MODULE 1

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Unit 2   Economic, Ecological and Social Values of Biological Resources
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UNIT 1   CONCEPT OF BIOLOGICAL DIVERSITY

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1.0   INTRODUCTION

Global biodiversity is changing at an unprecedented rate as a complex response to several human-induced changes in the global environment. The magnitude of this change is very large and very strongly linked to ecosystem processes and society's use of natural resources that biodiversity change is now considered an important global change in its own right. The definition of biodiversity in this course include all terrestrial and freshwater organisms-including plants, animals, and microbes-at scales ranging from genetic diversity within populations, to species diversity, to community diversity across landscapes. The definition excludes exotic organisms that have been introduced and communities such as agricultural fields that are maintained by regular human intervention. We do not consider marine systems in this study. This unit therefore, defines and considers the dimension of biological diversity (Fauna and Flora).

2.0 A: OBJECTIVES

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

* define biodiversity;
* state the magnitude of species on the earth;
* describe the types of species; and
* explain why some communities are more diverse than the others.

2.0 B: HOW TO STUDY THIS UNIT
1. You are expected to read carefully, through this unit twice before attempting to answer the activity questions. Do not look at the solution or guides provided at the end of the unit until you are satisfied that you have done your best to get all the answers.
2. Share your difficulties in understanding the unit with your mates, facilitators and by consulting other relevant materials or internet.
3. Ensure that you only check correct answers to the activities as a way of confirming what you have done.
4. Note that if you follow these instructions strictly, you will feel fulfilled at the end that you have achieved your aim and could stimulate you to do more.

3.0   MAIN CONTENT

3.1   Definition of Biodiversity

Biodiversity or Biological diversity means the variety of plant and animal life at the ecosystem, community or species level, and even at the genetic level. Biodiversity is most commonly measured and reported at species level with characteristics such as species richness (number of species), species diversity (types of species) and endemism (uniqueness of species to a certain area) being the most useful elements for comparison (UNEP, 2002). Species is a group of creatures or plants having common characteristics.

3.2   Magnitude of Species

The Global Biodiversity Assessment completed by 1500 scientists under the auspices of UNEP in 1995 updated what we know or more correctly how little we know, about global biological diversity at the ecosystem, species and genetic levels. The assessment was uncertain of the total number of species on Earth within an order of magnitude. But studies show that between 3 and 30 million species exist on the Earth while only an estimated figure of 1.5 – 1.8 million have been scientifically described.

Birds   -   9000 species (3-5 new/year - some new, some splits)
Mammals -   4000 species (20 new/year) - mostly splits
Bacteria   -   3000 species known, lots more probably exist
Insects   -   millions undescribed

More than a half of the world species are found in tropical forests. Tropical forests are characterised with - warm, no seasons, adapt into stable niches, moist, 3 or more layers of habitat (ground, shrub, several layers of trees). For examples, 43 ant species are found in Peruvian rain forest; 700 tree species found in 10 ha Indonesia forest while 300 tree species found in 2 ha Peru forest.

Ecological community diversity of species is poorly known, as is its relationship to biological diversity, and genetic diversity has been studied for only a small number of species. The effects of human activities on biodiversity have increased so greatly so that the rate of species extinctions is rising to hundreds or thousands of times the background level. These losses are driven by increasing demands on species and their habitats, and by the failure of current market systems to value biodiversity adequately.

Since Rio, many countries have improved their understanding of the status and importance of their biodiversity, particularly through biodiversity country studies such as those prepared under the auspices of UNEP/GEF. The United Kingdom identified 1250 species needing monitoring, of which 400 require action plans to ensure their survival. Protective measures for biodiversity, such as legislation to protect species, can prove effective. In the USA, almost 40 per cent of the plants and animals protected under the Endangered Species Act are now stable or improving as a direct result of recovery efforts. Some African countries have joined efforts to protect threatened species through the 1994 Lusaka Agreement, and more highly migratory species are being protected by specialised cooperative agreements among range states under the Bonn Convention.

3.3   Types of Species

Species are of various types and some communities are more diverse than the others while Tropical communities are more diverse than temperate. As **Evolutionary Time Theory** argued, Tropics are more ancient (not affected by ice age) thus, species had so more time to develop than the Temperate region. Besides, **Climatic Stability Theory** asserted that in unstable climate, species develop wide range of tolerance, which could make them to adapt to many niches. But in stable climate, few species specialise into niches (the physical, chemical, and

biological conditions species needs to live). Among the divert kinds of species are:

i.   Native species

This evolved in and for that ecosystem. Fit into the system and provide food or eat food as part of cycle.

ii.   Alien species

Migrate into or are brought into system from elsewhere. Some die immediately, because they could not adapt to the new environment. Others out-compete the natives, and eliminate them. Example: mammals brought to New Zealand. Many 'LGBs' (little gray birds) acted like mice and rats and squirrels do in our ecosystems.   Introduced rats and mice killed most LGBs, including national symbol (kiwi), which is nearly extinct now.

iii.   Keystone species

Absolutely essential for particular ecosystem - e.g. plankton for arctic ecosystem; ponderosa for our local forests.

iv.   Indicator species

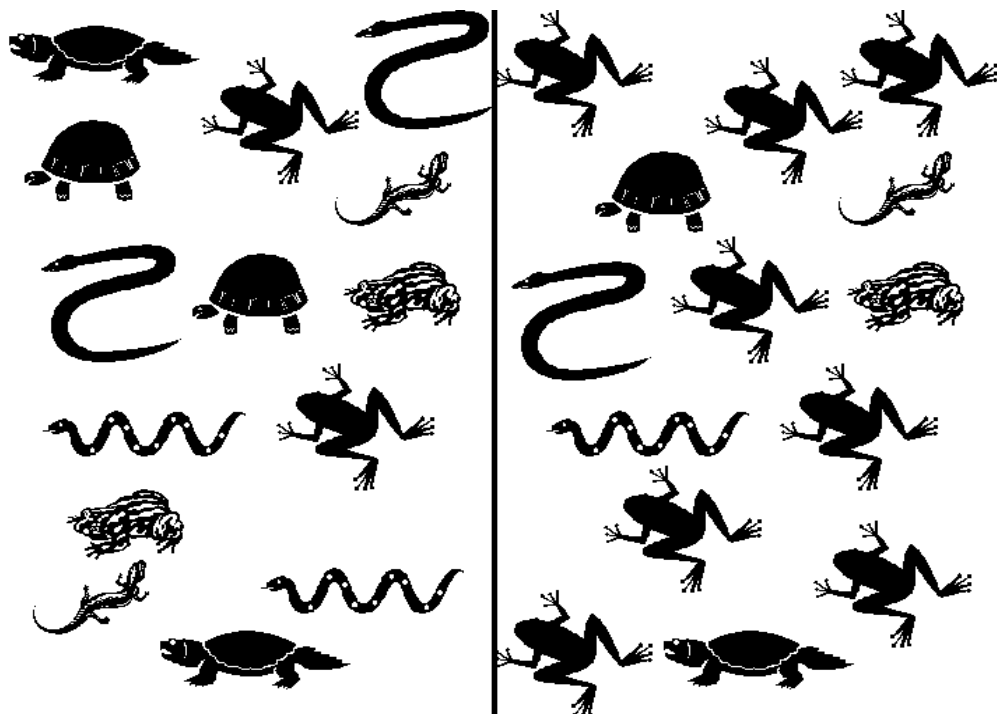Easily affected by loss of habitat, so serve as early warning.

Fig. 1:   **Animal Diversity**

Fig. 1b: **Bird Species**

Fig. 2a: **Plant Diversity**

Fig. 2b: **Plant Diversity**

Fig. 2c: **Plant Diversity**

Fig. 2d: **Plant Diversity**

SELF ASSESSEMENT
Discuss types of species

4.0   CONCLUSION

The study of biodiversity is essentially hinged on the knowledge of organisms- including plants, animals and microbes-at scales ranging from genetic diversity within populations to species diversity, to community diversity across landscapes.

5.0   SUMMARY

In this unit, you have learnt that:

- biodiversity is the variety of plant and animal life at the ecosystem, community or species level and even at the genetic level
- species on earth numbered between 3 and 30 million
- only 1.5 - 1.8 million of the species have been scientifically described
- species is a group of creatures or plants having common characteristics with different varieties
- some communities are more diverse than the others while tropical communities are more diverse than temperate region
- species are of various kinds.

6.0   TUTOR-MARKED ASSIGNMENT

Differentiate between Biodiversity and Species. Explain why some communities are more diverse than others.

7.0   REFERENCES/FURTHER READING

Heywood, V. H. (ed.). (1995). *Global Biodiversity Assessment*. United Nations Environment Programme. Cambridge: University Press, Cambridge.

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UNIT 2   ECONOMIC, ECOLOGICAL AND SOCIAL VALUES OF BIOLOGICAL RESOURCES

CONTENTS

1.0   INTRODUCTION

Biological resources are the backbone of the African economy as well as the life support system for most of Africans. A variety of resources, both plant and animal are used for food, construction of houses, carts and boats, household utensils, clothing and as raw materials for manufactured goods. Many resources, such as timber and agricultural produce are traded commercially and others are used in traditional crafts such as basket weaving and carving.

In addition, many species with medicinal properties are harvested by local communities and pharmaceutical multinationals alike. These include the African potato (*Hypoxis rooperi*) in Southern Africa, the rosy periwinkle (*Catharanthus roseus*) from Madagascar and Mozambique, and prunus (*Prunus africana*) from Cameroon, Democratic Republic of Congo, Kenya and Madagascar. Other species provide the generic resources for improved agricultural products such as disease or drought resistant crops.

For example, an African species of rice has been used in the development of a high productivity, drought resistant variety and the native Mauritian caffeine-free coffee species could be used to develop coffee cultivars with low caffeine content.

The richness and diversity of ecosystems in Africa also provide the opportunities for tourism which many African countries have successfully exploited. The coral reefs of the Red Sea, Eastern African coast and Western Indian Ocean Islands, for instance, are among the

most famous savannas of Eastern and Southern Africa are popular destinations for safari-goers.

2.0 A: OBJECTIVES

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

- economic and ecological values of biological resources;
- environmental benefits of tropical forests resources
- social values of plants and animals.

2.0 B: HOW TO STUDY THIS UNIT

1. You are expected to read carefully, through this unit twice before attempting to answer the activity questions. Do not look at the solution or guides provided at the end of the unit until you are satisfied that you have done your best to get all the answers.
2. Share your difficulties in understanding the unit with your mates, facilitators and by consulting other relevant materials or internet.
3. Ensure that you only check correct answers to the activities as a way of confirming what you have done.
4. Note that if you follow these instructions strictly, you will feel fulfilled at the end that you have achieved your aim and could stimulate you to do more.

3.0   MAIN CONTENT

3.1   Economic, Ecological and Social Values of Tropical Forests Resources

All forests have both economic and ecological value, but tropical forests are especially important in global economy. These forests cover less than 6 per cent of the Earth's land area, but they contain the vast majority of the world's plant and animal genetic resources. The diversity of life is astonishing. The original forests of Puerto Rico, for example, contain more than 500 species of trees in 70 botanical families. By comparison, temperate forests have relatively few. Such diversity is attributed to variations in elevation, climate and soil, and to the lack of frost.

There is also diversity in other life forms: shrubs, herbs, epiphytes, mammals, birds, reptiles, amphibians and insects. One study suggests that tropical rain forests may contain as many as 30 million different kinds of plants and animals, most of which are insects (Figure 2.1).

Fig. 2.1:   **Example of Tropical Rain Forest Insect**

Tropical forests provide many valuable products including rubber, fruits and nuts, meat, rattan, medicinal herbs, floral greenery, lumber, firewood and charcoal (Figure 2.2). Such forests are used by local people for subsistence hunting and fishing. They provide income and jobs for hundreds of millions of people in small, medium and large industries. Tropical forests are noted for their beautiful woods (Figure 2.3).

Fig. 2.2:   **Rubber Tree as Source of Income**

Fig. 2.3:   **Tropical Forest**

Four important commercial woods are mahogany, teak, melina and okoume. Honduras mahogany (*Swietenia macrophylla),* grows in the America; from Mexico to Bolivia. A strong wood of medium density, mahogany is easy to work on, is long lasting, and has good colour and grain. It is commonly used for furniture, molding, paneling and trim. Because of its resistance to decay, it is a popular wood used in boats. Teak (*Tectona grandis*) is native to India and Southeast Asia. Its wood has medium density, is strong, polishes well, and has a warm yellow-brown colour. Also prized for resistance to insects and rot, teak is commonly used for cabinets, trim, flooring, furniture, and boats. Melina (*Gmelina arborea*) grows naturally from India through Vietnam. Noted for fast growth, melina has light colored wood that is used mainly for pulp and particleboard, matches and carpentry. Okoume (*Aucoumea klaineana*) is native to Gabon and Congo in West Africa (Figure 2.4).

Fig. 2.4:   **Example of Tropical Forest Wood**

A large fast-growing tree, the wood has moderately low density, good strength to density ratio, and low shrinkage during drying. It is commonly used (for plywood, paneling, interior furniture parts and light construction (Figure 2.5).

Fig. 2.5:   **Plywood from Tropical Wood**

Tropical forests are home for tribal hunter-gatherers whose way of life has been relatively unchanged for centuries. These people depend on the forests for their livelihood. More than 2.5 million people also live in areas adjacent to tropical forests. They rely on the forests for their water,

fuel wood and other resources and on its shrinking land base for their shifting agriculture. For urban dwellers, tropical forests provide water for domestic use and hydroelectric power. Their scenic beauty, educational value and opportunities for outdoor recreation support tourist industries.

Many medicines and drugs come from plants found only in tropical rain forests (Figure 2.6). Some of the best known medicines are quinine, an ancient drug used for malaria; curare, an anesthetic and muscle relaxant used in surgery; and rosy periwinkle, a treatment for Hodgkin's disease and leukemia. Research has identified other potential drugs that may have value as contraceptives or in treating a multitude of maladies such as arthritis, hepatitis, insect bites, fever, coughs and colds (Figure 2.7). Many more may be found. In all, only a few thousand species have been evaluated for their medicinal value.

Fig. 2.6:   **Medicinal Plants and Products as Source of Income**

Fig. 2.7: **Drugs Manufactured from Tropical Medicinal Plants**

In addition, many plants of tropical forests find uses in homes and gardens. They include ferns and palms, the hardy split-leaf philodendron, marantas, bromeliads and orchids to name just a few.

3.2   Environmental Benefits

Tropical forest resources do more than respond to local climatic conditions; they actually influence the climate. Through transpiration, the enormous number of plants found in rain forests returns huge amounts of water to the atmosphere, increasing humidity and rainfall and cooling the air for kilometres around. In addition, tropical forests replenish the air by utilising carbon dioxide and giving off oxygen. By fixing carbon, they help maintain the atmospheric carbon dioxide levels low and counteract the global "greenhouse" effect.

Forests also moderate stream flow. Trees slow the onslaught of tropical downpours, use and store vast quantities of water and help hold the soil in place. When trees are cleared, rainfall runs off more quickly, contributing to floods and erosion.

SELF ASSESSEMENT
What are the economic, ecological and social values of tropical forests resources?

4.0   CONCLUSION

The knowledge of the values of biological resources is hinged on the benefits man derives from the use of the resources, which are the diverse importance ranging from the use for food, construction of houses, carts and boats, household utensils, clothing and as raw materials for manufactured goods.

5.0   SUMMARY

In this unit, you have learnt that:

- biological resources are the backbone of the African and global economy as well as the life support system for most people
- tropical forests, which cover less than 6 per cent of the earth's land area and contain the vast majority of the world's plant and animal genetic resources provide varieties of benefits both to Africa and global economy
- tropical forests provide many valuable products including rubber, fruits and nuts, meat, rattan, medicinal herbs, floral greenery, lumber, firewood and charcoal
- such forests are used by local people for subsistence hunting and fishing
- they provide income and jobs for hundreds of millions of people in small, medium and large industries.
- tropical forests are home for tribal hunter-gatherers whose way of life has been relatively unchanged for centuries
- these people depend on the forests for their livelihood
- they provide educational value, and opportunities for outdoor recreation support tourist industries
- many medicines and drugs come from plants found only in tropical rain forests
- they not only influence local climate, they actually influence climate and moderate stream flow.

6.0   TUTOR-MARKED ASSIGNMENT

Highlight various economic, ecological, social and environmental benefits of tropical forests biological resources.

7.0   REFERENCES/FURTHER READING

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http://www.fao.org/english/newsroom/focus/2003/wf c3.htm – *Tapping Forests to Reduce Poverty.*

UNIT 3   BIODIVERSITY LOSS AND EXTINCTIONS

CONTENTS

1.0   INTRODUCTION

It is feared that human activity is causing *massive extinctions.* The previous link, to a new report from *Environment New Service* (1999) says that "The current extinction rate is now approaching 1,000 times the background rate and may climb to 10,000 times the background rate during the next century, if present trends continue. At this rate, one-third to two-thirds of all species of plants, animals and other organisms would be lost during the second half of the next century, a loss that would easily equal those of past extinctions." Current extinction rates assume 1% destruction of rain forest per year, which gives extinction rate of 0.2 - 0.3% extinctions per year. This is equivalent to 46,000 species loss per year and 10,000 times the natural rate.

Anecdotal evidence shows that of the Fishes in North America, which is equivalent of 1000 species, 3% have gone into extinction in the last 100 years, many in SW because of loss of riparian corridors, groundwater withdrawals, dam building. Besides, Fish in Malaysia were identified to be 266 species but 122 have left. 20% of the world Birds have gone into extinction in the last 2000 years (many on islands). In Solomon Islands, 13 of 164 birds in the last 100 years have gone into extinction, as well as many in New Zealand. Of the songbirds in US there was 50% loss of population. In 1992, it was estimated that if rainforests are cut at 2% per year, by 2022, 10-22% of the species would go into extinction. In thus unit, you will know the factors (natural and human) that are responsible for the loss and extinction of biological diversity.

2.0 A: OBJECTIVES

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

* recall the current extinction rate of global biodiversity;
* state the anecdotal evidence of biodiversity loss; and
* identify various human activities causing *massive extinctions.*

2.0B: HOW TO STUDY THIS UNIT

1. You are expected to read carefully, through this unit twice before attempting to answer the activity questions. Do not look at the solution or guides provided at the end of the unit until you are satisfied that you have done your best to get all the answers.
2. Share your difficulties in understanding the unit with your mates, facilitators and by consulting other relevant materials or internet.
3. Ensure that you only check correct answers to the activities as a way of confirming what you have done.
4. Note that if you follow these instructions strictly, you will feel fulfilled at the end that you have achieved your aim and could stimulate you to do more.

3.0   MAIN CONTENT

Africa's biodiversity is under threat from four main sources. These are:

1. habitat destruction and fragmentation
2. high demands for biological resources
3. invasion by alien (non-native) species and
4. lack of recognition of indigenous knowledge and property rights.

3.1   Causes of Biodiversity Loss

Causes of biodiversity loss include habitat destruction and fragmentation, high demands for biological resources and invasion by alien (non-native) species.

3.1.1 Habitat Destruction and Fragmentation

As landscapes are "fragmented" by human development, the patches become smaller, and can support fewer species and fewer numbers of individual members of species. Smaller patches also suffer more "edge effect"---whereby the habitat near the edge of the patch is compromised (meaning it is less useful to species who need that habitat) because processes from the "matrix" in which the patch is embedded work their way into the patch (e.g. wind, predation, pollution, etc.). This effectively reduces the patch size even further.

Natural habitats in Africa are being degraded or lost; owing to a number of 'proximate' and 'ultimate' (or root) causes. Proximate causes include clearing for alternative land uses (mainly agriculture and human settlements) and over-harvesting of resources (most notably timber in the forest of Central and Western Africa).

More than 211 million hectares of African forest have been lost since 1970, amounting to almost thirty percent (30%) of the original extent. In the same period, the land area under cultivation has increased by 36 million hectares, or 21 per cent (FAOSTAT, 2000).

Other threats to terrestrial habitats include bush fire which is commonly used in agriculture to prepare the soil, but which can get out of control and destroy large areas of forest or woodland. On the other hand, fire (along with grazing) is also considered to be one of the most important factors determining the structure of savanna ecosystems (Gichohi, Gakahu & Mwangi, 1996).

The ultimate causes of habitat loss in Africa are human population growth and the resulting demand for space, food and other resources; widespread poverty; a dependence on natural resources; and economic pressures to increase exports, particularly of agricultural produce, timber and mineral products.

3.1.2 High Demands for Biological Resources

Individual species are under threat from a variety of pressures in addition to loss of their natural habitat. Recent estimates show that a total of 126 recorded animal species have become extinct in Africa, and that there are 2018 threatened animal species across the region. Some 123 plants are recorded as extinct and 1771 are threatened (IUCN, 1997).

The reasons for such high rates of species loss or endangerment include:

- habitat loss
- illegal hunting for food
- medicinal, or commercial use and
- national and international trade.

A recent study found that the bush meat trade in Central and Western Africa is contributing significantly to the decline in populations of gorillas, chimpanzees, elephants, bush pigs and forest antelopes. Bush meat is a traditional supplement to the diets of many African communities, but the increasing human populations and commercial

trade are pressurizing these species to the extent of a million tones of bush meat a year (Greenwire, 2001).

Another recent study shows that activities such as logging and mining contribute significantly to improving access to previously remote areas thereby making collection from the wild more profitable. Besides, research reveals that road density is linked to habitat fragmentation, deforestation and intensified bushmeat hunting (Wikie, *et al,* 2000).

An estimated 484 plant species from 112 families are currently threatened with extinction in Nigeria, and animal species such as the *Cheetah,* the *Pygmyape,* the *Hippopotamus*, the *Giraffe,* the *black Rhinoceros* and the *giant Eland* have disappeared (Jaiyeoba, 2002).

Selective harvesting of medicinal plants is also taking its toll on species diversity and abundance. The World Health Organization (WHO) has estimated that eighty per cent (80%) of people in the developing world are reliant on traditional medicines. Eighty-five per cent (85%) of these medicines use plant extracts, so it is estimated that around 3000 million people around the world rely on plants for traditional health treatment. The number is even larger if plant derived commercial drugs are included (Sheldon *et al.,* 1997).

In Africa, eighty percent (80%) of both rural and urban populations depend on medicinal plants for their health needs (and those of their livestock) either because they prefer them for cultural or traditional reasons, because such remedies are effective in treating certain diseases, or because there is lack of affordable alternatives (Baquar, 1995; Ole Lengisugi & Mziray, 1996).

3.1.3 Invasion by Alien (non-native) Species

A further threat to biodiversity comes from invasion by non-native, or alien, species of plants and animals. These are species that have been introduced both accidentally and intentionally, and that are free from their natural predators or other natural limitations to their population growth. They are thus, able to dominate plant and animal communities, either by out-competing native species for space, light or nutrients, or through predation (UNEP, 2002 p.61).

Invasion by alien species reduces biodiversity either through predation, competition or smothering in some cases, alien plants form such dense infestations and produce so many seeds that are dispersed so widely that it is virtually impossible to control them. They also change the dynamics of the natural system and may produce toxic chemicals, inhibiting the

growth of native species. In other cases, they threaten native species and functioning of ecosystems through an excessive consumption of resources such as water.

In Southern Africa, pines, eucalyptus and acacias have been introduced for commercial forestry, but have invaded natural habitats where they threaten ecological integrity by using many times more water than native species (Working for water, 2000).

Water hyacinth, a prolific weed, believed to have entered Nigeria through Benin Republic, now covers about 60 km^2 and over 30 km of Nigeria's coastal waterways and constitutes a major threat to marine life (UNEP, 2002: 134). Option to control the introduction and spread of alien species include tightening controls on importation of products of animal or plant origin. However, lack of resources to police borders and entry points, results in continued threats to biodiversity (UNEP, 2002).

Generally, factors that tend a species toward endangerment include:

1. limited range (endemic to limited areas)
2. small population (limited breeding success, and/or genetic degradation due to in-breeding)
3. isolated
4. narrow habitat requirements (habitat specificity) and
5. Non-adaptive behavior.

While the main human causes of species loss are:

1. habitat destruction and fragmentation
2. hunting (for sport and food), including illegal poaching
3. purposeful extermination
4. pollution (e.g., DDT in bird shells reduces reproduction success) and
5. introduction of exotics (may out-compete or prey on endemic species).

SELF ASSESSEMENT

Explain the concept of fragmentation

4.0   CONCLUSION

The knowledge of biodiversity loss and extinctions is hinged on various human activities causing massive extinctions.

5.0 SUMMARY

In this unit, you have learnt that:

- natural habitats in Africa are being degraded or lost owing to a number of 'proximate' and 'ultimate' (or root) causes
- proximate causes include clearing for alternative land uses (mainly agriculture and human settlements) and over-harvesting of resources
- the ultimate causes of are human population growth and the resulting demand for space, food and other resources; widespread poverty; a dependence on natural resources; and economic pressures to increase exports, particularly of agricultural produce, timber and mineral products
- individual species are under threat from a variety of pressures in addition to loss of their natural owing to:

a. high demand for bush meat trade as the case of Central and Western Africa
b. logging and mining
c. selective harvesting of medicinal plants.

6.0 TUTOR-MARKED ASSIGNMENT

Critically examine the impacts of proximate and ultimate factors in the loss and extinction of biodiversity.

7.0 REFERENCES/FURTHER READING

Ros-Tonen, M. A. F. & Dietz, T. (2005). *African Forests between Nature and Livelihood Resources:* Interdisciplinary Studies in Conservation and Forest Management. Lewiston, NY: The Edwin Mellen Press.

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UNIT 4   BIODIVERSITY CONSERVATION METHODS

CONTENTS

1.0   INTRODUCTION

There is an emerging realization that a major part of conservation of biological diversity must take place outside of protected areas and involve local communities. The extensive agricultural areas occupied by small farmers contain much biodiversity that is important for sustainable food production. Indigenous agricultural practices have been and continue to be important elements in the maintenance of biodiversity, but these are being displaced and lost. There is a new focus on the interrelationship between agro-diversity conservation and sustainable use and development practices in smallholder agriculture, with emphasis on use of farmers' knowledge and skills as a source of information for sustainable farming. In this unit, we shall consider various ways of conserving biological diversity.

2.0 A: OBJECTIVES

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

* explain the measures for conserving biological diversity; and
* state three important elements in the maintenance of biodiversity.

2.0 B: HOW TO STUDY THIS UNIT
1. You are expected to read carefully through this unit twice before attempting to answer the activity questions. Do not look at the solution or guides provided at the end of the unit until you are satisfied that you have done your best to get all the answers.
2. Share your difficulties in understanding the unit with your mates, facilitators and by consulting other relevant materials or internet.
3. Ensure that you only check correct answers to the activities as a way of confirming what you have done.

   4. Note that if you follow these instructions strictly, you will feel
      fulfilled at the end that you have achieved your aim and could
      stimulate you to do more.

3.0   MAIN CONTENT

The best way to conserve biological diversity is to ensure that
development activities are planned so as to minimize any impacts on it.
Many past development activities have led to the degradation of land
and water resources. This can lead to loss of biological diversity and loss
of the opportunity to benefit from its future use. An example is the loss
of an aquatic amenity and other uses through eutrophication. Effective
planning and rehabilitation can allow resource development to occur in
many areas without long-term adverse impacts on biological diversity.
Governments, as well as industry, should provide a lead in restoration
practices since they have responsibility for much of land and all marine
areas. Direct beneficiaries of the use of land and water resources have a
responsibility to maintain or restore the biological diversity functions of
those resources. Degraded areas should be rehabilitated according to the
principles and objectives of ecologically sustainable development.
However, there are three general categories of measures for conserving
biological diversity of forest. These are:

- protection of natural or near-natural ecosystems
- restoration and rehabilitation of degraded lands and
- *ex-situ* protection of individual species.

By far, the most important of these is protection of ecosystems, which is
probably the only way to ensure maximum protection for the full range
of biological diversity involved. Under some conditions, measures to
restore and rehabilitate degraded lands may conserve biological
diversity. These measures range from planting one or few selected
species of indigenous trees to mounting complex efforts to replace a
range of the pre-existing species of plants and animals. Because abused
and degraded lands occupy an ever increasing area of the earth's
surface, these measures are becoming increasingly important, both to
restore productivity of lands for direct human use and to conserve some
biological diversity. The third category of measures (*ex-situ* protection
of species), for instance, in zoos, botanical gardens, aquaria, and seed
banks, may be the last resort for some species when survival in their
natural habitats is no longer possible, but its greatest value is probably in
the context of temporary protection with the objective of eventual
reintroduction in the wild.

Various forms of conservation methods have also been proposed for
conserving biological diversity. Among them are:

i.   Government initiatives

Ensure that policies and controls are developed and implemented by the governments for the management and conservation of native vegetation on private and public lands, in consultation with landholders and community groups, and for controlling broad-scale clearance. In accordance with the Intergovernmental Agreement on the Environment, review legislation relating to clearing and ensure that criteria for assessing land clearance applications take account of biological diversity conservation, land protection, water management and landscape values.

ii.   Incentives and rebates

Undertake cooperative development of a range of measures at all levels of government, including financial incentives, cost reimbursements and rate rebates, to encourage land managers to improve conservation of native vegetation.

iii.   Information program

Work through appropriate agencies to develop a native vegetation conservation information program that is targeted at land managers and focuses on the value of retaining native vegetation in-situ while integrating this retention with major land uses.

iv.   Voluntary protection

Encourage voluntary management of species remnants and review the effectiveness of all mechanisms for the long-term voluntary protection of native vegetation and wildlife. The landscape ecology principles suggest several management goals, which include:

a.   protection of all habitat and maintenance or recreating habitat patches as large as possible; try to improve the habitat in the patch,
b.   where possible, maintain or recreate habitat patches in corridors connecting larger patches and
c.   remove barriers (roads, developments, etc.) between patches -- or at least make the barriers more "permeable" to species (e.g. design roads so that species can cross them (or go under them) safely.

v.   Cooperative programs

Initiate a cooperative program between the State and Local Governments in consultation with industry and community groups to

rehabilitate degraded systems of national concern. The program should cover:

a.   the development of improved procedures and standards for rehabilitation activities
b.   investigation and trial of new mechanisms for increasing the role of the private sector in using rehabilitation to protect biological diversity (for example, in the establishment of native vegetation corridors)
c.   increased funding for necessary restoration programs
d.   assistance to private landholders in the form of technical support and the provision of appropriate seed stocks and
e.   development of a monitoring and reporting program to determine the effectiveness of rehabilitation.

vi.   Monitor and manage processes

Through sampling and other techniques, monitor processes and categories of activities that have or are likely to have significant adverse impacts on the conservation of biological diversity. Where a significant adverse effect on biological diversity is determined, regulate or manage the relevant processes and categories of activities.

vii.   Strengthen assessment

Ensure that all governments make environmental, including biological diversity, impact assessment procedures an integral part of policy formulation, planning and development activities. Such procedures should take account of significant adverse impacts on biological diversity, especially when assessing the likely impact of proposals in areas considered important for biological diversity. Where undertaken, the environmental impact assessment should, if appropriate, provide for continuing monitoring and the adoption of mitigating measures. Ensure that environmental impact assessment procedures allow for informed and comprehensive public participation.

SELF ASSESSEMENT
Explain measures for conserving biological diversety

4.0   CONCLUSION

The best way to conserve biological diversity is to ensure that development activities are planned so as to minimize any impacts on it.

5.0   SUMMARY

In this unit, you have learnt that:

- there are three general categories of measures for conserving biological diversity of forest, which include:
  a. protection of natural or near-natural ecosystems
  b. restoration and rehabilitation of degraded lands and
  c. *ex-situ* protection of individual species.
- all government arms should make environmental, including biological diversity, impact assessment procedures an integral part of policy formulation, planning and development activities.
- voluntary management of species remnants and review the effectiveness of all mechanisms for the long-term voluntary protection of native vegetation and wildlife should be encouraged.

6.0   TUTOR-MARKED ASSIGNMENT

Discuss various methods of conserving biological diversity.

7.0   REFERENCES/FURTHER READING

Global Environmental Change (1995). Human and Policy Implications. Special issue on *People, Land Management and Environmental Change*, Vol. 3, No. 4.

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UNIT 5   PROTOCOL ON BIODIVERSITY CONSERVATION

CONTENTS

1.0   INTRODUCTION

In addition to actions necessary to conserve biological diversity directly, there is a need for a range of supporting measures that can minimise the impact of various external factors on biological diversity. In June 1992, the Earth Summit in Rio de Janeiro, Brazil was convened. There was an agreement on a set of "Principles for a global consensus on the management, conservation and sustainable development of all types of forests and marine ecosystem. The conference devoted some chapters of its Agenda to "Combating deforestation" and Pollution of the Sea. The articles of the conference supporting biological diversity conservation are highlighted in this chapter.

2.0 A: OBJECTIVES

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

- state the aim of the protocol
- describe scope of the protocol
- explain duties of the contracting parties as regards conservation of biodiversity.

2.0 B: HOW TO STUDY THIS UNIT
   1. You are expected to read carefully through this unit twice before attempting to answer the activity questions. Do not look at the solution or guides provided at the end of the unit until you are satisfied that you have done your best to get all the answers.
   2. Share your difficulties in understanding the unit with your mates,

facilitators and by consulting other relevant materials or internet.

3. Ensure that you only check correct answers to the activities as a way of confirming what you have done.

4. Note that if you follow these instructions strictly, you will feel fulfilled at the end that you have achieved your aim and could stimulate you to do more.

3.0   MAIN CONTENT

Recognising that in recent decades there have been significant human induced changes in the biota and **physico**-chemical conditions of the Sea and forest ecosystem; there have been concern on various **threats** to biodiversity, such as eutrophication, over-fishing, pollution and introduction of non-native species. Accepting the importance of control on the Sea and threats to forest ecosystem for the conservation of biodiversity and the maintenance and restoration of ecosystem functions; various articles were signed in the Earth Summit held in Rio de Janeiro, Brazil on June 5, 1992. The Contracting Parties are required to pay particular attention to Combating deforestation" and Pollution of the Sea and Atmosphere.

3.1   Aim of Protocol

The purpose of this Protocol is to maintain ecosystem in the good ecological state and its landscape in the favourable conditions, to protect, to preserve and to sustainably manage the biological and landscape diversity in order to enrich the biological resources.

3.2   Scope of the Protocol

In conjunction with provisions of the Convention on the Protection of marine ecosystem against Pollution and other Protocol to this Convention, the Protocol is intended to serve as a legal instrument for developing, harmonising and enforcing necessary environmental policies, strategies and measures in preserving, protecting and sustainably managing nature, historical, cultural and aesthetic resources and heritage for present and future generations.

3.3   Articles of the Protocol
They include articles 1-10 as outlined along with terms under the article.

3.3.1 Definition of Terms

Article 1

1. **Biological diversity** means variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems as defined by Article 2 of the Convention on Biological Diversity.
2. **Landscape** means an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors as defined in the Chapter 1, the article 1 of European Landscape Convention (October 20, 2000, Florence, Italy).
3. **Landscape Diversity** means the formal expression of the numerous relations existing in a given period between the individual or the society and a topographically defined territory, the appearance of which is the result of the action, over time, of natural and human factors and a combination of both.

3.3.2 Duties of contracting party

The duties of the contracting parties are highlighted in Articles 2-10

Article 2

1. Each Contracting Party shall take all necessary measures to:

    i.   protect, preserve, improve and manage in a sustainable and environmentally sound way areas of particular biological or landscape value, notably by the establishment of protected areas
    ii.   ensure that species occurring in the area to which this Protocol applies are maintained at favourable conservation status and habitats close to undisturbed
    iii. ensure that species of economic importance, especially living marine resources, are used sustainably
    iv.   restore and rehabilitate damaged areas of previously high biodiversity and landscape value
    v.   restore and maintain in good conditions the landscape of high nature, historical, cultural and aesthetic value.

2. The Contracting Parties shall identify and compile inventories of the components of biological and landscape diversity in the area to which this Protocol applies and identifies those components

important for their conservation and sustainable use within three years of this Protocol coming into force.

3. The contracting parties shall adopt a list of species of economic importance, which may be threatened or important by reason of their role in ecosystem functioning or other significance for the region preferably within three years of this protocol coming into force.

4. The Contracting Parties shall adopt a list of landscapes and habitats of the Black Sea importance that may be destroyed, or important by their nature, cultural or historical value that constitute the natural, historical and cultural heritage or present other significance for the Black Sea region preferably within three years of this Protocol coming into force.

Article 3

5. The Contracting Parties shall act, directly or in co-operation with competent international organisations and in consistency with other Protocols to this Convention, in the conservation and sustainable use of biological and landscape diversity.

6. The Contracting Parties shall produce and commonly agree on the Strategic Action Plan for the marine Biodiversity and Landscape Conservation Protocol within three years of the Protocol coming into force which shall be reviewed every five years

7. On the basis of the Strategic Action Plan for the marine Biodiversity and Landscape Conservation Protocol, the Contracting Parties shall adopt strategies, national plans and/or programmes for the conservation of biological and landscape diversity and the sustainable use of marine and coastal biological and landscape resources and shall integrate them into their national sectoral and intersectoral policies.

8. The Contracting Parties shall take all appropriate measures to regulate an intentional introduction and prevent an accidental introduction of non-indigenous species or genetically modified organisms to the wild flora and fauna and prohibit those that may have harmful impacts on the ecosystems, habitats or species in the area to which this Protocol applies.

9. The Contracting Parties shall endeavour to implement all appropriate measures to eradicate or reduce to a possible level, species that have already been introduced when it appears that

such species cause or are potentially causing damage to ecosystems, landscapes, habitats or species in the area to which this Protocol applies.

Article 4

1.   In implementing this Protocol, the Contracting Parties shall take into account, the traditional subsistence and cultural activities of local communities. They may grant exemptions from protection and conservation measures, as necessary, and where appropriate, to meet such needs. No exemption which is allowed for this reason shall:

   i.   endanger either maintenance of landscapes of high aesthetic value or the ecosystems protected under this Protocol or the biological processes contributing to the maintenance of those ecosystems,

   ii. cause a substantial reduction in the number of individuals making up the populations of species of flora and fauna, in particular threatened, migratory or endemic species, destruction of their habitats or landscapes, especially ones of regional importance and

   iii. cause an irreversible damage of the landscapes constituting the nature, cultural, historical, or aesthetic heritage of the marine importance.

2.   A Contracting Party which grants exemptions from the protection measures shall inform the other Contracting Parties accordingly, within one month period.

Article 5

1.   The Contracting Parties shall endeavour to inform the public of the value of protected areas, species and landscapes and shall give appropriate publicity to the establishment of these areas and regulations relating thereto.

2.   The Contracting Parties shall also endeavour to promote the participation of all stakeholders including their public in measures that are necessary for the protection of the areas, species and landscapes concerned, including environmental impact assessments.

3.   The Contracting Parties shall endeavour to provide information on this Protocol and related matters through appropriate education and public awareness programmes.

Article 6

1.   The Contracting Parties shall co-operate in conducting scientific research aimed at protecting and preserving the biological and landscape diversity and shall undertake, where appropriate, joint programmes and projects of scientific research and exchange relevant scientific data and information.

2.   The subsidiary bodies of the Commission (the Advisory Group on the Conservation of Biological Diversity and the Advisory Group on the Development of Common Methodology for Integrated Coastal Zone Management) in co-operation with the competent national authorities of the Sea coastal states shall be responsible for scientific activities and monitoring and assessment in the field of the biological and landscape diversity, delegating the co-ordination of their work.

3.   The Contracting Parties will invite intergovernmental organisations to co-operate with the Contracting Parties and/or the Commission by preparing and implementing specific programmes and projects, with a view to fulfilling the objectives of the Protocol.

Article 7

1.   The Contracting Parties are responsible for the fulfilment of their international obligations concerning the protection and conservation of the biological and landscape diversity.

2.   Each Contracting Party shall adopt rules and regulations on the liability for damage caused by natural or juridical persons to the biological and landscape diversity in areas where it exercises, in accordance with international law, its sovereignty, sovereign rights or jurisdiction.

3.   The Contracting Parties shall facilitate any legal action or procedure in accordance with their legal systems aiming at prompt and adequate compensation or other relief for damage caused by pollution or human activities to the biological and landscape diversity by natural or juridical persons under their jurisdiction.

4.   The Contracting Parties shall co-operate in developing and harmonising their laws, regulations and procedures relating to liability, assessment of and compensation for damage caused by human activities and/or pollution of the marine environment of the Black Sea, in order to ensure the highest degree of deterrence

and protection for the biological and landscape diversity as a whole.

Article 8

Each Contracting Party shall provide, in accordance with its capabilities, financial support and incentives of those national/regional activities which are intended to achieve the objectives of this Protocol, in accordance with their national plans, priorities and programs.

Article 9

1. The Commission and its Permanent Secretariat shall promote the implementation of this Protocol, inform the Contracting Parties of its work and make recommendations on measures necessary for achieving the aims of this Protocol.

2. The Commission shall report on the state of the biological and landscape diversity and efficacy of undertaken measures to preserve and manage it to the Meeting of the Contracting Parties on five years basis in a jointly agreed reporting format.

Article 10

1. Nothing in this Protocol nor any act adopted on the basis of this Protocol shall prejudice the rights and the interests of any state in full compliance with the international law, in particular, the nature and extent of marine areas, the delimitation of marine areas between States, with opposite or adjacent coasts, freedom of navigation on the high seas, the right and modalities of passage through straits used for international navigation, as well as the nature and extent of the jurisdiction of the Coastal State, the Flag State and the Port State.

2. No act or activity undertaken on the basis of the Protocol shall constitute grounds for claiming, contending or disputing any claims to national sovereignty, sovereign rights or jurisdiction.

3. Each Contracting Party shall apply the measures provided for in this Protocol without prejudice to the sovereignty, sovereign rights or the jurisdiction of other Contracting Parties or other States. Any measures taken by a Contracting Party to enforce these measures shall be in accordance with international law.

SELF ASSESSEMENT
State and describe scope of protocol

4.0   CONCLUSION

Biological diversity conservation can often be affected by planning and development decisions and actions. These effects sometimes occur as a result of inadequate information or a lack of sensitive application of policies on the part of the public and private sectors. Although environmental impact assessment procedures have been developed in various countries of the world, the application and scope of these procedures vary considerably between jurisdictions. To redress this problem, overseen the development of common principles for environmental impact assessment and developing guidelines and criteria for determining the need for and level of such assessment should be put in place. Assessment of individual projects cannot always anticipate cumulative environmental impacts. Assessment of broader policies and programs that are likely to significantly affect biological diversity, together with bioregional environmental planning with appropriate development controls, can help overcome this problem.

5.0   SUMMARY

In this unit, you have learnt that:

- in June 1992, the Earth Summit in Rio de Janeiro, Brazil was convened and was meant to discuss the earth resources and the management, conservation and sustainable development of those earth biological resources,
- the Protocol of the convention is intended to serve as a legal instrument for developing, harmonising and enforcing necessary environmental policies, strategies and measures in preserving, protecting and sustainably managing nature, historical, cultural and aesthetic resources and heritage for present and future generations,
- the meaning of Biological diversity, Landscape and Landscape Diversity were clearly spelt out in the conference and
- Articles which dictated the duties of the contracting countries were clearly articulated and signed by participatory countries.

6.0   TUTOR-MARKED ASSIGNMENT

i.   Critically examine the content of Articles 3 and 4.
ii.   Differentiate between Biological diversity, Landscape and Landscape Diversity.

7.0   REFERENCES/FURTHER READING

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