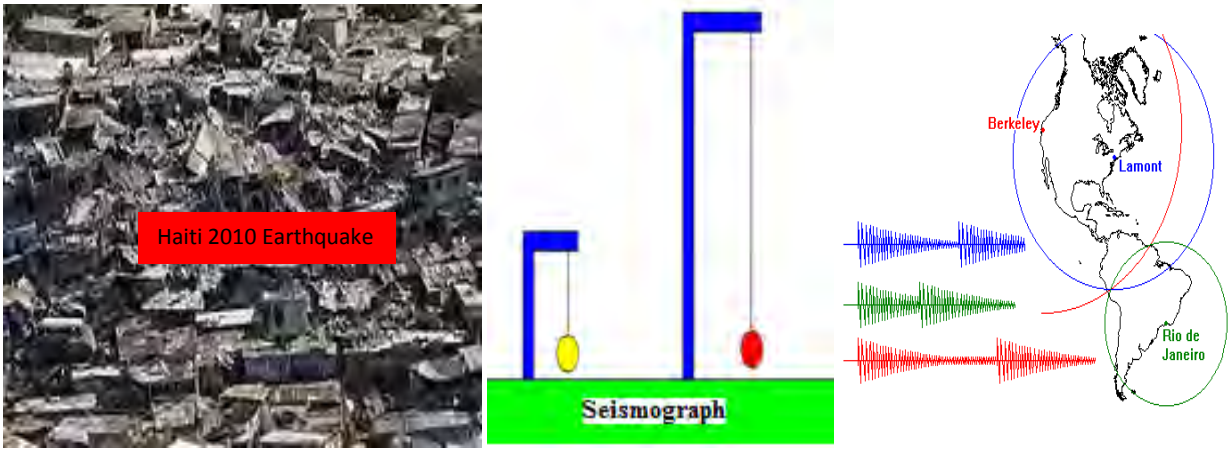


Figure 13: (a) (b)

Photo xvi: Over 350,000 persons died. (a) Instrument that measure earthquake waves (b) Wave motion along plate margins

Seismograph is the instrument for measuring seismic waves. There are primary and secondary earthquake waves, all travel in sinusoidal form and prominent along plate margins.

World Earthquake prone areas

Philippines; U.S.A; Syria; China; Japan; Mexico; India; Italy; Haiti; Afghanistan

Important notes

1. Earthquakes generate waves that travel through the earth
2. Earthquakes occur when rocks slip along faults
3. Faults are classified by the kinds of movement that occur along them
4. Earthquakes don‘t kill people, buildings kill people
5. Magnitude and Intensity are processed by earthquakes
6. Seismic waves are used to map the earth‘s interior
7. Predicting earthquakes is not yet possible

Some important older earthquakes

1755 - Lisbon, Portugal

- *Killed 70,000, Raised Waves in Lakes all over Europe*
- *First Scientifically Studied Earthquake*

1906 - San Francisco

- *Killed 500 (later studies, possibly 2,500)*

- *First Revealed Importance of Faults*

1923 – Tokyo - Killed 140,000 in firestorm

1964 - Alaska

- *Killed about 200*
- *Wrecked Anchorage.*
- *Tsunamis on West Coast.*

1976 - Tangshan, China

- *Hit an Urban Area of Ten Million People*
- *Killed 650,000*

Focus: Location within the earth where fault rupture occurs to originate earthquake
Epicenter: Location on the surface above the focus
Intensity: How Strong Earthquake Feels to Observer
Magnitude: Related to Energy Release

- Determined from Seismic Records
- Rough correlation between the two for shallow earthquakes

How Strong Earthquake Feels to Observer
Depends On: Distance to Quake, Geology and Types of Building
Mercalli linear scale describes intensity while Ritcher logarithmic scale describes magnitude. **Scale:** 1-4 (minor vibration); 4-6 (Felt by people, trees); 6-7 (Alarm, buildings crack); 7-8 (Land break, land slide, buildings collapse); ≥8 (total destruction, city crumble with uncountable death toll).

Deforestation and Desertification

Africa is particularly vulnerable to desertification. About two thirds of the continent consists of desert or dry lands. The obvious causes of desertification and deforestation consist of major ecosystem changes, such as land conversion for various purposes, over-dependence on natural resources and several forms of unsustainable land use. Continuous falling of trees for timber and firewood (Plate xvii) and indiscriminate bush burning are common players. However, the issue of desertification is inseparable from social problems such as poverty and land tenure issues. Politics, war and natural disasters affect the movements of people and thus impact on the land. A coalition of non-governmental organizations, Civil Rights Congress (CRC) and Climate Change West Africa Region Network (CLICWAN), have in 2009 stated that the Northern Nigeria stand to be wiped off, following the persistent desert encroachment of the region.

Photo xvii: Deforestation to Desertification

Statistics have shown that desert is encroaching with about 600 to 700 meters annually or more than that in contrast to 10 years back when there was a shelterbelt program. The northern states so affected are Sokoto, Kebbi, Jigawa, Katsina, and Zamfara due to their North West geographical locations. The Federal Government says it has set aside N10 billion to halt desert encroachment in the Northern part of the country.

Causes and Effect of Desertification in Nigeria

Desertification, according to the Princeton University Dictionary is the conversion of grassland or an already arid land into a desert through indiscriminate human activities magnified by droughts. (Drought is a long period of dry weather in which there is not enough rain for successful growth of plants). About 11 states in Nigeria are desert prone already. Below is a map of Nigeria showing the desert prone states (Figure 14).

Figure 14: map of Nigeria showing the desert prone states

Desertification in Nigeria is believed to be caused by the following factors:

1) Deforestation: This is the process whereby vegetation is cut down without any simultaneous replanting for economic or social reasons.
2) Bush Burning: Bush burning in Nigeria is seen as a means of hunting bush animals by hunters especially the Grass cutters and also seen by some local farmers as a means of clearing land for farming.
3) Erosion: This is the process by which soil and rock particles are removed from the Earth's Surface by natural processes such as wind or water flow and then transported and deposited in other locations.
4) Over Cultivation by farmers: This is the situation whereby a particular plot of land is being used for repeated farming over a long period of time thereby resulting in the loss of nutrients by the land in use.
5) Over grazing: This occurs when there are continuous activities of animal especially cattle on a particular area of land through the process of feeding. This brings about reduction in groundwater.

Effects of Desertification

1) Migration: Areas affected by desertification is usually known to be of no use to the inhabitants as there will be a great reduction in agricultural productions and exposure to risks of natural disaster like flooding. Such population is likely to move to a better yielding area for survival which would result in competition and sometimes over population in such areas thereby bringing imbalance in population distribution.

2) Exposes soil to heat and rain: When forests are cleared, vegetation which covers the soil is either injured or totally removed. This exposes the bare soil to extreme conditions produced by the sun‘s heat and rainwater.

3) Soil becomes less usable: Desertification brings about exposure of land and loss of some nutrients from the land through the action of rain and wind thereby rendering this soils less usable

4) Food Loss: Soils on desert land is not usually suited for growing food. Therefore the amount of food being produced in a desert prone area declines with increase in desertification. If the population is growing, this may lead to economic problems and starvation.

5) Loss in number of biodiversity: This is probably the most serious consequence of desertification. It is the destruction and extinction of many plant and animal species, many of whom remain unknown and whose benefits will be left undiscovered.

Acres of Land Affected

Deforestation has seriously affected some states in the northern part of Nigeria. It has already affected over 22000 hectares of land. The key states include Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa, Yobe, Adamawa, Bauchi, Gombe and Borno.

A Projection of Desert Encroachment in Nigeria

It is estimated that 43% of the total land area of the country is prone to desertification. It is also believed that over 40 million people in Nigeria are affected by desertification. With these kinds of statistics, it is a matter of time before the effects begins to bear overwhelmingly on the socio-economic life of the people. Migration will increase and there will be constant friction between the original inhabitants of arable land and the migrants. There will be more pressure on the declining arable lands. Food shortages will set in and ethnic clashes would increase.

Nigeria's Plan to Combat Desertification

The Great Green Wall Program, which was introduced by President Olusegun Obasanjo and was adopted by African Union (AU) is one of the major strides the country has taken in recent times. Other activities include planting of 100,000 hectares of shelterbelt and orchard/garden, promotion of livelihood activities in communities and provision of clean energy devices. There is also public sensitization, community mobilization and capacity building of communities and implementing institutions and procurement of about 10millionassorted free seedlings. The major challenge of most government plans is that it overlooks the institutions that will drive it faster. The issue of environmental control should be engraved into our school curricula from primary school level. This will complement the mass mobilization campaigns and make environmental management a lifestyle.

Drought

This is an extended period when a region notes a deficiency in its water supply whether surface or ground water. This global phenomenon has a widespread impact on agriculture. Lengthy periods of drought have long been a key trigger for hunger, poverty, mass migration and other humanitarian crises within Africa and the Sahel. For example, Lake Chad, once the 6th largest lake in the world, has shrunk to 1/10 of its size 35 years ago, from 25,000 km2 in the 1960s to 500 km2 today. It was originally 7m deep in the 1960s and now averages only 1.5m deep. These changes in size are mainly due to a changing climate and the reduction of inflow into the lake. As the Sahara Desert encroach to northern Nigeria, Lake Chad shrinks to sand dunes

Plate xviii: Desertification to Drought

Stop deforestation or go by the rule of "Cut one tree and plant two" Tree cutting without replacement lead to desertification and drought (Plate xviii).

Hurricane

Hurricane**s** are destructive weather systems which involve strong winds, heavy rain and thunder. Examples are Hurricane Katrina (2005, photo xix), with damage estimate cost of $108 billion and Hurricane Sandy (2012), with damage estimate cost of $65 billion. Winds exceeding 80 mph cause flooding and damage which result in injury and death. Houses, buildings, cars and other vehicles will be ruined. and people will be killed. When a hurricane is done, it sends a HUGE downpour. That means it rains VERY hard. Some hurricanes may cause floods or landslides with Strong wind and storm surge, and the possibility of tornadoes. Storm surge is the fast uprising of sea level that happens when a hurricane approaches the coast.

Galveston Island on the Texas coast has suffered much damage due to hurricane-caused storm surges. A large sea wall has been built to help reduce the damage caused by the surges. The frequent occurrence of storm surges has also played a part in the destruction of Highway 87 along the Texas coast, which was used by many local beach-goers. Heavy rainfall is produced by hurricanes. The amount of rainfall usually varies between 6 and 12 inches. The most deadly rainfall occurs inland because a hurricane produces destructive floods. The flooding is the major cause of hurricane-related deaths. The danger from flooding depends on the storm's speed, other weather systems in the same area, the ground saturation, and the terrain.

Plate xix: Hurricane Sandy 2012

Sometimes a hurricane can last for days and produce floods. Sometimes the remnants of the hurricane may join with other storm systems like tornadoes (Plate xx) causing severe rainfall in states far away from where the hurricane moved inland. Hurricane Camille in 1969 came into the Gulf Coast area, but the remnants combined with a cold front in the mountains of Virginia and produced 30 inches of rain. This storm also killed 109 people. A high wind is another effect of hurricanes. The wind speed and potential damage of a hurricane is expressed as categories according to the Saffir-Simpson Hurricane Scale. These high winds can easily destroy homes and buildings. Debris, such as signs or broken materials, can become airborne and penetrate just about anything with missile-like force. Tornadoes are often produced by hurricanes. Even though the tornadoes most likely form in the right-front quadrant of the hurricane, they can appear elsewhere. During Hurricane Beulah in 1967, 141 tornadoes developed on the Texas coast. The impact of hurricane on natural environments is that most of plants that are not secured in the ground will be blown away. One effect of hurricanes on the environment is they cause erosion. Mostly, trees and tree branches are down.

Remarks: *Hurricanes are not given names, rather tropical storms are given. They retain their name if they develop into a hurricane. If a tropical storm reaches a sustained wind speed of 74 miles per hour it becomes a hurricane. Hurricanes occur every year and sometimes two or three hurricanes can be active at the same time. Using names for these hurricanes makes it much easier for meteorologists and the public to communicate about specific hurricanes. World climatologists should intensify research in hurricane prediction. Training of climatologists should emphasize on hurricane study, making available improved research equipments in hurricane research institutes.*

Plate xx: Tornadoes during Hurricane Beulah in 1967

Volcano

A volcano is a mountain that opens downward to a pool of molten rock below the surface of the earth (Plate xxi). When pressure builds up, eruptions occur. In an eruption, gases and rock shoot up through the opening and spill over or fill the air with lava fragments. Eruptions can cause lava flows, hot ash flows, mudslides, avalanches, falling ash and floods. The danger area around a volcano covers about a 20-mile radius. Fresh volcanic ash, made of pulverized rock, can be harsh, acidic, gritty, glassy and smelly. The ash could cause damage to the lungs of older people, babies and people with respiratory problems. Volcanic lightning occurs mostly within the cloud of ash during an eruption, and is created by the friction of the ash rushing to the surface. Roughly 200 accounts of this lightning have been witnessed live. An erupting volcano can trigger tsunamis, flash floods, earthquakes, mudflows and rock falls. More than 80% of the earth's surface is volcanic in origin. The sea floor and some mountains were formed by countless volcanic eruptions.

Plate xxi: Japan –2009 volcano

Gaseous emissions from volcano formed the earth's atmosphere. There are more than 500 active volcanoes in the world. More than half of these volcanoes are part of the "Ring of Fire," a region that encircles the Pacific Ocean. Active volcanoes in the U.S. are found mainly in Hawaii, Alaska, California, Oregon and Washington, but the greatest chance of eruptions near areas where many people live is in Hawaii and Alaska. The sound of an eruption volcano can be quiet and hissing or explosive and booming. The loud cracks travel hundreds of miles and do the most damage, Hurricane Sandy storm surge including hearing loss and broken glass. The most deadly eruptions have occurred in Indonesia, with tens of thousands of lives lost to starvation, tsunami (as a result of the eruption), ash flows, and mudflows.

Road Failure

There are various types of asphalt failures, each with its own unique causal classifications and repair approaches. Knowing the type of failure and its cause is absolutely essential to providing an accurate long-lasting repair solution that not only repairs the failure, but also addresses root cause. Potholes are what most people think of when they talk of pavement failures. These are usually non-functional pavement areas where the pavement has completely failed, exposing the base material below it. Potholes usually pose liability issues such as causing vehicular suspension damage, or tripping hazards if they reside within pedestrian walkways. Potholes are often the result of several years of failing pavement in areas of fatigue where pre-emptive repair was not done until the area has completely failed. In the southeastern Nigeria, many road failures link with erosion and flood, abandon borrow pits and poor drainage.

Photo xxii: Gully erosion causing road failure

In most cases, the roads are found cut into two, becoming impassable with high accident potentials. Greater of road accidents causing loss of lives and destruction of property are attributed to road failure (Plate xxii).

Erosion

Over sixty five percent of soil on earth is said to have displayed degradation due to soil erosion, salinity and desertification (Okin, 2002). Much in the rain forest belt of the world, rain drops on the shallow streams, splash the soil, increase turbulence and sediment carrying capacity. The transition to agriculture from natural vegetation often does not provide protective cover to the soil. Soil to gully erosion (Plate xxiii) is one of the most serious environmental problems facing human society. Humans obtain more than 99.7% of their food (calories) from the land and less than 0.3% from the oceans and other aquatic ecosystems. Each year about 10 million ha of cropland are lost due to soil erosion, thus reducing the cropland available for food production.

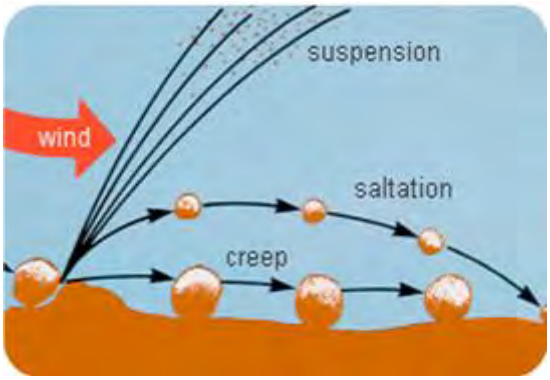


Plate xxiii: Erosion devastates farm land in parts of eastern Nigeria.

Figure 15: Wind erode and transports particles in different ways depending on their size

The loss of cropland is a serious problem because the World Health Organization reports that more than 3.7 billion people are mal-nourished in the world. Overall soil is being lost from land areas 10 to 40 times faster than the rate of soil renewal imperiling future human food security and environmental quality (Pimentel, 2006). Southern Nigeria is affected by massive and expanding gully erosion, an advanced form of land degradation. The root causes of gully erosion are complex, and climate change amplifies the challenge. The Nigeria Erosion and Watershed Management Project (NEWMAP) is mobilizing resources to tackle erosion challenges in Nigeria.

Remarks: *Many road failures occur due to erosion originating from roadside excavation or the abandoned borrow pits. Channelization of runoff water to nearby water way is necessary. Although water is a much more powerful eroding force than wind, wind erosion is much a serious issue in arid environments such as deserts. Wind erosion and deposition changes shape of the Earth surface, cause environmental and health hazards.*

Abandoned Mine Pits

The increasing number of abortive and abandoned quarry pits (Plate xxiv) and the several associated geo-environmental hazards have given cause for greater concern. Environmentalists, governments, and the general public now seek innovative ideas, and research collaborations that will reduce incidents of abortive and abandoned quarry pits. Quarry operators may be charged with the responsibility to reclaim quarry pits as soon as their operation is over. Indiscriminate roadside excavation of borrow pits for road construction and other civil Engineering works without the intention of restoring or reclaiming the pits have left much to be desired in terms of the potential hazards.

Abandoned road sides borrow pits causes landslides, rock falls, gully erosion, road failure, and ground water contamination with high accident risk factor. Abandoned borrow pits show evidence of unsustainable engineering practices. Firstly, there should be no road side excavation, and operators of borrow pits should get the necessary site approval from government ministries of environment before opening a borrow pit. Secondly, geotechnical assessment must be carried out to certify adequacy of a site, in terms of its soil characteristics to avoid cases of trial pits that leads to abandon borrow pits. There is loss of human life and arable land, ecosystem disorder with poor environmental quality and safety. Stagnant water in the pits supports daily breeding of mosquito (Nwachukwu and Eburukevwe, 2013).

Plate xxiv: Abandoned quarry pit turn lake

Remarks: *Surface mine pits (Quarry pits) must not be abandoned at end of mining. Operators must be responsible to the immediate reclamation to maintain environmental safety, environmental quality and ecosystem. Where reclamation is not accomplished, perimeter fencing of the pit is obvious. Warning signs placed at strategic points within or up to 500 m from the pit is important. This will control movement into the pits by humans, roaming animals and cattle grazing, for safety.*

Landslide

Incidences of landslide, represents a serious environmental problem in different areas. Landslide is described as a down slope movement of rock and soil along a slip surface (Plate xxv). It is also associated with disturbance of the equilibrium which normally exists between stress and strength of materials resting on slopes and this relationship is dependent on factors like height, steepness of the slope, density, strength, and friction of the material on the slope. Recent study by Nwachukwu and Eburukevwe (2013) revealed a slope angle between 80 to 85° as active for sliding. The slope is weakened by water saturation and overburden pressure after heavy rainfall. The accompanied landslides may lead to loss of hundreds of life and damage to properties. Abandoned borrow pits not reclaimed are active slide areas associated with unquantifiable loss of properties.

Plate xxv: Land slide destroy homes, life

Sliding angle, overburden stress, resisting force, water saturation, pit slope angle, and pit effective depths, aid the occurrence of landslides in abandoned mine pits.
Remarks: *Embankments should be well maintained and monitored, possibly with slide barrier walls to check landslides.*

Flooding

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss (Plate xxvi). As much as 90 percent of the damage related to all natural disasters (excluding droughts) is caused by floods and associated debris flows. Melting snow can combine with rain in the winter and early spring; severe thunderstorms can bring heavy rain in the spring and summer; or tropical cyclones can bring intense rainfall to the coastal area.

Floods are one of the leading causes of death from natural disasters in the United States. Over 200 flood-related fatalities are reported each year with over half being vehicle-related as people try to drive through floodwaters. Floods can damage and devastate homes and farms, displace families as well as pets and livestock, damage crops, and disrupt agricultural business. Heavy rains have in recent time unleashed floods in parts of Nigeria and other tropical rain forest belt of West Africa, testing the countries‘ emergency preparedness for flood events. The 2012 floods in parts of Nigeria displaced about 7 million people.

Plate xxvi: Terrible flood, great disaster

Remarks: *Flooding can be very disastrous. Continuous monitoring of rainfall intensity and sea level rises over climate change responses is essential. This will enable prediction of flood events in a region or locality. Environment Agency warns of flooding risk across much of England as scientists reveal January-May 2014 period was wettest in over a century*

5.5 Environmental Health Issues

Diseases

The effects of climate change such as drought and environmental degradation (Plate xxvii) has created ideal conditions for the emergence, resurgence and spread of infectious diseases. These diseases kill more than 17 million people annually. Increased climate change has also altered the functional balance among predators and prey, which is important for controlling the proliferation of pests and pathogens. Sometimes wetter weather may already be extending the range of infectious diseases beyond regions where they are endemic. These were some of the disturbing conclusions of a study by Epstein and Ferber (2011) of the Centre for Health and Global Environment, Massachusetts, USA. In a book titled: *Changing Planet, Changing Health*. Global warming may cause one million additional deaths from malaria each year,‘ the book warns.

The prevalence of human diseases is increasing rapidly worldwide, as is the number of deaths from diseases. The rapid expansion of human populations is a major factor in the rise of environmental related diseases: Humans living in crowded urban areas are in an ecosystem that is ideal for the resurgence and rapid spread of old and new diseases. Sustainability study this century must emphasize disease surveillance along environmental degradation. How much disease could be prevented through better management of our environment? The environment influences our health in many ways. Most disease carriers breed in dirty wet environments. For example, environment littered with moist wastes, stagnant water in cans and pools support breeding of mosquito that causes malaria.

Malaria

Malaria is a life-threatening blood disease caused by a parasite that is transmitted to humans by the ***Anopheles*** mosquito. Malaria is a preventable and treatable disease. It was not until 1880 that scientists discovered that malaria was a parasitic disease which is transmitted by the *anopheles* mosquito. The mosquito infects the host with a one-cell parasite called *plasmodium*. By the end of the 18th century, scientists found out that Malaria is transmitted from person-to-person through the bite of the female mosquito, which needs blood for her eggs. Approximately 40% of the total global population is at risk of Malaria infection. During the 20th century the disease was effectively eliminated in the majority of non-tropical countries. According to the World Health Organization (WHO) Media Center Report, the under listed information are real.

- Approximately 660,000 people died from malaria in 2010 globally, most of them were African children.
- There were an estimated 219 million cases of malaria infection in 2010 worldwide.
- Malaria is a preventable and curable disease.
- Malaria mortality rates have fallen by over 25% since 2000. In the WHO African region rates have dropped by 33%.
- The malaria burden in many parts of the world is being dramatically reduced thanks to increased malaria prevention and control measures.
- Travelers from malaria-free areas who enter endemic areas are especially vulnerable to severe symptoms when they become infected.
- About 80% of all malaria cases occur in just 17 countries.

- Nigeria and the Democratic Republic of Congo account for more than 40% of all malaria deaths worldwide.

Roll Back Malaria

WHO is also a co-founder and host of the Roll Back Malaria partnership, which is the global framework to implement coordinated action against malaria. The partnership mobilizes for action and resources and forges consensus among partners. It is comprised of over 500 partners, including malaria endemic countries, development partners, the private sector, nongovernmental and community-based organizations, foundations, and research and academic institutions.

Plate xxvii Drought induced rain pit as source of water
The use of rain pits for rural water storage must stop, for safety of public health.

Efforts of World Health Organization (WHO) in making treatments and vaccinations readily available for diseases control in developing countries notwithstanding, it is important to also focus on improving the environmental conditions in these countries (Figure 16). Environmentally-related‘ disease burden is much higher in the developing countries than in developed countries. Many WHO studies have examined the collective disease burden attributed to environmental risks globally and regionally, quantifying the amount of death and disease caused by environmental degradation: unsafe drinking water, poor sanitation, air pollution and unsafe food items produced from contaminated soil. These reports confirm that approximately 25% of the global disease burden, and more than one-third of the burden among children, is due to environmental factors. Environment determines the quality of life or better to say that environment is life.

Figure 16: Global disease burden Prüss and Corvalán (WHO, 2006)

The results suggest that an important transition in environmental risk factors will occur as countries develop. For some diseases, such as malaria, the environmental disease burden is expected to decrease with development. However, the burden will increase from other non communicable diseases, such as chronic obstructive pulmonary disease (COPD). This is expected to level approximately with those seen in more developed regions of the world. Children suffer a disproportionate share of the environmental health burden. Globally, the per capita number of healthy life years lost to environmental risk factors was about 5-times greater in children under five years of age than in the total population.

Diarrhea, malaria and respiratory infections all have very large fractions of disease attributable to environment, and also are among the biggest killers of children under five years old. In developing countries, the environmental fraction of these three diseases accounted for an average of 26% of all deaths in children under five years old. Prenatal conditions (e.g. prematurity and low birth weight); protein-energy malnutrition and unintentional injuries are other major childhood killers that also have a significant environmental component particularly in developing countries. DALYs is a weighted measure of death, illness and disability. Diseases with the largest environmental contribution in DALYs are in decreasing order:

1. Diarrhea (38%)
2. Lower Respiratory infection (25%)

3. Other unintentional injuries (14%)
4. Malaria (12.5%)
5. Road Traffic injuries (10%)
6. COPD (8%) = Chronic obstructive, pulmonary disease
7. Perinatal conditions (7.5%)
8. Ischaemic hearth disease (7.5%)
9. Childhood cluster disease (7%)
10. Lead-caused mental retardation (7%)
11. Drowning (6.5%)
12. HIV/AIDS (5.5%)
13. Malnutrition (5.5%)
14. Cerebrovascular Disease (5%)
15. Others

The environment plays a powerful role in the transmission of infectious diseases. In epidemiology, environmental disease is disease caused by environmental factors that are not transmitted genetically or by infection. The most common environmental factors that influence the spread of communicable diseases prone to cause epidemics are:

- Water from shallow substandard wells supply water of poor quality
- Poor sanitation such as improper disposal of human and animal wastes
- Food insecurity such as cultivated in polluted soil like around mechanic village
- Climate change such as effect of flooding.

A lack of safe water, inadequate excreta disposal facilities, poor hygiene, poor living conditions and unsafe food can all cause diarrheal diseases. These diseases are a major cause of suffering and death in an emergency situation. Climate can affect disease transmission in a variety of ways. The distribution and population size of disease vectors can be heavily affected by local climate. Flooding after heavy rains can result in sewage overflow and widespread water contamination. In addition, there is some evidence to suggest that pathogens can be spread from one region to another by air. Environment has no boundary when considering human exposure to pathogens. The air environment is the easiest exposure pathway of pathogen to human, followed by water and soil. Daily inhalation of toxic and carcinogen substances increase disease burden on human beings all over the world.

6.0 Biodiversity and Ecosystem

Biodiversity

Biodiversity is the degrees of variation of life which can be referred to as genetic variation, species variation, or ecosystem variation within an area, biome, or planet. It is the variety of all living things; the different plants, animals and micro organisms; the genetic information they contain and the ecosystems they form**.** In ecology the word sustainability describes how biological systems remain diverse and productive over time. Long-lived and healthy wetlands and forests are examples of sustainable biological systems. For humans, sustainability is the potential for long-term maintenance of well being, which has ecological, economic, political and cultural dimensions. Sustainability requires the reconciliation of environmental, social equity and economic demands. Healthy ecosystems and environments are necessary to the survival and flourishing of humans and other organisms. Human activity is having a significant and escalating impact on the biodiversity of world ecosystems, reducing both their resilience and bio-capacity (Walter, 2006).

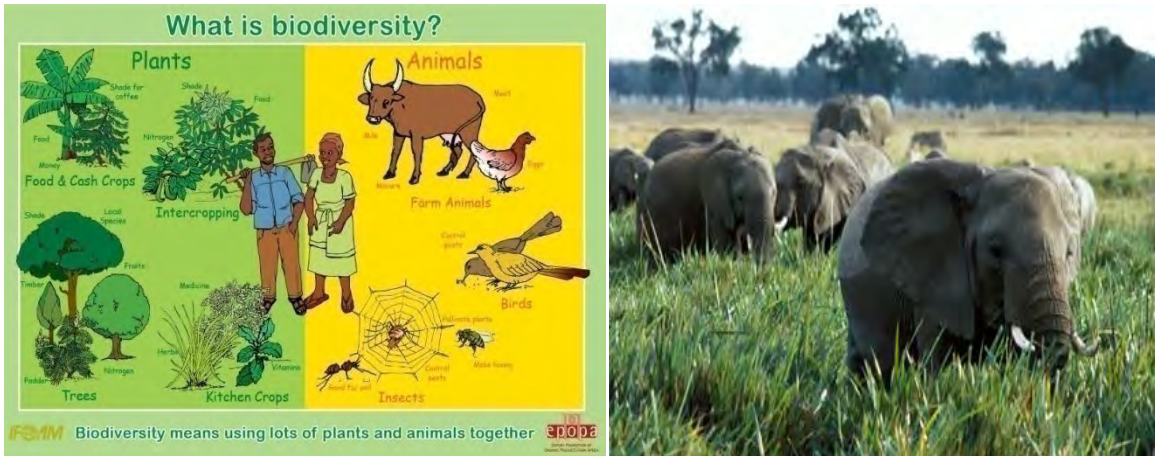


Photo xxviii Preserving biodiversity

Loss of biodiversity stems largely from the habitat loss (Photo xxviii) and fragmentation produced by the human appropriation of land for development, forestry and agriculture as natural capital is progressively converted to man-made capital. Land use change is fundamental to the operations of the biosphere. This is because alterations in the relative proportions of land dedicated to urbanization, agriculture, forest, woodland, grassland and pasture have negative effects.

Photo xxiv: Canopy protection of biodiversity

The extended effects on the global water, carbon and nitrogen biogeochemical cycles can impacts natural and human systems (Kreb, 2001). Biodiversity is the variety of species in an ecosystem and variability *within species* (genetic differences among individuals) and *of species* (the number of different species). Today, species are becoming extinct 1,000 times faster than the natural rate, resulting in enormous losses in biodiversity.

Remark: *The world is currently undergoing the greatest loss of species since the dinosaurs. This loss of* ***biodiversity*** *poses a serious threat to humans. Some people think about the importance in developing new medications, while others consider ecosystem as being significant in fishing. Different approaches exist when making canopy case to preserve biodiversity (Photo xxiv). There are many arguments about biodiversity protection. Students will discuss the importance of maintaining ecosystems and will learn about the various arguments that people make in favor of preserving the Earth's biodiversity*

Ecosystem

A system formed by the interaction of a community of organisms with their environment such as aquatic ecosystem (Photo xxv). It is a complex set of relationships among the living resources, habitats and residents of an area. It includes plants, trees, animals, fish, birds, micro-organisms, water, soil and people, each depending somehow on the other. There are two forms: Aquatic (Water- ocean, river, lake and swamp areas) and terrestrial (Land- tundra, taiga, temperate deciduous forest, tropical rain forest, grassland and desert areas).

Photo xxv; Aquatic ecosystem

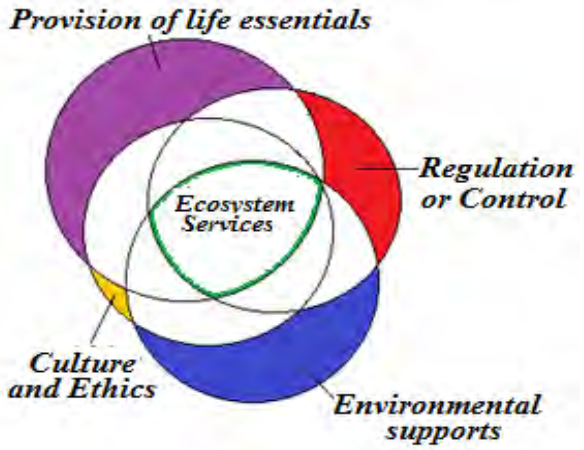


Figure 17: Four categories of Ecosystem services

Ecosystem varies greatly in size and composition and if one part of an ecosystem is destroyed or disappears, the rest will feel the impact. To this effect ecosystem become the complex of a community of organisms and its environment functioning as an ecological unit. Ecosystems are essential to our well-being and prosperity as they provide us with food, clean air and fresh water. Ecosystem management is a process that aims to conserve major ecological services and restore natural resources while meeting the socioeconomic, political and cultural needs of current and future generations as illustrated in figure 17.

Humankind benefits in a multitude of ways from ecosystem. Collectively, these benefits are known as *ecosystem services*. Ecosystem services are regularly involved in the provisioning of clean drinking water and the decomposition of wastes. While scientists and environmentalists have discussed ecosystem services implicitly for decades, the ecosystem services concept itself was popularized by the Millennium Ecosystem Assessment (MA) in the early 2005. This grouped ecosystem services into four broad categories: *provisioning*, such as the production of food and water; *regulation*, such as the control of flood, climate and disease; *environmental supporting services*, such as nutrient cycles and crop pollination; and *cultural*, such as spiritual and recreational ethics.

Remarks: *Human beings all over the world depend on ecosystem services such as clean water and oxygen, marine and other food resources, and a stable climate. However, as a result of rapid development, ecosystems are being quickly degraded. To preserve ecosystems and maintain biological diversity, society must reduce the environmental burden on ecosystems and promote their recovery and sustainability.*

Ecosystem and biodiversity strive in the same environmental system of planet earth. The two are both related and interconnected operating in a biogeochemical cycle apparently representing life and the sustenance of life on earth. An ecosystem is a community of living organisms in conjunction with the nonliving components of their environment, interacting as a system. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows. Biodiversity on the other hand is the variety of all living things; the different plants, animals and micro organisms, the genetic information they contain and the ecosystems they form constitute the real world.

Ecosystem processes

This is the physical, chemical and biological actions or events that link organisms and their environment. Ecosystem processes include decomposition, production (of plant matter), nutrient cycling, and fluxes of nutrients and energy (Figure 18). The four fundamental ecosystem processes are: water cycle, mineral cycle, solar energy flow, and community dynamics. Monitoring these four processes tells us whether landscape health is improving or deteriorating. Ecosystem processes therefore runs on input and output of nutrients in the natural environment. At both input and output, the sun provides the energy, producing heat. There is wide spread of plants and movement of animals, weathering of soil, accumulation of organics and transport to deposition.

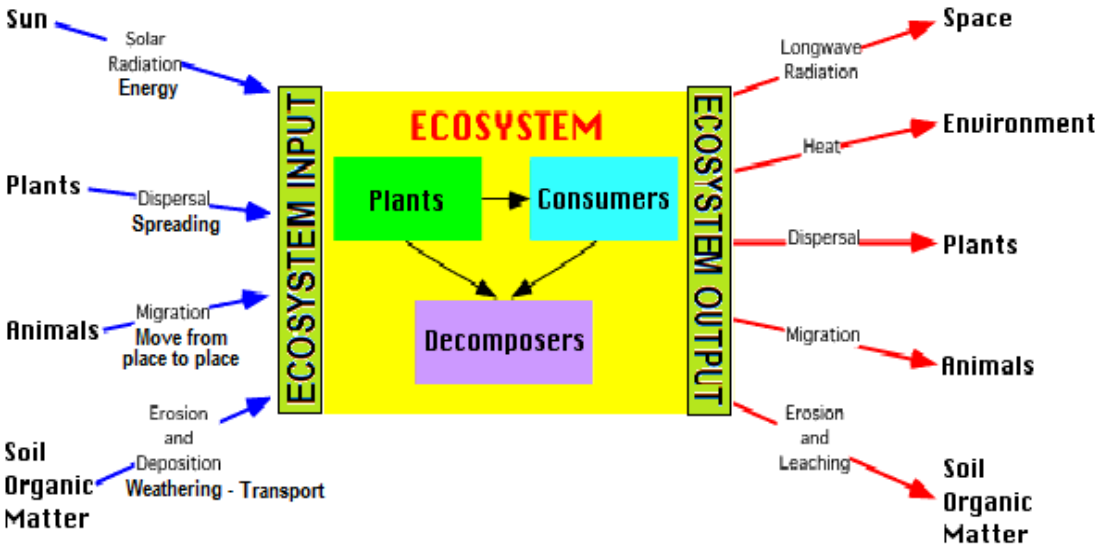


Figure 18: Ecosystem Processes

7.0 Sustainability Issues

7.1 Sustainability studies

These are studies related to the interdisciplinary perspectives of the sustainability concept. It is education for sustainable development. Programs include instruction in sustainable development, earth science, environmental policies, ethics, ecology, landscape architecture, city and regional planning, economics, natural resources, sociology, and anthropology. The world is facing greater challenge in the 21st century: we need to redesign and rethink much of our way of life to make it sustainable given the planet‘s limited and fragile resources. Rigorous science has explained that current consumption trends threaten the planet with several issues such as climate change by placing hardships on vulnerable peoples. Modern systems ranging from transportation networks to community building to food production will need to be significantly changed and adapted to this new reality. The leaders of this critical effort will be the next generation of college-educated students. Sustainability studies prepare students for global citizenship while providing the knowledge and skill sets that are increasingly in demand.

Sustainability study students gain understanding of the ways in which these three goals are interdependent and explore how they best can be pursued over the long term on local, national, and global levels. Education for Sustainable Development allows every human being to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future. The overall goal of sustainability is to achieve sustainable development. UNESCO is the lead agency for the UN Decade of Education for Sustainable Development (2005-2014). According to the International Institute for Sustainable Development; *"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key concepts:*

- *the concept of **needs**, in particular the essential needs of the world's poor, to which overriding priority should be given; and*
- *the idea of **limitations** imposed by the state of technology and social organization on the environment's ability to meet present and future needs."*

7.2 Sustainable Initiative

Sustainable initiatives are voluntary, non-regulatory programs within sustainability studies that assist industry and citizens to protect their immediate and the global environments. The goal of the Sustainable initiatives programs is to promote sustainability concepts anywhere in the world.

Few examples of sustainable initiative programs are:
The one man one tree planting program
The shallow aquifer decontamination program
The environmentally friendly automobile mechanic village concept
The hybrid automobile technology program
The environmentally friendly alternative energy programs

7.3 Sustainable Engineering

This is the process of using resources in a way that does not compromise the environment or deplete the materials for future generations. It is the process of designing operating systems such that they use energy and resources at a rate that does not compromise the natural environment, or the ability of future generations to meet their own needs. Sustainable engineering refers to the integration of social, environmental, and economic considerations into product, process, and energy system design methods. Generally, sustainable engineering minimizes environmental impacts across the entire lifecycle of an engineered system while simultaneously maximizing the benefits to social and economic stakeholders. Sustainable engineering practice provides environmental safety and safety of the consumers. It is an engineering system that stands the test of time, durable and with high degree of efficiency while utilizing affordable and available input materials. This should be the primary design goal of all engineering projects.

7.4 Sustainable Agriculture

In simplest terms, sustainable agriculture is the production of food, fiber, or other plant or animal products using farming techniques that protect the environment, public health, human communities, and animal welfare. This form of agriculture enables us to produce healthful food without compromising future generations' ability to do the same. Sustainable agriculture can be defined in many ways, but ultimately it seeks to sustain farmers, resources and communities by promoting farming practices and methods that are profitable, environmentally sound and good for communities. Sustainable agriculture fits into and complements modern agriculture. It rewards the true values of producers and their products. It draws and learns from organic farming and irrigation systems. It works on farms and ranches large and small, harnessing new technologies and renewing the best practices of the past. As defined by the U.S. Congress, sustainable agriculture is: "an integrated system of plant and animal production practices having a site-specific application that will, over the long term:

- Satisfy human food and fiber needs through mass production
- Enhance environmental quality and security of food products
- Make the most efficient use of nonrenewable resources and on-farm resources
- Sustain the economic viability of farm operations; and
- Enhance quality of life of farmers and society as a whole.

7.5 Sustainable Architecture and housing

This is architecture that seeks to minimize the negative environmental impact of buildings by efficiency and moderation in the use of materials, energy, and development space. Sustainable architecture uses a conscious approach to energy and ecological conservation in the design of the built environment. Sustainable architecture can be described with different names such as: Eco-housing, Green building, Sustainable design or environmentally sound housing. Sustainable architecture provides energy efficient buildings. These are structures that take less from the Earth and giving more to people. In practice, "green" housing varies widely. It ranges from being energy efficient to having green roof. From using nontoxic interior finishes to being constructed of recycled materials and completely powered by the sun. Generally, sustainable architecture promotes land conservation, energy efficiency, renewable energy, and water conservation. It considers environmental impacts and waste minimization; create a healthy and comfortable environment; reduce operation and maintenance costs; and address issues such as historical preservation, access to public transportation, water supply and other community infrastructure systems. The entire life cycle of the building and its components is considered, as well as the economic and environmental impact and performance.

7.6 Sustainable Management

This refers to a comprehensive management framework that bridges the gap between commerce and the common good. It holds a strategic approach to management and policy that requires a blending of social, natural and financial capital to create an integrated bottom line. This means sustainable management considers not just the financial benefits of a decision, but also its economic, environmental and social impact. By doing so, sustainable management transforms business and public policy to bring about a more just, prosperous and sustainable world. Ultimately, sustainable management involves creating wealth and minimizing future risk for individuals, companies and communities while optimizing and restoring economic, environmental and social value. It is not a business or policy cost but a means to improve strategy, stakeholder value and financial performance with minimal waste.

Sustainable management is about realizing opportunities and being proactive. It makes possible to plan effectively and profitably. It enables healthful and affordable products and services and to address global issues such as poverty, ecosystem degradation and human rights. Sustainable management is a resource management technique that seeks to make any harvesting or consumption of natural resources as sustainable as possible. Proactive management philosophy takes the approach that managers should act first to correct problems or be proactive by establishing sustainable business practices. This philosophy can be somewhat difficult, as it requires more time and communication to achieve goals and objectives.

7.7 Sustainable Urban and Regional Planning

Sustainable urban and regional planners attempt to find ways of organizing the structure and function of cities, including land use, buildings, and infrastructure (e.g. water, wastewater, flood management, transport, etc.), in order to bring them into greater harmony with their natural or original surroundings. Sustainable urban plan for example must take cognizance of population and its growth rate and programmed for periods between 50 to 100 years. Sustainable planning attempts to reduce the ecological impacts of both the urban footprint such as sprawl and the source areas from which resources are imported to the city. Sprawl is the spread of suburban development, usually into rural and sub-rural landscapes. It may also mean the densification and spread of industrial and urban footprints. In either case, the sprawl is minimally constrained by land use zoning and is characterized by significant land consumption. Other constrains are centralized infrastructure for water and wastewater, transport and disregard for ecosystem services such as wetlands as components of floodplain. Management and minimal concern for amenities such as parks, greenways, and wildlife may apply. Sustainable planners include both social and economic factors in order to plan an energy- and materials-efficient economy with minimal pollution and equitable distribution of benefits.

One of the first principles of sustainable design and urban planning is to recognize that we are all connected, and what one of us does affects us all. As such, sustainable design and urban planning is about creating sustainable "communities." This means that we need to be concerned not only with the direct and obvious negative environmental impacts that can be traced to our individual actions, but that we also need to address the collective and cumulative impacts of our societal activities. That is where urban and regional design and planning comes in. Urban and regional design and planning is how we as a community or society can work cooperatively to build sustainable communities.

Urban and regional design and planning consists of three components: (1) research to identify problems; (2) brain-storming through design and other means to develop alternatives; and (3) public participation to reach consensus on proposed means of implementation. Urban and regional design and planning, however, does not replace the political process in making the ultimate decision on implementation actions such as revised zoning, public infrastructure funding, etc. What urban and regional design and planning does is to help promote informed decision making and a long-range vision to guide development. In this context, what sustainable design and urban planning does is to include sustainability as a criterion to help guide development decisions. For example, the need for railway transport system in Nigerian cities and the suburban is obvious. This sustainable means of transport is yet elusive. In some cities where plans were made for such infrastructure, those early plans were never followed up. As a result, pre-planned rail tracks now fall along built up areas due to inability of governments to keep or implement a plan. One problem is to have a sustainable urban and regional plan, another is the ability to implement or uphold the plan.

7.8 Sustainability Science

Sustainability science has emerged in the 21st century as a new academic discipline. This new field of science was officially introduced with a "Birth Statement" at the World Congress "Challenges of a Changing Earth 2001" in Amsterdam organized by the International Council for Science (ICSU), the International Geosphere-Biosphere Program (IGBP), the International Human Dimensions Program on Global Environmental Change and the World Climate Research Program (WCRP). Sustainability science, like sustainability itself, derives some impetus from the concepts of sustainable development and environmental science. Sustainability science provides a critical framework for sustainability while sustainability measurement provides the evidence-based quantitative data needed to guide sustainability governance. This section is dedicated to an emerging field of research dealing with the interactions between natural and social systems, and with how those interactions affect the challenge of sustainability: meeting the needs of present and future generations while substantially reducing poverty and conserving the planet's life support systems.

Sustainability Science probes interactions between global, social, and human systems. It touches on the complex mechanisms that lead to degradation of these systems, and concomitant risks to human well-being. Many sustainability studies have provided platform for building sustainability science.

This is a new academic discipline which can point the way to a sustainable global society by facing challenges that existing disciplines have not addressed. These include endeavors to simultaneously understand phenomena and solve problems. Many universities and colleges across the world already have different degree and certificate programs on sustainability science, thus producing graduates who are more knowledgeable in the following areas:

- Climate change and Adaptation
- Culture Sustainability
- Ecosystems and Natural Resources Management
- Energy Efficiency and Renewable and Alternative Energy
- Food Security and Agricultural systems
- Water Quality and Supply

Sustainable Development

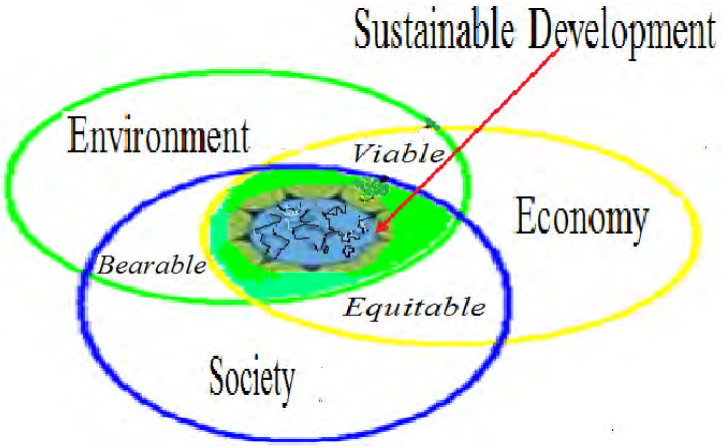


Figure 19: Sustainable Development indicators

Remark: *Sustainability* develop indicators that measure progress toward a *sustainable* economy, society and environment. *These three important keywords of sustainability (figure 19) address issues of sustainable development along UN programs. Sustainability study should addresses the integration of cultural, economic, environmental, and energy components and supports projects and perspectives that have positive impacts on future resources, ecosystem health, and human wellbeing. It is essential for all engineers to consider environmental influences caused by their work and products.*

8.0 Some UN Network Programs to Address Earth Environmental Issues

The United Nations

The name "United Nations", coined by United States President Franklin D. Roosevelt was first used in the Declaration by United Nations of 1 January 1942, during the Second World War, when representatives of 26 nations pledged their governments to continue fighting together against the Axis Powers. Later, representatives of 50 nations met in San Francisco April-June 1945 to complete the Charter of the United Nations. Poland, which was not represented at the Conference, signed it later and became one of the original 51 Member States. Today, there are 193 United Nations (UN) member states, and each of them is a member of the United Nations General Assembly. In 1992, the UN Conference on Environment and Development, the "Earth Summit", held in Rio De Janeiro attended by leaders from over 100 countries, the largest intergovernmental gathering in history, resulted in Agenda 21, a plan of action for sustainable development, saving the planet earth by reducing environmental degradation. At present the United Nations has some agencies that carry out its various action plans. A number of these agencies established to address specific environmental issues, their year of establishment and specific roles are presented in this manual. Job opportunities exist in these agencies as tenure, contract and voluntary staff, strictly for persons from member nations.

Figure 20: UN Emblem

Explanation of UN Symbol

The current United Nations emblem (Figure 20) was approved on 7 December 1946. The design is ~~–a~~ map of the world representing an azimuthal equidistant projection centered on the North Pole, inscribed in a wreath consisting of crossed conventionalized branches of the olive tree, in gold on a field of smoke-blue in all water areas. The projection of the map extends to 60 degrees south latitude, and includes five concentric circles". Olive branches symbolize peace. The world map depicts the area of concern to the United Nations in achieving its main purpose, peace and security. The use of the emblem is restricted, based on General Assembly resolution 92(I), 1946, Regulations for the control and limitation of documents, and use of the United Nations emblem on documents and publications.

Selected United Nations Agencies and Organizations Established to Improve Global Environmental Quality.

Food and Agriculture Organisation (FAO)

This agency was established in 1945 with headquarters in Rome to lead the fight against hunger.

International Fund for Agricultural Development (IFAD)

Established in 1977, to finance agriculture and eradicating rural poverty in developing countries.

International Monetary Fund (IMF)

Established in 1945, Provides monetary cooperation; financial advice and stability to poor nations.

United Nations Educational, Scientific and Cultural Organization (UNESCO)

Established in 1946, head quarters in Paris, to contribute to peace and security by promoting International collaboration through education, science and culture

United Nations Industrial development Organization (UNIDO)

Established in 1988, has a crucial role to play in accelerating economic growth, reducing poverty and achieving the Millennium development goals.

World Health Organization (WHO)

Established in 1948 to coordinate international public health; sanitation, diseases and epidemics.

World Meteorological Organization (WMO)

Established in 1950, for meteorological and through hydrology and related geophysical sciences.

United Nations Development Programme (UNDP)

Since 1966 UNDP partners with people at all levels of society to help build nations that can withstand crisis, and drive and sustain the kind of growth that improves quality of life for everyone.

World Bank Group

The World Bank was created at the 1944 Bretton Woods Conference, along with three other institutions, including the *International Monetary Fund (IMF)*. The World Bank and the IMF are both based in Washington, D.C., and work closely with each other. The World Bank is a United Nations international financial institution that provides loans to developing countries for capital programs. The World Bank is a component of the World Bank Group, and a member of the United Nations Development Group. The World Bank's official goal is to reduce poverty.

World Trade Organization (WTO)

Most of the WTO's agreements were the outcome of the 1986-94 Uruguay round of trade negotiations to liberalize international trade in services for the growth and development of the world economy. International Trade Centre (ITC): Is a subsidiary organization of the world trade organization mandate with helping developing and transition economies to promote their exports.

International atomic Energy Agency (IAEA)

Established in 29 July, 1957 for Scientific and technical cooperation in nuclear technology. It seeks to promote the peaceful use of nuclear energy and to inhibit its use for military purpose.

United Nations Children's Fund (UNICEF)

Created in 1946, provides long-term humanitarian and developmental assistance to children and mothers in developing countries. It provides emergency food healthcare to children in countries that had been devastated by World War II. In 1953, UNICEF became a permanent part of the United Nations System and its name was shortened from the original United Nations International Children's Emergency Fund but it has continued to be known by the popular acronym based on this previous title. It relies on contributions from government and private donors.

World Food Program (WFP)

This was established in 1961 to eradicate hunger and malnutrition. Their primary objectives are to support food security and nutrition, save lives in emergencies.

World Education Forum

Was established in the year 2000, involves representatives from governments and education departments across the world and is committed towards achieving education for all by the year 2015.

United Nation Development Program (UNDP)

Formed in 1965 to help countries eliminate poverty and achieve sustainable human development, an approach to economic growth that emphasizes improving the quality of life of all citizens while conserving the environment and natural resources for future generations. It focuses on the challenges of democratic governance, poverty reduction, crisis prevention and recovery, energy and environment and HIV/AIDS. It also coordinates national and international efforts to achieve the millennium development goals aimed at poverty reduction.

United Nations Office on Drugs and Crime (UNODC)

Established in 1997 through a merger of the United Nations Drug Control Program and the Centre for International Crime Prevention, UNODC has approximately 500 staff members worldwide. It is a global leader in the struggle against illicit drugs, international crime, and terrorism.

United Nation Population Fund (UNPFA)
Established in 1967 to ensure that every pregnancy is wanted, every birth is safe, every young person is free of HIV/AIDS. Every girl and woman is treated with dignity and respect.

United Nation Environment Program (UNEP)
Established in 1972 to coordinates United Nations environmental activities by developing international environmental convention, assesses global environmental trends, encourages new civil sector partnerships and strengthens Institutions so they might be better to protect the environment and save planet earth.

United Nation Women
Established in 2010 as the United Nations entity for gender equality and the empowerment of women. The United Nations Girls' Education Initiative (UNGEI) is a partnership organizations committed to narrowing the gender gap in primary and secondary schools worldwide

United Nations High Commissioner for Refugees (UNHCR)
Was established in 1950 as UN Refugee Agency mandated to protect and support refugees at the request of a Government or the UN itself and assists in their voluntary repatriation, local integration or resettlement to a third country.

United Nation Human Settlement program (UNHSP)
Established in 1978 to promote socially and environmentally sustainable towns and cities with the goal of providing adequate shelter for all.

United Nations Forum on Forest (UNFF)
Was established in 2000 to promote the management, conservation and sustainable development of forests, strengthen long-term political commitment based on the Rio declaration. It produced the UN agency for reducing emissions from forest degradation.

United Nation Geographic Information Working Group (UNGIWG)
Established in 2000 to address common geospatial issues, improve geographic information for better decision-making. Promote standards maps and other geospatial data to avoid duplication.

Global Migration Group (GMG)
Established in 2006 to contribute to the global forum on migration and development

Partnership for Environment and Disaster Risk Reduction (PEDRR)
Was established in 2008 to provide technical and science-based expertise and applies best practices in ecosystem-based DRR approaches.

United Nations International Strategy for Disaster Reduction
Established in 1999 in response to a need for main-streaming disaster risk reduction within the UN's development and other work areas like climate change adaptation, increasing investment.

Inter-Agency Standing Committee Taskforce on HIV in Humanitarian Situations
Established in 2007 to strengthen and harmonize the monitoring and evaluation of HIV interventions in humanitarian situations

The United Nations Convention to Combat Desertification (UNCCD)
This is the United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa. It is a Convention to combat desertification and mitigate the effects of drought through national action programs that incorporate long-term strategies supported by international cooperation and partnership arrangements. It is the only convention stemming from a direct recommendation of the Rio Conference's Agenda 21, was adopted in Paris, France on 17 June 1994 and entered into force in December 1996. It is the first and only internationally legally binding framework set up to address the problem of desertification.

United Nations Framework Convention on Climate Change (UNFCCC)
The United Nations Framework Convention on Climate Change is an international environmental treaty negotiated at the United Nations Conference on Environment and Development (UNCED). It is informally known as the Earth Summit, held in Rio de Janeiro in 1992. The objective of the treaty is to "stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system"

UFCCC Executive Secretary Christiana Figueres said the latest government-approved climate science points more clearly than ever to the extreme risks posed by climate change. "We live in an era of man -made climate change," said Vicente Barros, Co-Chair of Working Group II.
UN Under-Secretary-General and UNEP Executive Director Achim Steiner said: "Climate change is a long-term challenge but one that requires urgent action today."The latest IPCC report paints a picture of a complicated future due to climate change, where no one gets by unscathed, where existing risk factors will be tremendously increased and where we need to prepare for the worst.

Photo xxxi: UN General Assembly Hall

Most major decisions of the United Nations may be taken at its General Assembly hall (Photo xxxi) at the UN Headquarters, New York, U.S.A.

9.0 Conclusion

The idea about this manual and its wall chart stems from lack of awareness observed among students at all levels and the civil society about the state of earth environment, its resources and development. Awareness creation of global environmental issues and the sustainability concept is indeed a global challenge. This situation is critical to lack of sustainable development programs in many developing countries. The ‗ultimate' aim of this wall chart/manual is to provide a simplified summary of environmental education acceptable to all. It is important ‗for each university or college graduate and school leaver in Africa but not excluding other parts of the world to have formulated a responsible attitude towards sustainable development of the Planet Earth. The need to appreciate its beauty, conserve its resources and preserve its natural landscape.

This manual and the analysis, on which it rests, provide the material base for individuals to acquire a general knowledge and disposition to make decisions on regional, national, and global environmental issues. The goal is for human population to support the United Nations programs to save planet earth. This wall chart and its manual are treasure in homes, classrooms, libraries and offices, and are standard material set for teaching environmental education in schools world wide.

10.0 Environmental Education and Awareness Test Questions

10.1 Trial Quiz; Find Answers

1 One of the under listed is not a socio-environmental issue;
Poverty, Terrorism, Population, Erosion

2 Two of the following are not Socio-environmental issues
Landslide, Hunger, Gas flaring, Illiteracy, Gender parity

3 Two of the under listed issues are purely natural geo-environmental issues
Flooding, Earthquake, Desertification, Volcano

4 The under listed are all man-made geo-environmental issues except:
Global warming, Hurricane, Groundwater pollution, Oil spill

5 All the under listed cause air pollution except;
Coal plant, Petrochemical plant, Nuclear power plant, Automobile exhaust, None

6 Which of the under listed waste type is not required to be sorted at home for recycling; *Bottle, Plastics, Food remnants, Cans, Papers, Fabrics*

7 Which two of the under listed waste types are more sensitive to soil pollution
E-waste, Automobile waste, Oil spill, Agricultural wastes, Medical waste

8 Which two of the under listed are more critical to groundwater pollution
Domestic waste, Mine waste, Industrial waste, Abandoned mine pit, Nuclear waste

9 Which of the under listed are more sensitive to the spread of diseases pathogens
Surface water pollution, Groundwater pollution, Landfill leachate, Air pollution, All

10 Which of these rocks is not common in sedimentary environment?
Shale, Limestone, Granite, Sandstone

11 Which of these rocks is not common in igneous environment?
Diorite, Basalt, Gneiss, Gabbro

12 About what percent of the earth surface is covered by land or continents?
70%, 28%, 30%, 25%

13 What energy controls the water cycle?
Wind energy, Thermal energy, Solar energy, Nuclear energy

14 What portion of the electromagnetic spectrum is most harmful to living organism?
X-ray, Infra red, Ultraviolet A, Ultraviolet C, Ultraviolet B

15 What UN agencies are specifically following the issue of climate change?
UNCCD, UNFCCC, UNEP, NUDP

16 Which UN organization is after disease eradication?
WTO, WMO, WHO, WFP

17 From what part of the world is waste automobile and electrical electronics equipments mainly shipped to Nigeria and other West African countries?
North U.S.A, Western Europe, South America, Russia, Australia, Canada, All

18 What is the cause of militant attack and crises in the Niger Delta Nigeria?
Environmental degradation, Environment Neglect, Corruption, Unemployment, All

19 What are the three keywords of Sustainability Concept?
Population, Society, Hunger, Economy, Politics, Environment

20 In what year was Sustainability introduced as environmental watch word?
1950s; 1960s; 1970s; 1980s; 1990s

21 Rank these environmental issues according to the degree of global concern?
Hunger; Terrorism; Poverty; Disease (HIV); Earthquake; Flooding; Global warming

22 Sea level has risen because of warmer climate over the last 100 years by about:
20 - 25 cm; 10 – 12.5 cm; 1.0 m, None of these

23 What period is named by the UN as Decade of Education for Sustainable Development?

24 What is global population as October 2011?
6.5 billion, 8 billion, 7 billion, 7.7 billion

25 Apart from Earth, which other planet is capable of sustaining life?
Mars, Jupiter, Venus, Saturn, Neptune, None

10.2 General Quiz; Answers provided

1 What word, derived loosely from 'two oxygen', refers to a highly toxic group of pollutant chemicals produced typically as by-products from manufacturing processes? *Dioxins*

2 A photovoltaic module is more commonly known as what? *Solar panel*

3 What structural modification of oxygen is an air pollutant in the lower atmosphere but beneficial in the upper atmosphere? *Ozone*

4 What is the climate change agreement aimed at a framework about controlling greenhouse gas emission, reached in Japan in 1997? *Kyoto Protocol*

5 The UN Stockholm Convention signed in 2001 seeks to limit the production and use of POPs. What is the full meaning of POPs? *Persistent Organic Pollutants (or pesticides)*

6 What colourless/colorless, odourless/odorless, poisonous polluting gas is chiefly emitted by small engines typically used in lawn-mowers and chainsaws, etc*? Carbon monoxide*

7 What highly toxic element was traditionally used in thermometers, that caused safety and disposal risk? *Mercury*

8 The 1987 Montreal Protocol concerns specifically, and includes in its full title, substances that deplete what layer in the stratosphere? *The Ozone Layer*

9 Carbon dioxide, methane, nitrous oxide, and sulphur/sulfur hexafluoride are widely referred to by what collective metaphorical term? *Greenhouse Gases*

10 From the Greek root words for 'house' and 'study of' what term refers to the scientific study of the relationship between living things, and their natural environment? *Ecology*

11 One of these is not among the three components of Sustainability: Society, *Culture,* Economy, and Environment

12 What is the source of earth magnetic field?
Force of gravity, Density of the core, metal in the outer core, Geo-dynamo effect

13 The use of microorganism metabolism to remove pollutants such as oil spills in soil is known as : [A]Biomagnification [B]Bioremediation* [C]Biomethanation [D]Bioreduction

14 Which of the following statements is NOT true? [A]Photochemical smog always contains Ozone. [B]The toxic effect of Carbon Monoxide is due to its greater affinity for haemoglobin as compared to oxygen. [C]Lead is the most hazardous metal pollutant of automobile exhaust. [D]None of the above*

15 Identify the non Green-House Gas (GHG) from the following : [A]Methane [B]Nitrous Oxide [C]Sulphur Hexafluoride [D]Carbon Monoxide*

16 The highest per capita emitter of Carbon dioxide in the world is: [A] US [B] China [C] Qatar* [D] Saudi Arabia

17 Where was Italy originally situated (pre-continental drift)?
In Africa*; In North America; In South America, In Europe

18 In Nitrogen Cycle, soil nitrates are transformed into free nitrogen by: [A]Nitrifying bacteria [B]Denitrifying bacteria* [C]Ammonifying bacteria [D]Both [A] and[C]

19 Two of these are non components of Ecosystem services: Life essentials; Economy; Culture*; Control; Society*; Environmental Supports

20 On this day in 1972, the Stockholm Conference on Human Environment was held in Sweden. Since then the World Environment Day is celebrated on this day:
March 8; June 5*; May 22; October 8

21 Study of earth gravity field was first started by X, but concluded by Z
X = Newton, Z = Galileo; X= Plato, Z= Aristotle; X= Galileo, Z= Newton*;
X= Aristotle, Z= Newton

22 In the world‘s worst nuclear accident in 1986, 31 people died, 129 others suffered acute radiation and many thousands were expected to die prematurely as a result of exposure to radiation released from the stricken plant. Name the site of this mishap.
Three Mile Island, USA*; Chernobyl, erstwhile Soviet Union; Bhopal, India; UK

23 Name the metal contained in broken fluorescent bulbs, tube lights and dead batteries which gets transported with common municipal solid waste and can be easily swallowed, inhaled or absorbed through the skin and can cause damage to the kidneys and nervous system.
Copper; Cadmium; Mercury*; Arsenic

24 The following pollutant is not contained in the vehicular exhaust emissions:
Lead; Ammonia*; Carbon monoxide; Particulate matter

25 Bhopal gas tragedy struck in the year 1984 due to the leakage of the following gas:
methyl-iso-cyanate*; nitrous oxide; methane; carbon monoxide

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