NATIONAL OPEN UNIVERSITY OF NIGERIA

SCHOOL OF SCIENCE AND TECHNOLOGY

COURSE CODE: ESM 112

COURSE TITLE: INTRODUCTORY ECOLOGY

COURSE GUIDE

ESM 112
INTRODUCTORY ECOLOGY

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INTRODUCTION

Applied Ecology and Ecosystem Management is a one semester, 20 Units course. It will be suitable to all students to take towards the core module of B.Sc. Environmental Studies. It will be also suitable as an elective course for any student in Science and Technology who does not want to complete an NOU qualification but want to learn about applied Ecology and Ecosystem Management.

The course will consist of 20 units, which involves basic concept in ecology, ecosystem processes and ecosystem management. The material has been developed to suit students in Nigeria by building from global approaches to local approaches. In order to learn more about his course you will be expected to make reference to other sources, of information for example the Internet and library.

There is a pre-requisite to this course and that is Introduction to Ecology, in addition you must have previously been a science student in your secondary or have taken geography as one of your core - subjects. You will definitely be at home in this course.

This course guide tells you briefly what the course is all about, what course materials you will be using and how you can work your way through these materials. It suggest some general guidelines for the amount of time you are likely to spend on each unit of the course in order to complete it successfully. It also gives you some guidance in your tutor-marked assignments. Tutor marked assignments are always at the end of the unit. There are regular tutorial classes, which are linked to the course. Endeavour to attend these sessions

WHAT YOU WILL LEARN IN THIS COURSE

The overall aim is to build upon what you learn in the course introduction to ecology. During this course you will learn about the ecosystems, characteristics, concept and function. You will also learn about the crisis of the ecosystem and how to manage them. This course will also enable you to learn about the Nigerian ecosystem and the nature, constituents and threats to Nigerian ecosystem and how the threats are being controlled and managed. Your study of this course will be a thorough and intensive, so that you will understand the basic structure upon which the study of environment and it problems are built.

COURSE AIMS

The aim of this course can be summarized as follows: This course aims to strengthen and sustain your understanding of ecology and how the ecosystem functions and nature of ecosystem crisis and the approaches to ecosystem management. This will be achieve by aiming to

- Build upon your previous knowledge.
- Introduce you to the basic concept
- Illustrate the processes, which occur in the ecosystem.
- Demonstrate the relationship between the localized ecosystem and global.
- Explain to you the nature of stress that exists in the ecosystem.
- Give you the approaches to the management of these stresses.

COURSE OBJECTIVES

To achieve the aims set out above, the course set overall objectives in addition, and each unit also has specific objectives. The Unit objectives are always included in the beginning of a unit; you should read them before you start working through 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 was required of you by the Unit.

Presented for you below are the wider objectives of the course as a whole. By meeting these objectives you should have achieved the aims of the course as a whole.

On successful completion of the course, you should be able to:

1. Explain the concepts in ecosystem.
2. Illustrate diagrammatically the cycles of energy flow in the ecosystem.
3. Describe the major types of ecosystems.
4. Differentiate between major types of ecosystem
5. Discuss the characteristics of an ecosystem
6. Identify the threats to ecosystems.
7. Describe the management approaches to ecosystem management.
8. Demonstrate the problems of ecosystem management.

WORKING THROUGH THIS COURSE

To complete this course you are required to read study units, read set books and read other materials provided by the NOU. Each unit contains self-assessment exercises, and of points in the course you are required to submit assignments for assessment purposes. At the end of the course is a final examination. The course should take you 20 weeks in total to complete. Presented for your information are the components of the course, what you have to do and how you should allocate your time to each unit in order to complete the course successfully on time.

COURSE MATERIALS

Major components of the course are:

1. Course Guide
2. Study Unit
3. Textbooks

In addition you must obtain the set of books. These are provided by the NOU, obtaining them is your responsibility.

STUDY UNITS

There are 20 units in the courses; as follows:

Module 1

Unit 1 Ecology
Unit 2 The Ecosystem
Unit 3 Energy Flow in Ecosystems
Unit 4 Matters Recycling in Ecosystems
Unit 5 Species Interaction in Ecosystem

Module 2

Unit 1 Terrestrial Ecosystems 1
Unit 2 Terrestrial Ecosystems ii
Unit 3 Aquatic Ecosystems & Types
Unit 4 Major Oceans
Unit 5 Freshwater Ecosystems

Module 3

Unit 1 Overview of Nigerian Environment
Unit 2 Nigerian Terrestrial Ecosystems
Unit 3 Nigerian Aquatic Ecosystem
Unit 4 Flora and Fauna in the Nigerian Ecosystem
Unit 5 Threats of Nigerian Ecosystems

Module 4

Unit 1 Systems Approach to Ecosystem Stability and Instability
Unit 2 Human Impacts on Terrestrial Ecosystems
Unit 3 Concept, Meaning and Crisis of Ecosystem Management
Unit 4 Methods of Ecosystem Management
Unit 5 Problems of Ecosystem Management

The first Unit, which is (Module 1), concentrates on basic concept of ecosystem. The second five units (Module 2), addresses the major types of ecosystem. Third five units (Module 3) Discusses the Nigerian Ecosystem. The final Unit (Module 4) focuses on the ecosystem stress and management.

Each study unit consists of 2 hours' work and it includes specific objectives, directions for study, reading material and other sources. The units direct you to work on exercises related to be the required reading. Each unit contains a number of self-tests. In general these self-tests question you on the material you have just covered or required you to apply it in some way and, thereby help you to gauge your progress and to reintroduce your understanding of the material. Together with tutor marked assignments, these exercises will assist you in achieving the stated learning objectives of the individual units and of the course.

SET TEXTBOOKS

There are no compulsory set books. To broaden your knowledge you are advised to purchase any of the following books:

1. Jefferies, M. J. (1997). Biodiversity Conservation.
2. O'Riordan, T. (ed) (1995). Environmental Science for Environmental Management.

3. Pack, C. (1980). Ecology and Environmental Management.
4. NEST (1991). Nigeria's Threatened Environment: A National Profile.
5. Miller G.T. (1991) Environmental Science: Sustaining the Earth.
6. Lean, G. Hinrichbase, D., & Karkham, A. (1990). Atlas of Environment.
7. Jones, R. Robertson, A; Forbes, J; & Holler (1990). Collins Dictionary of Environmental Science.

ASSIGNMENT FILE

The assignments are contained at the end of each study units. The marks you obtain for these assignments will count towards the final work you obtain for the cause. Further information will be found in this Course Guide in the section on assessment.

PRESENTATION SCHEDULE

The presentation schedule included in your course materials gave you the important dates for this year for the completion of tutor-marked assignments and attending tutorials.
Remember, you are required to submit all your assignments by the due date. You should guard against falling behind in your work.

ASSESSMENT

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

In talking the assignments, you are expected to apply information, knowledge and techniques gathered during the course. The assignments must be submitted to your tutor for formal assessment in accordance with the deadlines stated in the Presentation Schedule and the Assignment File. The work you submit to your tutor for assessment will count for 50% of your total course mark.

As the end of the course you will need to sit for a final written examination of three hours' duration. This examination will also count for 50% of your total course mark.

TUTOR-MARKED ASSIGNMENTS (TMAS)

There are ten tutor-marked assignments in this course. You only need to submit eight or ten assignments. You are encouraged, however, to submit all ten assignments, in which case the highest eight of the ten marks will be counted. Each assignment counts 12.5% towards your total course mark.

Assignment questions for the units in this course are contained in the Assignment File. You will be able to complete your assignments from the information and materials contained in your set books, reading, study units and the Internet. However, it is desirable in all degree level education to demonstrate that you have read and researched more widely from the required minimum. Using other references will give you a

broader viewpoint and may provide a deeper understanding of the subject.

When you have completed each assignment, sent it, together with a TMA (tutormarked assignment) form, to your tutor. Make sure that each assignment reaches your tutor on or before the deadline given in the Presentation Schedule and Assignment File. If, for any reason, you cannot complete your work on time, contact your tutor before the assignment is due to discuss the possibility of an extension. Extensions will not be granted after the due date unless there are exceptional circumstances.

FINAL EXAMINATION AND GRADING

The final examination for applied ecology and ecosystem management will be of two hours' duration and have a value of 50% of the total course grade. The examination will consist of questions which reflect the types of self-testing, practice exercises and tutor-marked problems you have previously encountered. All areas of the course will be assessed.

Use the time between finishing the last unit and sitting the examination to revise the entire course. You might find it useful to review your self-tests, tutor-marked assignments and comments on them before the examination.

The final examination covers information from all parts of the course.

COURSE MAKING SCHEME

The following table lays out how the actual course marking is broken down.

Assessment	Marks
Assignments 1-10	Ten assignments, best for marks of the ten count @ 12.5% each = 50% of course marks
Final Examination	50% of overall course marks
Total	100% of course marks

Table 1 Course marking scheme.

COURSE OVERVIEW

This table brings together the units, the number of weeks you should take to complete them, and the assignments that follow them.

Unit	Title of Work	Weeks Activity	Assessment (end of unit)
	Course Guide	1	
1	Ecology	2	
2	The Ecosystem	2	Assignment
3	Energy Flow in Ecosystems	2	
4	Matters Recycling in Ecosystems	2	Assignment
5	Species Interaction in Ecosystem	2	
6	Terrestrial Ecosystems i	2	Assignment
7	Terrestrial Ecosystems ii	2	
8	Aquatic Ecosystems & Types	2	Assignment
9	Major Oceans	2	
10	Freshwater Ecosystems	2	Assignment
11	Overview of Nigerian Environment	2	
12	Nigerian Terrestrial Ecosystems	2	Assignment
13	Nigerian Aquatic Ecosystem	2	
14	Flora and Fauna in the Nigerian Ecosystem	2	Assignment 7
15	Threats of Nigerian Ecosystems	2	
16	Systems Approach to Ecosystem Stability and Instability	2	Assignment 8
17	human impacts on terrestrial ecosystems	2	
18	Concept, Meaning and Crisis of Ecosystem Management	2	Assignment 9
19	Methods of Ecosystem Management	2	
20	Problems of Ecosystem Management	2	Assignment 10
	Revision	3	
	Total	44	

Table 2 Course organizers

HOW TO GET THE MOST FROM THIS COURSE

In distance learning the study units replace the university lecturer. This is one of the great advantages of distance learning; 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 the lecturer might set you some reading to do, the study units tell you when to read your set books or other material, and when to undertake computing practical work. Jut as a lecturer might give you an in-class exercise, your study units provide exercises for you to do at appropriate points.

Each of the study units follows a common format. The first item is an introduction to the subject matters of the unit and how a particular unit is integrated with the other units and the course as a whole. Next is a set of learning objectives. These objectives let you know what you should be able to do by the time you have completed the unit. You should use these objectives to guide your study. When you have finished the unit you must go back and check whether you have achieved the objectives.

If you make a habit of doing this you will significantly improve your chances of passing the course.

The main body of the unit guides you through the required reading from a Readings Section.

Self-tests are interspersed throughout the units, and answers are given at the ends of units. Working through these tests will help you to achieve the objectives of the unit and prepare you for the assignments and the examination. You should do each self-test as you come to it in the study unit. There will also be numerous examples given in the study units; work through these when you come to them, too.

The following is a practical strategy for working through the course. If you run into any trouble, telephone your tutor. Remember that your tutor's job is to help you. When you need help, don't hesitate to call and ask your tutor to provide it.

1. Read this 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 assignments relate to the units.

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 work. 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 `overview' at the beginning of each unit. You will almost always need both the study unit you are working on and one of your set books 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 instructed to read sections from your set books or other articles. Use the unit to guide your reading.

7. Review the objectives for each study unit to confirm that you have achieved them. If you feel unsure about any of the objectives, review the study material or consult your tutor.

8. When you are confident that you have achieved a unit's objectives, you can then start on the next unit. Proceed unit by unit through the course and try to pace your study so that you keep yourself on schedule.

9. 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 your tutor as soon as possible if you have any questions or problems.

10. 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 objective (listed to this Course Guide).

TUTORS AND TUTORIALS

There are 40 hours of tutorials (twenty 2-hour sessions) provided in support of this course. You will be notified of the dates, times and location of these tutorials, 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 assignments to your tutor well before the due data; (at least two working days are required). 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-tests or exercises.
- You have a question or problem 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 to ask questions which are answered instantly. You can raise any problem encountered in the course of your study. To gain the maximum benefit from course tutorials, prepare a question list before attending them. You will learn a lot from participating in discussions actively.

SUMMARY

Applied Ecology and ecosystem management intends to strengthen your knowledge or ecology and basis of life. Upon the completion of this course, you will be equipped with the knowledge of how the ecosystem functions, the crisis and its management. You thus be able to answer these kinds of questions:

- What is an ecosystem?
- How does energy flow in the ecosystem happen?
- What are the major types of ecosystems?
- What are the terrestrial ecosystems types?
- What is the nature of Nigerian Environment?
- What constitutes the Nigerian ecosystems?
- What are the problems of ecosystem management in Nigeria?
- How are the problems being managed?
- What do you understand by ecosystem stability and instability?
- How can the problems of ecosystem be managed?

Of course, the list of the question you can answer is limitless. To gain most of this course along, see your immediate environment on ecosystem.

We wish you success with the course and hope you will find it both interesting and useful. In longer term, we hope you enjoy your acquaintance with NOU. And we wish you every success in your future.

MAIN COURSE

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MODULE 1

UNIT 1 ECOLOGY

CONTENTS

1.0 INTRODUCTION

Now you have gone through the course guide. It is expected that you would have gained a certain level of understanding of what this unit is all about as well how it fits into the whole course. This unit will help you to understand the basic meanings of ecology. This understanding will embolden you to answer questions such as, what organisms live in a forest or a pond? How do they get enough matter and energy resources to stay alive? How do these organisms interact with one another? This unit will guide you through some of the basic terms associated with this foundation unit. Before going further, it is imperative for you to glean what you are expected to learn in this unit as specified in the unit objectives presented below.

2.0 OBJECTIVES

After the completion of this unit, you should be able to:

- Define the term ecology.
- Explain the two major natural processes, which keeps us and other Organisms alive.

- Illustrate the flow of energy to and from the earth and explanations of the key features.

3.0 MAIN CONTENT

3.1 Defining Ecology

Ecology is the science that attempts to answer such questions about how nature works. The term ecology was coined from two Greek words: Oikos meaning "house" or "place to live" and Logos, meaning, "study of'. The coining of the term was done in 1869 by a German biologist Ernst Haeckel. Ecology is the study of living things in their home or environment: all the external conditions and factors, living and non-living that affect an organism (Figure 1.1). In the words of Miller (1991) ecology is the study of the interactions between organisms and their living (biotic) and non-living (abiotic) environment. Note that the key word is interactions.

Collins dictionary of Environment (1990) defined ecology as the study of the relationships between living organisms (the biota) and their physical environment (the abiotic). In its broadest sense ecology is the study of organisms, as they exist in their natural environment.

Examples of the biota are all living organisms i.e. plants and animals.

On the other hand, examples of abiota are all non-living organisms i.e. soil, mountain, rain and sun.

It is important for you to note that biotic means relating to living organisms. biotic depicts an environment without life.

SELF-ASSESSMENT EXERCISE 1

- Reflect on these definitions of ecology. Do you consider them to be different from those you know?
- Interactions and relationships are the key words in the two definitions you have encountered in this unit. Do they mean the same thing?

3.2 Biosphere and the Ecosphere

The earth has several major parts that play a role in sustaining life. You are part of what ecologists call the "biosphere" - the living and dead organisms found near the earth surface in parts of the atmosphere, hydrosphere and lithosphere

In a more descriptive term, biosphere is that part of the earth's surface and its immediate atmosphere that is inhabited by living organisms. The biosphere as you will discover fulfils three (3) primary functions for plants and animals.

The three primary functions are presented below.

a) It provides a safe "HABITAT" within which an individual organism can complete its life cycle.
b) It provides a stable habitat within which the evolution of species can occur.
c) It forms a self-regenerating system in which energy is provided by the sun and the materials essential for life are recycled from within the system (Collin Dictionary of Environmental Science, 1990).

As you will see in figure 1.3, the biosphere represents a complex series of interrelationships between the soil, rock, water and air and the living organisms contained therein.

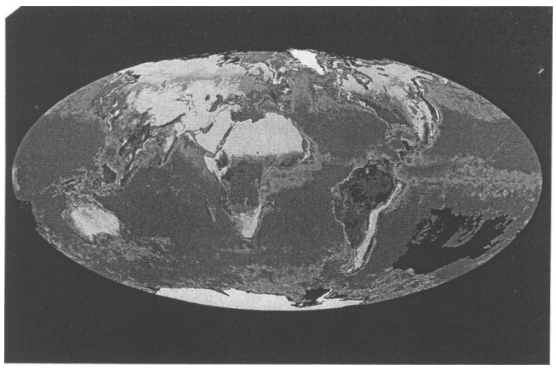

Figure 1.3 the biosphere. Three years of satellite data were combined to produce this picture of the earth's biological productivity. Rain forests and other highly productive areas appear as dark green, deserts as yellow. The concentration of phytoplankton, a primary indicator of ocean productivity, is represented by a scale that runs from red (highest) to orange, yellow, green, and blue (lowest).
SOURCE: Adapted from Miller G.T. (1991:87)

Within the biosphere can be found different types of ecosystems. At this point, it is important for you to note that the collection of living and dead organisms i.e. biosphere do interact with one another and their non-living environment i.e. energy and chemicals throughout the world. The interactions which takes place between the biosphere and non-living environment is known as "ecosphere"

Note: The analogy presented below will help you to understand more what an ecosphere is.

Imagine the earth were an apple. As you know, an apple could either be green or red coloured. This green or red colour back of the apple is the skin. If peeled, the skin of the apple would be thin. Thus, the ecosphere would not be thicker than the apple's skin.
The ecosphere can therefore be described further as the thin part of which plays a major role in sustaining life on earth.

3.3 Energy Flow and Matters Recycling

Do you know what wonder keeps humans (you, me), and most other organisms alive on this planet. To unravel this wonder, you need to understand the fundamental processes, which govern life on planet earth. It will interest you to know life (yours inclusive) on earth depends largely on two fundamental processes presented below:

a) The one-way flow of high-quality energy from the sun, through materials and living things on or near the earth's surface, then into the atmosphere, and eventually into space as low quality heat.

b) The recycling of chemicals required by living organisms through parts of the ecosphere.

Figure 1.4: Diagrammatically explain these two fundamental processes.

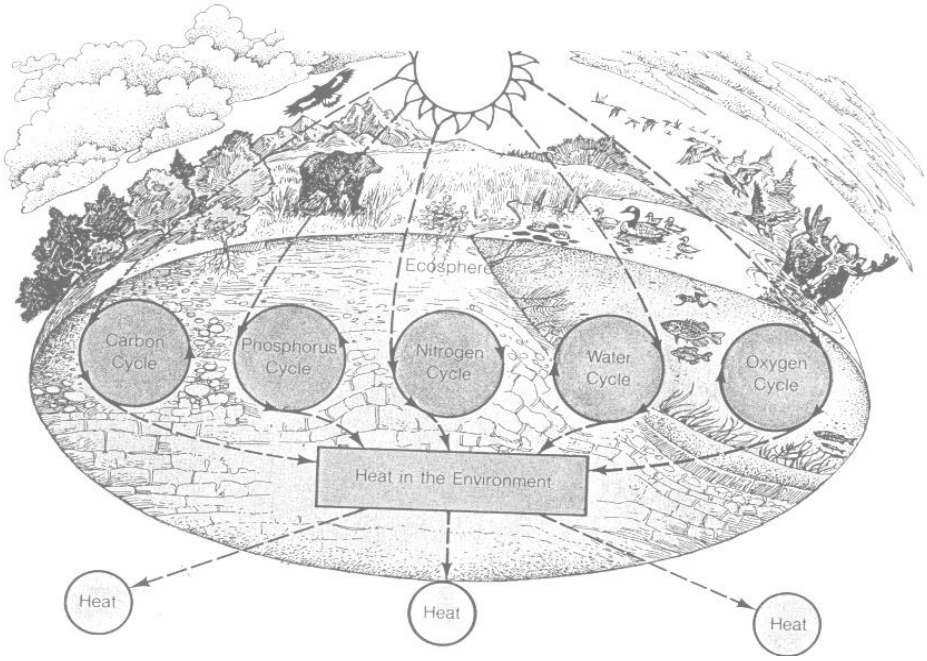

Figure 1.4 life on earth depends on the recycling of critical materials 9solid lines) and the one-way flow of energy through the ecosphere (dashed lines). This greatly simplified overview shows only a few of the many chemicals that are recycled.

Source: Adapted from Miller G.T (1991:61)

In order to further understand these fundamental processes, you are encouraged to cast your mind back to your knowledge of elementary biology. You will recall that the source of the energy, which sustains life on earth, is the sun. And that energy from the sun is also known as "Solar energy".

The sun lights and warms the earth and supplies the energy used by green plants to synthesize the compounds, which keep them alive and serve as food for almost all other organisms. Solar energy also powers the recycling of key chemicals and drives the climate and weather, which distribute heat and fresh water over the earth's surface. (Figure 1.5)

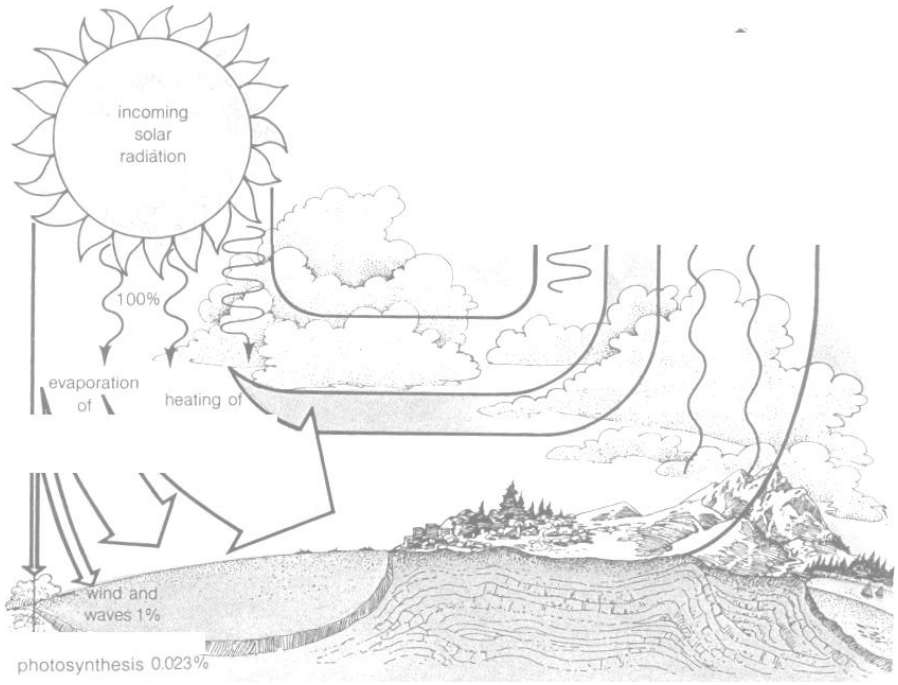

Figure 1.5 the flow of energy to and from the earth.

Source: Adapted from Miller G.T. (1991.62)

SELF-ASSESSMENT EXERCISE 2

- Study the diagram (Figure 1.5) by G.T. Miller. How is energy radiated to the earth from the sun? What is your opinion this figure in helping us to reach an understanding of the flow of energy to and from the earth?

- Figure 1.4, shows life on earth depends on the recycling of critical chemicals and the one-way flow of energy through the ecosphere. In your opinion, what do you think will happen if there was no recycling and one-way flow of energy?

4.0 CONCLUSION

In this unit you have learned the basic components of ecology. You should also by now understand how organisms interact with their environment. Furthermore you should have learned how to define ecology. You should have learned about the earth's life-support systems and its functions. This unit has also exposed you to those processes, which keep all organisms alive on earth.

5.0 SUMMARY

This unit has exposed to the various definitions of ecology. This unit also explains further the earth's life support system, thereby creating a scenario of what the goal of ecology is in learning how ecosphere works. This unit is structured in such that you will understand what lies ahead in the other units to follow.

6.0 REFERENCES/FURTHER READING

Belmont: Wadsworth Publishing Company.

Collins Dictionary of Environmental Science, London: Harper-Collins Publishers.

Jones, R.; Robertson, A; Forbes, J & Hollier, G. (1990) Miller, G.T. (1991). Environmental Science: Sustaining the Earth.

UNIT 2 THE ECOSYSTEM

CONTENTS

1.0 INTRODUCTION

In Unit 1 we looked at ecology, and the earth's life support system as well as energy flow and matters recycling on earth. As you will discover in this unit, Unit I was aimed at giving you some foundation.

Knowledge that will help your understanding of what unit 2 is all about.

In this unit will help you understand what is an ecosystem, type, components as well as the limiting factors in an ecosystem. Now over to the objective to have a glimpse of what you should be able to do at the end of Unit 2.

2.0 OBJECTIVES

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

- Define/Describe an ecosystem.
- Explain its major living and non-living components
- Give an account of the limiting factors in Ecosystem.

3.0 MAIN CONTENT

3.1 What is an Ecosystem?

An ecological system or ecosystem according to Agabi (1995) is a set of interacting, interdependent living (organic or biotic) and non-living (inorganic or abiotic) components or sub systems. It is a neat, concised term originally coined to convey the idea of a group of organisms and

the place or habitat (i.e. home) they occupy, and the way the two are linked together to form a working or functioning unit.

Another definition of ecosystem states that it is any system in which there is an interdependence upon and interaction between living organisms and their immediate physical, chemical and biological environment (Figure 2.1) (Collins Dictionary of Environmental Science, 1990).

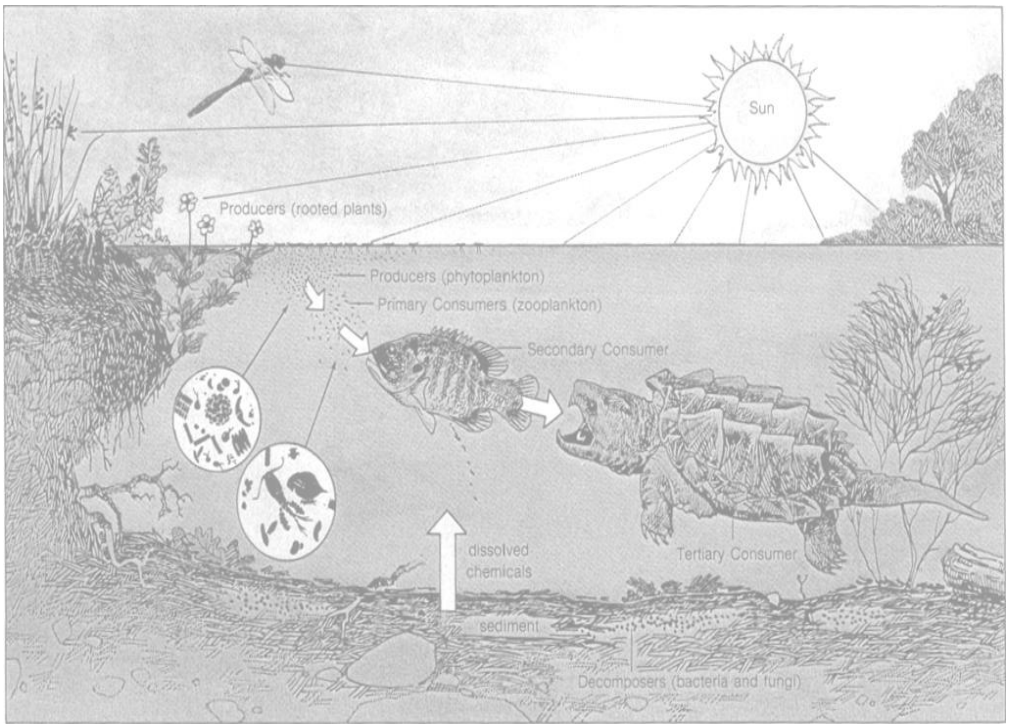

Figure 2.1 the major components of a freshwater pond ecosystem.

Source: Adapted from Miller G.T. (1991.67)

It is very important for you to know that biosphere (refer to Unit 1) can be regarded as an ecosystem, and is also sometimes referred to as the ecosphere (mentioned in Unit 1).

ELECTROSTATIC PRECIPITATOR

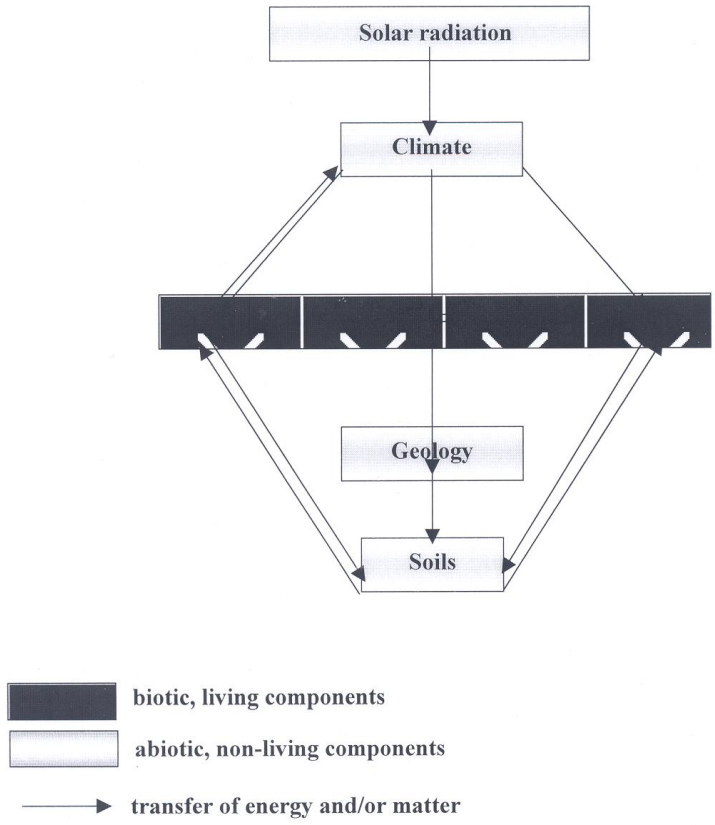

Fig. 2.1. Ecosystem. The relationship between the main components of an ecosystem.

In simplified description, an ecosystem is any forests, deserts, grasslands, ponds, lakes, oceans or any set of organisms interacting with one another and with their non-living environment.

According to Miller (1991:112) an ecosystem has six major features.

i) interdependence

ii) diversity

iii) resilience

iv) adaptability

v) unpredictability

vi) limits

SELF-ASSESSMENT EXERCISE 1

- Review the definitions of ecosystem; establish if there is a relationship with the definitions of ecology in Unit 1.
- The ecosystem was described by Park 1980) as the basic functional unit of ecology. Do you agree with this description?

3.2 Concept of Ecosystem

You are now familiar with the definitions of ecosystems. Therefore in order to further strengthen your understanding, a conceptualization is important. The concept of ecosystem may according to Barrow (1993:23) may be applied to cities or agriculture (urban ecosystems and agro-ecosystems respectively) although these are not actually true, discrete units in terms of energy flows, function and so on. You should note that there are no two ecosystems, which can exactly be the same.

3.3 Types of Ecosystem

Classification of ecosystem can only be done based on the general types, which contain similar types of organisms. On the basis of general types therefore, ecologists have discovered two types of ecosystems. These two ecosystems types are the terrestrial ecosystems and aquatic ecosystems.

We will now look at the two types of ecosystems and establish their distinguishes based on their descriptions.

3.3.1 Terrestrial Ecosystems

These are major land ecosystems. They are described by their types of vegetation e.g. forest, grasslands, or deserts. These various types of vegetation are factored by climatic conditions such as temperature and rainfall (fig. 2.2).

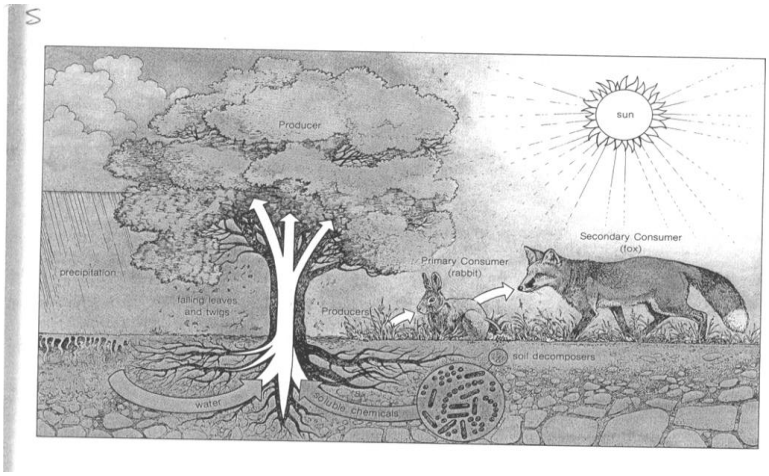

Figure 2.2 The major components of an ecosystem in a field

Source: Adapted from Miller G.T. (1991.67)

3.3.2 Aquatic Ecosystems

These are majorly water ecosystems. Aquatic ecosystems can be further classified to include oceans, lakes, rivers, estuaries (mouth of river segment or ocean inlets where saltwater and fresh water mix), coastal, and inland wetlands (swamps, marshes). These various types of aquatic ecosystems are a result of local physical conditions.

These physical local conditions, which shape the aquatic ecosystems, are differences in amount of nutrients dissolved in water, differences in depth of sunlight penetration and differences in average water temperature.

3.4 Components of Ecosystems

The components of ecosystems can be categorized into two: the abiotic (nonliving) components and biotic (living components).

3.4.1 Abiotic or Non-Living Components

This means without life. The abiotic elements of an ecosystem comprise of climatic components (average temperature and temperature range, sunlight and Shade, wind and geological components, level of water and air in the soil, nature of soil and salinity of water).

3.4.2 Biotic or Living Components

The biotic components of ecosystems is relating to living components. The biotic elements of an ecosystem consist of its plants and animals. These biotic elements are usually classified as producers, consumers and decomposers.

It is important to let you know that ecosystems operate on a wide variety of scales, ranging from our tropical rain forests to the small rock pools and in each, nutrients and matter more continuously between the various components, often in well defined cyclical pathways. You are advised to refer to Figure 2.1 for clearer picture of the components of ecosystems.

3.5 Tolerance Range of Species

It is useful to examine why organisms don't spread everywhere. A plant such as that found in mangrove swamp is known require so much water cannot be found in the desert. Also it will be difficult for the fish to live outside water. The reason for this is each species or individual organism has a particular range of tolerance to abiotic factors such as temperature.

The tolerance range includes the optimum range. At the optimum range, species can operate efficiently and thrive.

Some individual organisms have been found at slightly above or below the tolerance range. This is so because of small genetic differences in their make-up, age and health. For example, a frog or toad can adequately exist on both the ground and inside water.

The above explanations are captured in the law of tolerance as adopted from Miller (1991).

"the existence, abundance, and distribution of species in an ecosystems are determined by whether the levels of one or more physical or chemical factors fall above or below the levels tolerated by species ".

3.6 Limiting factors in Ecosystems

The studies of the ecosystems have revealed abiotic factors can limit performance of species in an ecosystem when they exist too much or little.

Examples of limiting factor are: Terrestrial ecosystem: temperature, water, light and soil nutrients.

Aquatic Ecosystems: temperature, sunlight and dissolved oxygen content. In order to drive home this explanations, Miller (1991) states that "too much or too little of any biotic factor can limit or prevent growth of a population of a species in an ecosystem even if all other factors are at or near the optimum range of tolerance for the species".

SELF-ASSESSMENT EXERCISE 2

- Compare and contrast the terrestrial ecosystems and aquatic ecosystems.
- Establish if there is any relationship between tolerance range and limiting factor.

4.0 CONCLUSION

In this unit you have learned what an ecosystem is. You should have learned the types and components of an ecosystem. You should also have learned about the tolerance range of species as well as those factors, which limit an ecosystem.

5.0 SUMMARY

What you have learned in this unit concerns the ecosystem, types and components. You will no doubt agree that this is unit is a progression from Unit 1. The units that follow shall build upon this by taking you deeper into course.

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UNIT 3 ENERGY FLOW IN ECOSYSTEMS

CONTENTS

1.0 INTRODUCTION

The idea covered in this unit is derived from the two earlier units covered i.e. units 1 and 2. You will see that you may not understand the ecosystem and the manner of energy flow if you had not approached the units stage by stage.

2.0 OBJECTIVES

After completion of this unit you should be able to:

- Compare and contrast food chains and food webs.
- Explain your own definition of food chains and food webs and relate it to your immediate environment.
- Describe energy glow pyramid in ecosystems.

3.0 MAIN CONTENT

3.1 Food Chains

Your understanding of biology may help you understand this section and next section more. Around you exist, several food chains. Did I hear you say really? Yes it does, even sometimes as close as in your bedroom.

Imagine yourself outdoors in a garden, perching on the flower plant is a butterfly taking nectar from the plant. On satisfaction, the butterfly left flower to land on a nearby wall, unknown to the butterfly, an hungry lizard was lying tired nearby, what happen next is that the lizard on sighting the butterfly turned it to a meal. After the meal, the lizard decided to sun itself. It however ended being swallowed by another reptile - a snake (python).

What you observed in the depiction above is what is called a food chain. It is presented below in a simplified diagram (Fig. 3.1)

Flow Plant (Nectar) ⟶ Butterfly ⟶ Lizard ⟶ Snake

Fig. 1.3 A simplified diagram of food chain

Now let us examine the following definitions:" Food chain is a structured feeding hierarchy whereby energy in the form of food is passed from an organism in a lower tropic level (any of a series of distinct feeding or nourishment levels in a food chain) to one in a higher level. (Collins Dictionary of Environment Science)

The first strophic level (T_1) comprises of the primary producers (plants); T_2 the primary consumers (herbivores) or plant eaters); T_3, secondary consumers (carnivores or meat eaters); and T_4, Tertiary consumer (next eaters at the top of the food chain.

From Fig. 3.1, we can categorize as follows:

Flower Plant (Nectar)	-	T_1
Butterfly	-	T_2
Lizard	-	T_3
Snake (Python)	-	T_4

A simpler definition of a food chain is a series of organisms each eating or decomposing the preceding one.

It is important for you to know that the food chain concept is useful for tracing chemical recycling and energy flow in an ecosystem. (You will discover these next two sections ahead).

SELF-ASSESSMENT EXERCISE 1

- From your knowledge of what a food chain is, generate a food chain using other examples around you.

3.2 Food Web

Since you now understand the food chain. What then is a food web? Food web is the same as a food chain you want so say? Certainly you are right. It is just that a food web is more complex than a food chain. In a food web you rarely see what you have in a simple food chain, shown figure 3.1 above. However, what exist in a real term is frequently arranged as complex interconnected food chain or network. It is this interconnected food chain or network that is referred to as the food web.

This means that more organisms in an ecosystem are involved in a food web (Figure 3.2)

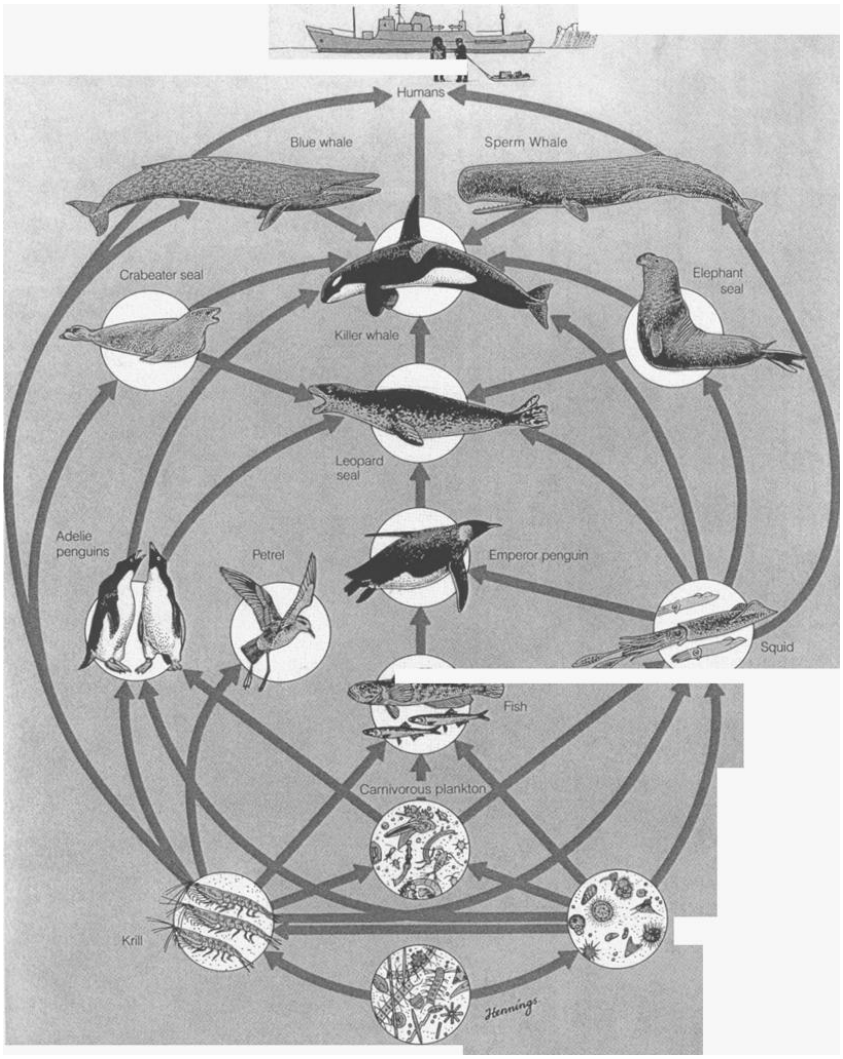


Figure 3.2 greatly simplified food web in the Antarctic. There are many more participants, including and array of decomposer organisms.

Source: Miller G.T. (1991.73)

3.3 Energy Flow Pyramid

From your elementary knowledge of physics, energy is the capacity of a body or system to do work. With the understanding of energy, we can say that what we want to know in this section is the transfer of energy within an ecosystem. In order to understand this section, organisms are grouped by function according to their tropic level- you should remember that tropic level is the level at which they gain nourishment. Each successive tropic levels organism depends upon those of the next lowest for energy requirements (food). (Figure 3.3).

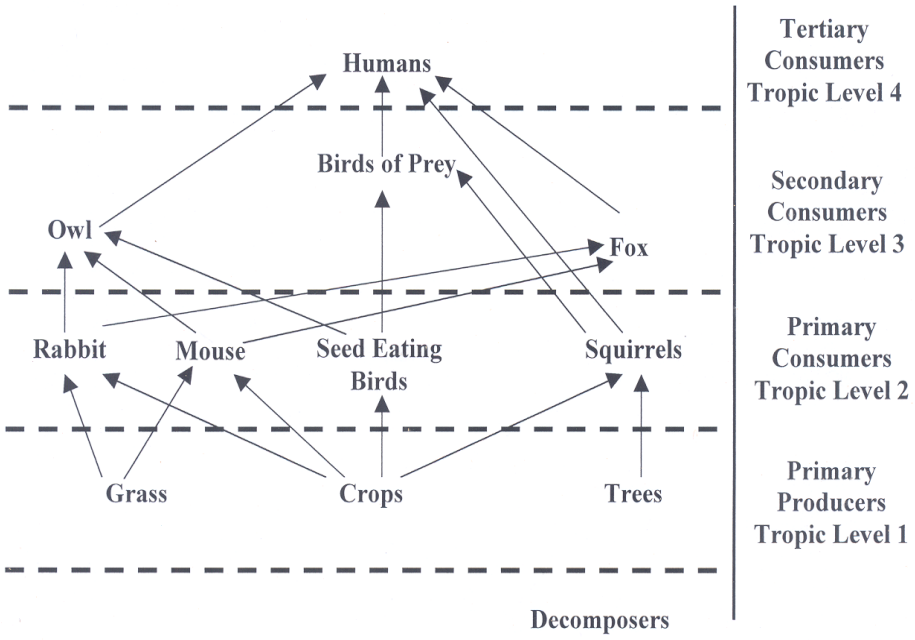


Fig. 3.3: Tropic Level: The arrangement of species in a food chain into feeding levels. The arrows show main directions of movement of energy and materials.

Adapted from Collins Dictionary of Environmental Science.

From the diagram, you will see that the first tropic level, primary producers in virtually every case convert sunlight into chemical energy.

You must have noticed that tropic level I is almost always photosynthetic plant. Transfer of energy continues level by level from the first tropic level. One basic point to note is that at each transfer from one tropic level to another in a food chain or web, work done is reduced.

This is so because low-quality heat is given to the environment, and the availability of high-quality energy to organisms at the next tropic level is reduced. In essence, within an ecosystem there is likely to be a pyramid

shaped patter of tropic levels for organisms to consume others with greater mass and number of organisms at lower levels.

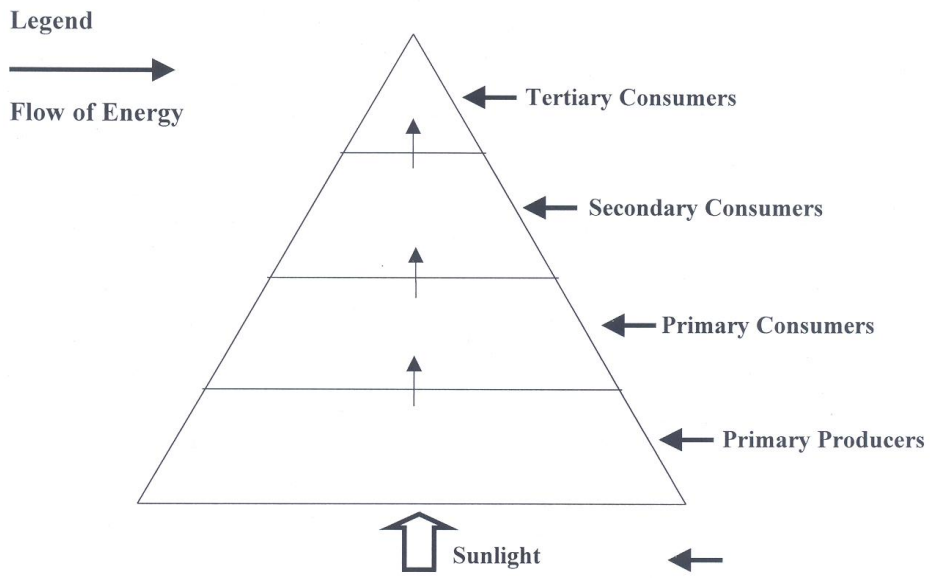
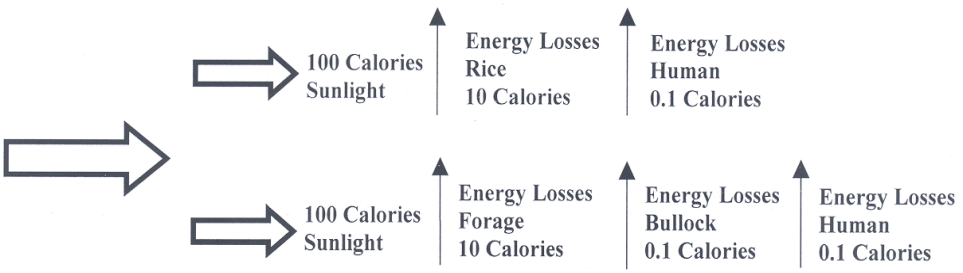


Figure 3.4: Energy Pyramid: The arrows shows the transfer of energy between each tropic level·

According to Miller (1991:72) the energy - flow pyramid explains why a larger population of people can be supported if people shorten the food chain by eating grains directly (for example, rice humans) rather than eating animals that feed on grains (grain steer human). Adapted barrow (1993)



Rice - human food chain provides more calories than forage - human.

(Figure 3.5). Hypothetical food chain

Adapted From Barrow (1993)

SELF-ASSESSMENT EXERCISE 2

- Do you agree that we should feed directly on grains instead of eating other animals? If yes what do you think should happen to large population of species that may result from the non-consumption of other animals?
- Compare and contrast food chain and food web.

4.0 CONCLUSION

This unit has exposed you to a number of important issues that relates to major happenings in an ecosystem. Furthermore you should have learned the consequences of large food chain or food web. You need to be aware however that energy loss can be reduced if there are no higher-level consumers in an ecosystem.

5.0 SUMMARY

What you have learned in this unit concerns the flow of energy within an ecosystem and characteristics of each tropic level in a food chain. You will agree that the study is becoming more interesting.

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UNIT 4 MATTERS RECYCLING IN ECOSYSTEMS I

CONTENTS

1.0 INTRODUCTION

In Unit 1 you were introduced to concept of matters recycling in the foundation unit. It was emphasized that life existence on earth will not be possible, if the process do not take place.

In Unit 4, the focus is on biogeochemical cycles - with the study of its functions and characteristics, and the examination of the two types of biogeochemical cycles. Specifically, this unit is about the cyclic processes, which takes place in ecosystem. At the same time it will reflect similar concepts, mentioned in Unit 1, except that discussion of it in this unit will be more detailed.

2.0 OBJECTIVES

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

- Describe the biogeochemical cycles be able to:
- Describe the biogeochemical cycles.
- Understand its functions and its characteristics.
- Explain the types of biogeochemical cycles.

3.0 MAIN CONTENT

3.1 Biogeochemical Cycles

Within the mature ecosystem, cyclic processes move and renew supply of energy, water, chemical elements, sediments and air. These cyclic processes enable the constant transfer of essential nutrients in a cyclical pathway in the ecosystem. The cyclic process is referred to as biogeochemical cycle or nutrient cycle.

The Collins Dictionary of Environmental science defines biogeochemical or nutrient cycle as the "the constant transfer of essential nutrients from the living organisms to the physical environment and back to the organisms in a cyclical pathway". This sequence is achieved by physical processes such as weathering and/or by biological processes such as decomposition. Therefore for organic life to continue the nutrients, which are finite in nature, must constantly be re-used.

SELF-ASSESSMENT EXERCISE 1

- Flip back to Unit l, Figure 1.3 and compare with Figure 4.1. Do you observe any differences or similarities in the two figures?

3.1.1 Functions

The major function of biogeochemical cycles is that it is responsible for the movement and renewal of energy, water, chemical elements sediments and air supplies in a mature ecosystem. Biogeochemical cycles control the movement of nutrients between the non-living environments and living organisms. 3.1.2

3.1.2 Classification and Characteristics

Biogeochemical cycles according to Chadwick and Goodman 1975:4 in Barrow (1993:23) could be classified as:

1) Natural -Barring occasional catastrophic events. Biogeochemical cycles are always in a state of dynamic stability.
2) Upset by humans -Where biogeochemical cycles are upset by human activity, the result is runaway positive feedback i.e. upset to one process may affect others; problems could become magnified and uncontrollable.
3) Recycling managed by humans and sustainable.

3.2 Types of Biogeochemical Cycles:

There are two basic types of biogeochemical cycles. They are

a) Gaseous cycles and
b) Sedimentary cycles (Miller 1991)

3.2.1 Gaseous Cycles:

Gaseous cycles are responsible primarily for the movement of nutrients back and forth between reservoirs in the atmosphere and hydrosphere and living organisms. Recycling of elements occurs within a short span of hours or days. Examples of gaseous cycles are oxygen, carbon, hydrogen and nitrogen cycles.

3.2.2 Sedimentary Cycles:

Just as the name implies biogeochemical cycles involve sediments, with a cycle so slow perhaps authors of years. Materials in the sedimentary cycle are non renewable as far as human are concerned. Specifically, sedimentary cycles are responsible for the movement of nutrients front and backward between reservoirs in the earth crust, hydrosphere and living organisms (Miller, 1991).

3.3 Human Interventions in Matters Recycling in Ecosystem

All the chemical elements are subject to some degree of biogeochemical cycling, but these cycles, which are crucial for the nutrition of organisms or for the maintenance of atmospheric gas and global temperature within acceptable limits. The cycles are water, oxygen, carbon, and nitrogen, phosphorous. And they're over 30 known biogeochemical cycles.

Now let us study of the cycles to understand what we (humans) have done to them.

3.3.1 Carbon Cycle

Carbon is very important to life; it mixes with other organic compounds necessary for life to form the basic building block. Plants get their carbon by absorbing carbon dioxide from the atmosphere through pores in their leaves (photosynthesis).

How have we intervened?
Our interventions in this cycle are two fold.

i) Deforestation and devegetation of land which today has destroyed the trees, which serve as the carbon-dioxide bank.

ii) Our continued dependence on burning fossil fuel and woods, which have led to increase in atmospheric carbon dioxide. The resultant effect is the global warming problems.

3.2.2 Water Cycle

This cycled collects, purifies and distributes the earth's fixed supply of water. Human interventions in this cycle are:

1) Damming and irrigation projects have led to the withdrawal of freshwater quantities from lakes, rivers etc.
2) Deforestation - this has reduced seepages that recharges ground water supplier. What therefore result is that there is increase in flood risks.

4.0 CONCLUSION

In this unit you have learned how nutrients move in the ecosystem. Specifically, this unit focused on biogeochemical cycles, its functions classification and characteristics as well as the types. You are aware that upset by humans is the most potent danger that can face the biogeochemical cycles.

5.0 SUMMARY

This unit concerns functions, classification and characteristics of biogeochemical cycles. It has served to introduce you to matters recycling in the ecosystems.

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UNIT 5 SPECIES INTERACTION IN ECOSYSTEM

CONTENTS

1.0 INTRODUCTION

As you progress in this module, particularly from Units 1 - 4, you must have observed that the ecosystem is not a complex system after all. You should by now have learned how the ecosystem functions as well as what goes on within it, with regards to nutrients transfer among others. However here is a question begging for an answer. How do these organisms react with one another and with their physical and chemical environment? In this unit therefore, we will explore the interactions of species within an ecosystem. Looking further to examine the types of species found in a particular ecosystem and the types of interactions, which exist among species in an ecosystem?

2.0 OBJECTIVE

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

- Identify the types of species within an ecosystem.
- Explain the roles played by different organisms in an ecosystem.
- Describe the kind of interaction, which exist among organisms in an ecosystem.

3.0 MAIN CONTENT

3.1 Definition of Species

Before we go further it is imperative that you understand the meaning of species. There is no precise simple universal definition of universal definition of what a species is. The word `species' literally means outward or visible form. According to Jeffries (1997) classifications up to the twentieth century relied on the physical, often outward, similarity of features to distinguish a species.

However we shall adopt the definitions of Miller (1991) and Jeffries 1997.

According to Miller (1991) *a species is one or more populations whose members actually or potentially inter-breed under natural conditions.*

Jeffries (1997) on the other hand defined a species as "*consisting of populations of inter-breeding individuals, able to reproduce successfully with other populations.*

Central to these definitions is the idea of reproductive isolation, be it a physical barrier, or behavioural, physiological or genetic inability to mate and produce fertile young.

Facts about species are that there exist 12.5 million different types (Groomsbridge, 1992), although estimates put it at 30-50m. Out of all these, only a paltry 1.6 million have been named, with as much as 50,000 - 100,000 being named yearly. It will interest you that even at this pace some species may never be discovered or named. This is because some will go into extinction before they are discovered.

A species is designated in italics by the gems name followed by its specific name e.g. Felix domesticus (the domestic cat).

3.2 Types of Species in Ecosystem

There are four basic types of species found in an ecosystem. The types according to Miller (1991) are:

- Native species
- Immigrant or alien species
- Keystone species.

Immigrant or Alien Species: These types of species migrate or are deliberately or accidentally introduced into an ecosystem by humans. They may be beneficial while some types are not thereby causing problem within the ecosystem.

Immigrant or Alien Species: These types of species migrate into another ecosystem from an ecosystem that is being degraded.

Keystone Species: These types of species play a key role in the sustenance of other species in an ecosystem. The loss of a keystone species may affect other dependant species in an ecosystem either by "sharp population drop or by extraction of other species" (Miller 1991:80).

Interaction between Species.

The major types of interactions between species in an ecosystem are presented below (figure 5:1).

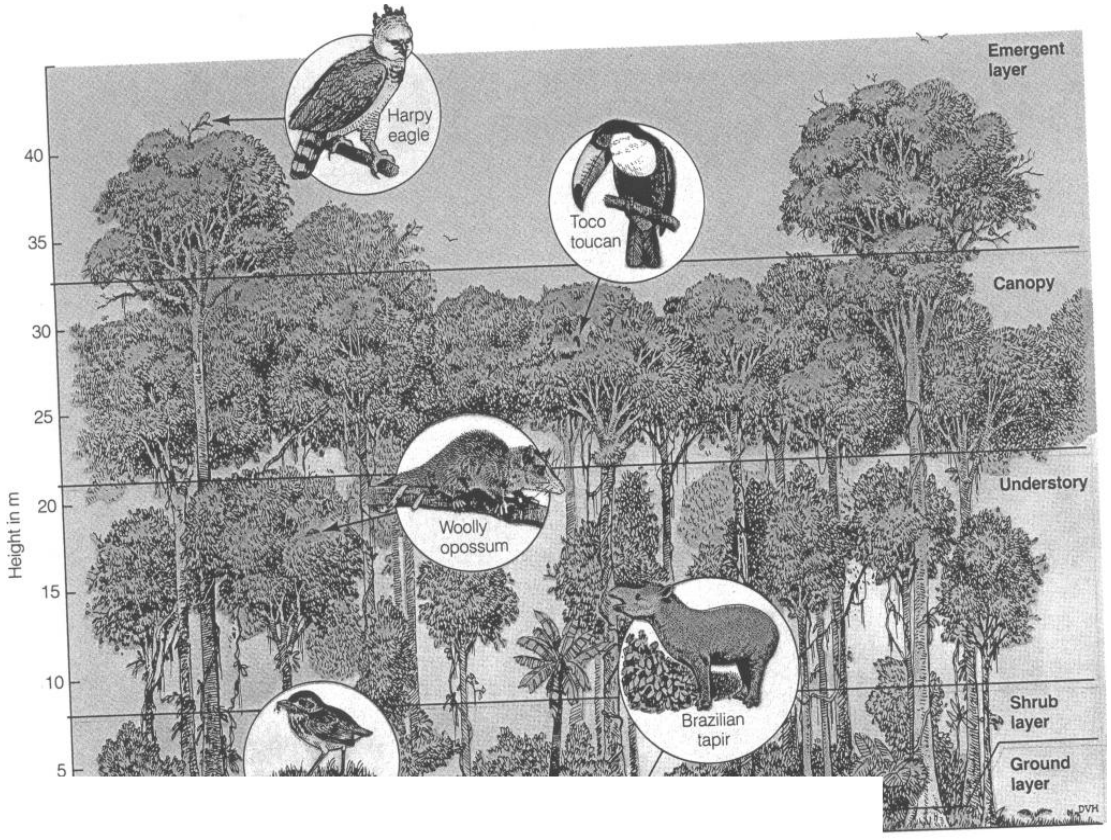

Figure 5.1 Stratification of specialized plant and animal niches in a tropical rain forest. Species occupy specialized niches in various layers of vegetation.

Source: Adapted from Miller G.T. (1991:82)

3.3.1 Competition

Species interact by contesting a resource. Where a resource is limited, inferior competitors may be driven to extinction. Competition is often depicted or detrimental to all species involved competition leads to one species suffering and the other unaffected. Competition provides a selection pressure with species diversifying by refinement of different abilities to stay alive.

3.3.2 Exploitative

In this type of interaction, one species exploit another as a food source. Exploitative interactions include predation and parasitism, disease and herbivory. The victim loses exploiter gains. Exploitative interactions lead to decrease in diversity if exploiters wipe out victims or promoted if the monopoly of a few dominant competitors are prevented. Examples of predator species are the lion, shark (case study) while victim or prey is the antelope, zebras. Examples of parasitism or parasite-hose relation are human/other animals and tapeworm.

CASE STUDY SHARKS: THE OCEANS' MOST IMPORTANT PREDATOR

Sharks have lived in the oceans for over 400 million years, long before dinosaurs appeared (Fig 5.2). During their long history sharks have evolved into more than 350 species whose size, behaviour, and other characteristics differ widely.

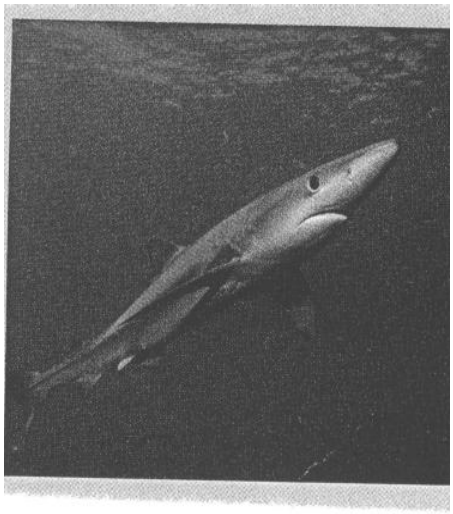

Figure 5.2 this blue shark and other types of sharks are key predators in ocean ecosystem.

Source: Adapted from Miller G.T. (1991:83)

The smallest species, the cigar shark, is only a foot long at maturity. Another species, called "cookie cutters," is also about a foot long. Cookie cutters survive by taking bites out of the sides of porpoises, whales, and large fish such as bluefin tuna. At the other end of the scale is the whale shark, the world's biggest fish. It can grow to 18 meters (60 feet).

Sharks have extremely sensitive sense organs. They can detect the scent of decaying fish or blood even when it is diluted to only one part per million parts of seawater. They have superb hearing and better night vision than we do. They also sense the electrical impulses radiated by the muscles of animals, making it difficult for their prey to escape detection. They are powerful and rapid swimmers. Because their bodies are denser than seawater, most types of shark must always keep moving in order not to sink.

Sharks are the key predators in the world's oceans, helping control the numbers of many other ocean predators. Without sharks the oceans would be overcrowded with dead and dying fish and depleted of many healthy ones that we rely on for food. Eliminating sharks would upset the balance of ocean ecosystems.

Yet this is precisely what we are in danger of doing. Every year we catch over 100 million sharks, mostly for food and for their fins, which are sent off to Asia for shark-fin soup. Since 1986, the demand for sharks has increased dramatically. Others are killed for sport and out of fear. Some shark species such as edible thresher and mako sharks, are being commercially exploited and could face extinction. Sharks are vulnerable to over fishing because it takes most species about 12 years most species about 12 years to begin reproducing and they produce only a few offspring.

Influenced by movies and popular novels, most people see sharks as people-eating monsters. This is far from the truth. Each year a few types of shark - great white, bull, tiger and oceanic white-tip - injure about 100 people and kill perhaps 25. Most attacks are by great white sharks, which often feed on sea lions and other marine mammals and sometimes mistake human swimmers for their normal prey. Nevertheless, with hundreds of millions of people swimming in the ocean each year, the chances of being killed by a shark are minute - about 1 in 5 million. You are thousands of times more likely to get killed when you drive or ride in a car.

Furthermore, sharks help save lives. In addition to providing people with food, they are helping us learn how to fight cancer, bacteria, and viruses. Sharks are very healthy and have aging processes similar to ours. Their highly effective immune system allows wound to heal quickly without becoming infected. A chemical extracted from shark cartilage is being used as an artificial skin for burn victims. Sharks are among the few animals in the world that almost never get cancer and eye cataracts. Understanding why can help us improve human health.

Sharks are needed in the world's ocean ecosystems. Although they don't need us, we need them. Source:

Adapted from Miller G T (1991)

3.3.3 Mutualisms

In some cases when two different types of organisms interact directly in ways which is beneficial to both species. Such interaction is known as mutualism. Such relationships are often tightly forged, by co-evolution into a mutual dependency. Mutualism is important in that it help to promote diversity by opening up new ecological opportunities.

Examples of mutualisms is the honey been and certain flowers.

3.3.4 Engineering

In this type of species interactions, one type of organism benefit, while the other is neither helped nor harmed to any great degree.

SELF-ASSESSMENT EXERCISE 2

- In your own words generate a definition of species.
- List 3 examples for each of the interaction types discussed in this module.
- How would you classify interaction between humans and other species in the ecosystem?

4.0 CONCLUSION

In this unit, you have learned the definition of species, and the types of species in an ecosystem. This unit also exposed you to the various types of interactions taking place in an ecosystem.

5.0 SUMMARY

What you have learned in this unit concerns the connectedness and interdependence of species in an ecosystem. The next unit shows how this interdependence is the key to understanding the earth's major types of ecosystems.

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MODULE 2

UNIT 1 TERRESTRIAL ECOSYSTEMS 1

CONTENTS

1.0 INTRODUCTION

In Unit 2, you had a brief introduction into the ecosystem. The unit gave you an insight into what terrestrial ecosystems are. In this unit and the next, you will be exposed to a detailed study of the terrestrial ecosystems. Before we do that, why don't you have a feel of what you should learn in this unit?

2.0 OBJECTIVES

At the completion of this unit you should be able to

- Explain the factors, which determine plants types in the terrestrial ecosystems.
- Describe the major types of terrestrial ecosystems.

3.0 MAIN CONTENT

3.1 What is Terrestrial Ecosystem?

Refer back to Unit 2, for the definition of terrestrial ecosystems.

3.2 Factors Determining Plant Types in Terrestrial Ecosystems.

Have you ever wondered why there are different life forms in terrestrial ecosystem? Imagine yourself traveling round the world; you will come across different types of plants and animals along the way. To be specific you come across different types of terrestrial ecosystem types. The ecosystems you will come across can be summarized as forests, grasslands and deserts.

The answer to these different types of terrestrial ecosystem is the climate.

3.2.1 What then is a climate?

Climate is the average weather characteristics of a particular area over an extended period of time. Climates are largely determined by latitude, topography, the distribution of land and sea, ocean currents, and the nature and influence of vegetation and soils. A climate therefore can be affected by different factors such as mean seasonal temperatures, average precipitation, wind direction and speeds and the nature and extent of cloud cover. There are three types of climates, arid climate, semi-arid climate and Mediterranean climate.

And of all the factors which affect the climate of an area is mean seasonal temperature and average precipitation are the two most important factors.

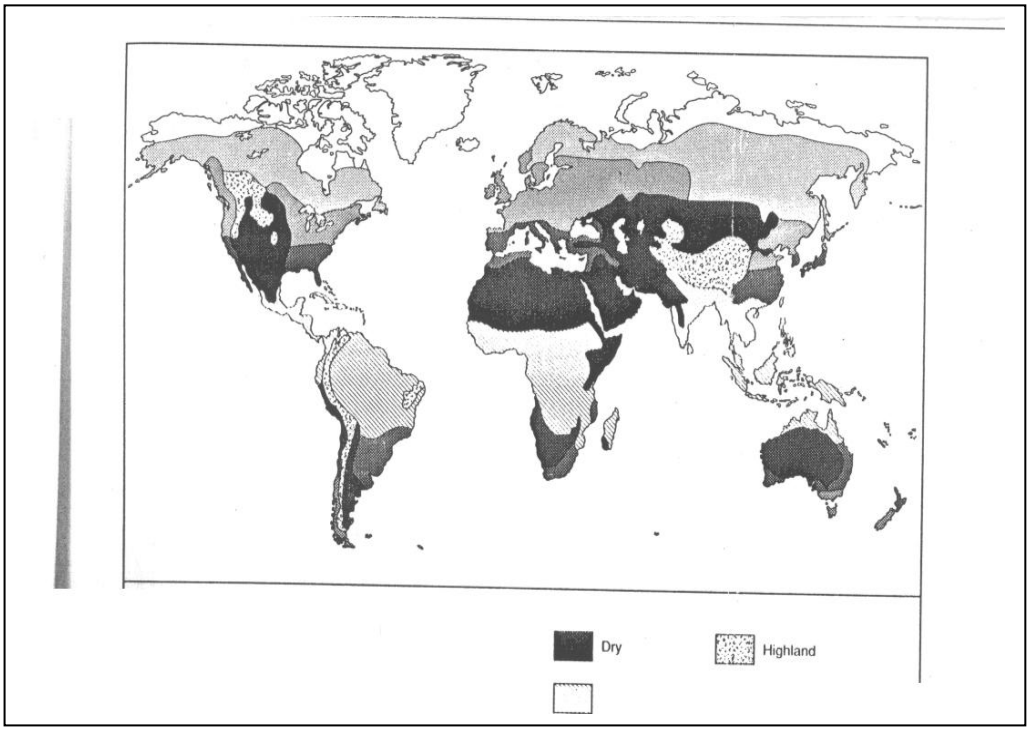

Figure 6.1 generalized map of the world's major climates.

Source:Adapted from Barrow.

These two climatic factors shape the terrestrial ecosystem of the world.The temperature with its seasonable variations and the quantity and distribution of precipitation over each year. The average temperature of an area depends upon the strength of the sun's rays reaching it and this upon latitude or distance from the equator, which receives the largest amount of sun's rays. However, this is modified by global air circulation, winds, ocean currents, and topographical features that distribute humidity and over the face of the earth. Because of these factors, the limits of the earth's climate zone do not follow the parallels of latitude we draw in figure 6.1, around the face of earth.

Also the average precipitation of an area determined the types of vegetation (plants). The average precipitation could be in the form of rain, dew, nail, snow, sleet and frost. Vegetation or plant types are therefore dependant on the amount of precipitation an area e experiences. The amount of precipitation therefore determines whether a place will be a forest, grassland or a desert.

SELF-ASSESSMENT EXERCISE 1

What general term can you use to describe dew frost? Hail and snow.

- Name the factors, which determine plant types in an ecosystem.

3.3 Major Terrestrial Ecosystems

The world's major terrestrial ecosystem can be classified into three (3) different types. These are deserts, grasslands and forests.

3.3.1 Deserts:

This is an area characterized by a climatic pattern in which evaporation exceeds precipitation. A precise climatologically definition of a desert is impossible due to considerable local variations, but generally, in areas where the annual precipitation is less than 250mm than deserts conditions will prevail. Such areas have little or low vegetation widely spaced.

A total of 21.76 million square kilometers are deserts (See Figure 6:2). The vegetation in the desert usually shows a marked transition in appearance and character along transact (two parallel lines) taken from the more timid edges towards the arid center of a desert.

Typically, woody plants become more quailed and assume a spreading form. The numbers of species and individuals becomes reduced; leaves become smaller in size and eventually form vestigial spines or blades.

Desert	Area (Million Km2)	% of World Desert Area
Sahara Desert	9.07	41.7
Australian Desert	3.37	15.5
Arabian Desert	2.60	11.9
Turkestan Desert	1.94	8.9
North American Desert	1.29	5.9
Patagonian Desert	0.67	3.1
Thar-sind Desert	0.60	2.7
Kalahari/Namib Desert	0.57	2.6
Taklimakan Desert & Gobi Desert	0.77	3.6
Iranian Desert	0.39	1.8
Atacama Desert	0.36	1.7
All other deserts	0.13	0.6
Total Area	21.76	100.0

Fig. 6.2: Desert Areas of the World.

3.3.2 Forests

This is an area characterized by a balanced climatic pattern. The precipitation pattern is moderate and high annually between 75 and 120cm. Largely made up of undisturbed areas containing various species of trees and smaller forms of vegetation.

Attempts to estimate the former extent of the earth's forest cover suggest that 6 x 109 ha of land was forested some 5000 years before, but by 1954 this figure had been reduced to 4 x 109 ha.

3.3.3 Grasslands

This is an area between forests and deserts. It can be referred to as the transition zone. The average precipitation of between 25 cm and 65 cm in this area can only allow grass to prosper. Periodic droughts fires characterize it, which prevents large trees from growing.

SELF-ASSESSMENT EXERCISE 2

Compare and Contrast Deserts Grasslands and Forests.

4.0 CONCLUSIONS

In this unit you have learned a number of issues, which relate to the world's major types of ecosystems. You should have also learned the various types of ecosystem and their characteristics.

5.0 SUMMARY

What you have learned in this unit concerns the factors determining the plants, types in an ecosystem and how these factors determines whether an area will be a desert, grassland or forest. It served to introduce you to the terrestrial ecosystems. The unit that follows shall build upon this introduction.

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UNIT 2 TERRESTRIAL ECOSYSTEMS II

CONTENTS

1.0 INTRODUCTION

This Unit is a sequel to Unit 1. Following the introductions to the terrestrial ecosystem types. Unit 2 seeks to expose you to the various types of major world's terrestrial ecosystems. In this unit examples of these types of major world's terrestrial ecosystem are given.

2.0 OBJECTIVES

At the completion of this unit you should be able to explain with examples the various types of deserts.

- Explain with examples the various types of forests.
- Explain with examples the various types of grasslands.
- Distinguish between the various types of deserts, forest and grassland.
- Describe the type of plants found in each of the various types of deserts, forests and grasslands.

3.0 MAIN CONTENT

3.1 Major World's Terrestrial Ecosystem

Refer to Unit 1.

3.2 Types of Deserts

There are basically three different types of deserts in the world.

3.2.1 Tropical Deserts

The types of deserts are common around the tropic zones of the world. They are characterized by very low annual precipitation. The interval between rains may be up to five years, but when rain does fall it may exceed 50mm in amount. They typically have few plants and a hard, windblown surface strewn with rocks and some sand. Examples of such plants found in this type of desert is the cactus, which have flesh stem used in water storage. Example of animals known to survive in this type of desert is the Carmel, which have special adaptations to conserve water. Examples of tropical deserts are the Sahara Deserts and Australian Deserts. It is interesting to note that about one-fifth of the world's deserts area is tropical desert.

3.2.2 Temperate Deserts.

These types of deserts are common around the temperate latitude (typically 35° - 50°N and S, although less extensive in the southern hemisphere. Plants in the temperate deserts are usually widely spaced, minimizing competition for water. Plants have wax-coated leaves to reduce amount of water lost by evaporation, example of plant is cactus. Daytime temperate in the temperate deserts is hot in summer and cool in winter. Example of temperate deserts is the Mojave Desert in California.

3.2.3 Cold Deserts

In cold deserts, a distinct winter cold season exists in which daily temperatures may not exceed 0°C. Plants in the cold desert as widely spaced minimizing competition for water. Example of cold deserts is the Gobo Deserts lying south of Siberia.

3.3 Types of Forests

Just like the deserts there are three (3) different types of forests. These types of forest are determined by the climate and precipitation of the

three distinct climatic regions of tropics, temperate and polar. These three forest types are tropical rain forests, temperate deciduous forests and northern coniferous forests.

3.3.1 Tropical Rain Forests

These types of forests are found in areas near the equator. They have a warm but hot annual mean temperature that varies little daily or seasonally. Humidity is high and rainfall is heavy occurring almost on daily basis. Tropical rain forests are characterized by evergreen trees, which keep most of their leaves or needles throughout the year.

Diversity of plants and animals is greater than any other terrestrial ecosystem. The tropical rain forests are important for being the haven of several species of life forms (biological diversity or biodiversity). Rain forest is threatened today, and the call for its protection have assumed international trend.

3.3.2 Temperate Deciduous Forests

These types of forests are found in areas with moderate average temperatures. These forests are characterized by few species of broad-leaf deciduous trees. Plants survive during the winter by chopping leaves. Examples of trees found in these forests are the Oak Maple, Sycamore among others.

3.3.3 Coniferous Forests

These types of forests are found in sub arctic regions. Climate in these areas are characterized by long, dry winters with light snowfall and short days, and temperature range from cool to extremely cold. Summers are short with mild to warm temperature. The sunshine typically for 19 hours daily. The coniferous forest plants have needle-shaped, wax-coated leaves. Plant diversity is low because of the cold winters. Coniferous forests are commonly found in Asia, Europe and North America.

3.4 Types of Grasslands

Grasslands of the world are known to make up of three types. They are the tropical grasslands, temperate grasslands and polar grasslands.

3.4.1 Tropical Grasslands

They are also known as the savannah. They occur in a wide belt on either side of the equator beyond the borders of the tropical rain forests. Climate is characterized with high average temperatures and abundant rain. The grasses, shrubs, small trees and soil on grasslands provide food and habitants for many types of wildlife such as elephant, lion, and zebra among others. Example of tropical grasslands is the Africa's Serengeti Plain covered with low or high grasses.

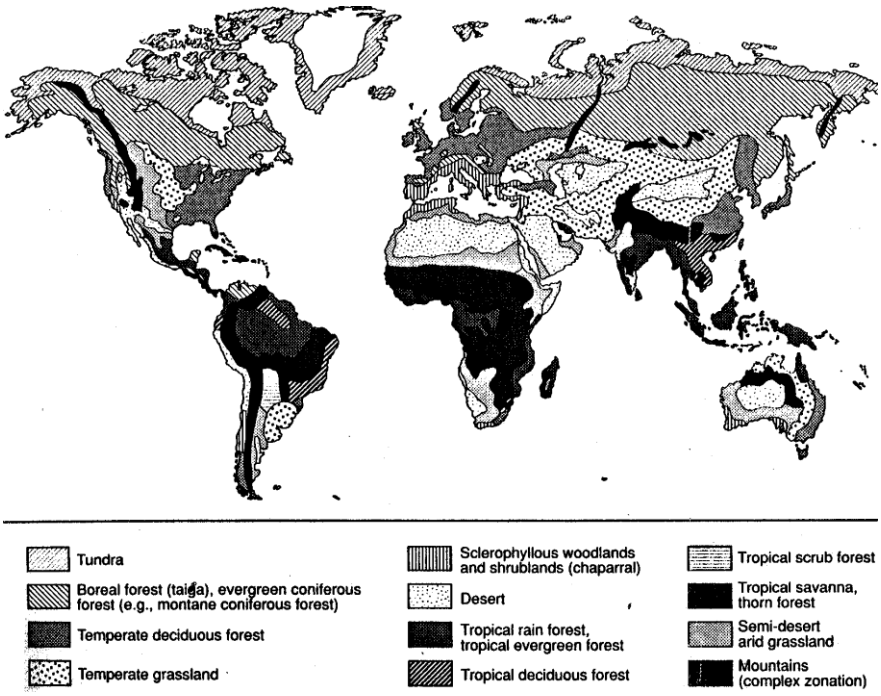

Figure 7.1 generalized map of world's major biomes (Adapted from Barrow C.J. 1993:25)

3.4.2 Temperate Grasslands

Tall-grass prairies characterize this type of grassland and short-grass prairies commonly found in the mid-western U.S.A. and Canada, the Pampas of South America and the Veldt of South Africa, and the steppes of Central Europe.

Temperate grasslands are noted as areas for growing crops.

3.4.3 Polar Grasslands

These types of grasslands are found areas just below the Artic Ice Region. The polar grasslands are characterized by bitterly cold, with icy gale like winds, usually covered with snow and ice. Animal precipitation is low and occurs mostly as snow /the polar grassland or carpeted with a

thick, spongy mart of low growing plants such as lichen and low shrubs among others.

SELF-ASSESSMENT EXERCISE 1

- Differentiate between tropical and cold deserts.
- Give examples of temperate deserts, plants and animal forms found in it. Your examples should be different from the ones cited in this unit.
- Tropical forests are known for its biodiversity, what are temperate forests known for?
- Compare and contrast temperate and polar grasslands.

4.0 CONCLUSION

This unit has exposed you to the various types of grasslands, forests and grasslands of the world. In this unit you have also learned the characteristics and examples of these three types of terrestrial ecosystems.

5.0 SUMMARY

What you have learned in this unit are the various types of the world's terrestrial ecosystems. This unit lucidly explains with examples the characteristics of these ecosystems.

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UNIT 3 AQUATIC ECOSYSTEMS & TYPES

CONTENTS

1.0 INTRODUCTION

You will recall in Module 1, Unit 2, a brief introduction was on the ecosystem and the types of ecosystem. Where as Unit 1, have treated the terrestrial ecosystem. This unit however is to take you through the aquatic ecosystems, with a view of creating an overview for the understanding of the aquatic ecosystems. This overview is aimed at setting you in tune for an in-depth knowledge of the aquatic ecosystem. Before we do this however, let us examine what you should do at the end of this Unit.

2.0 OBJECTIVES

At the end of this Unit you should be able to:

- Explain with definition what an aquatic ecosystem is.
- List the types of world's aquatic ecosystems.
- Describe with examples the major types of aquatic ecosystems.

3.0 MAIN CONTENT

3.1 What is Aquatic Ecosystem

You should refer to Unit 2 of Module for explanation and definition of aquatic ecosystems.

3.2 Factors Limiting Aquatic Ecosystems

Similarly as in the case of the terrestrial ecosystems, certain factors or conclusion determine the types and members of organisms in the aquatic ecosystems. These factors are summarized as follows:

1) Salinity
2) Depth of sunlight penetration
3) Amount of dissolved oxygen
4) Availability of plant nutrients
5) The water temperature.

3.2.1 Salinity

This is determine through the concentration of dissolved salts especially sodium chloride in a body of water. Furthermore the salinity of water body or used to divide the aquatic ecosystem into two major types. Examples are marine or saltwater ecosystem - are those with very high salinity levels and these includes the oceans, estuaries, coastal wetlands and coral reefs. Secondly is the freshwater ecosystem with a low salinity e.g. lakes, reservoirs and flowing water (these are characterized as the inland bodies of standing water)

3.2.2 Depth of Sunlight Penetration

This is determined by measuring in meters the depth of penetration of sunlight measured from the surface of the water body to the bottom. For a clear understanding of this, let us divide the oceans from its surface into three (3) regions. And these are:

i) Euphoric zone
ii) Bathyal zone
iii) Abyssal zone

i) **Euphoric Zone:** is the zone that enjoys the most sunlight. At this zone, which between O and 200 metres, photosynthesis do take place. This zone supports scattered population of microscopic drifting producers (mostly algae and bacteria), they fed upon by slightly larger and mobile zooplankton (animal plankton).

ii) **Basal Zone**: This zone is between the depth of 200metres and 1,500 metres. And it is also known as twilight zone.

iii) **Abyssal Zone:** This third zone exists between the depths of 1500 metres and 10000 metres. This area is also known as the darkness zone, as a result of the reduced penetration of sunlight.

SELF-ASSESSMENT EXERCISE 1

- List the five factors that limit ocean types.
- What do you think sunlight penetration is important for aquatic ecosystem?

3.3 Major World Types of Aquatic Ecosystems

Flowing from the five factors limiting aquatic ecosystems (explained earlier above). There are basically two types of aquatic ecosystems. These are categorized as follows:

1. Oceans
2. Inland Water bodies.

3.3.1 Major Ocean Zones

The ocean zones of the world can be divided into two zones. These are the coastal zone and open sea. These two zones are determined largely by five factors limiting aquatic ecosystems. (See Section 3.2). Examples are oceans, estuaries, streams, coastal wetland and coral reefs. It contains 90% of the total surface area of the ocean but only about 10% contain plants and animal life. They are divided in three zones based on sunlight penetrations.

3.3.2 Inland Water Bodies

Example of the inland water bodies is lakes, reservoirs, ponds, inland wetlands and flowing water (e.g. streams and rivers). The inland water bodies are low salinity. The inland water bodies are generally standing water. This type of major ocean zone is equally determined by those five factors limiting aquatic ecosystems.

SELF-ASSESSMENT EXERCISE 2

- Explain the two types of major ocean types.
- What are the major differences you can find in two?

4.0 CONCLUSION

This Unit has exposed to the aquatic ecosystems, as well as various types of aquatic ecosystem. In this Unit, you have also learned the various factors, which limit the aquatic ecosystem.

5.0 SUMMARY

What you have in this unit are the various types of aquatic ecosystem. This unit also gave you brief explanation into the nature of aquatic ecosystem as well as the key important factors, which determine aquatic ecosystem types.

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UNIT 4 MAJOR OCEANS

CONTENT

1.0 INTRODUCTION

You have learned about the aquatic ecosystem and the types in the previous unit. You have equally learned about those factor limiting aquatic ecosystems. This unit however is follow-up; on the previous unit. This unit will give you an indepth understanding of the open sea.

You will equally be exposed to the nature of the open seas, the importance, and the life forms in this type of ecosystem as well as its importance. Before that, let us see what you are supposed to learn in this unit.

2.0 OBJECTIVES

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

- Explain the meaning of open sea.
- List the examples of open seas of the world Mention the aquatic life forms.
- Discuss the various conventions and laws for protecting the oceans.

3.0 MAIN CONTENT

3.1 Open Sea

Modern science has taught us to know that the sea is the very source of life on earth. It is, so to speak, the amniotic fluid from which all living forms sprang. Throughout history, the oceans have been vital to human civilization - as a resource base, as a route to other lands and other peoples, or as an outlet for population overflow. For the human imagination, the sea has always been a symbol of vastness and freedom.

Paradoxically, the marine zone, which contain about 90% of the total surface of the ocean only contain about 10% of the plants and animal life found in the ocean zones. The open sea is divided into three zones of photosynthesis, twilight and darkness according to the depth of sun penetration.

3.1.1 Oceans of World

It was not until the frost colour pictures of earth come back from space that we knew our planet look blue. But with a little knowledge of geography, anyone might have guessed. Over 70 percent (70.8%) of the surface of the globe is ocean about 330 million square kilometers, or over 360 square kilometers when coastal water is also included. The oceans of the world are the Artic Ocean, Pacific Ocean, Indian Ocean and Atlantic Ocean. These four oceans together occupy the space mentioned above on the surface of the globe. Infact, all the landmass of the earth (continents and islands) would fit into the Pacific Ocean alone and with room to spare. (Figure 9:1)

3.1.2 A Vast Inter-connected System

Although the oceans and their adjacent seas have their own names, they behave much more like an entwined, moving snake than the massive lakes; we may imagine them to be. At the surface, water warmed by the tropical sun (sometimes reaching 30%) is transferred by an ocean current system towards high latitudes and the poles. Deep below the surface, wide cold (about 20C) "Thermohaline currents move slowly around the world. The water in this deep part of the so-called `conveyor belt' moves very slowly -- about 1 mm/sec, taking as long as 1,000 years to complete its cycle.

As a result, we find Mediterranean water at a depth of 2,200 meters near Bermuda and Iceland, while water from the Red Sea turns up in the Indian Ocean. Meanwhile, North Atlantic water meanders into the

Pacific and Indian Oceans, taking 500 years to get there. This deep current is technically hard to study and so is still poorly understood, but we know it plays a major role in stabilizing world climate. (Figure 9:2)

Where the atmosphere is very cold (for example, at the poles) there can be a major vertical transfer between the deeper layers of the oceans and the warmer surface water. Warm water from the tropics travels towards higher latitudes, where it meets cold air. Here, some of this water evaporates (forming fog land rain) and as a result, the surface layer becomes cooler (as low as - 2°C), denser and more saline. This denser water slowly sinks as it returns towards the equator on the global coupling of ocean and atmosphere is a major factor during climate in the medium term and regional weather in the short term.

How the oceans transport heat

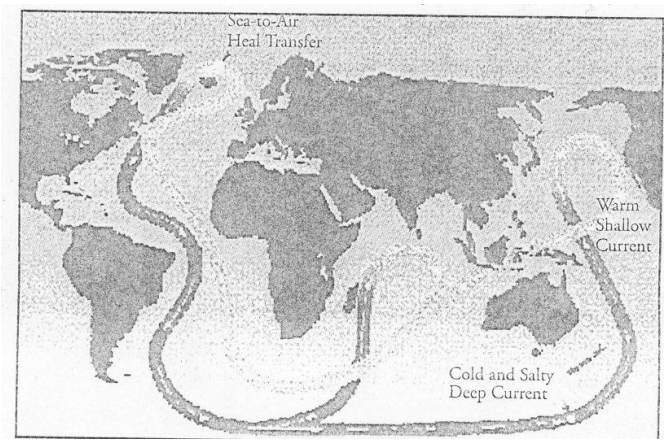

Figure 9:2

3.1.3 Importance of the Oceans

The vast ocean planet is important in number of ways. And these are:

a) They serve as receptacles for terrestrial water flowing from rivers.
b) They have the capacity to reduce harmful human-produced waste into less harmful or harmless state.
c) They play a major role in regulating climate of the earth.
d) They participate in other biogeochemical cycles.
e) They serve as habitat for 250, 000 species of more plants and animals.

f) They are a source of valuable resources such as sand, gravel, phosphates, lime, magnesium, oil and natural gas.

Case study: The Ocean Charter

The oceans and their resources are a necessary element of life on this planet.

The health of the oceans, and the wise, safe and sustainable use of the ocean resources, should be an axiom for all governments to accept and honour for the long-term benefit and existence of their respective and collective peoples.

The acquisition of the knowledge necessary for the understanding and stewardship of the oceans and their adjacent seas for the adoption of policies, standards and regulations to protect the ocean environment and to husband their resources, are goals to be pursued both nationally and internationally.

There should be mutual assistance and the will to work together to achieve common goals for the oceans - adjacent and regional coastal states should cooperate in the adoption of local policies and actions - countries with knowledge and resources should assist less fortunate neighbours - data and information for global and regional problems should be readily available - States should make use of international and intergovernmental organizations to generate global programmes and agreements.

We recognize the wisdom of acting in unison to protect the oceans and to use their resources in a sustainable manner and accept this Ocean Charter as a basis for future action.

Source: UNESCO/Intergovernmental Oceanographic Commission

3.2 Coastal Zones

This is relatively warm, nutrient-rich, shallow water that extends from the high tide mark on land to the edge of a shelf like extension of the continental land mass known as the continental shelf. Over 90 percent of the planet's living and nonliving resources are found within a few hundred kilometers of the coastal zone.

On or near these coasts live two-third of the world's people. The coastal zone represents less than 10% of the total ocean area. The coastal zone is also the commercial zone, of major ocean zones - it is the site for

major commercial marine fisheries. It is also the source of most of the oceans' biological productivity, which supports oceanic animal life.

3.3 Types of Coastal Zone

The coastal zone includes a number of different habitats. And these are the estuaries, wetlands and coastal wetlands.

3.3.1 Estuaries

These are semi-enclosed coastal body of water, which has a free connection with the open sea but within which the salinity level of the ocean is considerably diluted by the addition of fresh water brought in by a river system. Estuaries can be sub-divided into four main groups.

a) Drowned river valleys, which result from the submergence of a coastline e.g. Chesapeake Bay.

b) Fiords or Fjords - This form when the sea floods deep glacial valleys. These are found on most glaciated coastlines, including British Columbia, Southern Chile, Scotland Norway and News Zealand's South Island.

c) Teutonic Estuaries - which the down faulting of small sections of the earth's crust causes. Although generally uncommon example South Francisco Bay.

3.3.2 Wetlands

They're any area of low-lying land where the water table is at or near the surface for most of the time, resulting in open-water habitats and waterlogged land areas. Wetlands are typically founding estuaries, along rivers with little vertical desert or in uplands where natural drainage is impeded due to extensive boulder clay deposit or by drainage channels disrupted by glacial watershed beaching. Wetlands may also form in areas of very high rainfall and low temperature.

Depending on their location, wetland can be fresh water, brackish or salt-water habitats. Wetlands extending inland from estuaries and covered all or part of the year with-salt water are known as coastal wetland. In temperate areas, coastal wetlands usually consist of a mix of bags, lagoons and salt marches where grasses are dominant vegetation. In tropical areas, we find swamps dominated by mangrove trees. These nutrient-rich areas are among the worlds most productive and important ecosystem.

Table 9:1 Extent of Freshwater Wetlands. Globally and in Europe Versus Africa (3,000 km).

	Bogs	Fans	Swamps	March	Floodplain	Lakes	Mangrove	AnthroPogenic
Global	1,867	1,483	1,130	274	823	114	27	1300 (rice paddles)
Europe	4	93	1	4	1	1	0	Minor
Africa	0.38	85	57	174	39	6	46	

Source: Groombridge 1992

3.4 Protecting the Ocean Planet

The Ocean planet does not belong to the adults of today and should not be managed on the basis of short-term considerations of economic or political power. It was the need for sustainable ocean that propelled the United Nations Assembly to adopt a declaration providing that all seabed resources beyond the limits of national jurisdiction constitute the common heritage of human kind. The United Nations law of the sea - signed by 159 nations provided the international community with an effective legal framework covering navigational rights, territorial sea limits, rights of passage, question of economic jurisdiction, the conservation and management of living marine resources, and procedures for peaceful settlement of disputes. But the value of legal instruments is dependent on how far they are respected and enforced.

4.0 CONCLUSION

In this Unit you have learned a number of issues, which relates to the major ocean zones of the world. The various oceans and their importance. As well as the nearby coastal zones and types of coastal zones of the world.

5.0 SUMMARY

What you have learned in this unit concerns major ocean, zones. The nature of the oceans or open sea. The types of coastal zones as well as the effort at protecting the ocean planet. No doubt, what you learned in this unit should develop in you a sustainable sense of the oceans.

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UNIT 5 FRESH WATER ECOSYSTEMS

CONTENTS

1.0 INTRODUCTION

Do you know what lakes reservoirs and panels are? To know what these water bodies, you are advised to go back to Unit 3, before you move further into this unit. Now that you are aware of what they are, it is important to let you know that this unit shall build upon what you have learned in Unit 8. In the meantime, take a look at what you should learn in this unit.

2.0 OBJECTIVES

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

- Describe the freshwater ecosystem with examples.
- Explain with examples the different types of freshwater ecosystems.
- Differentiate between freshwater ecosystem and major ocean zones.

3.0 MAIN CONTENT

3.1 Freshwater Lakes

Lakes are body of standing water that occupies a depression on the earth's surface and is completely surrounded by land. Ranging greatly in size and de3pth, lakes form an important part of the psychological cycle and accounts for 75% of all the water (apart from that contained in oceans) on the earth's surface. Lakes generally have four district zones, which provide a variety of habitats and ecological niches for different

species. Also there are two types of lakes, and these are Oligotropic lake and eutrophic lake.

3.1.1 The Four Major Zones of a Lake

a) Littoral Zone includes the shore and the shallow, nutrient rich water were the shore, in which sunlight penetrates to the lake bottom. It contains a variety of free-floating producers, rooted aquatic plants and other form of aquatic life such as frogs, snails and snakes.

b) Limnetic Zone: This is the second zone of the lake.This zone, which is open-water surface layer, get enough sunlight for photosynthesis. It contains varying amount of floating phytoplankton, plant-eating zooplankton, and fish depending on the supply of plant nutrients.

c) Profundal Zone: This is the deep, open water where it is dark for photosynthesis. Fish adapted to its cooler darker water inhabits it.

d) Benthic Zone: This is the bottom of the lake and mostly large members of decomposers, detritus - feeding clams, and worm like insect larvae, inhabit it. The herbivores feed on dead plant debris, animal okmaisis and animal wastes that descent from above.

3.1.2 Types of Freshwater Lakes

a) Oligotropic Lakes: These lakes have small supply of nutrients. The lake is deep; water is crystal clear while the temperature is ranged between cool-cold. It contains small population of phytoplankton and fish.

b) Eutrophic Lake: This is the opposite of oligotropic lakes. These types of lakes have large supply of nutrients. Depth of lake is shallow; water is cloudy, while temperature is warm. It contains large population of phytoplankton, zooplankton as well as diverse population of fish and carp.

3.2 Reservoirs

There are large deep, human-made bodies of standing fresh-water. Reservoirs are built behind dams to collect water running down from mountains in stream and rivers. It is built to store water and the stored water is released in a controlled manner. Released water may be used for hydropower generation as in Kainji Dam. It can be used for irrigation purposes to grow crops on dry land as in Goronyo dam in Sokoto. It can

be stored and released, slowly to prevent flooding as in the case of Ogun-Osun River Basin Project. It can also be used for water supply to cities as in the case of Asejire dam in Oyo State. Other purposes to which a reservoir is put are recreation such as swimming, fishing and boating.

3.3 Freshwater Streams

When rainfalls, the rainwater that does not infiltrate into the land or evaporate into the atmosphere are left on ground surface as surface water. This type of water becomes run-off flows into streams and eventually downhill into oceans for reuse in the hydrologic cycle.

As the water move downhill they become powerful shapers of land. The channel of a stream may be though of as a long, narrow path, shaped by the forces of flowing water to be most effective in moving the quantities of water and sediment supplied from the drainage basin or watershed. Freshwater is a basic natural resource essential to man in his varied and intense agricultural and industrial activities. Runoff held in reservoirs behind dams provides water supplied for great urban centers. It also provides irrigation water for highly productive lowlands in lands.

3.4 Inland Wetlands

They are also known as freshwater wetlands. The RAMSAR convention (the treaty for the protection of global wetlands) defines wetlands as areas of marsh, fen, Pearland or water, whether natural or artificial permanent on temporary with water that is static, flowing fresh, brackish, or slat, including areas of marine water the depth of which at low tide does not exceed six metres.

Wetlands are characterized by the presence of water at the surface or in the root zone, unique soil conditions and hydrophytes (water loving plants). Wetlands are after marginal habitats between truly aquatic and terrestrial systems. Sizes can vary from small panels to huge regional expenses.

3.4.1 Importance of Wetlands

Wetlands throughout the world support their own unique wildlife. The astonishing variety of benefits local to global provided by wetlands is outlined as follows:

a) Consumptive - Wetlands yield fish, shellfish and prawns.

b) Non-consumptive - Tourism and recreation rely on the wetland landscape.

c) Storage - Wetlands acts as major water stores, allowing ground water recharge as water slowly seeps into deep aquifers and also discharge.

d) Buffering: Buffering is the ability to slow compensate and ameliorate against change. Wetlands buffer many potentially destructive environmental processes reducing both the size and rate of change.

e) Cleaning - Wetlands are effective filters, particularly between rivers and their surrounding catchments.

f) Pathways - The waterways ramifying throughout many wetlands provide pathways for natural fluxes such as nutrient cycling and alluvial deposition, increasing fertility. Open water also provides literal routes for movement of animal and humans.

Case study:

Role of Wetlands.

4.0 CONCLUSION

This has exposed you to the freshwater ecosystems as well as the various types of freshwater ecosystem. In this unit you have also learned the various uses to which the various types of freshwater ecosystem can be put to.

5.0 SUMMARY

What you have learned in this Unit are the various types of freshwater ecosystems. This Unit also gave the importance of each type of freshwater ecosystem.

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MODULE 3

UNIT 1 OVERVIEW OF NIGERIAN ENVIRONMENT

CONTENTS

1.0 INTRODUCTION

It is only logical for you to be exposed to make-up of Nigerian environment upon which the Nigerian ecosystem thrives. In this Unit therefore you will be exposed to those elements, which shapes the ecosystem. Elements such as climate, hydrology and drainage and vegetation.

However before we go into this unit let us look at what you are supposed to learn at the end of this Unit.

2.0 OBJECTIVES

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

- Describe the Nigerian Environment.
- Explain the elements, which shape the Nigerian ecosystems.

3.0 MAIN CONTENT

3.1 Climate

By virtue of its location, Nigeria enjoys a warm tropical climatic condition, with relatively high temperatures throughout the year and two seasons; the dry and wet seasons. The climate of the country is influenced by the interaction of two air masses: the relatively warm and moist tropical marine air mass (mT), which originates from the Atlantic Ocean and is associated with Southwest winds in Nigeria; and the relatively cool, dry and stable tropical continental air mass (cTs) that originates from the Sahara Desert and is associated with the dry, cool and dusty North-East Trades (Harmattan). The boundary surface area between the two air masses is known as the Inter-tropical Discontinuity (ITD) or the Inter-tropical Convergence Zone (ITCZ). The ITD migrates north and south of the country bringing rainfall or dryness to different areas of the country at different times of the year. Roughly, its northward movement brings the wet season to all areas south of its location, while its southward migration brings the dry season to areas north of its location. In general, while there is hardly any dry season in the extreme southern tip of the country, the wet season hardly lasts for more than three months in the northeastern part of the country.

Similarly, annual rainfall totals range from over 2,500mm in the south to less than 400mm in parts of the extreme north.

3.2 Geology, Land-form, and Soils

The geology of Nigeria is dominated by igneous structures that form most of the highlands and hills. The rocks of the Basement Complex, mainly of igneous origin, are encountered in over 60% of the surface area. Younger Granites have intruded into these rocks in Jos Plateau and environs. Volcanic rocks have also extruded on to the surface in places such as Jos Plateau and Adamawa Highlands. Areas of sedimentary formations are restricted to the coastal belt; the Niger-Benue Trough, including the southeastern scarps land and the Sokoto-Rima basin; and the Chad Basin.

The landforms can simply be classified into highlands, plateaus, hills, plains and river valley systems. Suffice it to state that the landforms are more deeply dissected in the southern parts than in the northern parts.

Indeed, except for the Eastern Highlands in Adamawa area and the Jos Plateau, basins characterized by broad gently. Sloping plains dominate

the northern half of Nigeria. An extensive section of this area is identified as the High Plains of Hausa land (Udo, 1970).

Table 1.1 Production Potential of Nigerian Soil

Fao Productivity Classes		Area	
High (1)		Km2	% of Total
Goods (2)	Fluvisols, Gleysols Regosols	50.4	5.52
Medium (3)	Lixisols, Cambisols, Luvisols Nitosols	423.6	46.45
Low (4)	Acrisols, Ferralsols, Affisols Vertisols	289.2	31.72
Low (5)	Arenosols, Nitosols	148.8	16.32

Source: Originally from FAO and reported in Agboola, S.A. 1979·

An Agricultural Atlas of Nigeria, Oxford University Press, Oxford, Modified by IAR & T, Ibadan.1996.

The geology and the geomorphological processes that shaped the landforms have greatly influenced the soils. The major soil types in Nigeria, according to the FAO soil taxonomy legends, are fluvisols, regosols, gleysols, acrisols, ferrasols, alfisols, lixisols, cambisols, luvisols, nitosols, arenosols, and vertisols. These soil types vary in their potential for agricultural use as shown in Table 2.2. Clearly none of these soils rated as Class 1 with high productivity by the FAO. Indeed, over 48% of Nigerian soils fall into classes 4 and 5. These are mainly vertisols, alfisols, acrisols, ferrasols, and arenosols. These soils usually have low productivity due to inadequate moisture retention capacity and low organic matter. What is more, except for the ferrasols, they are the most dominant types found in the northern dry parts of the country.

3.3. Drainage and Hydrology

There are three major drainage systems in the country. These are: the River Niger drainage system; the coastal drainage system and the Lake Chad inland drainage system. The River Niger drainage system consists of the river Niger and its tributaries, prominent among which are the Benue, the Sokoto-Rima, the Kaduna, the Gongola and the Anambra. The Lake Chad inland drainage system draws the following in-flowing rivers from Nigeria: the Komadougou-Yobe (with headstreams including Hadejia, Jama'are and Misau) and the Yedseram. However,

the Chari and Logone rivers from the Central African Republic constitute the most important inflow.

The coastal drainage system consists of rivers and short streams, draining directly into the Atlantic Ocean. Two sub-sets of this system can be recognized. There is the eastern system consisting of rivers and streams east of the Niger delta such as the Cross River, Imo, Qua Iboe and Kwa rivers. The western system consists of the Ogun, Oshun, Owena and Benin rivers. The total area of inland water bodies is estimated to be slightly over 12 million hectares as shown in Table 2.3

Table 1.1 Summary of Water Surface Area of Lakes, Reservoirs and Major Rivers in Nigeria.

Body of Water	Area (ha)	% of Total
Lake Chad (Nigerian Sector)	550,000	4.46
Kainji Lake	127,000	1.03
Major Rivers	10,812,210	87.62
Reservoirs	275,000	2.23
Flood Plains	575,000	4.66
Total	12,339.21	100

Source. Adapted from Ita et al (1985)

The hydrology of the country is influenced by the geologic structure. Areas of igneous structure are dominated by surface runoff while the areas of sedimentary formation are characterized by ground water retention. Most of the Chad Basin and the Sokoto-Rima Basin in the drier north are associated more with groundwater than surface water.

3.4 Vegetation

There is hardly any vegetation that has not been affected by human activities in the country. Farming, logging, grazing, hunting, urbanization, road construction and other development activities by the rapidly expanding population have together reduced the nation's natural plant cover to isolated remnants. Based on the climatic conditions, the following vegetation types are recognized in the country: the mangrove and fresh water swamps, the rain forest, the Guinea Savannah, the Sudan Savannah and the Sahel in a south-north transect. Between the rain

forest and the southern forest, that is, both the swamps and the rain forest, constitutes the country's main source of wood. The derived savannah zone, about 250km wide, was once the northern part of the forest zone, but transformed by such activities into a vegetation type, consisting largely of deciduous trees and grasses. The vegetation still supplies some wood. Most of the remaining part of the country is the Sudan Savanna, accounting for more than 25% of the surface area, and expanding at the expense of the Guinea Savanna. At the northeastern and northwestern corners of the country is the Sahel that ordinarily does not account for more than 5 - 10% of the surface area, but is now growing larger at the expense of the Sudan zone. So, it is more meaningful to take the two driest zones together as the sudan-sahelian zone.

This is the ecological zone described as the Nigerian dry land by many researchers, containing most of the rangeland of the country. This zone constitutes the main source of fodder and grazing land for livestock.

However, there is also the expansion of cultivation and extreme climatic variations that combine to reduce the grazing areas, and degrade the zone, including changes in plant species.

4.0 CONCLUSION

In this unit you have learned a number of important issues that relate to the Nigerian environment. You have also learned the basis of the Nigerian ecosystem. You need to be aware too that if these elements presented in this unit, which encourages the formation, thriving as well diversity found in the Nigerian ecosystem.

5.0 SUMMARY

What you have learned in this unit concerns the nature and characteristics of the Nigerian environment. It has served to introduce you to the basis of types of ecosystem found in Nigeria.

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UNIT 2 NIGERIAN TERRESTRIAL ECOSYSTEMS

CONTENTS

1.0 INTRODUCTION

You have no doubt to learn a lot with regards to the ecology, ecosystems and types as well as other issues related to this course. You may need to know that units 110 have successfully addressed global issues. It is imperative therefore that you should learn about the Nigerian ecosystems. This necessary for you to be at home with such knowledge as a student of Environmental Studies in Nigeria. This unit therefore will expose you to the various types of ecosystems found in Nigeria. This exposure will enable you to determine whether the Nigerian ecosystems are derived from the world. Before this is done, it is necessary to let you know what you are supposed to learn at the end of this unit.

2.0 OBJECTIVES

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

- State clearly the different ecosystems in Nigeria.
- Describe the Nigerian ecosystems and its extent.
- Draw and locate map of Nigeria showing the locations of each of the ecosystem.

3.0 MAIN CONTENT

3.1 Nature of Nigerian Vegetation

It is believed that prior to the activities of humans on the environment of the area now known as Nigeria was covered by three major types of vegetation.

i) Tropical Rainforest, apparently covering the southern most 39% of the country.
ii) Tropical Deciduous forest immediately to the north and also covering about 39% of the country.
iii) Tropical xerophytic woodland, covering the northern most 22% of the country.

It is instructive that you should know that grass was not an important part of the vegetation. Although it exists in occasionally patches in the tropical xerophytic woodland. Overtime with the activities of humans through bush burning, farming and grazing. These original three vegetation types have charged and reduced to two major types. These two types are forests and savannah grasslands.

3.2 Forests Zone

The Nigerian forests vegetation is dominated by woody species, the majority that are trees. The forest zone contains the following major types of vegetation.

1) Coastal vegetation
2) Mangrove Forest
3) Freshwater Swamp Communities
4) Riparian Forest
5) Lowland Rainforest

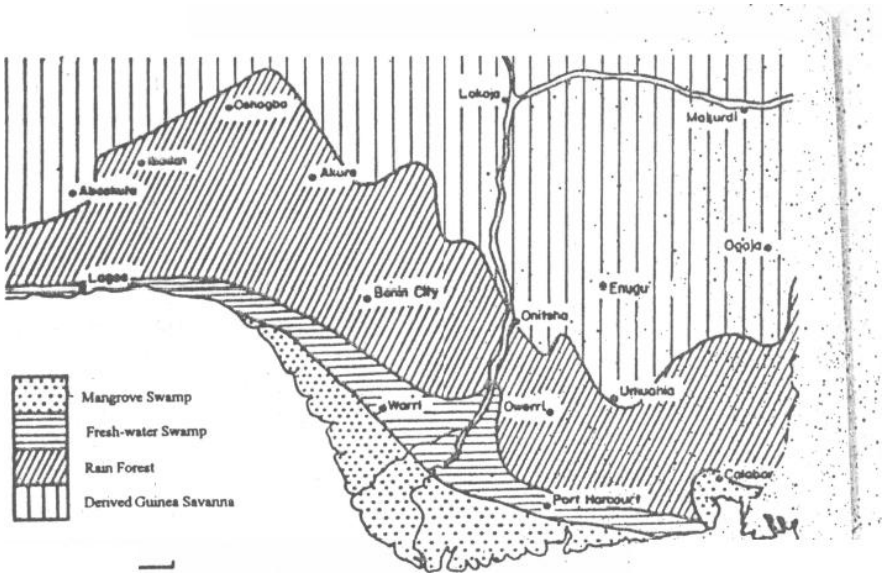

Figure 12:1 Coastal vegetation map of Nigeria.

Source: Adapted from Agabi et al (1997)

3.2.1 Coastal Vegetation

This vegetation type is associated with the mangrove formation described below. It occurs mainly as strand vegetation dominated by halophytes (salt-tolerant plants) growing at the ends of the mangrove swamps, near the seaboard, or mixed with the mangroves themselves. Strand vegetation consists mainly of shrubs, such as Conocarpus erectus and Hibiscus tiliaceus, and herbs, such as Ipomoea pescaprae. A recent study showed coastal vegetation at 25 beach stations taken along the entire coastline of Nigeria to be made up mainly of 43 plant species. The most common were Ipomoea aquatica and Paspalum vaginatum. The latter, together with Sesuvium portulacastrum, is located more landward than Ipomoea. Further landward, coastal vegetation consists of a mixture of climbers, edges, and thickets of shrubs and trees.

The total width of this type of vegetation varies from a few metres to about 100km perhaps because of its small extent and simplicity, Nigerian strand vegetation has been infrequently described. This also places it in great danger of being totally eliminated by oil pollution that is now pervasive along the coastline. The extent to which strand vegetation contributes in stabilizing beaches against coastal erosion in Nigeria is not known, but could be significant.

3.2.2 Mangrove Forest

Inland from the strand vegetation is mangrove, most of which occurs in the Niger Delta, because such vegetation is best developed in the deltas of large tropical rivers where the vigour of the sea surf is broken by sandbars and where rain forest climate prevails. Mangrove also thrives in marine and brackish habitat, in the zone between the high and low tide marks, and may be seen as narrow strips, for several kilometers inland, along the banks of the major rivers in the delta.

Mangrove in Nigeria is dominated by red mangroves (Rhizophoraceae) in association with white mangroves (Avicennia) and Laguncularia racemosa. The red mangrove Rhizophora racemosa is the commonest species, covering over 90 percent of the mangrove area.

Table 12:1: The Distribution of Mangrove Vegetation in Nigeria.

State	Area of Mangrove (s q. km)	Mangrove in Forest Reserve (sq. km)
Edo and Delta	3,470.32	143.75
Cross River and Akwa Ibom	721.86	67.19
Lagos	42.20	3.17
Ogun	12.18	-
Ondo	40.62	-
Rivers	5,43 5.96	90.62
Total	9,723.14	304.69

Source: FAO, 1981 op. cit.

3.2.3 Freshwater Swamp Communities

Aquatic grasslands, freshwater swamp forests, deltaic swamps, and undifferentiated swamps make up the freshwater communities that succeed mangrove and continue in low-lying places along waterways inland in the forest zone. Until recently, these communities were largely protected from human activities by the swampy ground on which they exist.

Now their continued existence in the delta region is seriously threatened by the ingress of seawater along canals constructed by the oil industry to

facilitate transportation to the sea. Studies around the Tsekelewu Oil Field in the Niger Delta of Edo and Delta States reveal massive destruction of vegetation because freshwater communitiare
exposed to saline water introduced through these canals.

Table 12.2: The Distribution of Freshwater Swamp Communities in the Forest Zone States of Nigeria.

a) Aquatic Grassland and Herbaceous Swamps: These are commonly observed at the outer edge of swamp forests and frequently consist of floating vegetatin of the grass Vossia

State	Area of Swamp Communities (sq. km)	Swamp Communities in Forest Reserve (sq. km)
Edo and Delta	426.57	148.44
Cross River and Akwa Ibom	7682.81	829.70
Imo	625.01	46.88
Lagos	1504.73	-
Ogun	907.77	25.00
Ondo	1871.89	23.44
Rivers	5937.48	806.35
Total	21.134.45	2,429.81

cuspidate, large communities of Cyperus spp. Or of grass vegetation consisting of Acroceras Echimochloa pyranmilalis, the aroid cylosperma senegalense, the Nephrolepis biserrata, or dicotyledonous herbs such as Jussiara, Polygonum and amplectens, Paspatham spp, fern Ipomoea species. Floating or

submerged plants in this sub-type formation also include lotus, N. *micranthus*, Pistia stratiotes, Impatiens, Eleocharis, Salvania, Lemna and Nymphaea Ultricularia species. This is the habitat being increasingly invaded by the water hyacinth, Eichhornia crassipes.

b) Terrestrial Swamp Forest: Terrestrial formations replace the aquatic communities described above inland from the waterfront. These formations have an outer fringe, close to the water edge, which is dominated by species of Raphia, Pandanus, Calamus and Alchornea. This fringing section of the swamp vegetation is

seldom more than 15m tall. Behind this fringe, the freshwater swamp may attain a height up to 45m. the best known species of this formation is *Mitragyna ciliata* (the Abura of the timber trade). Other conspicuous and wellknown species are *Symphonia, globulifera, Lophira* alata (fronwood). *Alstonia boomei*, and *Nauclea* gilletti. Less well-known species include *Spondianthus preussii, carapa prolcera,* Uapaca spp., Gozinia spp. (the sources of bitter kola and chewing sticks), Cleistropholis patens (used in canor bulging) and Oxystigma mannii. Some of these trees have stilt roots (e.g. Uapaca), pneumatophores and bulging corky knee roots (e.g. Mitragyna).

c) Undifferentiated Inland Swamps: Freshwater swamp forest farther inland in the Niger Delta is seasonally flooded. In the dry season, surface water is patchy or absent, while during the rainy season the forest is flooded. The main canopy of these forests is more or less open and, in the gaps, dense tangles of shrubs and liana practically form an impenetrable growth. The undergrowth is mostly of climbing palm (rattans), Alchornea cordfolia, and species of Urera, *Cissus, Dalbergia, Combretum, Afromomum* and *Megaphrynium*. Common weedy species include *Mimosa pudica,* Cdostus afer, Aspilia africana. Asystasia spp. And *Chromalaena odorata* (Edlupatorium).

3.2.4 Riparian Forest

These are closed stands of irregular structure, commonly found by stream banks. They are mature stands of trees with closed canopy and open undergrowth. Riparian forests vary in their width along with watercourse which they fringe a typical example exists around Obrikom pontoon crossing in the delta area.

Riparian forests are les complex than the lowland moist forests of the forest zone, but denser than similar woodlands in the savanna area. Characteristic tree species include Brachystegiacurcoma, *Cola laurifolia, Cleistophalis* patens, Cynometra vogelii, Irvingia grandifolia L Smithii, *Khaya grandifolioa*. K. *senegalensis*, Myrianthus seratus, Pterocarpus santandoides. Trichilia headelotii and Uapaca spp. The term kurmi is sometimes applied to fringing forests along streams in the savanna.

Riparian forest could play a major role in conservation, by serving as corridors interconnecting forest blocks for the passage and protection of wildlife.

3.2.5 Lowland Rainforest

The main block of the Nigerian forest formation at low and medium altitudes is called lowland rain forest. High human population densities have greatly transformed the complex structure and species richness of this vegetation type. Most of it has been converted into farmland, oil palm bush, and cocoa and cola plantations or, at best, degraded forest. Mature patches remain only in some forest reserves or as isolated sacred groves.

Using categories designated by the FAO (1981) the lowland rain forest is distributed in the forest zone as in Table 12.3

Table12.3: Distribution of Lowland Rain Forest in Nigeria

State	Land area (sq. km)	Lowland rain forest area (sq. km)	Forest area Converted to Farmland etc (sq. km)	Area of forest in forest reserves (sq. km)
Anambra	17,078.13	1,756.24	10,273.43	23.45
Edo and Delta	38,882.84	5,1796.86	14,865.65	3,964,14
Cross River & Akwa Ibom	27,214.15	10,345.33	9,353.18	5,140.64
Imo	11,534.42	479.70	9,328,23	3.13
Lagos	3,514.16	45.31	798.46	0.0
Ogun	17,179.69	2,209.37	8,735.97	1,196.69
Ondo	20,070.00	5,414.07	9,607.83	2,640.65
Oyo	36,892.29	1m501.59	834,38	953.17
Rivers and Balyesa	17,687.51	135,93	3m845, 31	150.01
Total	190,053.19	27,684,40	67,742.44	14,072.08

Source: Adapted F.A.O. 1981.

a) Forest mature, mature disturbed, immature, riparian and mosaic mature, disturbed/immature.

b) Forest areas converted to farmland (excluding swamps, oil palm, and rubber plantations).

On about 28,000 sq. km or 14.5 percent of the land area of the forest zone this type of vegetation covers States.

3.3 Savanna

Savanna occupies nearly 80 percent of the land surface of Nigeria, extending from about 6°N to the northern borders of the country. This is seasonal vegetation in which there is a closed or nearly closed cover of grasses at least 80 cm high with flat, usually cauline, leaves. Savanna is usually burnt annually and has various densities of trees and shrubs. On the basis of the density and proportion of woody species, savanna is usually distinguished into:

a) savanna woodland, with fairly closed canopy of trees and shrubs;
b) tree savanna, where the woody plants are scattered.
c) Shrub savanna, where trees are absent; and
d) Grass savanna, where woody plants are absent.

The various forms may exist side by side but tend to occur in varying proportions in the different zones into which savanna is subdivided. Keay's scheme is the basis for classifying savanna into zones from south northwards into

a) Derived savanna
b) Guinea savanna
c) Sudan savanna; and
d) Sahel savanna

The highlands in the zone bear distinctive grassland/tree vegetation types.

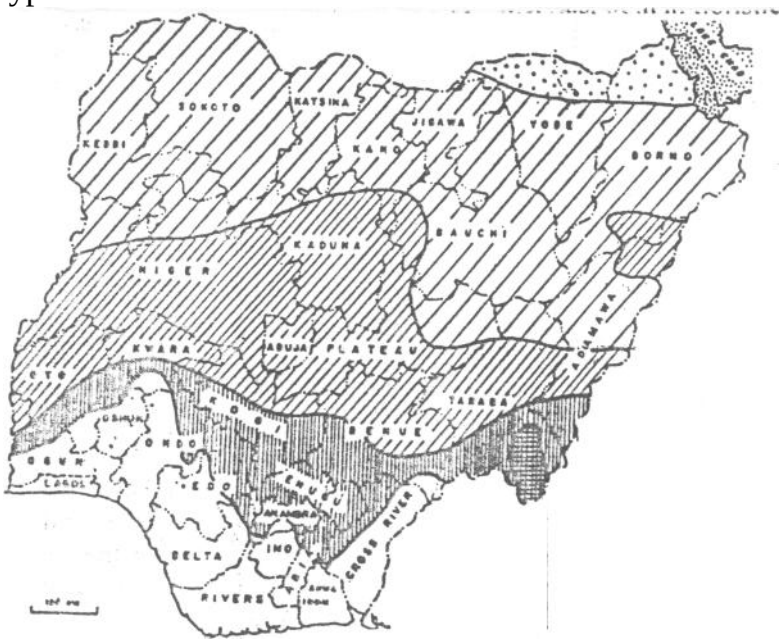

Figure 12.2 Savanna vegetation map of Nigeria

Source: adapted from Agabi et al (1997:46)

Derived Savanna

The transitional forest-savanna mosaid, occurring immediately north of the lowland rain forest belt, is called Derived Savanna. The Derived Savanna belt covers parts of Ogun, Oyo, Kwara, Edo and Delta, Anambra, Imo, Benue, Cross River and Gongola States, reaching 8°40'N in the east. It covers an area approximately 75,707 sq. km (about 8 percent of the country) being the widest (about 240 km) north of Okigwe. The dry season in this zone is about 3 months and means annual rainfall is 1,440 - 1,780 mm.

The vegetation of the zone is believed to have been derived from forest, through prolonged cultivation and annual burning. Fire-tender forest trees are replaced in the zone by fire-tolerant species, and the vegetation changes rapidly in character over short distances, such that low forest, dense woodlands and tickets alternative with open tree and grass savanna. The oil palm (*Elaeis guineenis*) is still abundant in this zone in which the typical savanna species are Daniellia olivery Vitex doniana, *Ficus capensiks*, *Lophira lanceolata*, and *Hymenocardia acida*. Relict forest species include Albizia spp, Cola spp, Milicia (Chlorophora) excelsa, Lonchocarpus spp. Colmbretum spp, and Dialium guinense. The dominant grasses in this belt are *Andropogon tectorum* (southern gamba grass) and Loudetia arundinacea.

Guinea Savanna

This is the most extensive vegetation zone in the country, covering 50 percent of the land area. It occurs immediately north of the Derived Savannah belt in the area where the dry season lasts 4 to 6 months and the annual rainfall varies from 1,020 to 1,520mm. The Guinea Savanna encompasses much of the thinly populated middle belt region. Recent developments indicate increased immigration of farmers, particularly operators of large scale mechanized farms, into the area and increased movement of incipient sedentarization of catle rearers, encouraged by government programmes of tse-tse eradication and demarcation of grazing reserves. In the southern parts, Daniellia olivery is a common tree while Androlpogon gayanus replaces A. tectorum as the major grass. Northwards, Afzelia afrcana and Isoberlinia spp. Replace Daniella as dominant trees, while Hyparrhenia spp., Andropogon spp., and Schizachyrium become co-dominant grasses. Guinea Savanna is thus sometimes divided into southern and northern zones, but on the bases of structure and species composition it may be grouped into:

a) mixed deciduous woodland, covering most of the Niger and Benue troughs;
b) Afzelia africana and semi-deciduous forest, around Abuja;
c) Isoberlinia savanna, around Kaduna and extending south westwards;
d) A patch of Burkea africanan savanna, north of the Kainji lake; and
e) Wooded savanna to the northeast of the zone. Sudan Savanna

This type of vegetation occurs, in the northernmost savanna belt in the country, covering a 250-km band running east to west. Mean annual rainfall is 510-1,140 mm, the dry season last 5 to 7 months. Increased seasonality and irregularity of rainfall impose semi-arid conditions on the zone. It is the belt currently being ravaged by desertification. There are extensive areas of seasonal swamps. The vegetation is typically mixed combretaceous woodland with Vitellaria paradoxa (formerly Butyrospermum paradoxum, shea butter), Acacia Senegal, Acacia albida, Zizyphuis, Adasonia digitata (baobab). The common grasses in this zone, Aristida, Brachuaria, Panicum, Chloris, Digitaria, and Eragrostis, are mostly short. Cultivations intense, and, together with heavy grazing, bush burning and cutting for fuel wood and browse, has contributed to extensive desertification in the zone.

Sahel Savanna

This exists in the northern part of Borno State. Here there is less than 500mm annual rainfall and the dry season lasts 7 to 8 months. The main vegetation layer consists of low-growing shrubs, mostly, Acacia spp. Angeisus leicocarpus, grass is dominant. The vegetation is sparse, the ground being bare and sandy under the short bushes.

4.0 CONCLUSION

In this Unit you have been introduced to the Nigerian terrestrial ecosystem. You should have learned about the different types of vegetation found in the Nigerian ecosystem and their types. You need to be aware that there is no difference(s) between global and Nigerian terrestrial ecosystems.

5.0 SUMMARY

What you have learned in this unit concerns the nature of the Nigerian vegetation and the different types of vegetation. It serves to introduce you to the Nigerian terrestrial ecosystem.

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UNIT 3 NIGERIAN AQUATIC ECOSYSTEM

CONTENTS

1.0 INTRODUCTION

If you remember, in Unit 3 of Module Two, we treated the global aquatic ecosystem. In that Unit, you learned about the ecosystem, factors limiting aquatic ecosystem as well as world's major types of ecosystems. You may want to ask why Nigerian aquatic ecosystem? What difference will exist between the global and Nigerian aquatic ecosystems?

Flowing from these two questions therefore, it is important to let you know that this unit is an attempt to repeat what you have learned in Unit 3 of Module 2. But to build upon the knowledge you learned previously in this course. Furthermore this unit is not intended to let you learn about difference(s) between global and Nigerian aquatic ecosystems. Rather, what you will learn in this unit is founded on what you have learned earlier in the course. Before going further, it is important for you to glean what you are expected to learn in this unit as specified in the Unit objectives below.

2.0 OBJECTIVES

At the completion of this Unit you should be able to:

- Describe the major types of aquatic ecosystem in Nigeria.
- Explain the extent and location of Nigeria's aquatic ecosystem.
- Explain the biological resources found in aquatic ecosystem.
- Illustrate the distribution of these biological resources.

3.0 MAIN CONTENT

3.1 Nigerian Wetlands

The Ramsar Convention of Wetland of International Importance defines wetlands as:

Areas of marsh, fen, pest land, or with water that is static or flowing, fresh, brackish or salty including areas of marine water the depth of which at low tide does not exceed six metres.

The vegetative components of wetlands are specially endowed with structural and functional attributes, which enable them to thrive in more or less continuously water logged, sometimes saline or acidic, soil conditions. Wetlands include marshes, swamps, floodplains, mudflats, estuarine and the littoral areas of large bodies of water.

Nigeria's wetlands fall into two broad categories, namely, the saline coastal mangrove swamps and the freshwater floodplains. The mangrove swamps cover 9,000 km2 in the six coastal states of Lagos, Ondo, Bendel, Rivers, Akwa lbom, and Cross River States.

Table3.1: Distribution and Extent of Nigerian Wetlands

Coastal Saline Wetlands (Mangrove Swamp)		Freshwater Wetlands (Flood Plains)	
Name.	Extent (ha)	Name	Extent (ha)
Niger Delta	617,000	Niger Delta	
		Niger River	1,177,000
Cross River Estuary	95,000	Benue River	242,000
Imo River and			
Qua lboe River	36,000	Cross River	250,000
Estuaries	110,000	Imo River	26,000
Others		Lake Chad	25,000
		Ogun/Oshun Rivers	380,000
Total	858,000		1,130,000

Source: Various

The non-saline wetlands, which are scattered throughout the country, are less precisely demarcated. Some of the important ones include the Hadejia-Nguru, (Baturiya), Lake Chad, Kamadugu Yobe, Kainji Lake, Adiani-Nguru, Margadu/Kabok, Kiri Kasama-Nguru, Sokoto-Rima, Ogun, Osun, Katsina Ala, Gongola, Imo and Cross River floodplains. Fig. 3.2 shows the distribution of wetlands in Nigeria.

The area extent of our wetlands is about 3 million ha. The coastal wetlands are the most extensive. They include the large lagoonal systems with mangrove swamps, raffia palm-pandanus swamps and reed swamps West of the Nigeria.

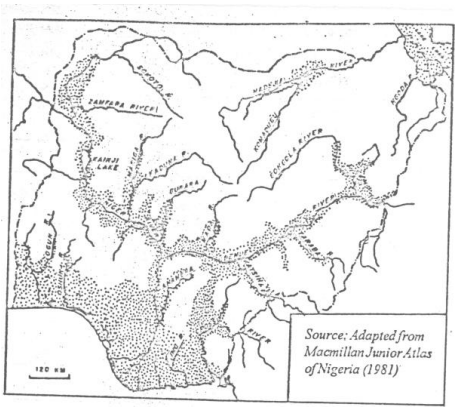

Fig. 3.1 Nigeria showing distribution of wetland

Source: Adapted from Macmillan Junior Atlas of Nigeria (1981)

3.1.1 Uses of Wetland in Nigeria

Nigerian wetlands offer multiple benefits, many of which are little appreciated. The many benefits of Nigerian wetlands are as follows:

a) The wetlands around the coast help reduce coastal erosion and stabilize estuaries flood plains.

b) Estuaries wetlands form important spawning grounds for fish, while the inland flood plains are very important for both indigenous wildlife and paleartic and Afro-tropical wildfowl.

c) It is also used for agriculture particularly the planting of rice in areas like Calabar, Oron, Warri and Oloibiri.

It should be noted that the Hadejia River system, a tributary of Lake Chad, is internationals noted for fisheries. Grazing, wildlife and water resources.

Why Are Nigeria's Wetlands of Major Importance?

Wetland areas of Nigeria include some of the most productive of the country's environments. They are a) The Baturiya (Hadejia-Nguru) Wetlands Game Reserve:

a) The Baturiya Wetlands Game

Reserve situated in the Hadejia River Valley in Kano State is 297 sq. kilometers. It contains the best-preserved piece of Sahelian woodland and is certainly one of the few remaining examples of this habitat in the Sahel. The area has been recommended as a candidate for the World Heritage List. At present, Baturiya is suffering from uncontrolled grazing by Fulani cattle and lopping of tree branches by the herdsmen. Furthermore, there has been no river flood in the area for two years due partly to reduced rainfall and the effect of drought, which has been aggravated by off-take of water upstream. Consequently, the Hadejia River has not been high enough to flood the Keffin Hausa, the branch of the river which runs through the reserve. In addition, sediment has been deposited by the Hadejia at the entrance to the Keffin Hausa, thus hindering the renewing of water supply to the reserve.

b) The Mardadu/Kabak Floodplain:

This area, approximately 100 square kilometers of marsh and oxbow lakes, is intensively used by the local population for fishing, grazing and

farming and supports a significant number of both migratory Pale arctic and Afro tropical water birds during the wet and early stages of the dry season. The importance of the wetlands in this area for both wildlife and human population makes their conservation a clear priority.

c) Kirikasama/Nguru Wetlands:

This area of floodplain, about 75 square kilometers, is dominated by a large ex-how lake, which, being the largest area of water in the region is of major importance throughout the dry season. The permanent nature of the lake gives it considerable importance as a dry season refuge for fish which can then repopulate and breed in the wet season inundation zone.

However, there is at present no control over fishing in any part of the river system, with the result that most fish stocks are very heavily exploited throughout the dry season.

c) Lake Chad Marches and Sambisa Game Reserve:

In January 1985, the water edge in the Nigerian section of the lake was 40 km nearer the center than in April 1984. The situation has deteriorated further and there is now virtually no water left. The causes are two-fold: the poor rainfall and the construction of dams on the inflow to the lake. Most of the inflow to Lake Chad comes from the Lagoons and Chad Rivers in Cameroon. Both now have major dams, which are being used for large-scale irrigation projects.If Lake Chad is ever to return to the Chad basin, the inflow in the Lagone, Chari and Hadejia Rivers needs to be reviewed and corrective measures taken. Whether this is possible will depend upon the extent to which the nations controlling the catchment area of the Lake (Cameroon, Nigeria and Chad) can be convinced of the need to view and manage the waters of the Chad basin as an international resource, and of the long term benefits of doing so.

d) The Niger Delta Area:

This vast oil-producing region of Nigeria, embracing at least three States - Bendel, Rivers and Imo and extending westward to Ondo and eastward to (Akwa Ibom and) Cross River, is by far the largest and most important wetlands area in the entire country. Oil activities, represented by oil spillage and pollution, are already spreading beyond the confines of the Delta Area into the Niger and up north. As a result of oil spillage, vast tracts of agricultural land have been laid waste, thus becoming unproductive. Surface water is invariably contaminated and polluted, rendering the water undrinkable; and aquatic life is destroyed. The

inhabitants of the area have become impoverished and deprived and are compelled to emigrate elsewhere.

Adopted from Nigerian Threatened Environment (NEST 1991:156)

3.2 Coastal Zone

The Nigerian coastal zone is not marked different from that which exists in the world. It is divided into mangrove swamps, freshwater bodies and estuaries.

3.2.1 Definition of the Nigerian Coastal Area

The Nigerian coastal area lies with in the Atlantic Ocean with its continental shelf, the Exclusive Economic Zone and the coastal fresh water and brackish wetlands ramified by an atomizing network of rivers and creeks. These water bodies are characterized by periodic tidal variations and ranges along water channels and the differences depend on the hydrological properties and the slopes of the various channels.

The Nigerian coastal area includes the area within the uppermost limit of tidal influence and the edge of the continental shelf (shelf break). It is bounded to the north by an extensive river (fresh water) flood plain. It is a low-lying area with heights not more than 3.5 in above sea level.

Onshore, the Nigerian Coastal Area is dominated by extensive stretches of sandy beaches (barrier islands) lagoons, estuaries, mud beaches, creeks and a deltaic complex.

3.2.2 The Nigerian Continental Shelf

The Nigerian continental shelf is mounted on a voluminous relatively localized protrusion into the Golf of Guinea ocean basin and consists of Tertiary sediments thickening seaward to a maximum of about 12,000m.

The continental shelf is narrow in the west and range in width from 28u - 33km. The width increases to 63 km off Cape Formoso at the nose of the Niger Delta, increasing eastwards to about 75km off Calabar.

According to Allen (1964), two series of later Quaternary sediments occur on the surface of the Nigerian continental shelf. The earlier series is quartzone sheet like sand bodies, which can be traced over most of the continental shelf. The older sand was deposited during late Pleistocene to early Holocene custatic rise of the sea (transgression of the sea). The surface of the sand sheet is formed into terraces and bridges parallel to the shore land crossed locally by shallow valleys with channeled floors.

These have been interpreted as drowned barrier beaches on island complexes.

The latter sediments, the Younger Suite, locally bury the Older-Sands on the continental shelf "They comprise sands near shore, silts in moderate depths and clays in deep water. They have been deposited during the seaward growth of the modern Niger Delta (Regression). River mouth bars and inshore terrace and rise are the principal morphological features of the modern continental shelf-underlain by Younger Suite.

Allen and Wells (1962) and Awosika (1990) described a system of dead Holocene coral banks in some parts of the middle and outer continental shelf. The dead coral banks, which run parallel to the coastline between 30 - 100 metres depth, attain heights of about 7m in some places especially along the western shelf.

Three major canyons: Avon, Mahin and Calabar deeply groove the Nigerian Continental shelf and slope.

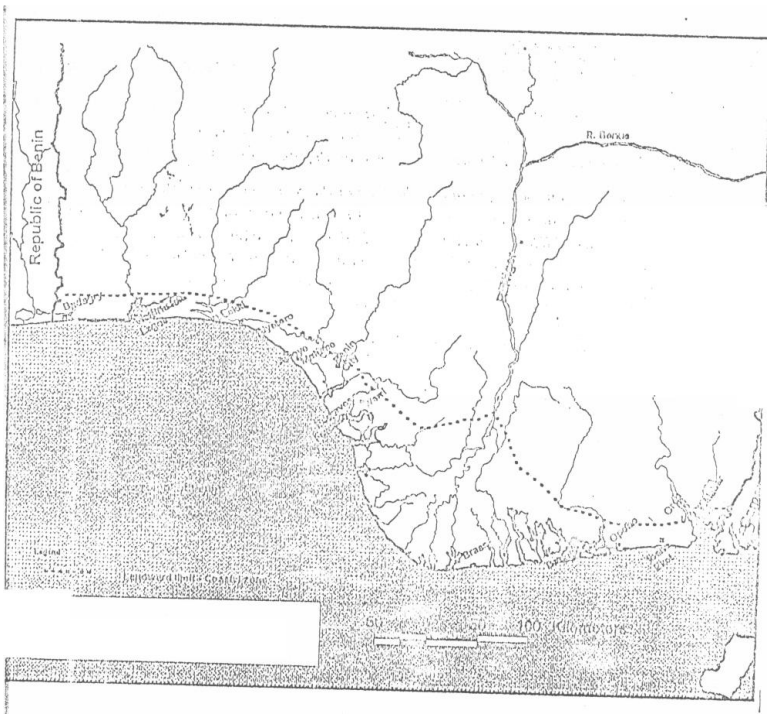

Figure 13.2 the Nigeria coastal zone and important coastal towns and settlements

The Avon Canyon (approx. 06°10°N, 03°55'E) is located off the Lagos coast with the head at about 3km off the coast in depths less than 18

metres of water. The Avon canyon is about 15 km wide and 730 acres deep.

The Mahin Canyon is located off the Mahin Mud Coast and at approximately (060°N, 080°E). It is smaller Avon Canyon and heads further from the coast in deeper waters at about 55 metres. The canyon is approximately 1.6 km wide and depth varies between 180-900 metres.

The Calabar Canyon is located eastwards off Calabar approximately 030°53°N, 080°l4°E. This canyon from the bays near the shelf by about 8 km, width is about 3 km and depth varies from 180 - 450 metres.

These canyons have been reported to serve as conduits for the channeling of sand into offshore submarine fans on the slope.

The overall nature of the Nigerian continental shelf is mainly depositional as compared to adjacent parts of the continental shelf along the Gulf of Guinea where Basement Complex rocks appear close to the coast

3.2.3 Mangrove Swamps

These are largely muddy and inhabitable occur south of freshwater swamps. The widest stretches of the mangrove swamps occur around Sapele, Warri and the Port-Harcourt-Abonema Areas, these swamps are bordered on the landward side by firm sedimentary rock of the coastal plain formation. Within this swamp may be found a number of fairly highlands, which are dry throughout the year. Soils of the swamps are rich in organic matter in the top layer, but contain too much salt, especially in dry season.

Note Below:

Refer to the diagram of showing the coastal vegetation of Nigeria in Unit 2.

3.2.4 Fresh Water Bodies

About half of the surface area of Nigeria, including all or most of Katsina, Kaduna, Niger Plateau, Kano, Oyo, Kwara, Ondo and Adamawa, is made up of ancient hard rocks into which water does not readily sink. Water in these areas is largely to be found at the surface of streams and rivers. The total amount of water flowing in the watercourses is unknown but is clearly very large.

However most of them, especially north of the Niger and the Benue are either ephemeral or seasonal.

To learn more about the Nigeria freshwater bodies, you are advised to flip back to Unit 1.

3.3 Biological Resources

3.3.1 Aquatic Flora and Fauna

The aquatic flora and fauna of the Nigerian Coastal Zone are well represented by numerous plants and animal communities. The flora consists of phytoplankton and macrophysics, while the fauna consists of zooplanktons, macrobenthos and invertebrates/vertebrates.

A total of ninety-one freshwater phytoplankton from the Nigerian Coastal Zone was recorded by RPI/NNPC in 1985. Predominant families include: Bacillarophyceac, Chlorophycene and Cyanophycene. The phytoplankton assemblage in the brackish waters varied with season. Densities and diversities are higher in the dry season. Dominant group include diatoms, a green and blue algae. The most common species of diatoms are: Coscinodiscus spp, Pleurosigma spp. Major zooplankton groups recorded in the Nigerian Coastal Zone include copepods, calanoids, amphipods, bivalve larvae, brachyuran larvae, rotifers. Coclenterates, gastroped larvae and natantia larvae and pods, bivalve larvae, brachyuran larvaed, rotifers. Coclenterates, gastropod larvae and natantia larvae and ostracods.

Dense macrophytic communities occur in many of the water bodies' especially non-flowing waters. In flowing rivers, submerged and free-floating forms are restricted to back waters. The submerged portion of aquatic macrophytes supports a large variety of insects and worm species. Principal macrophytes in the freshwater zone include water lettuce (Pistia sp), the hornwort Ceratophyllum spp,. Bladderwort - Ultricularia spp, and water hyacinth - Eichnornia crassipes, Azolla africana, Typical rooted aquatics include Nymphaca lotus and Vossia Cuspidata.

The benthic macrofauna consists of important groups such as; oysters, brachiotoma, bloody cockle (Senilia supp), molluscs, crustaccans and polychactes.

3.2.2 Forest Resources

Many forest resources are located within the Nigerian Coastal Area and are located mainly in Ondo, Edo, Delta, Bayelsa, Rivers and Cross River States. The forests are extensive and often regarded as inexhaustible with the result that little attention is given to conserving this resource.

Logging, farming, particularly of the bush-fallow/land rotation type associated with bush burning have reduced the true forest area considerably. Forest reserves occupy about 2.4 million ha or about 10% of the forest land area (NEST 1991). Some of the forest resources include timber trees such as; mahoagany (*Khaya spp, Entandrophagma spp),* obeche *(Triplochiton spp),* afara *(Terminalia spp, iroko Chlorophoral Milicia),* African walnut *(Lovoa),* abura *(Mitragyna ciliala) and mansonia*.

Other important forest resources include species that yield spices (*Xylopia, Piper, Dennettia, Tetrapleura*), leaves, barks, roots and fruits that play vital roles in rural cultures particularly in the ethno medicine and nutrition.

3.3.3 Mangrove Resources

Nigeria has the largest mangrove forest in Africa. It covers an area of about 9,723 km2 forming a vegetative band of 15 - 45 km wide above the barrier islands and running parallel to the coastline. About 305 km2 of the mangrove forest are in reserves.

The Nigerian mangrove resources are dominated by the red mangroves (*Rhizophoraccae)* in association with white mangroves (*Avicenneacene*).

The red mangrove Rhizophora racemosa is the most common species, covering over 90% of the area and can grow to a height of 45m in under favourable conditions. It is the pioneer species, and is followed by R. *harrisonii* and R. mangle as the land gets drier and salinity deceases. *Avieennia spp*, a smaller true than *Rhizophora spp*, grows singly on firm land.

The mangrove forest is a source of timber and due to its high thermal capacity; it is widely used as fuel for firing small-scale industrial boilers. The red mangrove *Rhizophora racemosa* is the most exploited species and is used for firewood, poles and timber. The numerous roots as well as stumps are used locally for the preparation of salt. The bark of the tree provides a cheap source of tannin for dyeing cloths and leather. The mangroves provide breeding and nursery grounds for many

commercially important species of fish and shellfish. The tilt roots of the mangroves and mud surface usually support a varied fauna of oysters, crabs and other invertebrates. Table 4 shows the distribution of mangrove forest in the Nigerian Coastal Area.

Table3. 4: Distribution of Mangrove Forest in the Nigerian Coastal Area (NEST 1991)

State	Area of Mangrove (Km 2)	Mangrove in Forest Reserve (Km 2)
Lagos	42.20	3.13
Ogun	12.18	-
Ondo	40.62	-
Edo-Delta	3,470.32	143.75
Rivers/Bayelsa	5,435.96	90.62
Cross River/Akwa Ibom	721.86	304.69
TOTAL	9,723.14	304.69

4.0 CONCLUSION

What you have learned in this Unit concerns the Nigeria aquatic ecosystems. You also learn about the Nigerian Wetlands and its uses, the coastal zone and the biological resources peculiar to the Nigerian aquatic ecosystem.

5.0 SUMMARY

This Unit has exposed you to an in-depth study of the Nigeria aquatic ecosystems. As the unit sought to expose you to the types of the Nigeria ecosystem; it also sought adequately give you insight into the biological resources found within the Nigerian aquatic ecosystem.

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UNIT 4 FLORA AND FAUNA IN THE NIGERIAN ECOSYSTEM

CONTENTS

1.0 INTRODUCTION

In Units twelve and thirteen we look at the Nigerian terrestrial and aquatic ecosystems. The ideas in this unit are derived from the two earlier units. Based on what you have learned so far about the Nigerian ecosystem. It is necessary for you to learn about the constituents of these ecosystems. This knowledge important because it is expected to consolidate your learning so far. In this unit, we are going to study the flora and fauna found in the Nigeria ecosystem.

2.0 OBJECTIVES

At the completion of this unit, you should be able to

- Explain what flora and fauna are
- Describe the types of flora and fauna found in the Nigerian Ecosystem
- Describe the fauna and flora found in Nigerian ecosystem.

3.0 MAIN CONTENT

3.1 What are Flora and Fauna?

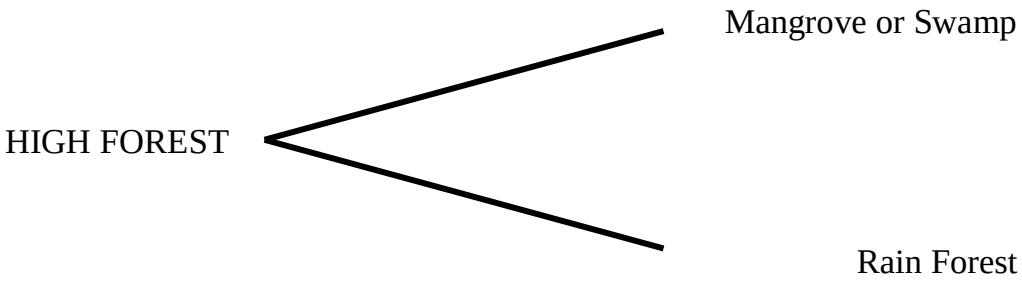
Fauna are animals occupying a special environment, locality, region or period of time. As a scientific usage, as `avifauna' to mean collective bird fauna, thus zoologist may speak of the microbial fauna of the intestines or the avifauna. In geology and paleontology, `fauna' is used

to refer to all the animals or their fossil remains of a given region and geological period or stratum as Miocene of India. The term fauna is used to denote a systematic report on the animals of a given region. Flora denotes the plants in environment locality, region and period of time. Flora can thus be described as the total assemblage of vegetation in a region, environment or locality.

3.2 Types of Flora in Nigerian Ecosystems

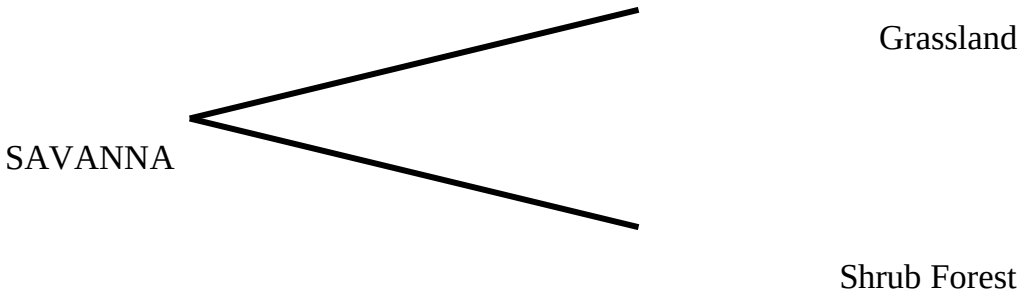
The types of vegetation found in Nigeria can be divided into two - the high forest zone, which covers one sixth of the country and savanna. For the purpose of description, these two types of vegetation can further be subdivided. The high forest can be divided into mangroves or swamp and rain forest.

e.g.



And the savanna into grasslands and shrub forest.

e.g.



Unfortunately the high forest zone has undergone developmental disturbances to the extent that the size of the virgin forest has been reduced tremendously. The rainforest, which was opened up; through the farming activities initially is being daily cleaned for building roads

and cities among others. The swamp, which hitherto was a no-go area because of the high condition of the area, has been opened up through the activities of oil exploration. The Nigerian rainforest zone is rich in latex producing rubber tress, coconut palm trees and cocoa trees.

Also present in the forest are several trees, which can be harvested for planks such as iroko, opepe, African walnut, obeche and red camwood. These trees are more than 61 metres high with a clear bole length of 30.5 metres or more. Trees more than 2.438 metres are not uncommon.

The distribution of commercial species ranges from saltwater mangrove to dry savanna zone mahogany. Among these species are found timbers used for various purposes, such as pharmacy, boat and shipbuilding, railway sleepers and marine application.

3.3 Fauna of Nigerian Ecosystem

The life forms found within the ecosystem are generally native to each of the different types of ecosystems and their sub-divisions. For example different kinds of animals accommodate themselves to the wide variations of habitats. Also found are different types of birds and insects, fishes and aquatic animals. The fauna of Nigeria ecosystems are an interesting study.

3.3.1 Birds and Insects

For the ornithologist, Nigeria has an extensive variety of Birdlife. There is also an almost inexhaustible area of exploration in the forest and bush for the entomologists in search of butterflies, moth, beetles and other forms of insects' life.

3.3.2 Fauna of the Creeks and Mangroves

Amphibious vertebrates like the toad, frogs, river turtles, crocodiles, hippopotamus, water snakes and other marine and lagoon animals can be found in the creeks and mangrove area of Nigeria. Crabs like the sand-crabs, crabs, hermit crabs and the hairy mangrove crabs are also found in these areas. The fauna of these areas include different types of shore-birds which depend on sea animals for their food. These seabirds are general of the wader type, which has long legs for paddling at the edge of the waves and long bills for probing the sand or mud for their prey. Examples of these are the common sand pipers and the whimbrels.

3.3.3 Fauna of the Rainforest

Tree and ground dwelling animals can easily be found in the Nigerian rain forest. Among such animals are monkeys, chimpanzees, antelopes, leopards and elephants. Others include, rodents like rats and squirrels, geckos, chameleons, and fruit bats also belong to this area. Reptiles include monitors-lizard and different types of snakes. Among the ants for the rain forest as the soldier ants, which are very ferocious and nomadic in nature and often, organize themselves into marching columns for hunting expeditions.

The birds of the Nigerian rain forest include the crested guinea fowls, hawks, ground horn-bills, green fruit pigeons, West African touraco, the African grey parrot and the wood-owls.

3.3.4 Fauna of the Savanna

The savanna areas of Nigeria abound in grass eaters, runners, hoppers and such types of animals. Large herbivores, mainly ungulates and small rodents like rats, squirrels and hares occur in large numbers and varieties.

The savanna ungulates include the desert hyenas, hunting dogs, bush cows, antelopes, horses, camels, lions, leopards and gazelles. This area also abounds in different types of monkeys, cows, goats, rams and sheep. Invertebrates in the area include spiders, scorpions, grasshoppers, termites and ants. Among the birds are the seed and insect eaters like the grey horn-bills, the cattle egret, common vulture, West African black kite, common bush fowls, owls, woodpeckers, piece crows, West African crowned cranes, parrots, weaver birds and the ostrich.

The Mangrove Swamps

The rainforest ecosystem can be divided into mangrove swamps and the rainforest swamp, the mangrove swamps which are largely muddy and uninhabitable, occur South of the freshwater swamps. Elsewhere, but particularly in the Sapele-Warri and the Port Harcourt - Abonnema areas where the widest stretches of the mangrove swamps occur, these swamps are bordered on the land 1 ward side by firm sedimentary rock of the coastal plain formation not by freshwater swamps. There are about 10,360 sq. km of mangrove swamps in the delta. Fig. 3.1 below shows the coastal vegetation of Nigeria. Within this swamp may be found a number of fairly high lands, which are dry throughout the year.

4.0 CONCLUSION

In this Unit, you have learned about the various vegetation (flora) types and fauna (life forms) types found in the Nigerian ecosystem. Furthermore you should have learned where each type of fauna and Flora are commonly found. You need to be aware that the types of the terrestrial or aquatic ecosystem determine the flora or fauna found in each region.

5.0 SUMMARY

What you have learned in this Unit concerns the types of Flora and fauna found in the Nigerian ecosystems. It has served to enlighten on the web of life that is found within our environment and their importance.

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UNIT 5 THREATS OF NIGERIAN ECOSYSTEMS

CONTENTS

1.0 INTRODUCTION

You have read the four previous Units of this module. If so, you will discover that we have focused on the Nigerian ecosystems. In this Unit we shall consider those activities that amounts to threats or capable of threatening the Nigerian ecosystem. You will discover that your study of the Nigerian ecosystem will be in complete without the study of those threats on the various types of ecosystems. Let us look at what you should learn in this unit, as specified in the Unit objectives below:

2.0 OBJECTIVES

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

- Explain threat elements.
- Identify the types of threat factors.
- Describe the threat factors.

3.0 MAIN CONTENT

3.1 Nature of Threats of Elements

The last two decades have witnessed a number of serious ecological problems, purposefully and advertently by humans. As you learned in the earlier Units, the ecological system is a set of interacting,

interdependent living (organic or biotic) and non-living (abiotic) components or sub systems.

Catastrophic changes on the landscape leading to wholesale degradation of the ecosystem are proceeding unabated throughout the country. These charges are fast destroying the ecosystems in the country. You need to know that human activities are largely responsible for these threats to the Nigerian ecosystems. The threads ranges from man induced land degradation and environmental change to agriculture and toxic wastes.

3.2 Factors in Nigerian Ecosystem

The general warming of the earth's environmental systems is accomplished by a variety of mutually interacting forces. The components of these agents of threat elements include among others divagation, coastal erosion, savanatisation, desertification, overgrazing population and urbanization.

3.2.1 Devegetation

Also popularly known as deforestation, a narrow and restrictive term devegetation has two major functional components. One is mass destruction and more or less total removal of the plant cover as hand is cleared for agriculture settlement, highway construction and so forth. 'The latter occurring chiefly through vegetation burning in the dry season and also through overgrazing has been largely responsible for the conversion of vast tracts of forests into derived savanna, equally referred to as the forest-savanna mosaic, which takes up about seven per cent of the area of Nigeria.

3.2.2 Coastal Erosion

a) Just as inland wind and rainfall peel off the soil and excoriate the land, so also along the shore of Nigeria, the land is eroded, in some locations very badly. Coastal erosion occurs in practically all the states fronting the Atlantic Ocean from Cross River State in the Far East to Lagos in the extreme west. Assisted by the movement of boats and ships, sea waves and other water currents all the time attack the shore.

   Portions of the land together with any human structure or vegetation thereon are torn off and washed into the sea. It is estimated that in parts of Rivers and Delta States where coastal erosion is strongest, the shoreline recedes by well above three metres every year.

b) Soil Erosion: Soil erosion or the removal of top soil chiefly by running water and wind is easily the single most important type of land degradation in Nigeria. Practically all parts of the country are directly affected: the Northern quarter, or some 231,000 km mainly by wind erosion and the Southern three-fourths (693,00 km2) by rainfall runoffs. Soil erosion is of three types: sheet erosion, rill erosion, and gully erosion. Although not so ready perceptible to the average person, sheet erosion, nonetheless removes vast tonnages of surface soil every year. Soil removal occurs primarily during the rains between May and October and secondarily in Northern Nigeria by wind during the dry season.

It is greatly aided, and sometimes is even sparked off, by many human activities like vegetation burning, land clearing for various purposes, road construction, agricultural tillage, etc. Hence bare land, cultivated fields, and poorly vegetated terrain are often badly devastated by erosion.

3.2.3 Overgrazing

Extensive livestock rearing primarily cattle grazing takes place in the drier Northern part of Nigeria. This is largely because the more southerly segment has a higher humidity level combined with more close vegetation structured that is an ideal habitat for the tsetse fly which transmits a major cattle disease called tripanosomiasis. All too often, unfortunately, the size of cattle herds is so large, the demand for farming space by cultivators is so keen, the dry season is so severe and the number of available nearby watering points is so small that a tremendous amount of overgrazing takes place.

This scenario encompasses a wide swath of territory from Borno State Westwards all the way to Sokoto State. What the cattle do not consume, the sheep and goats, ever in tow quickly gobble up and what escapes their jaw is trampled into the mud, said or dust by millions of hooves. Not only is vegetation re-growth thus severely discouraged but also the soil is compacted and is essentially laid bare for the natural agents of erosion, namely, water and wind. (NEST, 1992).

3.2.4 Desertification

This is the process where lands bordering true deserts are gradually reduced to desert-like conditions. Areas prone to desertification include the scrublands and where short rainy season and prolonged dry season is responsible for these conditions. The delicate balance in the ecosystems

of these dry lands is responsible for plants being unable to survive, which eventually leads to desertification. This in turn affects the sparse vegetal cover and reduces the thin soil underneath which are subject to erosion by wind and intense infrequent rainfall.

The cause of desertification is the negative effect on vegetal cover as a result of inappropriate farming practices like over-cropping on soils that sooner or later become exhausted. Overgrazing of cattle, bush burning and the cutting down of trees for fire are some of the pressures, which humans have brought to bear on delicate soils. The effects of desertification are that such land no longer supports the basic farming economies of the indigenous population. This in turn would aggravate famine and force migration and other related social implication that goes beyond the immediate environment. The impact of this kind of forced migration has taken place in the Sahel region of West Africa where limited supplies of food had forced Niger and Sudan nationals to Nigeria.

3.2.5 Human Activities

One of the most important economic activities in the world is agriculture. About two-thirds of the world's populations are engaged in it. And it supplies us with the primary products we find necessary for life like: Foodstuffs such as vegetables, meat, cereal and other dairy products. Others include beverages like coffee, cocoa and tea and; Industrial raw materials like hides, rubber, and wool land vegetable oils.

As agriculture has become more complex, more extensive and more demanding on the land. So has there been a striking increase in the environmental and socioeconomic problems associated with it. Some aspects of the on-going threat on the Nigerian ecosystem include human activities such as agriculture, energy production and consumption, industries, services and tertiary trade. Others are internationals trade and dumping of toxic waste materials and the challenge to biodiversity.

3.3 Threats to the Nigerian Wetlands

The general impression is that wetlands or marshlands are useless and unproductive. But studies have, however, shown that they are ecologically very important habitats for wildlife. Nigerian loses several hectares of wetlands to development projects annually. Construction firms and industries have converted wetlands into dumpsites. Our wetlands must be saved from wanton reclamation, dredging and cutting off water source by construction firms.

Illegal and improper sand filling, dredging and reclamation of swamps is destructive to the environment. In most cases, poor road construction has often led to the silting and disappearance of large portions of wetlands in the Niger Delta in the last 25 years. Sand filling of swamps lead to the eventual death of both plants and animals that depend on the peculiar ecological system for survival.

One other concern to environmentalist is the increasing pollution of wetlands with industrial and domestic wastes. Untreated wastes from industries and factories are freely discharged into the swamps.

The most deadly and serious threat to the wetlands ecosystem is oil exploration and spillage activities. Frequent oil spills or haphazard cleaning exercise have done great damage to wetlands. The laying of oil and gas pipelines is also harmful to wetlands or marshlands.

Increasing evidence in many communities show that wetlands are not only being polluted but also disappearing. The disappearance of some plant species such as the tall or red mangroves and the appearance of nips palm and dwarf or white mangroves are linked to the phenomena. The growing scarcity of and gradual disappearance of oysters, crabs, periwinkle and other molluscs have also been linked to the destruction and pollution of these marchlands.

Threats in Nigeria's Wetland

Chief threats to wetland species diversity include over-fishing, pollution, drainage, reclamation, increasing variability of flow, siltation due to watershed, deforestation, and diversion for irrigation and damming for flood control and electricity generation.

Wetlands drainage is probably the most important and certainly the most evident of the many threats in the industrial world.

Rivers and wetlands have traditionally been used as disposal sites for industrial and domestic waste. But, increasingly, water draining from agricultural land into lakes and rivers now carries with it pesticides and fertilizers which lead to eutrophication, the process by which nutrient levels are greatly increased and which results in excessive algal growth.

This leads to depletion of the oxygen content of water and mortality of aquatic life. With increased use of fertilizers, problem of eutrophication, seen in Europe will in a warm tropical climate, be severely aggravated. Furthermore, DDT, now banned in most industrialized nations is widely

used in developing countries like Nigeria with devastating effects on fish populations a major source of protein in these countries.

The construction of dams and irrigation systems in a bid to increase food output all too frequently destroys wetlands and so the productivity upon which the expectations of these developments are based. As dams are built to provide irrigation water, the consequence upon the natural resources further downstream and the people dependent upon these can be catastrophic. Following the construction of the Aswan High Dam on the Nile. For example the silt load carried by the river is now deposited in the lake itself and no longer provides an annual fertilization of Delta lands. Agricultures in the Delta now require the increased use of fertilizer.

Since the benefits we obtain from wetland habitats are many and varied, it is imperative that a major effort be made to ensure the continued existence of a sufficient number of diversity of wetland throughout the country in order that we may continue to obtain these benefits.

Adapted from Nigerian Conservation Foundation Press Release. September 17, 1985.

3.4 Threats to the Savanna Ecosystem

The problems of the Savanna ecosystem are many and varied. About 70 percent of the Savanna ecosystem is use das rangeland and about 23-30 percent for farming. Irrigation system may be helping to expand farmlands but there has been a general deterioration of the natural resource base in the Savanna Ecosystem, as a result of abuse and overuse of the land.

Increasing population on the land means intensive cropping and short period of fallow. This in turn will affect the amount of organic matter in the soil and would increase soil acidity and deficiency of potassium in the soil.

Large amounts of nutrients are usually lost from farmlands where soil organic matter has been depleted and the surface is uncovered. Where the soil loses fertility, farmland will be abandoned because there will be little or no vegetation left and the soil will be subjected to water and wind erosion.

Drought is an inevitable part of the climate of the arid and semi-arid areas of Nigeria. However, overgrazing, deforestation, bush burning and general environmental misuse, which have helped to create desert-like

conditions in some parts of the Northern States, are by no means inevitable. Whether or not drought becomes an environmental; problem depends on how people have been managing their environments before it occurs.

4.0 CONCLUSION

In this Unit you have learned about the different threats, which affects the Nigerian ecosystem. You need also be aware that those threats are largely propelled by consequences of human activities on earth.

5.0 SUMMARY

What you have learned in this unit concerns the nature of threat, the threat elements, threats of Nigerian wetlands and savanna ecosystems.

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MODULE 4

UNIT 1 SYSTEMS APPROACH TO ECOSYSTEM STABILITY AND INSTABILITY

CONTENTS

1.0 INTRODUCTION

It is our belief that you learned a lot in Module One, Two, and Three. Meanwhile it is important to let you know that the ecosystem as fragile as it is cannot cope with some stress being brought to bear on it. When the ecosystem succumbs to this stress it can generate and instability in the system. In this therefore you will exposed to the nature of stable ecosystem. The Unit guides through how the ecosystems respond to the various stresses. Before, we go into the Unit, it is important for you to see what you are supposed to learn at the end of this Unit as stated in the objectives below.

2.0 OBJECTIVES

At the end of this unit you should be able to

- Explain what you understand by ecosystem stability
- Describe ecosystem instability
- Discuss the factor capable of causing instability.

3.0 MAIN CONTENT

3.1 Concept of Ecosystem Stability

The concept of ecosystem has provoked much debate, is still not fully resolved, and has an inadequate terminology (Hill 1987). The ecosystem stability has been applied in recent times to development, at local, regional and global scales. Stability is in large part a function of sensitivity and resilience to change.

Sensitivity therefore may be defined as the degree to which an ecosystem undergoes change or a consequence of natural or human actions or a combination of both (Barrow 1993). Resilience on the other hand, may be used to refer to the way in which ecosystem can withstand change. In a stable ecosystem each species will have found a position, primarily in relation to its functional need, food and shelter. Furthermore ecosystem stability, the more variety of organisms there are ecosystem, the less likely is there to be instability. You must understand that regardless of diversity, some change is still possible. We can then say that as much as diversity help to stabilize the ecosystem, it is not capable of it guarantee.

3.2 Ecological Stability and Succession

It is widely held that, given long enough, a steady state will be reached by an ecosystem with a web of relationships that allows it to adjust to serious localized or moderate disturbances (Park, 1980:99). The ecosystem should remain in such a steady state unless a critical parameter alters it sufficiently: If change then occurs it is termed ecological succession or biotic development (Barrow, 1993).

There are two types of successions

1) Primary Succession
2) Secondary Succession

3.2.1 Primary Succession

This is the sequential development of biotic communities from a bare lifeless area (such as the site of fire and volcanic ash).

3.2.2. Secondary Succession

This is the sequential development of biotic communities from an area where the environment has been altered but has not had all life destroyed such as forest and abandoned farmland.

3.3 What is System Theory?

Physical scientists tend to try to treat social and physical processes as interacting pacts of an ecosystem. Social scientists tend to consider humans or acting within an environmental, political and economic structure which contains their actions in the short term but which can be changed or modified in time (Mannion and Browlby 1992:4).

According to system theory, changes in one component of a system will promote changes in other, possibly all, components as in the case for ecosystems (Barrow 1993).

As subsystem may interact in different ways the ecosystem approach is essentially holistic. Regulatory mechanisms of checks and balances (positive and negative feedbacks) counter charges within and outside the ecosystem (e.g. climatic changes) tending to maintain the steady state. Increasingly humans have upset the regulating mechanisms checks and balances of natural ecosystems.

3.4 What is Ecosystem Instability?

An ecosystem is said to be unstable when disturbed, it may be close to a starting point or it could be undergoing cyclic, more less constant or erratic change. Also when an erratic change. Also when an ecosystem is not resilient it can be described as an unstable ecosystem. Return to a pre-disturbance state is therefore uncertain.

3.5 Effects of Ecosystem Instability

The behaviour of an ecosystem (physical or human) can be modeled; however there is often such complexity that outcome is difficult to reliably predict with simple analysis. When an ecosystem is said to be unstable and it has cost all the resilience sensitivity. Chaos and catastrophes is challenged. Ultimately the resultant effect of such instability is what is known as ecosystem cascades. For example, ecosystem collapse in North Sea and Northeast Atlantic caused deaths and breeding failure of sea birds. Another common cascade impact is due to over enrichment of nutrients in seas and lakes. The abundant

supply can cause a switch form a diverse community to one dominated by a few species able to thrive on the enrichment.

4.0 CONCLUSION

In this Unit you have learned about the ability of the ecosystem to respond to stress whether natural or human induced. Furthermore you have learned how systems theory is employed to understand the ecosystem stability and instability.

5.0 SUMMARY

What you have learned in this Unit concerns the stability and instability of the ecosystems. It has served to expose to the stress and crisis in the ecosystem.

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UNIT 2 HUMAN IMPACTS ON TERRESTRIAL ECOSYSTEMS

CONTENTS

1.0 INTRODUCTION

In Units 6 and 7 we focused on the terrestrial ecosystems. Our concern was how the terrestrial ecosystems came to be. We equally study the different types of terrestrial ecosystems. What you will learn in this Unit is about the impacts of humans on the terrestrial ecosystem. Before we go through the objectives presented below to know what are you expected to learn in this Unit.

2.0 OBJECTIVES

At the end of the Unit you should be able to:

- List and explain the various impacts of humans on the terrestrial ecosystems.
- Relate your understanding to your immediate environment.

3.0 MAIN CONTENT

3.1 Natural Environments

Over much of the world vegetation would be forest, except where conditions are too cold or too arid. These natural forests are now greatly reduced in areas, either by felling or by the prevention regeneration through five or grazing (Grant 1995). The largest areas of natural vegetation are probably in those areas that are inhospitable to humans or their domestic animals such as deserts and tundra. Except where there is

no human population, it can be difficult to determine which habitats are truly undisturbed (Grant, 1995). Researchers and environmental managers argue that what we refer to, as natural environment today are not in the true sense natural. For example, the grasslands were seen as the effect of impacts of the humans on the forests.

3.2 Sub-natural Environments

A sub-natural environment is the type where human interference has not been able to alter significantly the structure of the vegetation. In this sense, a sub-natural environment will be created after the first clearance, the vegetation is allowed to regenerate and maintain its altered vegetation. See the example cited in 3.1 above.

3.3 Semi-natural Environment

Literally speaking, semi-natural environments that is not natural and has gone beyond the sub-natural environment. In semi natural environment, human interference has been able to significantly alter the structure of vegetation. The main point in this type of environment is that there is no intentional alteration of species occurs there spontaneously (Grant, 1955). Human interference through deforestation is responsible for the creation of semi natural environments. Of note is the bush burning, which occurs on continuous scale thus, destroying the natural vegetation to give rise to grasslands? Overgrazing is another human impact, which tends to alter permanently the vegetation in an environment. As much as possible, it need be stated that while some semi-natural environment can support plenty of plants and animal species, some may just only support few plants and animal species. Such semi-natural environment has been discovered to have regenerated on impoverished soils. According to Grant (1995) human interference through forest clearance has been noted to be a very effective agent in the creation of semi natural environment.

Consequently today, it is estimated a natural forest the size of a football field is being destroyed every minute in the world.

3.4 Cultural Environment

This category covers artificial systems, such as arable land, in which the vegetation type is deliberately determined by human. This involves the loss of a previous habitat, which may be natural, sub-natural or semi-natural. The new system usually has fewer species of plants than the system it replaces in consequence, is likely to have less rich Fauna (Grant, 1995). In its extreme form this involves the creation of arrears

dominated by a single species of plant. The fauna of such environments may be further impoverished by the use of their chemical pesticides to control pests.

3.5 Species Extinction

Another consequence of human activities are species extinction. Large scale habitat destruction will lead to local elimination of plant species and animals which depends upon those plants for their existence species extinction have failed to cease even when small reserves of the habitat are left undisturbed. The extinction at this level will result from lower population of species.Unit is so because the small can only support few lower animals or larger animals. The small population will not have species diversity and will have characteristically low genetic diversity of species extinction can also occur where a particular species or endemic to an area or habitat. Such species will go into extinction once the habitat is disturbed. Example of this is the White throated monkey in Delta area in Nigeria, where habitat is severely reduced. The danger here is local extinction can still lead to total species extinction. Beside, ground scale habitat destruction, hunting of large animals and birds has contributed seriously to species extinction.

3.6 Species Introduction

Species introduction occurs as a result of exotic plants or animals from other geographical areas. There introduced species than either out compete native species, or, in the cased of animals introduction eat or overgraze them (Grant 1995). The influence of the introduction of exotic animals is particularly clearly demonstrated by examples on Islands where species introductions have taken place in historical times, as such events are often well documented (Grant, 1995). Due to the fact that many Island lack large predators, so that introduction of a predator from elsewhere can have severe effects flightless and ground-nesting birds are particularly vulnerable. There have also been extinctions of species as a result of predatory specie which were introduced to control pests e.g. grant African snail Achatina folic predated other snail species. Introduced species also have deleterious effects on plants.

4.0 CONCLUSION

In this Unit, you have learned a number of issues that results from the effects of human impacts on the terrestrial ecosystems. You should have also learned that as a result of human actions the vegetation of which much of the earth has been altered and many species have also become extinct. You need to be aware that it is certainly true that increased

technological development and exponentially increasing human population have enabled our species to degrade the environment at a much greater rate in the last few centuries than previously.

5.0 SUMMARY

What you have learned in this unit concerns anthropogenic changes in terrestrial ecosystems for individual species. It has exposed to human impacts on the vegetation and its consequences. It has served to introduce you the consequences of ecosystems destruction the units that follow shall build upon this introduction.

SELF ASSESSMENT EXERCISE

1. List and explain the factors resulting from human impacts on terrestrial ecosystems.
2. Enumerate the threat elements in the Nigerian ecosystems

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UNIT 3 CONCEPT, MEANING AND CRISIS OF ECOSYSTEM MANAGEMENT

CONTENTS

1.0 INTRODUCTION

By now you should have learned a lot abrupt the ecosystem as well as the crisis within the ecosystem. It will interest you that it is not enough to learn this crisis. What is more important is the management of the disturbance within the ecosystem. This is important given the fact that survivability of humans on earth greatly depend on the ecosystem. Therefore focus must shift towards ecosystem care. In this Unit, what you learn will serve to introduce to the basic issues in ecosystem management. Before we do this, let us see what you are expected to learn in this Unit as stated below in the objectives.

2.0 OBJECTIVES

At the end of this Unit you should be able to:

- Define ecosystem
- Explain the concept of Ecosystem Management based on the Fundamental of Ecosystem Management.
- Identify and discuss the crisis of exploitations of the ecosystem.

3.0 MAIN CONTENT

3.1 Concept of Ecosystem Management

The management of the ecosystem can be understood from the realization of that, the global ecosystem is under the threat of humans. This threat by humans has brought to the fore the uncomfortable consequences of overuse or abuse of the natural world. Ecosystem management is management of natural resources. This type of management is concerned with the management of land and other renewable resources and may be described as a process of decision making, whereby resources are allocated after consideration of environmental economic and cultural aspects. (Omara-Ogungu, 1992:5).

3.2 What is Ecosystem Management

Ecosystem management according to Barkham (1995) is more than safeguarding a handful of isolated remnants of natural plants and animal communities or looking after newly created ones. Ecosystem management is also more than a series of approaches and techniques to produce particular desired outcome (Barkham 1999). Flowing from Barkham (1995) argument, ecosystem management may be defined as the holistic approaches and techniques aimed at safeguarding the natural world by correcting human consciousness and individual survival sense at whatever cost, for the benefit of future generation. Ecosystem management can also be described as good intentions for necessary action that will generate sustainable development.

Given the dependency of humans on the ecosystem, it is an escapable fact that humans cannot exist without ecosystem.

3.3 Exploitation and Its Consequences for Ecosystems

The word exploitation means to employ to the greatest possible advantage, to turn to maximum commercial advantage or to make use of, selfishly or unethically (Barkham 1995). By all means, this definition of exploitation implies that we can use any resources without bothering about its limits. This thought is anchored on three stead's namely,

1) Economic crisis
2) Attitude Outlook
3) Short term and self interest

3.3.1 Economic Crisis

This situation is attained if management of species is based on solely upon market forces, rather upon a flexible and regulated response to sustainable yield; the population may become extinct (Barkham 1995). (See Diagram 3.1).

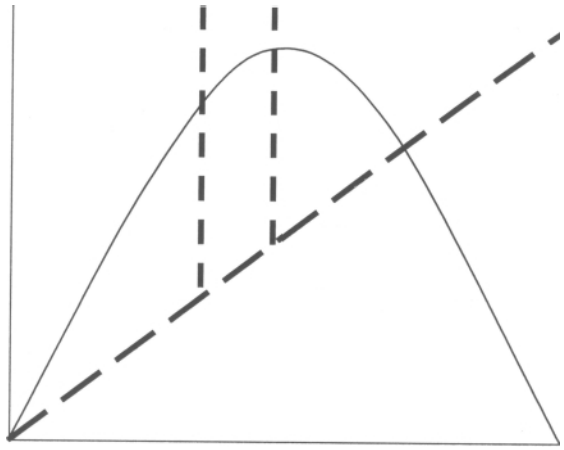

Fig. 3.1: The relationship between population, size, harvest size and catching effort (Source Clark 1976).

Flowing diagram 3.1 it can explain as follows:

a) As long as there is profit to be made, it is worth further investment in the business. Once invested, loss on habitat is discounted into the future, so the longer operators stay in business, the smaller the loss written off.

b) As effort increases beyond sustainable yield, the harvest decreases, and the price per unit rises. The alternatives are to switch to another resource, or, if there is none available, to pursue it to extinction unless measures are introduced to save the remaining few (Barkham 1995).

3.2.2 Attitude Outlook

Here you will discover that the prevailing attitudes towards management of natural resources are founded on principle of "free market". In a free market situation the destruction of natural resources, such as tropical forests, sea treasures and soil denudation. For example the argument against the free market was very strong at Rio Conference on Environment in 1992. The raged question was the morality of the Western nations despoiling the ecosystem in the third world regions,

while mouthing that developing nations should not lay claim to patency and royalty.

3.3.2 Short Term Self Interest

Exploitation approach to management is based on short term self interest. These processes are fueled by two factors.

1) Demand for higher standard of living
2) Increasing numbers of people.

The consequences for ecosystem according to Barkham (1995) are:

a) Loss of species, therefore of genetic diversity.
b) Loss of productive capacity: not as much plant and animal material biomass can be produced.

3.4 Fundamental Principles of Ecosystem Management

Drawing from the last section (Section 3.3) the fundamental principle of ecosystem is anchored on the fact that resource exploitation with impurity by humans will not solve any of the consequences of exploitation. At the same the effort to restore damaged ecosystem may defies any humans' knowledge. The outline of the fundamental principle of ecosystem management as stated by Barkham (1995) is reproduced below:

1) Exploitative use of ecosystems reduces options for their future use, either temporarily or permanently.

2) The attempt to restore damaged ecosystems is either expensive, or it takes long time, or may never have the required basis of scientific knowledge to achieve it or all three.

4.0 CONCLUSION

In this Unit you have learned a number of issues fundamental to ecosystems management, the meaning and concept of ecosystem management as it relates to resource exploitation and principles of ecosystem management. Furthermore you should have learned the implication and exploitative approach to ecosystem management.

5.0 SUMMARY

What you have learned in this Unit concerns the meaning, concept and crisis of ecosystem management. It served to create a foundation for your understanding of the issues concerning ecosystem management.

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UNIT 4 METHODS OF ECOSYSTEM MANAGEMENT

CONTENTS

1.0 INTRODUCTION

You have just read the meaning concept and crisis of management. If so, will a general knowledge of the underlying issues fundamental to ecosystem management. This unit will focus on some of the approaches to ecosystem management. Before we do that let us see what you are expected to learn in this Unit as stated in the objectives below.

2.0 OBJECTIVES

At the end of this Unit, you should be able to

- Explain what is meant by sustainable management of ecosystem
- Explain the global issues and local actions bothering on ecosystem management.

3.0 MAIN CONTENT

3.1 Sustainable Management of Ecosystems

Basic to this section, you need to understand the concept of sustainable management. Sustainable management is a derivative of sustainable development as widely disseminated by the World Conservation Strategy (IUCN, UNEP and WWF, 1980), which focused on approach to the management of living resources and to provide policy guidance on how to do so. The summary of the World Conservation strategy is presented as follows:

a) To maintain essential ecological processes and life support systems (the later being ecosystems natural and human-modified necessary for food production and other aspects of human well being).

b) To preserve genetic diversity (i.e. maintain wild and domesticated plants and animals to ensure as few possible become extinct).

c) To ensure the sustainable utilization of species and ecosystems (Barrow 1993).

Deriving from sustainable development therefore, ecosystem management is aimed at maintaining the productive capacity of ecosystems for the future generations. Ecosystem management also aimed at using ecosystems in such a way as to keep options for future use open.

Another focus of ecosystem is the maintenance crop systems without recourse to resources acquired at the expense of maintaining other ecosystem (Barkham, 1999). Diversity, the sustainable use of its components and the fair and equitable sharing of the benefits.

3.2 Management to maintain Biodiversity.

This focuses on the conservation of biodiversity. The principal objectives as stated contained in the World Conservation Strategy:

a) To maintain essential ecological processes and life support system.
b) To preserve genetic diversity, which being dangerously impoverished.
c) To ensure sustainable use of species and ecosystems by our children and us

Article 1 of the Biodiversity Treaty echoes this with its remit as "the conservations of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits.

In practice this means that the productive capacity of ecosystems managed for producing food materials for our use has to be maintained (Barkham, 1995). Furthermore, management to maintaining biodiversity can take place either in - situ or ex-situ in protected areas. The underlying principle is the management of biodiversity to meet our needs today and yet that of the future generations. This is so because it is

believed that we are keeping in trust the ecosystems or ecodiversity for the future generations. Managing for biodiversity is also known as wildlife conservation, or nature conservation. Environmentalists, ecologists and researchers have continually stressed since 1992 at Rio Conference on Environment and Development the need to protect the world's tropical ecosystem. This call is based on the fact that the tropical ecosystems have the greatest diversity of species, which depend on it. (See Fig 19.1).

Figure 19.1

Indicators of the importance of the living resources of tropical forests.

1. 70 percent of the world's vertebrates, papilionidae (the swallow tail butterfly family) and higher plants occur in just 12 tropical countries.

2. Tropical forests contain 155,000 of the 250,000 known plant species.

3. 700 tree species were found in ten 1-hectare plots in Borneo, a number equivalent to the total number in North America.

4. 90 percent of all primates are found only in tropical forest regions of Latin America, Africa and Asia.

5. One-fifth of all birds' species are found in Amazonian Forests.

6. About three-quarters of all Endemic Bird Areas identified by the International Council for Birds Preservation (ICBP) as priority areas for species conservation are within the tropics.

Source: Lean et al (1990) Bibby et al (1992) Adapted from O'Riordan (1995)

3.3 Habitat Management

Thus implies the management of natural world diversity and it occurs in two ways. These are:

a) **In-situ**: Primary the establishment and management of protected areas and:

b) Ex-situ: Maintenance of species in artificial environments, captivity, seed banks and the like.

Habitat management efforts is directed towards enabling organisms to sustain themselves in the wild, it is essential that their habitat is maintained. Habitat management consists of both the living and non-living components of the environment essential to the life and reproduction of the species in the areas in which it lives.

3.4 Species Conservation and Habitat Management

The major problem threatening species is habitat destruction; therefore safeguarding the habitat is an important factor in the conservation of species. Find in order to protect species from extinction, several effort have put in place through habitat management. Whilst other types of species are easy to conserve, the migratory birds and animals are inconvenient and expensive to conserve them.

To achieve the conservation of migratory animals, the convent in of migratory species of wild animals was adopted in 1979. The convention aims at protecting animals cross national boundaries (Barkham 1999).

Example of successful of individual species conservation is in the case of Panda (Logo of WWFN). An almost extinct animals and saved by conservation. You must understand that species conservation cannot occur in abstract. There has to be properly managed habitat for the species to be protected from human activities.

4.0 CONCLUSION

In this Unit, you have learned the various methods of ecosystem management. You should have also learned that ecosystem management stresses respect for life. Also, appropriate sustainable management practice or the basis for ecosystem management.

5.0 SUMMARY

What you have learned in this Unit concerns the methods of ecosystem management. It served to expose the different types of ecosystem management.

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UNIT 5 PROBLEMS OF ECOSYSTEM MANAGEMENT

CONTENTS

1.0 INTRODUCTION

You have come to the end of this course. Your journey through this course has no doubt exposed issues bothering on ecology, the ecosystem and its management of ecosystem crisis. This unit however will expose the problems associated with the management of the ecosystem. Let us look at what you should learn in this unit, as specified in the unit objectives state below:

2.0 OBJECTIVES

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

- Understand the major problems of ecosystem management.
- Evaluate your understanding of the problem associated with ecosystem management.
- Establish a relationship among all the problems.

3.0 MAIN CONTENT

3.1 Externalities in Habitat Management

This revolves round the crisis of climate change and several other problems, which threaten ecosystem management. It is a truism that the use of fertilizer and pesticide on farmland and their drift beyond their target. With threat of a hotter global temperature so obvious today, the threat to ecosystem management has become more obvious. Particularly,

because the ecosystem due its very fragile nature will suffer serious cascade or collapse, due to a slight change in the global climate. As you known death of a species is capable of triggering several losses of other species. Also climate change or action of pesticide is capable of threatening biodiversity conservation.

3.2 Ecosystem Destruction

This is a problem that keeps occurring even well managed ecosystem. The destruction of ecosystem occurs in a situation, for example, the harvesting of managed forest. It is obvious that the developed ecosystem, which occurs as a result of the managed forest over years, will be affected. The harvesting of these trees leaves a spectacle of a despoiled ecosystem because the process of harvesting in itself is capable of triggering destruction of the ecosystem put in place during the growth years of the plants. Another cause of ecosystem destruction is fire outbreak in the managed ecosystem. Oftentimes poaching or over kill (this may occur as over-fishing) or over-harvesting of species. Over-kill or over-harvesting occurs when license is given to carry out such activities and the limits are exceeded.

3.3 Protected Areas Problems

According to Jefferies (1997) not all protected areas are successful. Management failures have occurred on many sites. Very successful management can also create threat by imparting a false sense of security and providing symbols of success that none dare alter. This attracts increased pressure. From tourist, poachers, local people and industry, all keen to exploit pockets of wildlife. Another common feature is local conflict where protected areas operate an exclusion policy. Utilization may be difficult to build into existing management plans. There are problems of bias of designated sites, globally and naturally. Some ecosystems are extensively protected, other under represented and establishment of marine reserve lags behind terrestrial habitats.

3.4 Funding

The Rio convention explicitly stated the need for financial aid for conservation from developed to the developing world. Richer countries were asked to back their presidents' speeches (made during the Earth Conference) with money. This is because financial aid is vital of complement of laws and treaties. The situation today is different from the outcome of the Rio Conference in this area because no sooner had the conference ended that the developed countries dumped the developing ones. It is important to state that U.S.A. is the leading nation

in this effort of developed world not to grant financial aid to the developing world. A vivid case in example is the calls for swapping debt for Nature, which has received a deaf and dumb response from the developed world. Had the calls been headed the developing countries particularly in the tropical region believed it will go a long way by reducing the pressure on the tropical ecosystem which is noted for its diversity.

3.5 Legislation

All the good intentions, treaties and laws of the world are ineffective, if the will and means to conserve and protect the ecosystem are lacking. At the global level there are many conventions, treaties and laws, which have been signed by most nations or not signed. The problem here is not whether there are global treaties and conventions, its weakness lies in the fact that the global legislations aimed at protecting the ecosystem are not backed by local laws. This trend is most common in the developing nations. This is because many of the developing countries are often plagued by rule of force, coercion and corruption.

3.6 Human Population Growth

The global human population continues to grow rapidly. It is estimated that the world population, which peaked 6 billion, mark, increase by with as much as 100 million yearly. The resultant effect of a fast growing population is consumption. Research finding have revealed that consumption has outgrown population. The increase in population is a major threat to ecosystem management. For example increasing urbanization degrades biodiversity by habitat loss, fragmentation, introduction of exotic species, pollution, drawn of resources, disruption of natural geochemical cycles and conversion of adjacent kid for farming or suburbs as some try to escape the crowded cities. (Jefferies, 1997).

4.0 CONCLUSION

In this Unit, you have learned the problems of ecosystem management. You should have also learned the limitations of the approaches towards ecosystem management. You need to know to be aware that the problems are majorly human induced.

5.0 SUMMARY

What you have learned in this Unit concerns the various types of problems confronting ecosystem management. With this unit you have come to the end of this module

6.0 TUTOR-MARKED ASSIGNMENTS

Assignment 1

1. Based on the dynamic nature of soil, discuss the uses of soil to human kind.
2. What do you understand by soil structure?

Assignment 2

l. Parent material and climate are described as passive and active soil formers explain their roles.
2. Write short notes on (a) time (b) calcification (c) salinization

Assignment 3

1. Discuss the relationship between altitudes and soils.
2. How would you classify tropical soils?

Assignment 4

1. Compared and contrast zonal, intra-zonal and zonal soils.
2. What is hydro-morphic soils
3. What are differences between calcimorphic and halomorphic soils?

Assignment 5

1. Discuss the four major soil types in Nigeria and their economic importance to humans.

Assignment 6

1. Discuss the nature of soil erosion
2. What are the types of water erosion? (Support your answer with examples in the world).
3. Discuss the impact of soil erosion

Assignment 7

l. Discuss the Conservation practices employed by farmers to control erosion.
2. How can you reclaim soil that has been devastated by gully erosion?

Assignment 8

1. Why are wild species of plants and animals important to us?

Assignment 9

1. What are the characteristics of extinction prone species?
2. Wildlife management is not just a concept it is an approach to sustainability.

Assignment 10

1. What are the problems facing wildlife management in Nigeria?
2. Discuss wildlife management in Nigeria.

7.0 REFERENCES/FURTHER READING

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