NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF SCIENCE AND TECHNOLOGY

COURSE CODE: ESM 428

COURSE TITLE: ECOLOGY OF NATURAL RESOURCES

COURSE GUIDE

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INTRODUCTION

Ecology of Natural Resources is a 2 credit course and it is broken into 4 modules and 10 study units. At the end of this course, a student is expected to be conversant with the following terms; natural resources, their nature and types; Earth as a natural environment and the activities of man on the natural environment; how the natural resources can be sustainably used; policies, laws, and regulations on natural resources that include water and air; the instruments involve in the protection of the environment; conflicts in resources conservation, their elements and control; ways in considering the economy, culture, politics and social influences in the conservation and management of resources. This course further looks at other studies and terms like watershed management, nature reserves, their types, factors and importance; wildlife conservation taking Africa as a case study and finally the emerging issues arising in resources conservation.

The course guide, therefore, tells you briefly what the course: Ecology of Natural Resources is all about, the types of course materials to be used, what you are expected to know in each unit, and how to work through the course material. It suggests the general guidelines and also emphasises the need for self assessment and tutor marked assignment. There are also tutorial classes that are linked to this course and students are advised to attend.

WHAT YOU WILL LEARN IN THIS COURSE

The overall aim of this course, (Ecology of Natural Resources), is to introduce students to the basic variables associated with the studying of the natural resources in our world. During this course, you will be equipped with definitions of natural resources, natural environment, resources sustainability, environmental protection and resource conservation and management. More specifically, you will encounter terms like watershed management nature reserves and wildlife conservation.

The course will give you general and basic knowledge on nature of resources, sustainability in the use of most natural resources in ecology, the instruments of environmental protection. The National Environmental Standards and Regulations Enforcement Agency (NESREA) in Nigeria shall be view as a regulatory body on the environment. Reasons of conflicts and its control in resources conservation, and also the economic, cultural, political and social considerations shall also be discussed. Finally, this course will give explanations on watershed management and nature reserves, looking at some African countries wildlife conservation measures and literally explains emerging issues in resources conservation.

COURSE AIM

This course aims to give students an in-dept understanding of the ecology of natural resources. Basic tools in resources sustainability, protection, conservation and management of natural resources shall be discussed. It is hoped that the knowledge would equip students with the conceptual issues on natural resources conservation and management in area such as watershed, nature reserves and wildlife.

COURSE OBJECTIVES

Note that each unit has specific objectives. Students should read them carefully before going through the unit. You may want to refer to them during your study of the unit to check on your progress. You should always look at the unit objectives after completing a unit. In this way, you can be sure that you have done what is required of you by the unit.

However, below are overall objectives of this course. On successful completion of this course, you should be able to:

- Explain what natural resources are.
- Enumerate the various examples of natural resources
- Explain the Earth as a natural environment and how man influence it
- Explain the principles and goals of resources sustainability
- Understand the aims and objectives of policies, laws and regulations on natural resources
- Identify various instruments used in environmental protection
- Explain the conflicts in resources conservation and the control of it
- Give account of the economic, cultural, political and social considerations in resources conservation and management
- Define watershed and nature reserves in terms of their management
- Explain conservation in terms of wild life
- Discuss various emerging issues in resources conservation.

WORKING THROUGH THIS COURSE

To complete this course, you are required to read the units, the recommended text books, and other relevant materials. Each unit contains some self assessment exercises and tutor marked assignments, and at some point in this course, you are required to submit the tutor marked assignments. There is also a final examination at the end of this course.

COURSE MATERIALS

You will be provided with the following materials:

- Course Guide
- Study Unit
- Other resources

In addition, the course comes with a list of recommended textbooks which though not compulsory for you to buy, but indeed are necessary to supplement the course materials.

STUDY UNITS

There are 10 study units and 4 modules in this course. They are:

Module 1

Unit 1	Nature of resources
Unit 2	Man and the natural environment
Unit 3	Sustainability in the use of resources

Module 2

Unit 1	Policies, laws and regulations on natural resources
Unit 2	Instruments of environmental protection

Module 3

Unit 1	Conflicts in resource conservation
Unit 2	Economic, cultural, political and social considerations in resource conservation and management

Module 4

Unit 1	Watershed management and nature reserves
Unit 2	Wildlife conservation in Africa
Unit 3	Emerging issues in resources conservations

TEXTBOOKS AND REFERENCES

- Adams S. and David L. (2006). *Earth Science: An illustrated guide to science*. New York NY 10001: Chelsea House. pp. 20. earth science. ISBN 0-8160-6164-5.
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ASSESSMENT

There are two aspects to the assessment of this course. First, there are tutor marked assignments; and second, the written examination.

You are thus expected to apply knowledge, comprehension, information and problem solving gathered during the course. The tutor marked assignments must be submitted to your tutor for formal assessment, in accordance to the deadline given. The work submitted will count for 30% of your total course mark.

At the end of the course, you will need to sit for a final written examination. This examination will account for 70% of your total score.

TUTOR MARKED ASSIGNMENTS (TMAs)

There are 10 TMAs in this course. You need to submit all the TMAs. The best 3 will therefore be counted. When you have completed each assignment, send them to your tutor as soon as possible and make sure that it gets to your tutor on or before the stated deadline. If for any reason you cannot complete your assignment on time, contact your tutor before the assignment is due to discuss the possibility of extension. Extension will not be granted after the deadline, unless on exceptional cases.

FINAL EXAMINATION AND GRADING

The final examination for Ecology of Natural Resources will be of 2 hour duration and have a value of 70% of the total course grade. The examination will consist of questions which reflect the tutor marked assignments that you have previously encountered. Furthermore, all areas of the course will be examined. It is also better to use the time between finishing the last unit and sitting for the examination, to revise the entire

course. You might find it useful to review your TMAs and comment on them before the examination. The final examination covers information from all parts of the course.

COURSE MARKING SCHEME

The following table includes the course marking scheme

Table 1 Course Marking Scheme

Assessment	Marks
Assignments 1-10	10 assignments, 30% for the best 3 Total = 10% X 3 = 30%
Final Examination	70% of overall course marks
Total	100% of Course Marks

COURSE OVERVIEW

This table indicates the units, the number of weeks required to complete them and the assignments.

Table 2: Course Organizer

Unit	Title of Work	Weeks Activity	Assessment (End of Unit)
	Course Guide	Week 1	
Module 1			
Unit 1	Nature of resources	Week 1	Assignment 1
Unit 2	Man and the natural environment	Week 2	Assignment 2
Unit 3	Sustainability in the use of resources	Week 3	Assignment 3
Module 2			
Unit 1	Policies, laws and regulations on natural resources	Week 4	Assignment 4
Unit 2	Instruments of environmental protection	Week 5	Assignment 5
Module 3			
Unit 1	Conflicts in resource conservation	Week 6	Assignment 6
Unit 2	Economic, cultural, political and social considerations in resource conservation and management	Week 7	Assignment 7

Module 4			
Unit 1	Watershed management and nature reserves	Week 8	Assignment 8
Unit 2	Wildlife conservation in Africa	Week 9	Assignment 9
Unit 3	Emerging issues in resources conservations	Week 10	Assignment 10

HOW TO GET THE MOST OUT OF THIS COURSE

In distance learning, the study units replace the university lecturer. This is one of the huge advantages of distance learning mode; you can read and work through specially designed study materials at your own pace and at a time and place that suit you best. Think of it as reading from the teacher, the study guide tells you what to read, when to read and the relevant texts to consult. You are provided tutor marked assignment to study upon at the end of a unit, just as a lecturer might give you an in-class assignment.

Each of the study units follows a common format. The first item is an introduction to the subject matter of the unit and how a particular unit is integrated with the other units and the course as a whole. Next to this is a set of learning objectives. These learning objectives are meant to guide your studies. The moment a unit is completed, you must go back and check whether you have achieved the objectives. If this is made a habit, then you will significantly improve your chances of passing the course. The main body of the units also guides you through the required readings from other sources. This will usually be either from references or from other sources.

The following are practical strategies for working through this course

1. Read the course guide thoroughly
2. Organize a study schedule. Refer to the course overview for more details. Note the time you are expected to spend on each unit and how the assignment relates to the units. Important details, e.g. details of your tutorials and the date of the first day of the semester are available. You need to gather together all these information in one place such as a diary, a wall chart calendar or an organizer. Whatever method you choose, you should decide on and write in your own dates for working on each unit.
3. Once you have created your own study schedule, do everything you can to stick to it. The major reason that students fail is that they get behind with their course works. If you get into difficulties with your schedule, please let your tutor know before it is too late for help.
4. Turn to Unit 1 and read the introduction and the objectives for the unit.
5. Assemble the study materials. Information about what you need for a unit is given in the table of content at the beginning of each unit. You will always need both the study unit you are working on and one of the materials recommended for further readings, on your desk at the same time.

6. Work through the unit, the content of the unit itself has been arranged to provide a sequence for you to follow. As you work through the unit, you will be encouraged to read from your set books.
7. Keep in mind that you will learn a lot by doing all your assignments carefully. They have been designed to help you meet the objectives of the course and will help you pass the examination.
8. Review the objectives of each study unit to confirm that you have achieved them. If you are not certain about any of the objectives, review the study material and consult your tutor.
9. When you are confident that you have achieved a unit's objectives, you can start on the next unit. Proceed unit by unit through the course and try to pace your study so that you can keep yourself on schedule.
10. When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments, both on the tutor marked assignment form and also written on the assignment. Consult you tutor as soon as possible if you have any questions or problems.
11. After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in this course guide).

TUTORS AND TUTORIAL

There are 8 hours of tutorial provided in support of this course. You will be notified of the dates, time and location together with the name and phone number of your tutor as soon as you are allocated a tutorial group

Your tutor will mark and comment on your assignments, keep a close watch on your progress and on any difficulties you might encounter and provide assistance to you during the course. You must mail your tutor marked assignment to your tutor well before the due date. At least two working days are required for this purpose. They will be marked by your tutor and returned to you as soon as possible.

Do not hesitate to contact your tutor by telephone, e-mail or discussion board if you need help. The following might be circumstances in which you would find help necessary: contact your tutor if:

- You do not understand any part of the study units or the assigned readings.
- You have difficulty with the self test or exercise.
- You have questions or problems with an assignment, with your tutor's comments on an assignment or with the grading of an assignment.

You should try your best to attend the tutorials. This is the only chance to have face to face contact with your tutor and ask questions which are answered instantly. You can raise any problem encountered in the course of your study. To gain the maximum

benefit from the course tutorials, prepare a question list before attending them. You will learn a lot from participating in discussion actively.

GOODLUCK!

ESM 428: ECOLOGY OF NATURAL RESOURCES

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COURSE CONTENTS

MODULE ONE

UNIT 1 NATURE OF RESOURCES

UNIT 2 MAN AND THE NATURAL ENVIRONMENT

UNIT 3 SUSTAINABILITY IN THE USE OF RESOURCES

UNIT 1 NATURE OF RESOURCES

CONTENTS

1.0 Introduction

Nature of natural resources when learnt in this unit will expose what natural resources are and specifically give their types, classification and numerous examples of natural resources. The numerous types of natural resources are grouped under four headings which are water resources, sun energy resources, land resources, rock and mineral resources, and the atmospheric resources. This unit therefore, defines, explains and considers the dimension of all these natural resources.

2.0 Objectives

At the end of this unit, you should be able to:

- Define what natural resource entails
- State and describe the types and classification of natural resources
- State the nature of natural resources and give examples

3.0 Main content

3.1 What is nature and resources

The dictionary of environmental and ecology (5^{th} edition) define Nature as all living organisms and the environments in which they live, and Resources in ecological point of view as anything in the environment which can be used. The definition of these two terms brings to mind of the word natural resources. In other to comprehend the nature of resources, the natural resources in the environment must have to be unfolded.

3.2 Natural resources

Natural resources refer to the untamed natural essence of the environment. They contain a significant amount of material as well as aesthetic values that exist relatively undisturbed by mankind, in a natural form. Examples such as land or raw materials occur naturally within environments. Many of them are essential for our survival while others are used for satisfying our wants.

3.3 Types and classification of natural resources

Natural resources are classified in different ways but in a simple way, natural resources can be categorized into various types which can be based on the nature of their origin, stage of development, renewability and availability. In this simple way of classification the examples of natural resources given are interwoven.

3.3.1 Origin

(a) **Biotic** - Biotic resources are obtained from the biosphere, such as forests and their products, animals, birds and their products, fish and other marine

organisms. Mineral fuels such as coal and petroleum are also included in this category because they are formed from decayed organic matter.

(b) **Abiotic** - Abiotic resources include non-living things such as land, water, air and ores such as gold, iron, copper, silver etc.

3.3.2 Stage of development

(a) **Potential Resources** - Potential resources are those that exist in a region and may be used in the future. For example, petroleum which exists in many parts of the world are formed naturally in sedimentary rocks. It is drilled out and put into use and remains a potential resource.

(b) **Actual Resources** - Actual resources are those which can also be called developed resources, stock and reserves are those that have been surveyed, their quantity and quality determined and are being used in present times. The development of an actual resource, such as wood processing depends upon the technology available and the cost involved. That part of the actual resource which can be developed profitably with available technology is called a reserve.

3.3.3 Renewability

(a) **Renewable resources** –

Renewable resources are those materials that can be replenished or reproduced easily. Some of them, like sunlight, air, wind, etc., are continuously available and their quantity is not affected by human consumption. Many renewable resources can be depleted by human use, but may also be replenished, thus maintaining a flow. Some of these, like agricultural crops, take a short time for renewal; others, like water, take a comparatively longer time, while still others, like forests, take even longer.

(b) **Non-renewable resources** - Non-renewable resources are formed over very long geological periods. Minerals and fossil fuels are examples of this category. Since their rate of formation is extremely slow, they cannot be replenished once they get depleted. The metallic minerals in this case can be re-used by recycling them but coal and petroleum cannot be recycled.

3.3.4.1 Availability:

In terms of availability, resources could be classed either as inexhaustive and exhaustible

(a) **Inexhaustible natural resources** - Resources which are present in unlimited quantity in nature and are not likely to be exhausted easily by

human activity are said to be inexhaustible natural resources. These include sunlight, air etc.

(b) Exhaustible natural resources - The amount of these resources are limited. They can be exhausted by human activity in the long run. Examples are coal, petroleum, natural gas, etc.

3.4 Nature of Natural resources

Some examples of natural resources include the following:

- Atmosphere which include air, wind
- Animals which comprises of wildlife, game reserves.
- Land that comprises of Coal, fossil fuels, rock and mineral resources.
- Plants of the forest
- Range and pasture.
- Soils for agriculture and food.
- Water resources that include, sea, oceans, lakes, groundwater, rivers and fishery.
- Solar power of the sun energy.

3.4.1 Water resources

Water covers 71% of the earth's surface. Of this, 97.5% is the salty water of the oceans and only 2.5% is freshwater, most of which is locked up. The remaining freshwater is found in glaciers, lakes, rivers, wetlands, the soil, aquifers and atmosphere. Ocean circulation patterns have a strong influence on climate and weather and, in turn, the food supply of both humans and other organisms. From 1961 to 2001 water demand doubled, agricultural use increased by 75%, industrial use by more than 200%, and domestic use more than 400%. In the 1990s it was estimated that humans were using 40–50% of the globally available freshwater in the approximate proportion of 70% for agriculture, 22% for industry and 8% for domestic purposes with total use progressively increasing. All life is impossible without water. It is used for household purposes, irrigation, transport, for producing tidal energy etc.Water is also used in many industries like textiles, iron and steel, paper etc. Tides result in rise and fall of sea water (figure 1.0) which can be harnessed to produce electricity.

Figure 1.0 Ocean an example of a natural water resource

Water as a resources have the following importance;

(i) Around 71% of the earth's surface is covered with water. All life is impossible without it. It is used for household purposes, irrigation, transport, for producing tidal energy etc.

(ii) Water is also used in many industries like textiles, iron and steel, paper etc.

(iii) Tides result in rise and fall of sea water which can be harnessed to produce electricity.

3.4.2 Sun Energy resources

The Sun's energy, stored by plants which are the primary producers during photosynthesis, passes through the food chain to other organisms to ultimately power all living processes. Since the industrial revolution the concentrated energy of the sun stored in fossilized plants as fossil fuels has been a major driver of technology which, in turn, has been the source of both economic and political power.

Other importance of the sun energy resources are;

i. Whenever we look around,we are able to see because of light. The sun is the major source of light on earth.
ii. The process of photosynthesis also needs light. Animals also need light to move about and to locate their food.

1. Sunlight can be converted into energy called solar energy.

3.4.3 Land resources

Land is fundamental to the operations of the biosphere and biodiversity (figure 1.1). Alterations in the relative proportions of land is dedicated to urbanisation, agriculture, forest, woodland, grassland and pasture have a marked effect on the global water, carbon and nitrogen biogeochemical cycles and this can impact negatively on both natural and human systems. The major sustainability benefits of land are accruing from sustainable parks and gardens, and green cities.

Figure 1.1 Rainforests as natural resources on land often have a great deal of biodiversity with many plant and animal species.

The following are the importance of land as a natural resource

(i) The most important use of land to man is that it provides space for work. All activities of man take place on land whether it is agriculture, transport, industry, housing, mining etc.

(ii) Most of the passengers and goods are transported by land transportation.

(iii) Land provides a large number of minerals like coal, petroleum, iron, copper, gold, mica etc.

3.4.4 Rock and Mineral Resources

Rock and mineral resources have a wide variety of uses and play a huge role in our lives.Minerals which people need include, calcium, phosphorus, sulfur, copper, fluoride, iron, and zinc. Coal, oil and natural gas provide us with almost all of the energy we use to produce light, heat and run our world. Minerals are ingredients in almost all of the products we use from fertilizer to plastics, toothpaste, knivesand cutleries..Minerals are common ingredients in pigments. In fact, some of the earliest uses of minerals were as pigments. Minerals also play an important role in the processing of materials.

The Table below (Table 1.0) shows the nature, their uses of natural rock and mineral resources.

Table 1.0 The nature of natural rock and mineral resources and their uses

Resource	**characteristics exploited and uses**
Coal	used as a fuel because they are flammable. The oils and tars produced from coal processing are re-processed into a variety of organic solvents and compounds such as plastics, motor fuel, photo developer, perfume, medicine, and sugar substitute.
Oil/Natural Gas	Oil and natural gas are used as fuels and ingredients in the chemical industry to produce petroleum based products notably plastics
Clay	used to make pottery and bricks.
Barite	It is a mineral consisting of Barium Sulphate which is used in oil to weigh down the oil and prevent gushers,filler in paint, glass, toothpaste.
Chert	It is a fine-grained silica-rich microcrystalline or microfibrous sedimentary rock that may contain small fossils. It is used to make stone tools also as fill to provide a stable base for roads
Chalcopyrite	It is the main ore of Copper (Copper Iron Sulphide Mineral) It is found in igneous and metamorphic rocks. Since it has an attractive appearance it can be used in arts and deor, as Copper is used to make electrical wiring, used in alloys (bronze and brass) also used as an ingredient in pigments(blue and green)
Fluorite	*Fluorite* (also called fluorspar) is a halide mineral composed of calcium fluoride, CaF_2. It is used as a flux i.e. used as an

	intermediate chemical to separate metals from waste material. Another important product made from fluorite is hydrofluoric acid, which is used in the pottery, optics, and plastics industry. Fluorite is also used in making opalescent glass and in enameling cookware.
Galena (lead)	This is the natural form of Lead (II) Sulphide.One of the most abundant and widely distributed sulphide minerals.The largest use of lead is in automotive batteries. It is also used as weights because of their high specific gravity. They are used as ingredients in solder because of their soft, low melting point. Until recently it was also used as an ingredient in paint and as an additive in gasoline to make engines run more smoothly.
Gypsum	This is a soft white or gray mineral consisting of hydrated calcium sulfate. It occurs chiefly in sedimentary deposits and is used to make plaster of Paris and fertilizers, and in the building industry. It is also an ingredient in cement.
Ilmenite (titanium)	Ilmenite is a black mineral consisting of iron titanium oxide Titanium is used in alloys to make strong light-weight materials such as space ships, bicycles, artificial joints for humans and sporting equipment such as bicycle frames. It is also used in the manufacture of titanium dioxide for paint pigments
Iron	It is a metal in the first transition series. It is the most common element in the whole planet Earth, forming much of Earth's outer and inner core, Iron chemical compounds, which include ferrous and ferric compounds, have many uses. Iron oxide mixed with aluminium powder can be ignited to create a thermite reaction, used in welding and purifying ores. Iron plays an important role oin biology –blood circulation and is found in certain foods and vegetables.
Limestone	**Limestone** is a sedimentary rock composed of the mineral calcite (calcium carbonate). Limestone is used as building materials for ornamental stone for surfaces and sculpture, to make cement and mortar.
Mussel Shells	Mussel shells were used as ceremonial objects. They are also used as ornaments such as buttons and pearls for jewellery
Phosphate	Phosphate is an inorganic chemical, is a salt of phosphoric acid. Inorganic phosphates are mined to obtain phosphorus for use in agriculture and industry.

3.4.5 Atmospheric resources

The atmospheric resources of the Earth serve as key factors in sustaining the planetary ecosystem. The thin layer of gases that envelops the Earth is held in place by the planet's gravity. Dry air consists of 78% nitrogen, 21% oxygen, 1% argon and other inert gases, such as carbon dioxide. The remaining gases are often referred to as trace gases, among which are the greenhouse gases such as water vapor, carbon dioxide, methane, nitrous oxide, and ozone.

Figure 1.2 The atmospheric natural resource of wind use in turbines engines for electricity generation.

The use and importance of atmospheric resources include:

(i) Air : This is an integral component of environment. Man air for uses breathing, burning.and other life's processes.

(ii) Oxygen: Oxygen in air is required for breathing by all human beings and animals.It is also used by plants for their processes.

(iii) The sound waves travel in air, so we can hear easily.

(iv) Wind energy can be harnesses from moving air called wind (figure 1.2)

4.0 Conclusion

Nature of natural resources in this unit unfolds the definition, types, classification and numerous examples of natural resources. Natural resources can be classified in different ways but in a simple way natural resources can be categorized into various types based on the nature of their origin, stage of development, renewability and availability.

5.0 Summary

Natural resources in this unit refer to the untamed natural essence of the environment that contain a significant amount of material as well as aesthetic values that exist relatively undisturbed by mankind, in a natural form. The numerous examples of natural resources are interwoven under the categorized groups like water resources, sun energy resources, land resources, rock and mineral resources and atmospheric resources.

6.0 Tutor-Marked Assignment

1a. Explain the term natural resources.
b. Enumerate 5 examples of natural resources.

2. Explain with examples the types and classification of natural resources.

7.0 References/Further Readings

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UNIT 2 MAN AND THE NATURAL ENVIRONMENT

CONTENTS

1.0 Introduction

In this unit, all that encompasses the natural environment will be defined and explained in details with emphasis on the Earth as the natural environment. Humans play a great role in the natural environment in which they find themselves. Today, however, human pressure on natural environment is greater than before in terms of magnitude and efficiency in disrupting nature and natural landscapes. The ways by which human have greatly impacted their activities both positively and negatively will be learnt in this unit.

2.0 Objectives

By the end of this unit, the student should be able to;

- Explain the earth as a natural environment
- Enumerate and explain the components of the Earth
- Explain in details the various ways man had impacted on the natural environment

3.0 Main content

3.1 The natural environment

The natural environment encompasses all living and non-living things occurring naturally on Earth or some region thereof. It is an environment that encompasses the interaction of all living species. The ecological part of the natural environment take care of the natural systems without massive human intervention, including all vegetation, microorganisms, soil, rocks, atmosphere and natural phenomena that occur within their boundaries. In aspect of natural resources and physical phenomena of the natural environment, these lack clear-cut boundaries, such as air, water, and climate, as well as energy, radiation, electric charge, and magnetism, not originating from human activity.

3.2 Earth as the natural environment

The study of the earth as a natural environment is known as Earth science or Geosciences. Earth science generally recognizes four spheres namely, the lithosphere, the hydrosphere, the atmosphere, and the biosphere as correspondent to rocks, water, air, and life. Some scientists include, as part of the spheres of the Earth, the cryosphere (corresponding to ice) as a distinct portion of the hydrosphere, as well as the pedosphere (corresponding to soil) as an active and intermixed sphere.

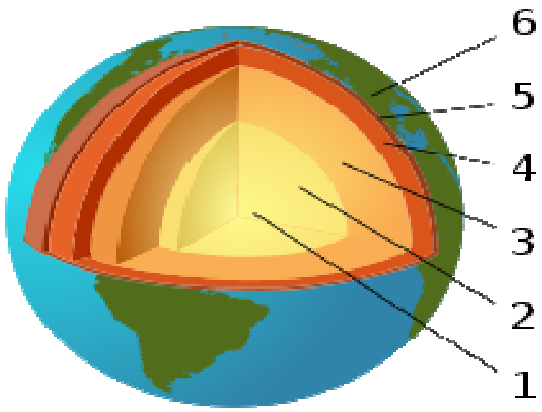

Figure 2.0 The Earth's layered structure. (1) inner core; (2) outer core; (3) lower mantle; (4) upper mantle; (5) lithosphere; (6) crust

3.3 Components of the natural environment

3.3.1 Lithosphere

The Lithosphere or the earth's crust (figure 2.0) is the outermost solid surface of the planet and is chemically and mechanically different from underlying mantle. It has been generated largely by igneous processes in which magma (molten rock) cools and solidifies to form solid rock. Beneath the lithosphere lies the mantle which is heated by the decay of radioactive elements. The mantle, although solid in nature, is in a state of rheic convection. This convection process causes the lithospheric plates to move, albeit slowly. The resulting process is known as plate tectonics. Volcanoes result primarily from the melting of subducted crust material or of rising mantle at mid-ocean ridges and mantle plumes.

3.3.2 Hydrosphere

The hydrosphere is the water body of the Earth natural environment and has the following divisions,

a. **Ocean** - the ocean is a major body of saline water approximately 71% of the Earth's surface is covered by ocean, a continuous body of water that is customarily divided into several principal oceans and smaller seas. More than half of this area is over 3,000 meters deep. The average oceanic salinity is around 35 parts per thousand (ppt), and nearly all seawater has a salinity in the range of 30 to 38 ppt.The major oceanic divisions are defined in part by the continents, these divisions according to descending order of size are the Pacific Ocean, the Atlantic Ocean, the Indian Ocean, the Southern Ocean and the Arctic Ocean.

Figure 2.1 A River flow

b. **Rivers** - A river is a usually freshwater natural watercourse, flowing toward an ocean, a lake, a sea or another river as seen in figure 2.1. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. Small rivers may also be termed by several other names, including stream, creek and brook. The water in a river is usually in a channel, made up of a stream bed between banks. In larger rivers there is also a wider floodplain shaped by flood-waters over-topping the channel. Flood plains may be very wide in relation to the size of the river channel. Rivers are a part of the hydrological cycle. Water within a river is generally collected from precipitation through surface runoff, groundwater recharge, springs, and the release of water stored in glaciers and snow packs.

c. Stream - a stream is a flowing body of water with a current, confined within a bed and stream banks. Streams play an important corridor role in connecting fragmented habitats and thus in conserving biodiversity. Types of streams include creeks, tributaries, which do not reach an ocean and connect with another stream or river, brooks, which are typically small streams and sometimes sourced from a spring or seep and tidal inlets.

Figure 2.2 A typical glacial lake formed from a glacial origin

d.**Lakes** - A lake is a body of water that is localized to the bottom of basin (figure 2.2). A body of water is considered a lake when it is inland, is not part of an ocean, is larger and deeper than a pond, and is fed by a river. Natural lakes on Earth are generally found in mountainous areas, rift zones, and areas with ongoing or recent glaciation. Other lakes are found in endorheic basins or along the courses of mature rivers. All lakes are temporary over geologic time scales, as they will slowly fill in with sediments or spill out of the basin containing them.

e. Pond - A pond is a body of standing water, either natural or man-made, that is usually smaller than a lake. A wide variety of man-made bodies of water are classified as ponds, including water gardens designed for aesthetic ornamentation, fish ponds designed for commercial fish breeding, and solar ponds designed to store thermal energy. Ponds and lakes are distinguished from streams via current speed. While currents in streams are easily observed, ponds and lakes possess thermally driven micro-currents and moderate wind driven currents. These features distinguish a pond from many other aquatic terrain features, such as stream pools and tide pools.

3.3.3 Atmosphere

The atmosphere is the thin layer of gases that envelops the Earth and held in place by the planet's gravity. Dry air consists of 78% nitrogen, 21% oxygen, 1% argon and other inert gases, such as carbon dioxide. The remaining gases as seen in figure 2.3 are often referred to as trace gases, among which are the greenhouse gases such as water vapor, carbon dioxide, methane, nitrous oxide, and ozone. Filtered air includes trace amounts of many other chemical compounds. Air also contains a variable amount of water vapor and suspensions of water droplets and ice crystals seen as clouds. Many natural substances

may be present in tiny amounts in an unfiltered air sample, including dust, pollen and spores, sea spray, volcanic ash, and meteoroids. Various industrial pollutants also may be present, such as chlorine may be elementary or in compounds, fluorine compounds, elemental mercury, and sulphur compounds such as sulphur dioxide [SO_2].

Figure 2.3 Atmospheric gases scatter blue light more than other wavelengths.

Lightening is an atmospheric discharge of electricity accompanied by thunder, which typically occurs during thunderstorms, and sometimes during volcanic eruptions or dust storms.

3.3.3.1 Atmospheric layers

The earth's atmosphere can be divided into five main or principal layers and five minor layers. The five main layers are mainly determined by whether temperature increases or decreases with altitude while the minor layers are determined by other properties.

Principal layers include;

a. **Exosphere** - is the outermost layer of Earth's atmosphere that extends from the exobase upward, mainly composed of hydrogen and helium.

b. **Thermosphere** – the top of the thermosphere is the bottom of the exosphere, called the exobase. Its height varies with solar activity and ranges from about 350–800 km. The International Space Station orbits in this layer, between 320 and 380 km.

c. **Mesosphere** - the mesosphere extends from the stratopause to 80–85 km. It is the layer where most meteors burn up upon entering the atmosphere.

d. **Stratosphere** - the stratosphere extends from the tropopause to about 51 km. The stratopause, which is the boundary between the stratosphere and mesosphere, typically is at 50 to 55 km.

e. **Troposphere** - the troposphere begins at the surface and extends to between 7 km at the poles and 17 km at the equator, with some variation due to weather. The troposphere is mostly heated by transfer of energy from the surface, so on average the lowest part of the troposphere is warmest and temperature decreases with altitude. The tropopause is the boundary between the troposphere and stratosphere.

Other minority layers are;

- **The ozone layer** – This is contained within the stratosphere. It is mainly located in the lower portion of the stratosphere from about 15–35 km, though the thickness varies seasonally and geographically. About 90% of the ozone in the atmosphere is contained in the stratosphere. The ozone layer of the Earth's atmosphere plays an important role in depleting the amount of ultraviolet (UV) radiation that reaches the surface. As DNA is readily damaged by UV light, this serves to protect life at the surface. This layer also retains heat during the night, thereby reducing the daily temperature extremes.
- **The ionosphere** – The ionosphere is the part of the atmosphere that is ionized by solar radiation, stretches from 50 to 1,000 km and typically overlaps both the exosphere and the thermosphere. It forms the inner edge of the magnetosphere.
- **The homosphere** - The homosphere includes the troposphere, stratosphere, and mesosphere.
- **Heterosphere** – The heterosphere is the upper part that is composed almost completely of hydrogen, the lightest element.
- **The planetary boundary layer** - is the part of the troposphere that is nearest the Earth's surface and is directly affected by it, mainly through turbulent diffusion.

3.3.3.2 Climate

The climate encompasses the statistics of temperature, humidity, atmospheric pressure, wind, rainfall, atmospheric particle count and numerous other meteorological elements in a given region over long periods of time. The climate of a location is affected by its

latitude, terrain, altitude, ice or snow cover, as well as nearby water bodies and their currents. Climates can be classified according to the average and typical ranges of different variables, most commonly is temperature and precipitation (figure 2.4). The most commonly used classification scheme is the one originally developed by Wladimir Köppen. The Thornthwaite system, in use since 1948, incorporates evapotranspiration in addition to temperature and precipitation information and is used in studying animal species diversity and potential impacts of climate changes.

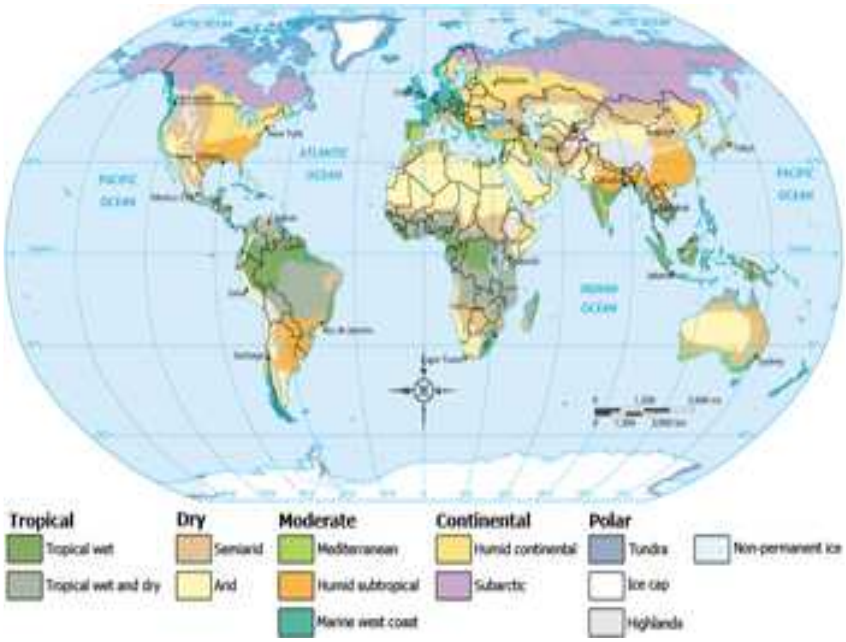

Figure 2.4 Worldwide climate classifications map

3.3.3.3 Weather

The weather is a set of all the phenomena occurring in a given atmospheric area at a given time. Most weather phenomena occur in the troposphere just below the stratosphere. Weather refers, generally, to day-to-day temperature and precipitation activity, whereas climate is the term for the average atmospheric conditions over longer periods of time.

The weather occurs due to density of temperature and moisture differences between one place and another. These differences can occur due to the sun angle at any particular spot, which varies by latitude from the tropics. The strong temperature contrast between polar and tropical air gives rise to the jet stream. Weather systems in the mid-latitudes, such as extra tropical cyclones, are caused by instabilities of the jet stream flow. Because the Earth's axis is tilted relative to its orbital plane, sunlight is incident at different angles at different times of the year. On the Earth's surface, temperatures usually range ±40 °C (100 °F to −40 °F) annually. Over thousands of years, changes in the Earth's orbit have affected the amount and distribution of solar energy received by the Earth and influence long-term climate

The surface temperature differences in turn cause pressure differences. Higher altitudes are cooler than lower altitudes due to differences in compressional heating. Weather forecasting is the application of science and technology to predict the state of the atmosphere for a future time and a given location. The atmosphere is a chaotic system, and small changes to one part of the system can grow to have large effects on the system as a whole. Human attempts to control the weather have occurred throughout human history, and there is evidence that human activity such as agriculture and industry has inadvertently modified weather patterns.

3.3.4 Biosphere

The biosphere of the natural environment is a diverse array of living organisms (life forms) as seen in figure 2.5 having varieties of plant species and figure 2.6 showing diverse species of animals. Evidence suggests that life on Earth has existed for about 3.7 billion years. All known life forms share fundamental molecular mechanisms, and based on these observations, theories on the origin of life attempt to find a mechanism explaining the formation of a primordial single cell organism from which all life originates. There are many different hypotheses regarding the path that might have been taken from simple organic molecules via pre-cellular life to protocells and metabolism.

Figure 2.5 There are many plant species on the planet.

Although there is no universal agreement on the definition of life, scientists generally accept that the biological manifestation of life is characterized by organization, metabolism, growth, adaptation, response to stimuli and reproduction. Life may also be said to be simply the characteristic state of organisms,a condition which distinguishes active organisms from inorganic matter, including the capacity for growth, functional activity and the continual change preceding death.

Figure 2.6 An example of the many animal species on the Earth

Properties common to these organisms such as plants, animals, fungi, protists, archaea, and bacteria are a carbon and water-based cellular form with complex organization and heritable genetic information. Living organisms undergo metabolism, maintain homeostasis, possess a capacity to grow, respond to stimuli, reproduce and, through natural selection, adapt to their environment in successive generations. More complex living organisms can communicate through various means.

3.3.4.1 Ecosystems

An ecosystem is a natural unit consisting of all plants, animals and micro-organisms i.e biotic factors in an area functioning together with all of the non-living physical (abiotic) factors of the environment. Central to the ecosystem concept is the idea that living organisms are continually engaged in a highly interrelated set of relationships with every other element constituting the environment in which they exist. Odum (1971) stated: that "any unit that includes all of the organisms in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity, and material cycles within the system is an ecosystem".

3.3.4.2 Biomes

Biomes are similar to the concept of ecosystems, and are climatically and geographically defined areas of ecologically similar climatic conditions on the Earth, such as communities of plants, animals, and soil organisms. Biomes are defined on the basis of factors such as plant structures (such as trees, shrubs, and grasses), leaf types (such as broad leaf and needle leaf), plant spacing (forest, woodland, savanna), and climate. Biomes are often identified with particular patterns of ecological succession and climax vegetation.

3.3.4.3 Biogeochemical cycles

The biogeochemical cycle is the series of nutrient movement i.e. exchange of materials between living and nonliving parts which are critical to life, most notably those of water, oxygen, carbon, nitrogen and phosphorus.

- **The nitrogen cycle** - This is the transformation of nitrogen and nitrogen-containing compounds in nature. It is a cycle which includes gaseous components.
- **The water cycle** – This is the continuous movement of water on, above, and below the surface of the Earth. Water can change states among liquid, vapor, and ice at various places in the water cycle. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go.
- **The carbon cycle** – The carbon cylce is the biogeochemical cycle by which carbon is exchanged among the biosphere, pedosphere, geosphere, hydrosphere, and atmosphere of the Earth.
- **The oxygen cycle** – This is the movement of oxygen within and between its three main reservoirs i.e. the atmosphere, the biosphere, and the lithosphere. The main driving factor of the oxygen cycle is photosynthesis, which is responsible for the modern Earth's atmospheric composition and life.
- **The phosphorus cycle** – This is the movement of phosphorus through the lithosphere, hydrosphere, and biosphere. The atmosphere does not play a significant role in the movements of phosphorus, because phosphorus and phosphorus compounds are usually solids at the typical ranges of temperature and pressure found on Earth.

3.3.4.4 Wilderness and wildlife

Wilderness is generally defined as a natural environment on earth that has not been significantly modified by human activity (figure 2.7). Wilderness can be defined in more detail as the most intact, undisturbed wild natural area left on our planet - those truly wild places that humans do not control and have not developed with roads, pipelines or other industrial infrastructure. Wilderness areas and protected parks are considered important for the survival of certain species, ecological studies, conservation, solitude, and recreation. Wilderness is deeply valued for cultural, spiritual, moral and aesthetic reasons. Some nature writers believe wilderness areas are vital for the human spirit and creativity.

Figure 2.7 a typical example of a mountainous wilderness

Wildlife includes all non-domestic plants, animals and other organisms. Domestic wild plant and animal species for human benefit have occurred in many places all over the planet, and have major impacts on the environment, both positive and negative. Wildlife can be found in all ecosystems. Deserts, rain forests, plains, and other areas including the most developed urban sites all have distinct forms of wildlife. While the term in popular culture usually refers to animals that are untouched by human factors, most scientists agree that wildlife around the world are impacted upon by human activities.

3.3.5 Human impact on the natural environment

Natural environment is of crucial importance for social and economic life. In this respect, the diversity of nature not only offers man a vast power of choice for his current needs and desires, it also enhances the role of nature as a source of solutions for the future needs and challenges of mankind. Today, however, human pressure on natural environment is greater than before in terms of magnitude and efficiency in disrupting nature and natural landscapes.

3.3.5.1 Ecosystems, habitats and species

Most notably impact includes:

- Intensive agriculture which replaces traditional farming. This, combined with the subsidies of industrial farming has had an enormous effect on rural landscapes and continues to be a threat.
- Mass tourism affecting mountains and coasts. The policies pursued in the industry, transport and energy sectors have a direct and damaging impact on the coasts, major rivers (dam construction and associated canal building) and mountain landscapes (main road networks).

- The strong focus of forestry management on economic targets primarily causes the decline in biodiversity, soil erosion and other related effects.

The clearest manifestations of the degradation of the natural environment are:

- **Reduction and fragmentation of habitats and landscapes in** expansion of human activities into the natural environment, manifested by urbanisation, recreation, industrialization, and agriculture, result in increasing uniformity in landscapes and consequential reduction, disappearance, fragmentation or isolation of habitats and landscapes. The consequences are decreased species diversity, due to reduced habitable surface area which corresponds to a reduced species carrying capacity.
- **The reduction of the size of** habitats also reduces the genetic diversity of the species living there. Smaller habitats can only accommodate smaller populations, as a result, there is an impoverished gene pool. The reduction of genetic resources of a species diminishes its flexibility and evolutionary adaptability to changing situations. This has significant negative impacts on its survival.
- **The conditions** under which the reduction of habitats often occur prevent living organisms from making use of their normal ways to flee their threatened habitat. Those escape routes include migration to other habitats, adaptation to the changing environment or genetic interchange with populations in nearby habitats. Of particular concern is the abrupt nature of human intervention; human projects are planned and implemented on a much shorter time scale than natural processes.
- Furthermore **human intervention**, such as the construction of buildings, motorways or railways results in the fragmentation of habitats, which strongly limits the possibility for contact or migration among them. In extreme cases even the smallest, narrowest connections between habitats are broken off. Such isolation is catastrophic for life in the habitat fragments.
- **Loss of species of Fauna and Flora.** The biodiversity is affected by decreasing species numbers and the loss of habitats in many regions. Approximately 30 % of the vertebrates and 20 % of the higher plants are classified as "threatened". Threats are directly linked to the loss of habitats due to destruction, modification and fragmentation of ecosystems as well as from overuse of pesticides and herbicides, intensive farming methods, hunting and general human disturbance.

3.3.5.2 Agriculture

As a result of needs for food production since the 1940s, policies have encouraged increased production through a variety of mechanisms, including price support, other subsidies and support for research and development. The success achieved in agricultural production has however entailed increased impact on the environment. Modern agriculture is responsible for the loss of much wildlife and their habitats, through

reduction and fragmentation of habitats and wildlife populations. The drainage of wetlands, the destruction of hedgerows and the intensive use of fertilizers and pesticides can all pose a threat to wildlife. Highly specialised monoculture is causing significant loss in species abundance and diversity. On the other hand increased production per hectare in intensive areas, raising of livestock volume, and lower prices for agricultural products have also caused marginalization of agricultural land, changing the diversity of landscapes into the direction of intensive agriculture and abandoned land.

3.3.5.3 Energy

All energy types have potential impacts on the natural environment to varying degrees at all stages of use, from extraction through processing to end use. Generating energy from any source involves making the choices between impacts and how far those impacts can be tolerated at the local and global scale. This is especially of importance for nuclear power, where there are significant risks of radioactive pollution as observed in figure 2.8.

Figure 2.8 Air-polluting emissions from a power plant

3.3.5.4 Fisheries

The principle environmental impact associated with fishery activities is the unsustainable harvesting of fish stocks and shellfish and its consequences for the ecological balance of the aquatic environment. This sector is in a state of crisis, with over capacity of the fleet, over exploitation of stocks, debt, and marketing problems. The growing aquaculture industry may increase water pollution and it is appearing to be a rising trend in the Mediterranean and Central/East Europe. Fishing activities have an impact on crustaceans and there is concern that large numbers of dolphins, and even the globally endangered Monk seal, are being killed.

3.3.5.5 Forestry

Forestry has impacted severely on natural forests (figure 2.9) in such a way that soils have been drained, pesticides and fertilizers applied, and exotic species planted. In many areas, monocultures have replaced the original diverse forest composition. Monocultures are extremely sensitive to insect infestations, fires or wind, and so can lead to financial losses as well as biological decline. The inadequate afforestation practices characterize new trends in impacting on the sustainability of the natural environment.

Figure2.9 A typical untamed natural rainforest

3.3.5.6 Industry

Almost all forms of industry have an impact on the natural environment and its sustainability. The impact varies at different stages in the life cycle of a product, depending upon the raw materials used through to the final end use of the product for waste residue, re-use or recycling. Industrial accidents and war damage to industrial plants can also endanger the natural environment.

3.3.5.7 Tourism and Recreation

Tourism and recreation impact on the natural environment in various ways. On one hand, natural areas form the very basis of many tourist attractions by highlighting scenic value or exceptional encounters with fauna and flora. However, some forms of tourism can be extremely detrimental to ecologically sensitive areas, resulting in habitat degeneration or destruction, in the disturbance or hunting even rare or threatened species.

3.3.5.8 Transport and Infrastructure

Transport is perhaps the major contributor to pollution in the world today, in particular global environmental issues such as the greenhouse effect. The key impacts of transportation include fragmentation of habitats and species and genetic populations, disruption of migration and traffic mortalities to wildlife. Since the 1970s, transport has become a major consumer of non-renewable resources, 80% of oil consumption coming from road transport and infrastructure development.

4.0 Conclusion

The earth is the natural environment in which enormous natural resources are inhabited. The importance of the natural environment in various ways have been unfolded, explained, and categorized based on their nature of existence. The different ways in which the natural environment have been influenced by human and their activities which greatly have both negative and positive impacts have been extensively expounded.

5.0 Summary

The natural environment encompasses all living and non-living things occurring naturally on Earth. Earth science generally recognizes four spheres namely the lithosphere, the hydrosphere, the atmosphere, and the biosphere. Man's impact on the natural environment includes activities in ecosystem, habitat and species; agriculture; energy; fisheries; forestry; industry; tourism and recreation; and transport and infrastructures.

6.0 Tutor-Marked Assignment

1. Define the term natural environment

2 a. List the various component of the Earth
   b. Explain the biosphere as part of the natural environment

3. Explain in details the various ways through which man had impacted the natural environment by their activities

7.0 References/Further Readings

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UNIT 3 SUSTAINABILITY IN THE USE OF RESOURCES

CONTENT

1.0 Introduction

In this unit, you will learn the historical development of resources, their sustainability, the principles and goals behind it. This unit will mainly focus on the environmental or ecological sustainability that comprises of the environmental factors such as atmosphere, freshwater and ocean, and land use. The management tools meant to sustain the use of resources will be emphasized alongside the elements concerned in resources sustainability. The challenges in the area of human behaviour, human population and consumption level as well as economic growth will be discuss in this unit. The final part of this unit will be the challenges to sustainability in the use of resources taking a look at major fundamental principles.

2.0 Objectives

At the end of this unit, you should be able to;

- Write the major principles and goals of resources sustainability
- Explain environmental/ecological sustainability
- Write on environmental management in terms of atmosphere, freshwater and ocean, and land
- Identify the challenges in sustainable use of resources
- Write on the obstacles to sustainability in the use of resources

3.0 Main content

3.1 Historical development of resources' sustainability

The history of sustainability traces human-dominated ecological systems from the earliest civilizations to the present. In early human history, the use of fire and desire for specific foods may have altered the natural composition of plant and animal communities. Between 8,000 and 10,000 years ago, Agrarian communities emerged which depended largely on their environment and the creation of a structure of permanence.

The Western industrial revolution of the 17th to 19th centuries tapped into the vast growth potential of the energy in fossil fuels. Coal was used to power more efficient engines and later to generate electricity. Modern sanitation systems and advances in medicine protected large populations from diseases. In the mid 20th century, a gathering of environmental movements (which comprised of private individuals, religious bodies, political groups etc) in the United States created an awareness of the environment by raising issues that militate against environmental protection.E.g pollution of land, air and water. It was at this period that Protectionists and Conservationists came up. They were of the opinion that the environment should be protected for its own sake while the Conservationists shared their view that the environment should be protected for the use of man.

They also argued that environmental costs associated with the many anthropogenic activities should be determined. In the late 20th century, environmental problems became global in scale. The 1973 and 1979 energy crises demonstrated the extent to which the global community had become dependent on non-renewable energy resources. In the 21st century, there was increasing global awareness of the threat posed by the human-induced greenhouse effect, produced largely by forest clearing and the burning of fossil fuels among other dangerous activities.

3.2 Principles and goals of resources sustainability

Sustainability principles are as follows;

- Reduced dependence upon fossil fuels, underground metals, and minerals.
- Reduced dependence upon synthetic chemicals and other unnatural substances.
- Reduced encroachment upon nature
- Meet human needs fairly and efficiently

Goals commonly expressed by environmental scientists to sustain the use of resources include:

- Reduction and clean up of pollution, with future goals of zero pollution.
- Cleanly converting non-recyclable materials into energy through direct combustion or after conversion into secondary fuels.
- Reducing societal consumption of non-renewable fuels.
- Development of alternative, green, low-carbon or renewable energy sources.
- Conservation and sustainable use of scarce resources such as water, land, and air.
- Protection of representative or unique or pristine ecosystems.
- Preservation of threatened and endangered species extinction.
- The establishment of nature and biosphere reserves under various types of protection.
- The protection of biodiversity and ecosystems upon which all human and other life on earth depends.

3.3 Environmental/Ecological Sustainability

Environmental/Ecological sustainability is the process of making sure current processes of interaction with the environment are pursued with the idea of keeping the environment as pristine as naturally possible based on ideal seeking behavior. In ecology, the word describes how biological systems remain diverse and productive over time. Sustainability in general terms requires that human activity only uses nature's resources at a rate at which they can be replenished naturally. An unsustainable situation occurs when the sum total of nature's resources is used up faster than it can be replenished. The long-term result of environmental degradation is the inability to sustain human life. Such degradation on a global scale could imply extinction for humanity. Sustainability, on the

other hand is the capacity to endure. Healthy wetlands and forests are examples of sustainable biological systems, a healthy ecosystem and environment provide vital goods and services to humans and other organisms when sustainably in use. Achieving sustainability in the use of resources is also a social challenge that entails international and national laws, urban planning and transport, local and individual lifestyles and ethical consumerism. Ways of living more sustainably can take many forms from reorganizing living conditions, reappraising economic sectors, or work practices, using science to develop new technologies, to adjustments in individual lifestyles that conserve natural resources. There are two major ways of reducing negative human impacts and enhancing ecological sustainability. The first is environmental management which is based largely on information gained from earth science, environmental science, and conservation biology. The second approach which is the management of human consumption of resources is based largely on information gained from economics.

3.4 Environmental Management

At the global scale and in the broadest sense, environmental management involves the atmosphere, oceans, freshwater systems and land but following the sustainability principle of scale, it can be equally applied to any ecosystem from a tropical rainforest to a home garden.

3.4.1 Atmosphere

The management of the global atmosphere now involves assessment of all aspects of the carbon cycle to identify opportunities to address human-induced climate change and this has become a major focus of scientific research because of the potential catastrophic effects on biodiversity and human communities.

Other human impacts on the atmosphere include the air pollution in cities, the pollutants including toxic chemicals like nitrogen oxides, sulphur oxides, volatile organic compounds and particulate matter that produce photochemical smog and acid rain, and the chlorofluorocarbons that degrade the ozone layer. Anthropogenic particulates such as sulphate aerosols in the atmosphere reduce the direct irradiance and reflectance of the Earth's surface, (known as global dimming). The decrease is estimated to have been about 4% between 1960 and 1990 although the trend has subsequently reversed. Global dimming may have disturbed the global water cycle by reducing evaporation and rainfall in some areas. It also creates a cooling effect and this may have partially masked the effect of greenhouse gases on global warming.

3.4.2 Freshwater and Oceans

Awareness of the global importance of preserving water for ecosystem services has only recently emerged.During the 20th century, more than half of the world’s wetlands have been lost along with their valuable environmental services. Increasing urbanization pollutes clean water supplies and much of the world still does not have access to clean, safe water. Greater emphasis is now being placed on the improved management of blue

(harvestable) and green (soil water available for plant use) water, and this applies at all scales of water management.

Ocean circulation patterns have a strong influence on climate and weather and, in turn, the food supply of both humans and other organisms. Scientists have warned of the possibility, under the influence of climate change, of a sudden alteration in circulation patterns of ocean currents that could drastically alter the climate in some regions of the globe.

3.4.3 Land use

Loss of biodiversity stems largely from the habitat loss and fragmentation produced by the human appropriation of land for development, forestry and agriculture as natural capital is progressively being converted to man-made capital. Land use change is fundamental to the operations of the biosphere because alterations in the relative proportions of land dedicated to urbanization, agriculture, forest, woodland, grassland and pasture have a marked effect on the global water, carbon and nitrogen biogeochemical cycles and these can impact negatively on both natural and human systems. At the local human scale, major sustainability benefits accrue from sustainable parks and gardens and green cities.

Figure 3.0 Land use making up more than half the world's food supply

Food is essential to life and feeding more than six billion human bodies on Earth takes a heavy toll on the Earth's resources. This begins with the appropriation of about 38% of the Earth's land surface (figure 3.0) and about 20% of its net primary productivity. Added to this are the resource-hungry activities of industrial agribusiness i.e. everything from the crops' need for irrigation water, synthetic fertilizers and pesticides to the resource

costs of food packaging, transport and retail. Environmental problems associated with industrial agriculture and agribusinesses are now being addressed through such movements as sustainable agriculture, organic farming and more sustainable business practices.

3.5 Management of Human Consumption

The underlying driver of direct human impacts on the environment resource use is human consumption. This impact is reduced not only by consuming less but by also making the full cycle of production, use and disposal more sustainable. Consumption of goods and services can be analysed and managed at all scales through the chain of consumption, starting with the effects of individual lifestyle choices and spending patterns, through to the resource demands of specific goods and services, the impacts of economic sectors, through national economies to the global economy. Analysis of consumption patterns relates resource use to the environmental, social and economic impacts at the scale or context under investigation. The ideas of embodied resource use, resource intensity, and resource productivity are important tools for understanding the impacts of consumption. The key resource categories relating to human needs are food, energy, materials and water which is discussed below.

3.5.1 Energy

Since the industrial revolution, the concentrated energy of the Sun stored in fossilized plants as fossil fuels has been a major driver of technology (figure 3.1) which, in turn, has been the source of both economic and political power. In 2007 climate scientists concluded that there was at least a 90% probability that atmospheric increase in CO_2 was human-induced, mostly as a result of fossil fuel emissions but, to a lesser extent from changes in land use. Stabilizing the world's climate will require high-income countries to reduce their emissions by 60–90% over 2006 levels by 2050 which should hold CO_2 levels at 450–650 ppm from current levels of about 380 ppm. Above this level, temperatures could rise by more than 2°C to produce catastrophic climate change. Reduction of current CO_2 levels must be achieved against a background of global population increase and developing countries aspiring to energy-intensive high consumption Western lifestyles.

Figure 3.1 Solar towers utilize the natural resource of the sun, and are a renewable energy source

Reducing greenhouse emissions, referred to as decarbonization, is being tackled at all scales, ranging from tracking the passage of carbon through the carbon cycle to the commercialization of renewable energy, developing less carbon-hungry technology and transport systems and attempts by individuals to lead carbon neutral lifestyles by monitoring the fossil fuel use embodied in all the goods and services they use.

3.5.2 Water

In the 1951–60s, human water withdrawals were four times greater than the previous decade. This rapid increase resulted from scientific and technological developments impacting through the economy especially increase in irrigated land, growth in industrial and power sectors, and intensive dam construction on all continents. These changes altered the water cycle of rivers and lakes, affected their water quality and had a significant impact on the global water cycle. Currently 35% of human water use is unsustainable(reference), drawing on diminishing aquifers and reducing the flows of major rivers. This percentage is likely to increase if climate change impacts become more severe, populations increase and aquifers become progressively depleted and supplies become polluted and unsanitary. From 1961 to 2001, water demand doubled for agricultural use as it increased by 75%, industrial use by more than 200%, and domestic use increased by more than 400%. In the 1990s it was estimated that humans were using 40–50% of the globally available freshwater in the approximate proportion of 70% for agriculture, 22% for industry, and 8% for domestic purposes with total use progressively increasing.

Water efficiency is being improved on a global scale by increased demand management, improved infrastructure, improved water productivity of agriculture, minimizing the

water intensity of goods and services, addressing shortages in the non-industrialised world, concentrating food production in areas of high productivity, and planning for climate change. At the local level, people are becoming more self-sufficient by harvesting rainwater and reducing use of mains water.

3.5.3 Food

The American Public Health Association (APHA) defines a sustainable food system as one that provides healthy food to meet current food needs while maintaining healthy ecosystems that can also provide food for generations to come with minimal negative impact to the environment. A sustainable food system also encourages local production and distribution infrastructures and makes nutritious food available, accessible, and affordable to all. Furthermore, it is humane and just, protecting farmers and other workers, consumers, and communities. At the global level the environmental impact of agribusiness is being addressed through sustainable agriculture and organic farming. At the local level, there are various movements working towards local food production, more productive use of urban wastelands and domestic gardens including permaculture, urban horticulture, local food, sustainable gardening, and organic gardening,

3.5.4 Materials

As global population and affluence has increased, so has the use of various materials increased in volume, diversity and distance transported. Some of these are included here e.g. raw materials, minerals, synthetic chemicals, manufactured products, food, living organisms and waste. Sustainable use of raw materials has targeted the idea of dematerialization, converting the linear path of materials to a circular material flow that reuses materials as much as possible, much like the cycling and reuse of waste in nature. This approach is supported by product stewardship and the increasing use of material flow analysis at all levels, especially individual countries and the global economy.

Synthetic chemical production includes everything from herbicides, pesticides and fertilizers to domestic chemicals and hazardous substances. Apart from the build-up of greenhouse gas emissions in the atmosphere, chemicals of particular concern include heavy metals, nuclear waste, chlorofluorocarbons, persistent organic pollutants and all harmful chemicals capable of bioaccumulation. Although most synthetic chemicals are harmless , there is still the need to rigorously test new chemicals in all countries for adverse environmental and health effects. International Legislation has been established to deal with the global distribution and management of dangerous goods. To reduce waste, industry, businesses and the Governments are now mimicking nature by turning the waste produced by industrial metabolism into new resource for use. Dematerialization is being encouraged through the ideas of industrial ecology, ecodesign and ecolabelling. In addition to the well established “reduce, reuse and recycle” shoppers are using their purchasing power for ethical consumerism.

3.6 Ecological footprint as elements of resources sustainability

The Ecological footprint measures human consumption in terms of the biologically productive land needed to provide the resources and absorb the wastes of the average global citizen. Ecological footprint can also be said to measure the area of biologically productive land and water required to produce the resources and absorb the waste of a given population and this is expressed in global hectares i.e hectares with world-average biological productivity. For instance, in 2008, 2.7 global hectares was required per person, 30% more than the natural biological capacity of 2.1 global hectares assuming no provision for other organisms.

3.7 Challenges in sustainable use of resources

The challenges in the sustainable use of resources involve the following; Human behaviour,Human population and consumption level, Economic growth

3.7.1 Human behaviour

Human behaviours have said to make things worse by these activities;

- having too many children
- agricultural burning
- over consumption of resources
- failure to re-cycle
- production/disposal of toxic waste
- improper disposal of human waste
- improper disposal of garbage
- mis-use of pesticides
- overcrowding
- economic dependence on growth
- depletion of soils by over farming
- erosion from removal of vegetation
- urban sprawl
- over-fishing

- removal of carbon sinks (trees)
- inefficient use of fuel
- urbanizing farmland
- urban growth where water is scarce
- eating meat

3.7.2 Human population and consumption level

According to the 2008 Revision of the Official United Nations population estimates and projections, the world population is projected to reach 7 billion early in 2012, up from the current 6.9 billion (May 2009) and to exceed 9 billion people by 2050. As always, population growth has a marked influence on levels of consumption and the efficiency of resource use. The impacts of the growing world population on land, water, energy, and biota resources are real and indeed overwhelming. Clear scientific evidence suggests worldwide problems of food availability already have emerged. According to the World Health Organization, nearly 60% of the world population now is malnourished, the largest number reported in history. More humans than ever before cover the earth with their urbanization, highways, and other activities. These activities impact on the availability of food resources.

To halt the escalating imbalance between expanding population numbers and the earth's essential natural resources, humans must control their numbers. At the same time, they must make efforts to conserve cropland, freshwater, energy, biodiversity, and the other life-supporting environmental resources. People in developed countries could contribute by reducing their high consumption of all natural resources, especially fossil fuels.

3.7.3 Economic growth

Historically there has been a close correlation between economic growth and environmental degradation.As communities grow, so do the environment declines. There is concern that, unless resource use is checked, modern global civilization will follow the path of ancient civilizations that collapsed through over exploitation of their resource base. While conventional economics is concerned largely with economic growth and the efficient allocation of resources, ecological economics has the explicit goal of sustainable scale rather than continual growth, fair distribution and efficient allocation, in that order. Sustainability studies have analysed ways to reduce the amount of resource e.g. water, energy, or materials needed for the production, consumption and disposal of a unit of goods or service whether this be achieved from improved economic management, product design or new technology. Ecological economics includes the study of societal metabolism, the throughput of resources that enter and exit the economic system in relation to environmental quality.

3.8 Obstacle to sustainability in the use of resources

These obstacles are seen in the following ways;

(a) **Inability to replace ecological functions** - While it is possible that we can find ways to replace some natural resources, it is much more unlikely that they will ever be able to replace eco-system services, such as the protection provided by the ozone layer, or the climate stabilizing function of the Amazonian forest.

(b) **Natural resources multifunction -** A further obstacle to sustainability lies also in the multi-functionality of many natural resources. Forests, for example, does not only provide the raw material for paper which can be substituted quite easily, but they also maintain biodiversity, regulate water flow, and absorb Carbon dioxide.

(c) **Partial irreversibility of natural resources** - Another problem of natural resources deterioration lies in their partial irreversibility. For example, the loss in biodiversity is often definite and consumption of natural capital or resources may have no observable impact until a certain threshold is reached. A lake can, for example, absorb nutrients for a long time while actually increasing its productivity. However, once a certain level of richness is achived, there is a lack of oxygen which causes the lake's ecosystem to break down.

(d) **Complementary role of resources** – The Ecological Economist Herman Daly had once asked, "what use is a sawmill without a forest?" From this perspective, the economy is a subsystem of human society, which is itself a subsystem of the biosphere and a gain in one sector is a loss from another.

4.0 Conclusion

Environmental/Ecological sustainability as defined in this unit as the process of making sure current processes of interaction within the environment are pursued with the idea of keeping the environment as pristine and as natural as possible based on ideal seeking behavior. In ecology, the words describe how biological systems remain diverse and productive over time. Resources sustainability principles and goals is mainly directed to; reduction and clean up of pollution,with future goals of zero pollution; cleanly converting non-recyclable materials into energy through direct combustion or after conversion into secondary fuels; reducing societal consumption of non-renewable fuels; development of alternative, green, low-carbon or renewable energy sources; conservation and sustainable use of scarce resources such as water, land, and air; protection of representative or unique or pristine ecosystems; preservation of threatened and endangered species extinction; the establishment of nature and biosphere reserves under various types of protection; and lastly the protection of biodiversity and ecosystems upon which all human and other life on earth depends.

5.0 Summary

In this unit you have learnt the historical development of resources sustainability with the major principles and goals within it context. Environmental/Ecological sustainability was defined, also environmental management in term of its factors. Energy, water, food, materials are needed to be managed in their human consumption level to sustain the use of resources in which ecological footprint is used as element of resources sustainability. Human behaviour, human population and consumption level together with economic growth are seen here as challenges to sustainability in the use of resources. The final lesson learnt in this unit are the obstacles to sustainability in the use of resources.

6.0 Tutor-Marked Assignment

1. State the principles and goals of resources sustainability

2 Give account of environmental management in their various factors

3. a. Explain the challenges in sustainable use of resources
   b. Write briefly on the obstacles to sustainability in the use of resources

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MODULE TWO

UNIT 1 **POLICIES, LAWS AND REGULATIONS ON NATURAL RESOURCES**

UNIT 2 **INSTRUMENTS OF ENVIRONMENTAL PROTECTION**

UNIT 1 POLICIES, LAWS AND REGULATIONS ON NATURAL RESOURCES

CONTENT

1.0 Introduction

Policies, laws, and regulation on natural resources as a topic in this unit will introduce the general policies, laws, and regulation governing the natural environment in which natural resources are found. The establishments of regulatory body and government agency have to be in place for the effective enforcement of policies, laws and regulation on natural resources. In this unit also, we shall take a look at the objectives and functions of the National Environmental Standards and Regulations Enforcement Agency (NESREA) in Nigeria to learn about the various policies, laws, and regulation on the natural environmental and natural resources.

2.0 Objectives

At the end of this unit, you should be able to;

- Write general functions and objectives of environmental policies, laws and regulations on natural resources
- State common policy, law or regulation on natural resources
- Mention local or international bodies and agencies on environmental and natural resources that enact policies, laws and regulation
- Write on the functions and objectives of the National Environmental Standards and Regulations Enforcement Agency (NESREA) in Nigeria

3.0 Main content

3.1 General functions of environmental law and policy

Environmental law is a complex body of law on natural resources that is made up of global, international, national, state and local statutes, treaties, conventions, regulations and policies which seek to protect the environment and natural resources affected, impacted or endangered by human activities. For example Environmental Protection Agency (EPA) is a body in most countries that administer the laws required to protect human health and to safeguard the natural environment such as air, water and land upon which life depends.
The goal of every environmental policy is to protect the environment for future generations while interfering as little as possible with the efficiency of commerce or the liberty of the people and to limit inequity in who is burdened with environmental costs. The two major policy tools for protecting the environment are rules (regulations) and inducements. Such regulations can come in the form of design standards and performance standards. Performance standards specify emission levels and let those covered by the rules decide how those levels will be met. Design standards specify exactly how performance standards will be met.

Alternatively, the government which is mostly responsible for enforcing environmental policies and laws, can use inducements, or market reform. Inducements are rewards and punishments used to influence people or groups. The two major types of market reforms are charge systems, such as emissions taxes, and tradable permit systems. One type of

tradable permit system is an auction of pollution rights in which the amount of allowed pollution is set and divided into units, which are then auctioned, giving environmental organizations the opportunity to buy the units to create a cleaner environment than originally planned.

3.2 General Objectives of policies and regulation on natural resources

The following general objectives serve as basis for policy formulations and regulations on natural resources law:

- Assure the availability and sustainability of natural resources through their judicious use and systematic restoration or replacement, whenever possible.
- Increase the productivity of natural resources in order to meet the demands for forest, mineral and land resources of a growing population in a manner consistent with environmental protection and enhancement.
- Enhance the contribution of natural resources for achieving national economic, political, social development and ecological integrity.
- Promote equitable access to natural resources by the different sectors of the populations.
- Maintain a desirable level of environmental quality.
- Conserve specific terrestrial and aquatic areas of natural and cultural heritage for present and future generations

3.3 General Functions Of Environmental And Natural Resources' Law Enforcement And Regulatory Body

The general functions of the body established by government for environmental and natural resources are as follows;

- Advise on the enactment of laws relative to the development, use, regulation and conservation of natural resources and the control of pollution.
- Formulate, implement and supervise the government's policies, plans and programs pertaining to the management, conservation, development, use and replenishment of natural resources.
- Promulgate rules and regulations in accordance with laws governing the exploration, development, conservation, extraction, disposition, use and such other commercial activities which tend to cause the depletion and degradation of natural resources.
- Exercise supervision and control over forest lands and mineral resources and impose appropriate payments, fees, charges, rentals and any such form of levy and collect such revenues for the exploration, development, utilization or gathering of such resources.
- Undertake exploration, assessment, classification and inventory of the natural resources using ground surveys, remote sensing and complementary technologies.

- Promote proper and mutual consultation with the private sector involving natural resources development, use and conservation.
- Undertake geological surveys of the whole country including its territorial waters.
- Establish policies and implement programs for the:

(a) Accelerated inventory, surveys and classification of lands, forest and mineral resources using appropriate technology, to be able to come up with a more accurate assessment of resource quality and quantity.
(b) Equitable distribution of natural resources through the judicious administration, regulation, utilization, development and expansion of natural resource-based industries.
(c) Promotion, development and expansion of natural resource-based industries.
(d) Preservation of cultural and natural heritage through wildlife conservation and segregation of national parks and other protected areas.
(e) Maintenance of a wholesome natural environment by enforcing environmental protections laws.
(f) Encouragement of greater people's participation and private initiative in natural resource management.

- Assume responsibility for the assessment, development, protection, conservation, licensing and regulation as provided for by law, where applicable, of all natural resources such as:

(a) The regulation and monitoring of service contractors, licenses, leases, and permits for the extraction, exploration, development and utilization of natural resource products.
(b) The implementation of programs and measures with the end in view of promoting close collaboration between the government and the private sector.
(c) The effective and efficient classification and sub-classification of lands of the public domain; and the enforcement of natural resources laws, rules and regulations.

- Promulgate rules, regulations and guidelines on the issuance of co-production, joint venture or production sharing agreements, licenses, permits, concessions, leases and such other privileges and arrangement concerning the development, exploration and utilization of natural resources and shall continue to oversee, supervise and police natural resources; to cancel or cause to cancel such privileges and arrangements upon failure, non-compliance or violations of any regulations, orders, and for all other causes which are in furtherance of the conservation of natural resources.
- Promulgate rules and regulations for the control of water, air and land pollution in away to promulgate ambient and effluent standards for water

and air quality including the allowable levels of other pollutants and radiations.
- Exercise other powers and functions and perform such other acts as may be necessary, proper or incidental to the attainment of its mandates and objectives.

3.4 Common policies, laws and regulation on natural resources

Most of the policies, laws and regulations on some natural resources are stated below:

- **Clean Air Act**

The Clean Air Act (CAA) is the comprehensive Federal of the United States law that regulates air emissions from stationary and mobile sources. Among other roles, this law authorizes EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and public welfare and to regulate emissions of hazardous air pollutants.

- **Clean Water Act**

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters. The basis of the CWA was enacted in 1948 and was called the Federal Water Pollution Control Act, but the Act was significantly reorganized and expanded in 1972. "Clean Water Act" became the Act's common name with amendments in 1977.

- **Energy Policy Act**

The Energy Policy Act (EPA) addresses energy production in the United States, including:

(a) Energy efficiency
(b) Renewable energy
(c) Oil and gas
(d) Coal
(e) Tribal energy
(f) Nuclear matters and security
(g) Vehicles and motor fuels, including ethanol
(h) Hydrogen
(i) Electricity
(j) Energy tax incentives
(k) Hydropower and geothermal energy;
(l) Climate change technology.

The Act provides loans and guarantees for entities that develop or use innovative technologies that avoid the by-production of greenhouse gases. Another provision of the Act increases the amount of biofuel that must be mixed with gasoline sold in the United States.

- **Natural Resources Defense Council (NRDC)**

  NRDC is the most effective environmental action organization which uses law, science and the support of 1.3 million members and online activists to protect the planet's wildlife and wild places and to ensure a safe and healthy environment for all living things.

- **United States Environmental Policy**

  The environmental policy of the United States is federal governmental action to regulate activities that have an environmental impact in the United States. This policy grew mainly out of the environmental movement in the United States in the 1960s and '70's during which several environmental laws were passed, regulating air and water pollution and forming the Environmental Protection Agency (EPA).

- **Environmental Foundation for Africa (EFA)**

  The Environmental Foundation for Africa (EFA) aims to protect and restore the environment in West Africa. For over 15 years, EFA has led:

  (a) Environmental Education (EE) and awareness raising campaigns;

  (b) Restored degraded lands and conserved pristine forests;

  (c) Minimized the impacts of civil war on the environment and its inhabitants.

  (d) Equipped thousands of people with sustainable livelihood skills such as agroforestry.

- **Earth Policy Institute**

  The Earth Policy Institute (EPI) was founded in 2001 by Lester Brow to provide a plan of a sustainable future along with a roadmap. EPI works at the global level simply because no country can fully implement a Plan B economy in isolation. EPI’s goals are;

  (a) to provide a global plan (Plan B) for moving the world onto an environmentally and economically sustainable path.

(b) to provide examples demonstrating how the plan would work.

(c) to keep the media, policymakers, academics, environmentalists, and other decision-makers focused on the process of building a Plan B economy.

- **Conservation International**

  Conservation International is committed to helping societies adopt a more sustainable approach to development that considers and values nature at every turn. It imagine a healthy prosperous world in which societies are forever committed to caring for and valuing nature for the long-term benefit of people and all life on Earth.

- **Conservation Law Foundation (CLF)**

  The Conservation Law Foundation (CLF) works to solve the most significant environmental challenges facing New England. Since 1966, CLF's advocates have used law, economics and science to create innovative strategies that conserve natural resources, protect public health and promote vital communities in our region.

- **United Nations Environment Programme**

  The mission of the UN'S Environment Programme is:

  To provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.

- **United Nations Framework Convention on Climate Change (UNFCCC**)

  The United Nations Framework Convention on Climate Change (UNFCCC) is an international treaty that begins to consider what can be done to reduce global warming and to cope with whatever temperature increases are inevitable. More recently, a number of nations approved an addition to the treaty: the Kyoto Protocol, which has more powerful and legally binding measures.

- **Vienna Convention to Protect the Ozone Layer**

  The Vienna Convention for the Protection of the Ozone Layer is a treaty on the framework for international cooperation concerning the protection of the ozone layer, which was adopted in 1985 and entered into force in

1988. It provides observations, research and information exchange on the ozone layer.

- **European Union Environmental Laws**

The EU's environmental laws help protect against water, air and noise pollution and control risks related to chemicals, biotechnology and nuclear energy within the Union. The overall direction of EU environment policy is laid out in the latest action program "Environment 2010: Our Future, Our Choice." It concentrates on four priority areas:

(a) climate change.

(b) nature and biodiversity.

(c) environment and health.

(d) natural resources and waste.

Also, an Environment and Health Action Plan for 2004-2010 to promotes a close relationship between health, environment and research policy.

- **Convention on Biological Diversity (CBD)**

The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives:

(a) The conservation of biological diversity.

(b) The sustainable use of the components of biological diversity.

(c) The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

- **International Union for Conservation of Nature (IUCN)**

The International Union for Conservation of Nature helps the world find pragmatic solutions to our most pressing environment and development challenges. It supports scientific research, manages field projects all over the world and brings governments, non-government organizations, United Nations agencies, companies and local communities together to develop and implement policy, laws and best practice.

3.5 Overview of National Environmental Standards and Regulations Enforcement Agency (NESREA) of Nigeria

The Nigerian Senate and the House of Representatives, respectively, passed the National Environmental Standards and Regulations Enforcement Agency (Establishment) Bill, 2007. On 30 July, 2007, the Nigerian President, Late Umaru Musa Yar'adua, assented to the Bill, thus heralding the new law on environmental protection, hereinafter called the NESREA Act, 2007. The NESREA Act also charged the Agency with the enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

3.5.1 Objectives of the Agency are provided as follows;

(a) the responsibility for the protection and development of the environment, biodiversity conservation and sustainable development of Nigerian's natural resources in general and environmental technology, including coordination and liaison with relevant stakeholders within and outside Nigeria on matters of enforcement of environmental standards, regulations, rules, laws, policies and guidelines.

(b) to prohibit processes and use of equipment or technology that undermine environmental quality

(c) to conduct field follow-up compliance with set standards and take procedures prescribed by law against any violator

(b) to establish mobile courts to expeditiously dispense cases of environmental infringements. However, this has to be done with the relevant judicial authorities as well as in consonance with the Nigerian Constitution.

(c) to conduct public investigations and make proposals to the Minister for the review of existing guidelines, regulations and standards on environment.

(d) to develop environmental monitoring networks, and compile environmental data from other sectors, except the oil and gas sector.

(e) to promote the expansion of research experiments, surveys and studies with partnership with the public or private agencies, institutions and organizations.

(f) to establish programmes for setting standards and regulations for the prevention, reduction and elimination of pollution and other forms of environmental degradation in the nation's air, land, oceans, seas and other water bodies and for restoration and enhancement of the nation's environment and natural resources with the approval of the Minister.

(g) to collect and make available basic scientific data on environmental standards through publications and other appropriate means.

(h) to charge fees for their services.

It is pertinent to note that the powers of the Agency do not extend to environmental issues arising from the oil and gas sector. In other words, the Agency lacks jurisdiction over environmental matters emanating from the oil and gas sector. Also noteworthy is the fact that the Agency still remains like its predecessor, the Federal Environmental Protection Agency (FEPA), a parastatal within the Federal Ministry of Environment, Housing and Urban Development.

3.5.2 Functions of the Agency are as follows;

(a) Enforce compliance with laws, guidelines, policies and standards on environmental matters.
(b) Coordinate and liaise with stakeholders, within and outside Nigeria, on matters of environmental standards, regulations and enforcement.
(c) Enforce compliance with the provisions of international agreements, protocols, conventions and treaties on the environment, including climate change, biodiversity, conservation, desertification, forestry, oil and gas, chemicals, hazardous waste, ozone depletion, marine and wild life, pollution, sanitation and such other environmental agreements as may from time to time come into force.
(d) Enforce compliance with policies, standards, legislation and guidelines on water quality, environmental health and sanitation, including pollution abatement.
(e) Enforce compliance with guidelines and legislations on sustainable management of the ecosystem, biodiversity conservation and the development of the Nigeria's natural resources.
(f) Enforce compliance with any legislation on sound chemical management, safe use of pesticides and disposal of spent packages thereof.
(g) Enforce compliance with regulations on the importation, exportation, production, distribution, storage, sale, use, handling and disposal of hazardous chemicals and waste other than in the oil and gas sector.
(h) Enforce through compliance monitoring, the environmental regulations and standards on noise, air, land, seas, oceans and other water bodies other than in the oil and gas sector.
(i) Ensure that environmental projects funded by donor organizations and external support agencies adhered to regulations in environmental safety and protection.
(j) Enforce environmental control measures through registration, licensing and permitting systems other than in the oil and gas sector.
(k) Conduct environmental audit and establish data bank on regulatory and enforcement mechanisms of environmental standards other than in the oil and gas sector.
(l) Create public awareness and provide environmental education on sustainable environmental management, promote private sector compliance with environmental regulations other than in the oil and gas sector and publish general scientific or other data resulting from the performance of its functions.
(m) Carry out such activities as are necessary or expedient for the performance of its functions.

4.0 Conclusion

The goal of every environmental policy is to protect the environment for future generations and the two major policy tools for protecting the environment are regulations and inducements. These policies, laws and regulations are enforced mostly by governmental bodies and agencies. Local and international organizations also make and implement policies, laws and regulations on the environment and natural resources.

5.0 Summary

In this unit, Environmental Law is defined as a complex body of law on natural resources that is made up of global, international, national, state and local statutes, treaties, conventions, regulations and policies which seek to protect the environment and natural resources affected, impacted or endangered by human activities. The general functions and objectives of environmental law and policy on natural resources is discussed here as well as the general functions of body established by government for the enforcement of environmental and natural resources policies, laws and regulations. An overview of the objectives and functions of the National Environmental Standards and Regulations Enforcement Agency (NESREA) in Nigeria were also outlined.

6.0 Tutor-Marked Assignment

1. Enumerate the general functions and objectives of environmental policy, law and regulation on natural resources

2 Mention 10 (ten) local/international body/organization with common policies, laws and regulation on the environment and natural resources

3. Write short notes on the functions and objectives of National Environmental Standards and Regulations Enforcement Agency (NESREA) in Nigeria

7.0 References/Further Readings

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UNIT 2 INSTRUMENTS OF ENVIRONMENTAL PROTECTION

CONTENT

6.0 Tutor-Marked Assignment

7.0 References/Further Readings

1.0 Introduction

In the unit before this, you have learnt the policies, laws and regulation on natural resources and the environment. Despite these tools been implemented, environmental degradation has emerged as one of the most important issues of the century and has resulted in new approaches to supplement penal laws and environmental protection. Therefore, instruments used for environment protection will be learnt in this unit.

2.0 Objectives

At the end of this unit, you should be able to;

- State the common instruments used for environmental protection
- Explain the instruments of environmental protection

3.0 Main content

3.1 Environmental Policy Instruments

Environmental policy is any course of action deliberately taken or not taken in order to manage human activities with a view to prevent, reduce or mitigate harmful effects on nature and natural resources, and ensuring that man-made changes to the environment do not have harmful effects on humans. Thus, environmental policy focuses on problems arising from human impact on the environment, which retroacts onto human society by having a negative impact on human values such as good health or the clean and green environment. Environmental issues generally addressed by environmental policies include air and water pollution, waste management, ecosystem management, biodiversity protection and the protection of natural resources, wildlife and endangered species.

Environmental Policy Instruments on the other hand, are tools used to implement environmental policies either by government or established bodies. Governments may use a different types of instruments such as economic incentives and market-based instruments such as taxes and tax exemptions, tradable permits,and fees. Market-Based Instruments (MBIs) are policy measures that rely on prices and incentives rather than regulations to influence behaviour. These environmental policy instruments can be very effective to encourage compliance with environmental policies so as to protect the environment.

3.2 Economic Incentive and Market-Based Instrument

Economic incentive and market-based instrument involve the following measures discussed below.

3.2.1 Environmental or Green Taxes

Taxation may be, and has been used as a deterrent to environmental degradation by imposing taxes on environmentally damaging processes, products, as well as consumption patterns. In addition to these preventive aims, the taxes so raised have been committed to environmental protection activities. Normally, taxes on a particular industry or product would go to support remedial measures for the element of the environment damaged by the industry or product. For example, money raised from taking wood products of a particular tree may be used in planting new trees of the same species. The green taxes is aimed at raising money from polluting activities with the principal objective of putting the sums so raised into environmental protection. The establishment of an environmental tax on permits, imports and domestic goods are earmarked mostly for the following areas;

- Air pollution enforcement and subsidy programs.
- Water pollution enforcement and subsidy programs.
- Solid waste management/pollution enforcement and subsidy programs.
- Protection of public health through enforcement of public health laws, and Land reclamation activities.

3.2.2 Tax Relief and Subsidies

Taxation is mainly a government instrument for raising revenue, however taxation may also be used to achieve other objectives such as encouraging or discouraging certain activities or behaviour. The government can use taxation to support environmental protection by waiving or imposing lower taxes on environmentally friendly technologies or products. Governments can also induce compliance with environmental standards by providing government subsidies for those who adopt methods of abating pollutants which arise from production or consumption.

3.2.3 Polluter Pays Principle

The polluter pays principle refers to a devise of internalizing environmental costs by making those who benefit from the environmentally damaging activity bear the costs of the damage. The polluter pays principle is implemented through charging polluters for the right to pollute. This may be achieved through a variety of means including taxes and fees on licenses. Polluter pays taxes are mainly intended to punish the polluter without necessarily using the monies raised for environmental protection activities. The other method which is increasingly being used to implement the polluter pays principle is the legal imposition of compensatory damages as well as environmental reparation features which hereto have seldom been included in pollution control legislation. In the near future, compensation and reparation in the form of environmental clean-up are features likely to replace penal sanctions as the main characteristics of environmental law. This in turn will dramatically increase the cost of polluting the environment.

3.3 Environmental Impact Assessment

Environmental Impact Assessment (EIA) is another environmental legal instrument considered most effective for the achievement of sustainable environmental protection. It is the requirement that environmental impact assessment shall be undertaken for all proposed development that are likely to have significant adverse impacts on the environment and which are subject to a decision of a competent national authority. The objective of EIA which is to allow maximization of long-term benefits of development while maintaining the natural resource base. However, the objectives of EIA are broader as they seek to protect the environment in the wider sense, and not just the natural resources. Thus, an activity which would raise noise levels near a hospital or school or which can affect the human-made environment such as archaeological sites, historic towns, monuments and artifacts or relics, may also be subjected to environmental impact assessment. Such assessment forms the basis for refusal of permission to undertake a particular activity or grant of permission with conditions necessary to minimize the effect on the environment. Different countries have adopted different elements of the traditional EIA process, which originated in the U.S. For example, some countries authorize EIA for all projects, while others limit the process to those which have a certain level of government involvement, such as the requirement of licensing and permitting or the expenditure of funds, and a test of potentially significant environmental impacts. (for further information on Environmental Impact assessment, study your course ESM 342)

3.4 Greener Public Purchasing/Procurement Programs

Another instrument that can enhance environmental protection is the implementation of greener public purchasing/procurement programs. Greener public procurement means that public purchasers take account of environmental factors when buying products, services or works. Public purchasers are often under the impression that they already apply environmental criteria when purchasing. Certain categories of purchase are more suitable for greening than others. Professional services such as advertising, general management, research and auditing services seldom contain environmental criteria whereas furniture construction, equipment for IT, engineering and other office items often do. The following product groups has been identified as suitable for 'greening' in

the framework of green public procurement, based on the financial and environmental impact and the availability of *'environmental friendly'* products in the market place. These include:

- Cleaning products and services
- Horticultural services
- Medical equipment
- Electrical machinery
- Energy
- Chemical products, rubber, plastic
- Food products and beverages,
- Services e.g architectural, construction, installation and related consultancy services
- Sewage and refuse disposal services
- Sanitation and environmental services
- Transport equipment
- Office machinery (computers/monitors/printers/copiers)
- Construction work and construction products e.g. heating/cooling/lighting appliances
- Furniture and other manufactured goods
- Paper, printed matter, printing services
- Transport and communication services

Note that, if all public authorities were to purchase green electricity in place of conventionally generated electricity, the equivalent of over 61 million tones of CO_2, would be saved each year. This figure equates to approximately 18% of EU's commitment under the Kyoto Protocol to reduce CO_2 equivalent emissions by 340 million tonnes between 2008-2012.

3.5 Voluntary measures

Voluntary measures such as bilateral agreements between the government and businesses, industry or private firms are other instruments used in environmental policy to ensure environmental protection.

4.0 Conclusion

Policy Instruments are important in order to ensure environmental protection. Human beings, if not controlled, would abstract natural resources up to the point where the system would no longer be sustainable.As a result, each government would explore the instrument that would be most beneficial to reducing the rate of environmental degradation.

5.0 Summary

You have learnt in this unit that environmental policy instrument is one of the keys to environmental protection are implemented either by government or established bodies. These could be economic incentives and market-based instrument that involve environmental or green taxes, tax relief and subsidies, and polluter pays principles. Environmental Impact Assessment (EIA) is a legal instrument considered most effective for the achievement of sustainable environmental protection especially for new development. Another vital instrument of environmental protection learnt again are the greener public purchasing/procurement programs and voluntary measures, such as bilateral agreements negotiated between the government and private organisations.

6.0 Tutor-Marked Assignment

1. a. Enumerate the various instruments of environmental protection
   b. Explain environmental policy instruments

2. Write short note on the following;

   i. Economic incentive and market-based instrument
   ii. Environmental Impact Assessment (EIA)
   iii. Greener public purchasing programs/procurement

7.0 References/Further Readings

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MODULE THREE

UNIT 1 **CONFLICTS IN RESOURCE CONSERVATION**

UNIT 2 **ECONOMIC, CULTURAL, POLITICAL AND SOCIAL CONSIDERATION IN RESOURCE CONSERVATION AND MANAGEMENT**

UNIT 1 CONFLICTS IN RESOURCE CONSERVATION

CONTENT

6.0 Tutor-Marked Assignment

7.0 References/Further Readings

1.0 Introduction

The central objective of resource conservation or management in various countries of the world have for long over-looked the role of local people in the conservation process. The consequences have been the series of conflicts experienced in such areas which have a tendency to undermine the conservation drive not only for the present but also, for the future generations. This unit will cover factors that lead to conflicts in resource conservation, its management and control for effective conservation.

2.0 Objectives

At the end of this unit, you should be able to;

- Explain resource conservation
- Discuss factors that influence conflicts in resources conservation
- Explain the two approaches in the management of conflicts in resource conservation
- Outline the control measures of conflicts in resource conservation.

3.0 Main content

3.1 Resource Conservation

The term "conservation" came into use in the late 19th century and referred to the management, mainly for economic reasons, of such natural resources as timber, fish, game, topsoil, pastureland and minerals. In addition it included the preservation of forests (forestry), wildlife (wildlife refuge), parkland, wilderness, and watersheds. However, natural resource conservation has a history that extends prior to the age of conservation. Consequently, resource ethics grew out of necessity through direct relations with nature. Regulation or communal restraint became necessary to prevent selfish motives from taking more than could be locally sustained, therefore compromising the

long-term supply for the rest of the community. This social dilemma with respect to natural resource management is often called the "Tragedy of the Commons". From this principle, conservation biologists can trace communal resource based ethics throughout cultures as a solution to communal resource conflict.Efforts to conserve and protect global biodiversity and natural resources are a recent phenomenon which had resulted in conflicts in resources conservation.

3.2 Land-use Pressure

Land is needed for agriculture, housing, industrial development, military establishments, and so many infrastructural projects. Hence, it becomes difficult to understand the rationale for the conservation of large areas of biological significance exclusively for wild life conservation. Conserved areas of natural resources face various land use problems such as deforestation, wildlife poaching, illicit loggings, uncontrolled bush fires, shifting cultivation and overgrazing. The reason is not far-fetched as the land environment is faced with dense population pressures, inequality and access to natural resources. For example the Queen Elizabeth National Park in Uganda is an example of a conserved area that is increasingly been affected by the various land pressures for conversion from a forest land to cropland and its need to meet the food requirements of her inhabitants. Conflicts over land-use are based on the many socioeconomic activities that are performed within the area conserved namely fishing, cultivation, livestock grazing, hunting, collection of firewood and the harvesting of salt. Conflicts within these environments are based on the access restrictions which prohibit resources exploitation. Again, within the Volcanoes National Park of Rwanda are communities that believe that the rationale behind the designation of conservation areas is to forcefully take possession of their lands. These communities who more often than not are preoccupied with the availability of land for their agricultural activities believe that conserved area within their territories is an indication that enough lands would not be available for their children. As a result,little consideration is given to the aesthetic, scientific or moral objectives of the protection of the conserved environment. The drive to protect the conserved lands as a heritage for the future is the motivation behind these conflicts. Similarly, the wildlife of the Serengeti National Park in Kenya is threatened by the increasing human population which exert pressures on the conversion of the park to agricultural farmlands. These pressures lead to land and political conflicts among the ethnic groups within the park. The need for the conservation efforts was the consequence of unsustainable exploitation of forest resources characterized by unmanaged legal and illegal harvesting of fuel wood, timber, poles, bamboo, and medicinal herbs. Other factors include a high dependence on agriculture, a lack of alternative non-land sources of livelihood, land scarcity as evidenced by increasing population-land ratio, low-level of productivity per unit area of cultivated land, economic, social and political pressure for the removal of forests to human settlements or other land projects.

3.3 Multiple Use Value of Natural Resources

The resources obtained from the natural environment such as trees, plant and wildlife species are employed on one hand for consumption, habitat, soil productivity

maintenance, medicine, cultural development, economic security etc. On the other hand, the same environment is subjected to both small and large scale projects which frequently exert undue pressure on its life supporting capacity. For instance, many of the wild-life reserves in Europe and Canada are tourism and recreation-oriented while the task of conservation is secondary. The resultant effect of this separation is that as more areas of the park and sanctuaries are demarcated to suit recreational activities, a lot of financial expenses are used to maintain recreation. Consequently, severe degradation of the natural wild-life habitat occurs which in turn does not aid the goal of conservation. It is necessary to have an understanding of the values attached to natural resource use as found in such environments as conserved areas because it largely determines the success of conservation goals.

Value conflicts frequently result when controversies surround various resource uses. For example the Nazinga Game Ranch in Burkina Faso is a protected area in which wild animals are harvested to generate income. Similarly, the incomes generated from the sale of animal products, sport, hunting and tourism are used by the park administrators to carry out administrative expenses, research and law enforcement for the protected area. This type of management reflects a clear case of value inconsistency which provides breeding grounds for conflicts as the value use of the reserve is contradicted. The values attached to conservation by a society often depend on moral and ethical factors such as interest in the survival and welfare of the present resource status and the willingness to protect these resources for the future. The World Development Report in 1992 regards the environment-development issue to be complimentary in nature, particularly as the absence of one factor will ultimately result in the failure of the other. For example, the inadequate conservation of the natural environment can only result in a poor quality of development and vice verse, such as the development of large projects as hydroelectric power project, the over exploitation of the African natural resources and the establishment of reserves and parks as against the negative cultural losses of exclusion of communities from their ancestral lands.

3.4 Conflicts of Ownership

The objectives behind the conservation scheme is to conserve natural resources for long-term benefits, while the concern of the inhabitants of the conserved areas is the need to have a means of livelihood for survival. The different functional interpretations given to conserved areas have generated the varying degrees of conflicts experienced. Local people regard the conserved environment as their rightful property and rather view the authorities as intruders on their land and as such would willingly go to extraneous lengths to preserve their heritage. Lewis (1993) identified the major reason for the conflicts to include people in such areas having substantive needs which are contrary to the different goals of governmental authorities. This is indicated by the needs of indigenous people for grazing lands, firewood, building materials, medicinal plants and land for hunting as opposed to the conservation needs of the authorities for sustainability. A study revealed that the 82% of the set-aside conservation park land in the Aceh Tenggara District, Indonesia have resulted in more rapid forest destruction resulting from illegal logging and agricultural encroachment. The situation was further worsened by the imposition of

severe threats to life of the Park Officials who attempted to report cases of encroachment to the authorities. Similarly, the establishment of the Khao Yai National Park in Thailand and the adoption of enforcement measures met with stiff opposition and hostility which culminated in armed clashes between the workers of The Royal Forestry Department and the indigenous people. Cases of loss of lives on both sides were reported, notwithstanding the illegal activities of poaching, logging, etc still persisted such that between January - April of 1986, over 258 poachers had been arrested. From the case studies of the two parks examined above, it is seen that the unsuccessful administration of these parks evidently stem from a lack of cooperation between the park officials and the indigenous people. The Government Department paid little attention to the needs of the indigenous people in terms of local settlement, and subsistence resource, and the use of their conserved area, as a result, conflict ensued. The ownership of land and sea within protected areas is one of the key factors responsible for conflicts within protected areas. This is more so in sites having high human population density and areas which receive an influx of migrants from surrounding regions. Thus access to land constitute a significant factor in conflict generations between indigenous people and protected area authorities.

3.5 Human Population Pressure And Consumption

The impact of the growing world population on land, water, energy and biota resources are real and indeed overwhelming. Clear scientific evidence which suggests worldwide problems of food availability have emerged. More humans than ever before have covered the earth with their urbanization, highways and other activities. This imperils the availability of food resources. Each year, more than 10 million hectares of valuable cropland are degraded and lost because of soil erosion. In addition, an added 10 million hectares are being destroyed by salinization resulting from improper irrigation. The world's soil erosion and salinization account for the major losses in productive cropland due to human population pressure creating conflicts in the conservation of natural resources. Adequate quantities of freshwater which support the very survival of every human, plant, and animal on earth are not available in many regions of the world because of too much dependence by the human population. Indeed, more than 70% of all available freshwater is used in world agriculture for this same reason. This confirms the importance of water and the role of irrigation in world food production. For instance water is being removed in some aquifers in the Western United States ten times faster than the recharge rate and nearly 20% of all the fossil energy used in the United States is devoted to supplying food for her population need.

The world supply of oil has peaked because of the population pressure of the world and the remaining oil will continue to decline as use continues. Reliable projections are that by 2040 the world supply of oil will be more than 60% depleted. As oil resources diminish worldwide, costs increase. In the United States for example, supplies of natural gas and coal are expected to last fifty to one hundred years, depending on how fast they are substituted for oil and how fast the U.S. population grows. However, the processing of coal into oil and gas will contribute to air pollution unless technology is developed to help overcome these serious consequences. This rate of consumption will continue to increase as the population continues to grow and further diminish fossil energy reserves.

This calls for renewable energy sources that must be investigated and priority given to their development and use. These renewable energy sources would occupy another additional land area. Some of this required land would compete with vital cropland, pasture and forest land. Clearly, the current energy-population imbalance will impose drastic changes in energy, land, and water use. Achieving energy conservation and efficiency of all energy sources is paramount but population pressure has been a conflict for its conservation. To halt the escalating imbalance between expanding population numbers and the earth's essential natural resources, human beings must control their numbers. At the same time, they must make efforts to conserve the use of cropland, freshwater, energy, biodiversity and the other life-supporting environmental resources.

3.6 Conflict Management In Resources Conservation

Two approaches that are useful in understanding the management of Conserved areas for natural resources include the Top-Down, the Mixed Top- Down and Bottom-Up Management approaches.

(a) **The top-down management approach** – This involves a command management in which the management of conserved or protected areas is strictly controlled by the authorities while the local communities have no direct control or power in the administration and management of the conserved area and its resources. Revenues accruing from ecotourism in such cases are not allocated to the surrounding communities or utilized to enhance their standard of living. The resulting effects have been the involvement of local communities in economic activities that are less sustainable than previously engaged in.

(b) **The Mixed Top-Down approach** – The mixed top-down approach attempts to partially involve the local communities in the management and administration of conserved areas. In this case, suggestions by local communities are appreciated by the authorities, bringing about a collaborative management effort. The **Bottom Up management approach** is the piecing together of systems to give rise to grander systems. In a bottom-up management approach, the individual base elements of the system are first specified in great detail. These elements are then linked together to form larger subsystems, which then in turn are linked, sometimes in many levels, until a complete top-level system is formed. The resultant effects of such attempts have been the creation of various land uses of the zone, anthropogenic landscape features, culturally significant and sacred areas and natural resource distribution aimed at enhancing the communities' abilities to support their livelihoods within the confines of the conserved area such as wildlife protection, agricultural fields and livestock management. The involvement of the local authorities in the management of the park results in reduced incidences of conflicts.

3.7 Control of Conflicts In Resources Conservation

In recent times, concern has been based on the best practices that could be adopted to control conflicts for sustainable conservation of natural resources. The realization by many countries of the world that the way forward in the control of conflicts within conserved areas, should involve the adoption of measures that seek to integrate the indigenous communities into the conservation scheme, is rapidly gaining momentum. In other words, there is the need to ensure that the bottom-up management approach rather than the top-down is practiced within the conserved area. The bottom-up management approach will enable the surrounding communities of protected or conserved areas to be actively involved in the management and administration of their regions. In addition to this, is the need for conserved area managers to put in place measures that can aid the communities to enhance their living standards such as improved educational, and infrastructure facilities. Alternative development options such skills acquisition training in tailoring, sustainable farming, carpentry and so on, can provide a background for the shift in dependence from the natural environment to other sustainable forms of livelihood.

The utilization of technological innovations provides a sound and appropriate opportunity for the application of multi-media tools in natural resources management and environmental education in order to reduce conflicts within conservational environment. The adoption of modern information technology particularly multi-media methods that incorporate geographic information systems (GIS), in addition to sophisticated simulation models and accessible network systems will undoubtedly serve as efficient tools for resources management and ultimately development. The use of remote sensing in environmental monitoring is rapidly gaining consciousness particularly in detecting vegetation changes and degradation. Hence, the emission of early warnings triggered by undesired events can help to resolve complex land management issues. The use of GIS and remote sensing can be effectively used to gather and compile information regarding land-use activities and patterns among the communities of the areas for conservation in order to aid constant monitoring. The significance of this for the future of conservation is to provide the needed platform for the participatory involvement and planning of indigenous knowledge and technological innovations for efficient conservation and human development and growth within protected areas for resources conservation.

4.0 Conclusion

Land-use pressure, multiple use value of natural resources, conflicts of ownership, and human population pressure and consumption have contributed immensely to conflicts in resource conservation. The management approaches described are the tools used to effectively reduce conflicts in resource conservation.

5.0 Summary

You have learnt in this unit that natural resource conservation referred to the management, mainly for economic reasons, of such natural resources as timber, fish, game, topsoil, pastureland, and minerals. In addition it referred to the preservation of

forests (forestry), wildlife (wildlife refuge), parkland, wilderness, and watersheds. The factors to conflicts in resource conservation are explained here, such as the land-use pressure, multiple use value of natural resources, conflicts of ownership, and human population pressure and consumption. Two approaches for management of conflicts in resource conservation were discussed and lastly in this unit are the effective measures to control conflicts in resources conservation.

6.0 Tutor-Marked Assignment

1. Explain natural resource conservation

2 Write short note on the following;

   i. Land-use pressure
   ii. Multiple use value of natural resources
   iii. Conflicts of ownership
   iv. Human population pressure and consumption

3. a. State the two approaches for management of conflicts in resource conservation
   b. Write briefly on the control of conflicts in resource conservation

7.0 References/Further Readings

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UNIT 2 ECONOMIC, CULTURAL, POLITICAL AND SOCIAL CONSIDERATIONS IN RESOURCE CONSERVATION AND MANAGEMENT

CONTENT

1.0 Introduction

In the previous unit, you have been introduced to conflicts in resources conservation and management. Following the introcuctionis this unit which will discuss the consideration of the economic, cultural, political, and social aspect in resources conservation and management.

2.0 Objectives

At the end of this unit, you should be able to;

- Clearly define resource conservation and management
- Discuss the Economic, cultural, political and social considerations in resource conservation and management

3.0 Main content

3.1 Resource Conservation and Management

Natural resource conservation and management signifies the control of environmental and socioeconomic factors. This will bring about an efficient use of raw materials, recycle materials and energy that are vital to human survival, restore derelict land and maintain the capacity of ecosystems, which are the basis of all economies. Over the years, particularly at a governmental level, resources conservation and management has come to focus on biological resources such as:

- Agriculture and pastoralism
- Fisheries

- Forestry
- Water
- Tourism and recreation
- Wildlife
- Genetic resources

From this perspective, the aim of resource conservation is to foster attitudes in community and industry to the use of biological resources, changing from the maximum yield approach to one of ecologically sustainable yield. This new attitude recognizes the need for conservation of natural resources, biodiversity and maintenance of ecological integrity.

3.2 Economic, cultural, political and social considerations in resource conservation and management

The Conservation and management of natural resources are social processes since they rely on people's behaviour, values and decisions. Human individuals relate to nature through social relations established with others, which in turn shapes their perceptions, values, knowledge, power, opportunities and decisions. The success of resource conservation and management depends on people's behaviour and decisions, and it can be judged by the degree to which it contributes to the well-being of people and their environment. It is then essential to consider social, cultural, economic, and political factors in natural resources conservation and management of conserved area. These factors include peoples' values, attitudes, beliefs, and behaviors, both individually and collectively, the ways they value and use natural resources and the social, economic, and political organization of resource use. Therefore, it is especially important to consider the social and economic impacts and people's perceptions, attitudes, expectations, and behavior regarding, resources conservation and management. The relevant questions to be asked in considering these factors include;

- What is the nature and extent of the activity in and near the conserved area?
- Do the local people or indigenes support or oppose the conserved area? Why or why not?
- What social and economic effects might be expected from establishing protected or conserved area? How are these effects distributed? Are there alternative sites or designs that might lessen the negative effects or increase the positive effects on resource users?
- How might the nature and extent of activity change with the conservation goal? Is there a concentration of much activity at the area reserved?
- How would these changes affect resource conditions and outcomes in ecological, social, and economic terms within and outside the conserved area?

The provision of information and understanding of these aspects of conservation scheme can be used to minimize their negative effects and maximize their positive effects on resources conservation. Failure to consider them can lead to the failure of resources conservation to achieve their ecological, social, and economic goals.

There is a need to open dialogue and negotiation among different stakeholders within global, regional, national and local contexts, in order to achieve more equitable sharing of the costs and benefits in considering conservation. Policy issues at the national and global level, such as international trade agreements, global conventions and treaties, shape decisions affecting the use of natural resources and ecosystems, and therefore affect social stability and human security. There is a need for environmental laws, regulations, policies and practices that contribute to more equitable sharing of the cost and benefits of conservation, and more even distribution of entitlements of natural resources. There is a need to build capacity at the local and national level to support democratic participation of local people within policy development, in order to reach more equitable power sharing between poor and rich countries.

The concept of social equity in conservation refers to the need for fair distribution of the benefits and costs of conservation among different social groups and individuals. It recognizes that social groups and individuals have differential needs, interests, rights to and responsibilities over resources, and that they experience different impacts of conservation. Unless special provisions are made to balance differences in tenure, power, knowledge and decisions, conservation and sustainable use initiatives are going to perpetuate and sharpen social and economic differentiation. By doing so, they would fail to build a solid social base for sustainability and socio-environmental security. Broad participation of stakeholders without gender, class, age, ethnicity, religion, culture or racial discrimination is required within natural resources management, in order to ensure their integrity and human development. Social equity is not only the keystone of long-term social stability and security, which are essential aspects of human welfare and sustainable development, but it is also a fundamental condition for sustainable use of natural resources.

The International Union of Conservation of nature (IUCN) understands that to be able to design effective programs that promote sustainable and equitable conservation and natural resources management, it has to fully embrace socio-economic and cultural equity concerns in its policies, programs and projects at the local, national, regional and global level. Within IUCN's mission six major areas have been identified, in which issues of social equity in resources conservation need to be explicitly addressed, these are:

- Social Diversity and Equity
- Gender and Equity
- Tenure and Participatory Management
- Indigenous and Traditional Peoples
- Security and Equity
- Poverty

Conservation of natural resources cannot be achieved unless fair access and control to natural resources are available to local people, without discrimination based on gender, class, ethnicity, age or other social variables. There is a need to empower communities and local users, recognizing their rights and responsibilities, ensuring their means to sustainable livelihoods and human development. Fair and safe tenure systems for land

and natural resources increases social stability and local resources users' incentives and abilities to participate in resource management decisions in effective ways.

Indigenous and traditional peoples have often been unfairly affected by conservation policies and practices, which have failed to fully understand the rights and roles of indigenous peoples in the management, use and conservation of biodiversity. In line with numerous international agreements (e.g., Agenda 21; ILO convention no. 169; Article 8(j) of the CBD; and the draft UN Declaration on the Rights of Indigenous Peoples) several IUCN WCC resolutions emphasize indigenous people’s rights to lands and territories, and natural resources on which they have traditionally subsisted. These resolutions stress the need to enhance participation of indigenous peoples in all conservation initiatives and policy developments that affect them. Furthermore, they recognise that indigenous peoples possess a unique body of knowledge related to the conservation and use of natural resources. These include;

- Respect indigenous people's knowledge and innovations, and their social, cultural, religious and spiritual values and practices.
- Recognize the social, economic and cultural rights of indigenous peoples such as their right to lands and territories and natural resources, respecting their social and cultural identity, their customs, traditions and institutions.
- Ensure full and just participation of indigenous peoples in all conservation activities supported and implemented by IUCN.
- Support indigenous peoples' right to make their own decisions affecting their lands, territories and resources, by assuring their rights to manage natural resources, such as wildlife, on which their livelihoods and ways of life depend, provided they make sustainable use of natural resources.
- Strengthen the rights and full and equal participation of traditional institutions and to strengthen the capacity of indigenous people to ensure that they benefit from any utilization of their knowledge.

Social equity is the cornerstone of long-term environmental and human security, and a prerequisite of sustainable conservation of nature and management of natural resources. The main driver of unsustainable environmental practices is the demand for natural resources generated by inequitable consumption, distribution and global economic development patterns. These global mechanisms exacerbate the demographic pressure on natural resources exerted by communities and individuals whose livelihoods rely more directly on natural resources. The same patterns that increase high standards of wasteful consumption in the developed countries increase resource scarcity, conflicts and poverty in developing countries. It is often the poorest people and communities who are affected by this disproportionate appropriation and consumption, and by environmental degradation.

Globalization has many different impacts on local and national economies and societies, affecting people's lives and the use of natural resources. Expansion of markets, communication, Western consumption patterns, homogenization and modernization of culture and lifestyles, increasing pressure on natural resources, and sharpened differences

between rich and poor, are some trends affecting the long-term security of the human race on global scale and directly on natural resources. Increasing interdependencies leave no conserved place on earth, making environmental and social issues a common urgent agenda for all people around the world. There is a need to raise awareness, increase networking and to build institutional capacity to speed and spread this process to ensure resources conservation. The aim is to secure healthy ecosystems in term of natural resources conservation and to build strong democratic and fair civil society throughout the world.

In cultural ways, it is seen that the differing cultural value systems between conserved area and their support communities have frequently resulted in incidences of conflicts particularly as many of the native societies within protected or conserved areas believe that the natural environments within these areas are sacred habitats which connect them to their religious inclinations. Hence, such areas are consciously protected from any form of intrusion. For example, farmers of the south East Asian region traditionally honour sacred groves- patches of wilderness amidst agricultural fields and rural landscapes as abodes of their powerful deities. For the indigenous Indians of Panama, patches of forests are regarded as super natural parks for the refuse of wild-life and spirits, while the Tukano Indians of Brazil guard forests and waterways for spiritual recourse. The indirect effect of this is the protection of over 60% of the streams within the locality as sanctuaries for fishes and other aquatic life. Similarly the taboo and religious traditional value placed on orange-utang population in the upper reaches of Butang-Ai river in southern Sarawak has resulted in the preservation of the animal population.

For African conservation schemes to be laudable it is vital that such schemes take into consideration the peculiar cultural traits of the region in which they are established. This would include conservation education, infrastructure, funding and man-power availability. The United Nations has recognised the central role of culture and education, and have declared a decade of education for sustainable resources conservation and management, 2005–2014, which aims to "challenge us all to adopt new behaviours and practices to secure our natural resources". The Worldwide Fund (WWF) for Nature proposes a strategy for sustainability that goes beyond education to tackle underlying individualistic and materialistic societal values head-on and strengthen people's connections with the natural world.

Political and social disruptions like war, crime and corruption divert resources from areas of greatest human need, damage the capacity of societies to plan for resources conservation and management, and generally threaten human well-being and the environment. Depletion of natural resources including fresh water increases the likelihood of “resource wars”. This aspect of resources conservation has been referred to as environmental security and creates a clear need for global environmental agreements to manage resources such as aquifers and rivers which span political boundaries, and to protect global systems including oceans and the atmosphere.

4.0 Conclusion

Resource conservation issues to considering the economic, cultural, political and social considerations are generally expressed in scientific and environmental terms, but implementing change is a social challenge that entails, among other things, international

and national law, urban planning and transport, local and individual lifestyles and ethical consumerism.

5.0 Summary

The success of resource conservation and management depends on people's behaviour and decisions, it is then essential to consider social, cultural, economic, and political factors in natural resources conservation and management of conserved area. These factors include peoples' values, attitudes, beliefs, and behaviors, both individually and collectively, the ways they value and use natural resources and the social, economic, and political organization of resource use.

6.0 Tutor-Marked Assignment

1. Write an essay on the economic, cultural, political and social considerations in resource conservation and management

7.0 References/Further Readings

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MODULE FOUR

UNIT 1 **WATERSHED MANAGEMENT AND NATURE RESERVES**

UNIT 2 **WILDLIFE CONSERVATION IN AFRICA**

UNIT 3 **EMERGING ISSUES IN RESOURCES CONSERVATION**

UNIT 1 WATERSHED MANAGEMENT AND NATURE RESERVES

CONTENT

7.0 References/Further Readings

1.0 Introduction

In this unit you will learn the definition of watershed, their types and the determining factors as a prerequisite to watershed management. Water supply, water quality, drainage, storm water runoff, water rights, and the overall planning and utilization of watersheds are the features of watershed that need to be managed. The principles of watershed management will also be discuss as well as integrated watershed management. The importance of watershed will be learnt in this unit. In order to complement this unit, nature reserves will be defined and the well known nature reserves in some African countries will be unfolded.

2.0 Objectives

At the end of this unit, you should be able to;

- Define what watersheds are.
- Mention the types of watersheds.
- Explain watershed management.
- State the importance of watershed and nature reserves.
- Discuss nature reserves in African countries.

3.0 Main content

3.1 What are watersheds

Watersheds are areas of land defined by the flow patterns of rainwater or melting snow and ice when it is determined by topography of a region rather than political boundaries. In more general terms a watershed is a geographic area where all the water, sediments, and dissolved materials drain to a common outlet like a stream, river system, reservoir, lake, underground aquifer, estuary, wetland, sea, ocean or other body of water. It can also be thought of as an area that "catches" water and routes it to a common basin, channel, or network of channels. In the technical sense, a watershed refers to a divide that separates one drainage area from another drainage area. Watersheds drain into other watersheds in a hierarchical pattern, with smaller sub-watersheds combining into larger watersheds. However, the term is often used to mean a drainage basin or catchment area itself. Other terms that are used to describe a watershed are catchment, catchment basin, drainage area, river basin, and water basin.

Watersheds are similar but not identical to hydrologic units, which are drainage areas delineated so as to nest into a multi-level hierarchical drainage system. Hydrologic units are designed to allow multiple inlets, outlets, or sinks. In a strict sense, all watersheds are hydrologic units but not all hydrologic units are watersheds. The watershed acts as a funnel by collecting all the water within the area covered by the basin and channeling it to a single point. Each watershed or drainage basin is separated topographically from adjacent basins by a geographical barrier such as a ridge, hill or mountain in hilly country, but in flat country especially where the ground is marshy, the divide may be invisible with just a more or less national line on the ground on either side of which falling raindrops will start a journey to different rivers, and even to different sides of a region or continent.

Watershed or drainage divides are important geographical, and in determining political boundaries. Roads such as ridgeways and rail tracks often follow divides to minimise gradients, and to avoid marshes and rivers. In another way, watershed can be a hindrance to river navigation. In pre-industrial times water divides were crossed at portages. Later, canals were built to connect the adjoining watersheds.

3.2 Types of watershed

Watershed or Drainage divides can be grouped in three types:

3.2.1 Continental divide or Ocean basins

Continental divide is a divide in which the waters on each side flow to different oceans. The following is a list of some of the major ones:

(a) In North America, surface water drains to the Atlantic via the Saint Lawrence River and Great Lakes basins, the Eastern Seaboard of the United States, the Canadian Maritimes, and most of Newfoundland and Labrador. Nearly all of South America east of the Andes also drains to the Atlantic, as does most of Western and Central Europe, and the greatest portion of western Sub-Saharan

Africa. The three major Mediterranean seas of the world also flow to the Atlantic:

(i) The American Mediterranean Sea (the Caribbean Sea and Gulf of Mexico) basin includes most of the American interior between the Appalachian and Rocky Mountain ranges, a small part of the Canadian provinces of Alberta and Saskatchewan, eastern Central America, the islands of the Caribbean and the Gulf, and a small part of northern South America.
(ii) The European Mediterranean Sea basin includes much of northern Africa, east-central Africa (through the Nile), southern, central, and eastern Europe, Turkey, and the coastal areas of Israel, Lebanon, and Syria.
(iii) The Arctic Ocean basin drains most of Western and Northern Canada east of the Continental Divide, the north shore of Alaska and parts of North Dakota, South Dakota, Minnesota, and Montana in the United States, the north shore of the Scandinavian Peninsula in Europe, and much of central and northern Russia.

(b) Just over 13% of the land in the world drains to the Pacific Ocean. Its basin includes much of China, southeastern Russia, Japan, Korea, most of Indonesia and Malaysia, the Philippines, all of the Pacific Islands, the northeast coast of Australia, and the western parts of Canada, the United States (including most of Alaska), Central America, and South America.
(c) The Indian Ocean's drainage basin also comprises about 13% of Earth's land. It drains the eastern coast of Africa, the coasts of the Red Sea and the Persian Gulf, the Indian subcontinent, Burma, and most of Australia.
(d) The Southern Ocean drains Antarctica. Antarctica comprises approximately eight percent of the Earth's land.

3.2.2 Major and minor drainage divide

In the major drainage divide, the waters on each side of the divide never meet again, but do flows into the same ocean while that of Minor drainage divide, the waters part but eventually join again at a river confluence. The three largest river basins (by area), from largest to smallest, are the Amazon basin, the Congo basin, and the Mississippi basin while the three rivers that drain the most water, from most to least, are the Amazon, Congo, and Ganges Rivers.

3.2.3 Endorheic drainage basins

The Endorheic drainage basins are inland basins that do not drain to an ocean but drains to endorheic lakes or seas or sinks. The largest of these consists of much of the interior of Asia, and drains into the Caspian Sea and the Aral Sea. Other endorheic regions include the Great Basin in the United States, much of the Sahara Desert, the watershed of the Okavango River (Kalahari Basin), highlands near the African Great Lakes, the interiors of Australia and the Arabian Peninsula, and parts in Mexico and the Andes.

3.3 Watershed factors

The watershed factors which include topography, shape, size, soil type and land use (paved or roofed areas) are the most significant factor determining the amount or likelihood of flooding i.e topography and shape determine the time taken for rain to reach the river, while size, soil type and development determine the amount of water to reach the river.

3.3.1 Topography

Topography determines the speed with which the runoff will reach a river. Clearly rain that falls in steep mountainous areas will reach the river faster than flat or gently sloping areas.

3.3.2 Shape

Shape will contribute to the speed with which the runoff reaches a river. A long thin watershed will take longer to drain than a circular watershed.

3.3.3 Size

Size will help determine the amount of water reaching the river, as the larger the watershed the greater the potential for flooding.

3.3.4 Soil type

Soil type will help determine how much water reaches the river. Certain soil types such as sandy soils are very free draining and rainfall on sandy soil is likely to be absorbed by the ground. However, soils containing clay can be almost impermeable and therefore rainfall on clay soils will run off and contribute to flood volumes. After prolonged rainfall even free draining soils can become saturated, meaning that any further rainfall will reach the river rather than being absorbed by the ground.

3.3.5 Land use

Land use can contribute to the volume of water reaching the river, in a similar way to clay soils. For example, rainfall on roofs, pavements and roads will be collected by rivers with almost no absorption into the groundwater.

3.4 Watershed management

Watershed management is the process of creating and implementing plans, programs, and projects to sustain and enhance watershed functions that affect the plant, animal, and human communities within a watershed boundary. Water supply, water quality, drainage,

storm water runoff, water rights, and the overall planning and utilization of watersheds are the features of watershed that need to be managed. Environmental specialists and the local communities around watersheds all play an integral part in the management of a watershed.

3.4.1 Pollution source

In an agricultural landscape, common contributors to water pollution are nutrients and sediment which typically enters stream systems after rainfall washes them off poorly managed agricultural fields, called surface runoff, or flushes them out of the soil through leaching. These types of pollutants are considered nonpoint source pollution because the exact point where the pollutant originated cannot be identified. Such pollutants remain a major issue for water ways because the inability to trace their sources hinders any attempt to limit the pollution. Point source pollution originates a specific point of contamination such as if a manure containment structure fails and its contents enter the drainage system.

In urban landscapes, issues of soil loss through erosion, from construction sites for example and nutrient enrichment from land fertilizers exist. Point source pollution, such as effluent from wastewater treatment plants and other industries play a much larger role in this setting. Also, the greatly increased area of impervious surfaces, such as concrete, combined with modern storm drainage systems, allows for water and the contaminants that it can carry with it to exit the urban landscape quickly and end up in the nearest stream.

3.4.2 Controlling pollution

In agricultural systems, common practices include the use of buffer strips, grassed waterways, the reestablishment of wetlands, and forms of sustainable agriculture practices such as conservation tillage, crop rotation and intercropping. After certain practices are installed, it is important to continually monitor these systems to ensure that they are working properly in terms of improving environmental quality.In urban settings, managing areas to prevent soil loss and control storm water flow are a few of the areas that receive attention. A few practices that are used to manage storm water before it reaches a channel are retention ponds, filtering systems and wetlands. It is important that storm water is given an opportunity to infiltrate so that the soil and vegetation can act as a "filter" before the water reaches nearby streams or lakes. In the case of soil erosion prevention, a few common practices include the use of silt fences, landscape fabric with grass seed and hydroseeding. The main objective in all cases is to slow water movement to prevent soil transport.

3.4.3 The roles of environmental agencies and authorities

In the United States for example, the Natural Resources Conservation Service (NRCS) and the United States Environmental Protection Agency (EPA) are responsible for environmental issues on protection, conservation or management. The NRCS is typically involved with the planning and continued monitoring of environmental improvement

projects, while the EPA is generally responsible for compliance of several environmental laws such as the Clean Water Act. Assistance with watershed protection is also provided by other governmental bodies like departments of natural resources and departments of agriculture. Beyond governmental support, other organizations and companies exist that provide support in various manners with the goal of watershed protection in mind as well.

3.4.4 Environmental law

Environmental laws often dictate the planning and actions that agencies take to manage watersheds. Some laws require that planning be done, others can be used to make a plan legally enforceable and others set out the ground rules for what can and cannot be done in development and planning. Most countries and states have their own laws regarding watershed management.

3.5 Integrated watershed management

Integrated watershed management is a subset of environmental planning which approaches sustainable resource management from a watershed or catchment perspective, in contrast to a piecemeal approach that artificially separates land management from water management. Integrated watershed management recognizes the existence of ecosystems and their role in supporting flora and fauna, providing services to human societies, and regulating the human environment. It seeks to take into account complex relationships within those ecosystems i.e between flora and fauna, between geology and hydrology, between soils and the biosphere, and between the biosphere and the atmosphere. Integrated watershed management recognizes the cyclic nature of processes within an ecosystem, and values scientific and technical information for understanding and analysing the natural world.

3.6 Importance of watersheds

Watersheds are important in the following ways,

3.6.1 Geopolitical boundaries

Watersheds or drainage basins have been historically important for determining territorial boundaries, particularly in regions where trade by water has been important. For example, the English crown gave the Hudson's Bay Company a monopoly on the fur trade in the entire Hudson Bay basin, an area called Rupert's Land. Today, bioregional democracy can include agreements of states in a particular drainage basin to defend it. One example of this is the Great Lakes Commission.

3.6.2 Hydrology

In hydrology, the watershed is a logical unit of focus for studying the movement of water within the hydrological cycle, because the majority of water that discharges from the basin outlet originated as precipitation falling on the basin. A portion of the water that enters the groundwater system beneath the drainage basin may flow towards the outlet of

another drainage basin because groundwater flow directions do not always match those of their overlying drainage network. Measurement of the discharge of water from a basin may be made by a stream gauge located at the basin's outlet.

Rain gauge data is used to measure total precipitation over a drainage basin, and there are different ways to interpret that data. If the gauges are many and evenly distributed over an area of uniform precipitation, using the arithmetic mean method will give good results. In the Thiessen polygon method, the watershed is divided into polygons with the rain gauge in the middle of each polygon assumed to be representative for the rainfall on the area of land included in its polygon. These polygons are made by drawing lines between gauges, and then making perpendicular bisectors of those lines form the polygons. The isohyetal method involves contours of equal precipitation are drawn over the gauges on a map. Calculating the area between these curves and adding up the volume of water is time consuming.

3.6.3 Geomorphology

Drainage basins are the principal hydrologic unit considered in fluvial geomorphology. A drainage basin is the source for water and sediment that moves through the river system and reshapes the channel.

3.6.4 Ecology

Drainage basins are important elements to consider also in ecology. As water flows over the ground and along rivers it can pick up nutrients, sediment, and pollutants. Like the water, they get transported towards the outlet of the basin, and can affect the ecological processes along the way as well as in the receiving water source. Modern usage of artificial fertilizers, containing nitrogen, phosphorus, and potassium, has affected the mouths of watersheds. The minerals will be carried by the watershed to the mouth and accumulate there, disturbing the natural mineral balance. This can cause eutrophication where plant growth is accelerated by the additional material.

3.7 What are nature reserves

A nature reserve is a protected area of importance for wildlife, flora, fauna or features of geological (figure 1.0) or other special interest (figure 1.1), which is reserved and managed for conservation and to provide special opportunities for study or research. Nature reserves may be designated by government institutions in some countries, or by private landowners, such as charities and research institutions, regardless of nationality.

Figure 1.0, An early Bulgarian nature reserve established in 1934.

There are places such as quarries, canals railway cuttings which, although originally industrial, have become populated by a variety of plant and animal life. Some are now nature reserves or form part of one.

3.8 Nature reserves in African countries

African countries with a well known nature reserves are discuss below;

Figure 1.1 Nature reserves of the Bee Lick Creek, of the Jefferson Memorial Forest (a wildlife refuge)

3.8.1 South Africa

South Africa is well known for its many reserves, including Shamwari, Londolozi, Sanbona and Lalibela. It currently has 20 national parks covering 3,700,000 hectares (37,000 km^2), about 3% of the total area of South Africa. The best-known is Kruger National Park, which is also the oldest (proclaimed in 1898), and the largest, at nearly 2,000,000 hectares (20,000 km^2). The Kruger Park and Table Mountain National Park are two of South Africa's most visited tourist attractions. It also has a number of World Heritage Sites and peace parks, as well as many provincial and private parks.

3.4.2 Egypt

There are 29 nature reserves in Egypt which cover 12% of Egyptian land. Those nature reserves were built according to laws for protection of the Egyptian nature reserve. Egypt had announced a plan from to build 40 nature reserves from 1997 to 2017, to help protect the natural resources and the culture and history of those areas. The largest nature reserve in Egypt is Gebel Elba (35600 km^2) in the southeast, on the Red Sea coast.

4.0 Conclusion

In more general terms a watershed is a geographic area where all the water, sediments, and dissolved materials drain to a common outlet like a stream, river system, reservoir,

lake, underground aquifer, estuary, wetland, sea, ocean or other body of water. In this context, watershed management is the process of creating and implementing plans, programs, and projects to sustain and enhance watershed functions that affect the plant, animal, and human communities within a watershed boundary. Watersheds have its determining factors and very important in various ways. Nature reserves on the other hand, may be designated by government institutions in some countries, or by private landowners, such as charities and research institutions, regardless of nationality.

5.0 Summary

In this unit you have learnt that watersheds are areas of land defined by the flow patterns of rainwater or melting snow and ice when it is determined by topography of a region rather than political boundaries. It can also be thought of as an area that "catches" water and routes it to a common basin, channel, or network of channels. Watershed types, their determining factors and their importance in terms of geopolitical boundaries, hydrology, geomorphology and ecology are discussed. Finally in this unit was the definition of nature reserves as a protected area of importance for wildlife, flora, fauna or features of geological or other special interest, which is reserved and managed for conservation and to provide special opportunities for study or research. Nature reserves in two African countries were then discussed.

6.0 Tutor-Marked Assignments

1. Explain in details the term watershed

2 Write short note on the following;
   i. Types of watershed
   ii. Factors of watershed
   iii. Importance of watershed

3. a. Explain watershed management and integrated watershed management
   b. Write briefly on nature reserves.

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UNIT 2 WILDLIFE CONSERVATION IN AFRICA

CONTENT

1.0 Introduction

This unit will broadly explain wildlife conservation and specifically focus on the conservation of wildlife in Africa. Most measures undertaken for effective wildlife conservation in Africa shall be discuss stating the measures in Nigeria and Botswana, a South African country. The last discussion in this unit shall be the various wildlife and conservation projects in Africa.

2.0 Objectives

At the end of this unit, you should be able to;

- Explain wildlife conservation
- Enumerate the various threats to wildlife conservation in Africa
- Discuss the measures of wildlife conservation in Africa
- Name various wildlife and conservation projects in Africa

3.0 Main content

3.1 Wildlife conservation

Wildlife includes all non-domesticated plants, animals and other organisms which can be found in all ecosystems such as deserts, rain forests, plains, and other areas including the most developed urban sites, all have distinct forms of wildlife. While the term in popular culture usually refers to animals that are untouched by human factors, most scientists agree that wildlife around the world is impacted by human activities.

Figure 2.0 The Siberian Tiger is a subspecies of Tiger that is critically endangered; three subspecies of tiger are already extinct.

Wildlife conservation is the preservation, protection, or restoration of wildlife and their environment, especially in relation to endangered and vulnerable species (figure 2.0). All

living non-domesticated animals, even if bred, hatched or born in captivity, are considered wild animals. Wildlife in general represents all the non-cultivated and non-domesticated animals living in their natural habitats. Our world has many unique and rare animals, birds and reptiles. However the pressure of growing population in different parts of the world has led to the increasing need of using land for human habitations and agriculture. This has led to the reduced habitat of many wild animals.

3.2 Threats to wildlife conservation in Africa

Major threats to wildlife conservation in Africa can be categorised as follows;

3.2.1 Habitat Loss

Fewer natural wildlife habitat areas remain each year. Moreover, the habitat that remains has often been degraded to bear little resemblance to the natural wild areas which existed in the past.

3.2.2 Climate Change

Because many types of plants and animals have specific habitat requirements, climate change could cause disastrous loss of wildlife species. A slight drop or rise in average rainfall will translate into large seasonal changes. Hibernating mammals, reptiles, amphibians and insects are harmed and disturbed. Plants and wildlife are sensitive to moisture change so, they will be harmed by any change in the moisture level.

3.2.3 Pesticides and Toxic Chemicals

Pesticides are deliberately spread to make the environment toxic to certain plants, insects, and rodents, so it should not be surprising that other plants and wildlife are deliberately harmed at the same time. In addition many chemical pollutants are toxic to wildlife, such as PCBs, mercury, petroleum by-products, solvents, antifreeze, etc.

3.2.4 Hunting and Poaching

Indiscriminate hunting and poaching causes a major threat to wildlife conservation in Africa. Along with this, mismanagement of forest department and forest guards triggers this problem.

3.3 Wildlife conservation measures in Africa

3.3.1 Control Hunting

Hunting of resident small game is self regulatory since hunting success and hunting pressure decline as the season progresses. After reasonable hunting seasons, enough game animals usually remain to provide a breeding stock for the ensuring year. On the other hand, some migratory games prefer habitats in limited supply and habitat where

hunting is often concentrated. Limitation of hunting is usually important to assure survival of a breeding stock of these animals. Hunting may exterminate any game whose range has been restricted to small areas. Animals transplanted into new areas, or areas which they formally inhabited, are usually protected from hunting until the population becomes well established. Trapping and transplanting have combined as a technique to extend populations of most wild animals. When a new population of wildlife is transplanted into favorable habitat, the population increases faster at first than it does when the species approaches saturation of the available environment. For some wildlife, shooting is a beneficial part of management.

Many kind of wild games respond to an increase dry season hunting harvest through greater breeding success and survival of the young. The manager should therefore endeavor to increase recreational harvest to the point where breeding success and survival of young are near the maximum.

3.3.2 Refuge

Protected areas where animals could hide against hunting and predator is known as refuge. Refuges were first used extensively to protect farm game, but a number of studies especially in African countries have shown them to be ineffective as a widely used measure. Many refuges established were meant to relieve agricultural damage, however, many are now used to enhance and protect endangered wildlife. Where harvest is too limited because of refuge establishment, the animals may become unthrifty, over-populate the range, and seriously damage it.

3.3.3 Predator Control

Wolf, lion, wild cat and fox bountries are the major animals that prey on other game. Avian predators have been much reduced through pesticides interference with their reproduction. Control of the offending individual or family group may be advantageous.

3.3.4 Artificial Stocking

Artificial stocking of wild games reared in game farms has been a costly and generally inefficient method in Africa. Birds for example, produced under conditions of domestication are less able to compete or survive after liberation than the wild stock already in a field. This, in part, is a consequence of genetic selection. Artificial stock does provide recreation on specially managed areas, such as shooting preserves, where birds especially are released a few hours before they are to be hunted. The greater the time lapse between stocking and harvest, the lower will be the return to the hunter and the preserve manager in control.

3.3.5 Carrying Capacity

Carrying capacity is the sum of the environmental factors which make a game range habitable, examples such as food, water, escape cover, nesting cover, loafing areas,

brood and feeding areas are all important. All of these must be within daily and seasonal range of the animal. Wild games animal normally produce more than ample young to fill all the available "home range". Game farm reared individuals, released into occupied range, are most vulnerable and are usually the first individuals lost when the carrying capacity is exceeded. There are upper limits to carrying capacity. Some wild games can seldom be increased to more about one game/acre, possibly because individuals become "stressed" when the level of tolerance of their own kind is exceeded. Carrying capacity changes from season to season on same range. Despite the increased sophistication of management techniques, we still can not circumvent the long established principle that wild animals cannot be stockpiled in excess of the carrying capacity.

3.3.6 Habitat Improvement

Habitat improvement consists of bringing into useful association those conditions needed by species to reproduce and survive. If openings are created in uniform forest lands, it could encourage the production of herbaceous cover, increase population of birds etc. Habitat improvement involve provision of water holes, encouragement of salt licks, clipping and productivity estimation, and creation of small openings.

3.3.7 Interspersion

Interspersion is the positioning, configuration, and size of the lands of vegetation needed to sustain the species. Numbers of wild game usually depend on the interspersion of habitat types and their relation to the species cruising radius (the daily and seasonal movements). Grass cutter, quail and guinea foul ordinarily require woodland, brush land, grassland, and cultivated land, which illustrate the principle that game depends largely on 'edges' because it is the edges of vegetation types that are most used for feeding, loafing, resting, calling and resting. The abundance of non-migratory wildlife depends upon the edges of interspersion of essential habitat types because this determines the amount of edges.

3.3.8 Territories

All wild game, at some point during their life circle, exhibits a fixation for a territory, an area which contains all the immediate necessities for life. For example, antelope travel a distance averaging about 40km while birds have a territory of only a few hundred metres radius. The game manager endeavors to increase the number, and decrease the size of such territories, through changing the vegetative components in such a way that all the life's necessities are within the smallest unit of range that the species will inhabit. Among migratory birds, individuals have a strong attachment for their natal territories, returning year after year to breed in the same areas. This territorial homing tendency is now being exploited by game managers in Africa as measure for wildlife conservation.

3.4 Game Reserves As Wildlife Conservation Tools In Nigeria

Management of wildlife has been in game reserves and it is relatively recent. Nigeria has seven National Parks (Lake Chad, Cross River, Old Oyo, Kamuku, Okomu, Gashaka Gumpti and Kainji Lake National Park), in addition to several game reserves located in various part of the country. When these reserves are protected from illegal hunting, there will be rapid increase in the number of some of the mammals like, Duikers, water buck, Buffalo, Bush buck and cane rats. The cane rat (grasscutter) which is a popular bush meat has been domesticated, and there is rapid production of this particular wildlife in many farms in the country.

3.5 Wildlife Conservation in Botswana (South African)

In order to discourage illegal South African hunting parties and ensure future local use and sustainability, indigenous hunters in Botswana began lobbying for and implementing conservation practices in the 1960s. The Fauna Preservation Society of Ngamiland (FPS) was formed in 1962 by the husband and wife team, Robert Kay and June Kay, an environmentalist working in conjunction with the Batawana tribes to preserve wildlife habitat.The FPS promotes habitat conservation and provides local education for preservation of wildlife. Conservation initiatives were met with strong opposition from the Botswana government because of the monies tied to big-game hunting. In 1963, BaTawanga Chiefs and tribal hunter/adventurers in conjunction with the FPS founded Moremi National Park and Wildlife Refuge, the first area to be set aside by tribal people rather than governmental forces. Moremi National Park is home to a variety of wildlife, including lions, giraffes, elephants, buffalo, zebra, cheetahs and antelope, and covers an area of 3,000 square kilometers. Most of the groups involved with establishing this protected land were involved with hunting and were motivated by their personal observations of declining wildlife and habitat.

3.5 Wildlife and Conservation Projects in Africa

In an effort to manage the conservation of wildlife in Africa, various Wildlife and Conservation Projects in Africa have been established in most African countries. These include;

- **African Conservation Trust**
  The mission of the African Conservation Trust is to provide a means for conservation projects to become self funding through active participation by the public.

- **African Conservancy**
  A nonprofit organization dedicated to the conservation of African wildlife and traditional cultures. They implement education, wildlife protection and socioeconomic programs and provide educational tours to some of the less travelled areas of Africa.

- **The African Conservation Foundation**
  This foundation is trying to pull all flora and fauna Conservation Groups in Africa together to benefit both the conservation groups themselves and those people who feel there is a really urgent need to protect the world's endangered species.

Figure 2.1 An elephant Park which provides a home for rescued elephants

- **Save The Elephants (STE)**
  It is the mission to secure a future for elephants and to sustain the beauty and ecological integrity of the places where they live; to promote man’s delight in their intelligence and the diversity of their world, and to develop a tolerant relationship between the two species in figure 2.1 and figure 2.2.

Figure 2.2 A desert elephant species

- **The Southern Highlands Conservation Programme (SHCP)** Conserving important upland habitats and species in south-west Tanzania. These highlands cover a vast area between Lakes Nyasa (Malawi) and Tanganyika, on the junction of the eastern and western arms of the Great Rift Valley. Forests, plateau grasslands and crater lakes provide water, medicines, natural products and cultural identity, as well as refuge to flora and fauna of considerable conservation concern.

4.0 Conclusion

Wildlife in general represents all the non-cultivated and non-domesticated animals living in their natural habitats. Wildlife conservation in Africa looks at the great effort and measures taken by African countries to manage wildlife. In an effort to achieve this various wildlife and conservation projects have been created and established.

5.0 Summary

This unit has explained to you that wildlife conservation is the preservation, protection, or restoration of wildlife and their environment, especially in relation to endangered and vulnerable species. Threats to this wildlife conservation are habitat loss, climate change, pesticide and toxic chemicals, and hunting and poaching. The measures taken for wildlife conservation in Africa include control hunting, refuge, predator control, artificial stocking, maintaining carrying capacity, habitat improvement, interspersion and lastly, territories. In this unit also you learnt about the various wildlife and conservation projects been established in African countries.

6.0 Tutor-Marked Assignment

1. a. Briefly explain wildlife conservation
   b. Enumerate the threats to wildlife conservation in Africa

2 Write note on wildlife conservation measures in Africa

3. a. Write briefly on wildlife conservation in any named African country
   b. Mention any five (5) Wildlife and Conservation Projects in Africa

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UNIT 3 EMERGING ISSUES IN RESOURCES CONSERVATIONS

CONTENT

1.0 Introduction

The emerging issues in this unit to be discussed will be global warming and climatic change in resources conservation. Global warming and climatic not only have effect in resource conservation, these issues also cause problems for many ecosystems and species. Climatic change on land resources (agriculture production) and agricultural activities that mitigate the impact of Greenhouse Gas (GHG) emissions shall be explained in this unit. Lastly will be some emerging issues pertaining resource conservation that is given consideration and research in some selected organization.

2.0 Objectives

At the end of this unit, you should be able to;

- Discuss global warming and climate change in resource conservation.
- Explain climate change on land resources.
- Deliberate on agricultural activities that mitigate the impact of Greenhouse Gas (GHG) emissions.
- Mention other emerging issues in resource conservation

3.0 Main content

3.1 Global warming and climatic change in resource conservation

Global warming is the rise in global temperatures due to an increase of heat-trapping carbon emissions in the atmosphere. Climate change, on the other hand, in a general term refers to changes in many climatic factors around the world. These changes can be caused by dynamic process on Earth, external forces including variations in sunlight intensity, and more recently by human activities. These changes are happening at different rates and in different ways whereby the natural environment and natural resource have been altered in their natural state. For example, the Sahel region of central Africa has become drier.

The potential dangers of global warming on natural resources are being increasingly studied by a wide global consortium of scientists. These scientists are increasingly concerned about the potential long-term effects of global warming on our natural environment for resource conservation and on the planet. Of particular concern is how climate change and global warming caused by anthropogenic, or human-made releases of greenhouse gases, most notably carbon dioxide, can act interactively, and have adverse effects upon the planet, its natural environment and humans' existence. Efforts have been increasingly focused on the mitigation of greenhouse gases that are causing climatic changes, on developing adaptative strategies to global warming, to assist humans, animal and plant species, ecosystems, regions and nations in adjusting to the effects of global warming.

Climate change is one of the most critical global challenges of our time in resource conservation. Recent events have emphatically demonstrated our growing vulnerability to climate change. Climate change impacts range from affecting agriculture to further endangering food security, sea-level rise and the accelerated erosion of coastal zones, increasing intensity of natural and biological resources. According to the UNFCC, the climate does not respond immediately to external changes, but after 150 years of industrialisation, global warming has momentum, and it will continue to affect the earth's natural systems for hundreds of years even if greenhouse gas emissions are reduced and atmospheric levels stop rising. Changes in climate over the last few decades of the 20th century have already affected biodiversity. The observed changes in the climate system (e.g., increased atmospheric concentrations of carbon dioxide, increased land and ocean temperatures, changes in precipitation and sea level rise), particularly the warmer regional temperatures, have affected the timing of reproduction of animals and plants and/or migration of animals, the length of the growing season, species distributions and population sizes, and the frequency of pest and disease outbreaks.

There is a growing body of evidence showing that increases in atmospheric concentrations of 'greenhouse' gases will enhance the greenhouse effect, resulting on average in additional warming of the earth's surface. This is likely to lead to climatic changes, including increased temperatures, sea level rises and altered rainfall regimes. The extent, pattern and timing of such changes remain uncertain. However, sea level rises would have a direct effect on coastal and estuarine ecosystems and freshwater lagoons near the coast, many of which are important breeding grounds for birds. In alpine ecosystems relatively small temperature changes may result in extensive loss of habitat and consequently extinction of some alpine species.

The ability of species and ecosystems to adapt to climate changes is affected by the rate of change and possible increases in the frequency of extreme climatic events. Pollution and the fragmentation of many natural habitats place further stresses on biological diversity and ecosystem function. Integrated conservation and sympathetic management of large areas of the environment, within a bioregional context, have the greatest potential to mitigate the possible effects of climate change on biological diversity. Organisations such as Wildlife Trust, World Wide Fund for Nature, and Birdlife International are actively monitoring and research the effects of climate change on biodiversity and advance policies in areas such as landscape scale conservation to promote adaptation to climate change. Some examples of recent collaboration to address climate change and global warming in resource conservation include;

- **The United Nations Framework Convention Treaty and convention on Climate Change** - to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.
- **The Kyoto Protocol** - which is the protocol to the international Framework Convention on Climate Change treaty, again with the objective of reducing greenhouse gases in an effort to prevent anthropogenic climate change.

- **The Western Climate Initiative** - to identify, evaluate, and implement collective and cooperative ways to reduce greenhouse gases in the region, focusing on a market-based cap-and-trade system.

3.2 Climate Change on land resources (agriculture production)

Climate change and climate variability present a challenge to ecologically, economically, and socially sustainable land resources management. Drought, floods, and temperature fluctuations due to climate change can directly affect agricultural operations through damage to crops and livestock. Indirect effects of climate change include higher soil erosion rates, more invasive species, and changes in soil and vegetative relationships. The consequences of global warming will not be spread evenly across the planet and the challenges of coping with changes will be regionally unique.

The Natural Resources Conservation Service (NRCS) is focusing global climate change efforts in several areas that includes:

(a) Quantifying the effects of conservation practices on greenhouse gas emissions and carbon sequestration.

(b) Refining incentives in conservation programs to address the effects of climate change on agriculture.

(c) Developing and encouraging the use of conservation practices and systems that reduce GHG emissions.

(d) Enhance opportunities to increase farm profitability on the emerging voluntary emissions trading markets.

3.3 Agricultural activities that mitigate the impact of Greenhouse Gas (GHG) emissions

Agricultural and forestry activities can contribute to the reduction in atmospheric buildup of GHGs in three important ways; sequestration, emissions reductions, and fossil fuel substitution.

(a) Sequestration: Carbon dioxide (CO_2) removed from the atmosphere can be stored in soils, biomass, and harvested products, and protected or preserved to avoid CO_2 release back to the atmosphere. These become carbon stores or carbon sinks.

(b) Emissions reductions: Agricultural CH_4 and N_2O emissions can be reduced through effective manure and feed management and efficient fertilizer application. CO_2 emissions can be reduced by adopting more fuel efficient technologies and practices.

(c) Fossil fuel substitution: Using biofuel produced in the agricultural sector instead of fossil fuels can help lower GHG concentrations.

By adopting these practices, producers can save money and time while enhancing and improving the environment around them, a common goal for many farmers and ranchers as well as their community partners.

3.4 Emerging issues in resource conservation in some conservational organisations/institution

(a) Canadian Institute for Environmental Law and Policy
Issues include;

Nanotechnology, Biotechnology and GMOs, Increased use of market-based incentives for conservation, such as payments for ecosystem services and biodiversity offsets.

(b) United Nations Educational, Scientific and Cultural Organization
Issues under this organisation are;

Potential and actual impacts of the global financial crisis on biodiversity conservation and sustainable use efforts, Cultural and social drivers of biodiversity change, Climate change and its continuing effects, in particular:

- Opportunities offered and risks posed by Carbon offset schemes;
- Linkages between biodiversity and health, Assessing the nature and scope of processes and activities in the open and deep ocean.

(c) United Kingdom Global Biodiversity Sub Committee
Issues are:

Ocean acidification, Arctic Biodiversity, Impact of ground level ozone on biological diversity.

(d) Iran, Islamic Republic
Resource conservation issues are;

Effects of climate change on habitats, specifically the effects of drought on wetlands, Climate change effects on biodiversity, Endemic species, Effects of GMOs on genetic diversity of wild species, Effects of invasive alien species on genetic, species and ecosystem diversity of protected areas.

(e) Royal Society
Emerging issues that involve resource conservation is;

Impact of ground level ozone on biological diversity.

(e) Okeanos Foundation and Whale and Dolphin Conservation Society

Emerging issues in resource conservation are Marine Protected Areas and Undersea Noise.

(g) Applied Environmental Research Foundation

Emerging issues in resource conservation under this organization includes;

Integrating high conservation value native species into biofuel production for conservation and sustainable use of biodiversity.

4.0 Conclusion

Global warming and Climate change is one of the most critical global challenges of our time in resource conservation. Drought, floods, and temperature fluctuations due to climate change can directly affect conservation of resources and agricultural operations through damage to crops and livestock. There are other emerging issues in resource conservation that are developing and under research by countries, organization and institution to curb with resource conservation.

5.0 Summary

In this unit you have learnt that global warming and climatic change is one among numerous issues in resource conservation. In term of land resources in agricultural production, climate change and climate variability present a challenge to ecologically, economically, and socially sustainable land resources management. You have also learnt that the three important ways which are sequestration, emissions reductions, and fossil fuel substitution, mitigate the impact of Greenhouse Gas (GHG) emissions that are current issues in resource conservation. Finally in this unit is the listing of some organization/institution and unfolding current issues pertaining resource conservation.

6.0 Tutor-Marked Assignment

1. Discuss global warming and climate change as an issue in resources conservation.

3. a. Explain briefly the effect of climate change on land resources.
   b. Mention at least five other current emerging issues in resource conservation.

7.0 References/Further Readings

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