NATIONAL OPEN UNIVERSITY OF NIGERIA

COURSE CODE : ESM 317

COURSE TITLE:LAND AND WATER POLLUTION

COURSE GUIDE

ESM 317
LAND AND WATER POLLUTION

Course Team Fadeji Adetola (Developer/Writer) - UI
Prof. Edward C. Orji (Programme Leader) - NOUN
Dr. Jari Sanusi (Course Coordinator) - NOUN

NATIONAL OPEN UNIVERSITY OF NIGERIA

National Open University of Nigeria
Headquarters
14/16 Ahmadu Bello Way
Victoria Island
Lagos

Abuja Office
NOUN Building
No 5 Dar es Salam Street
Off Aminu Kano Crescent
Wuse II
Abuja, Lagos

e-mail: centralinfo@nou.edu.ng
URL: www.nou.edu.ng

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Introduction

Pollution of the environment is one of the most horrible ecological problem the world is subjected to today. The environment which comprises of Air, Land or Soil and Water was in the past pure, virgin, undisturbed, uncontaminated and basically most hospitable for man and other living organisms but the situation is just the reverse today due to man's interference on the natural environment. This is however largely due to innovations in science and technology leading to pollution of the environment and serious ecological imbalance which in the long run, may prove disastrous for mankind's. Environmental pollution which is the result of Urban-Industrial technological revolution and speedy exploitation of resources by man to satisfy his needs. As the craze of progress in agriculture, industry, transportation and technology are taken as the general criteria for any nation; these activities have created adverse effects on all living organisms in the biosphere. Rapid industrialization has left in its wake polluted air, water and soil, depleted wildlife and exhausted natural resources.

Small amounts of silt can eliminate desirable fish species. For example, when logging removes the protective plant cover from hillsides, rain may wash soil and silt into streams, covering the gravel beds that trout or salmon used for spawning.

Land pollution basically is the contamination of the land surface of the Earth through dumping of urban waste matter indiscriminately, dumping of industrial waste, mineral exploitation, and misusing the soil by harmful agricultural practices.

Land pollution includes visible litter and waste along with the soil itself being polluted. The soil gets polluted by the chemicals in pesticides and

herbicides used for agricultural purposes along with waste matter being littered in urban areas such as roads, parks, and streets.

Conservation of Natural Resources is done in order to protect natural resources from pollution. Here, all the stakeholders involving (Individuals, industries, and governments) have many obligations in order to protect the environmental. Actions to be taken includes prohibiting or limiting the use of pesticides and other toxic chemicals, limiting wastewater and airborne pollutants, preventing the production of radioactive materials, and regulating drilling and transportation of petroleum products. Failure to do so results in some countries being implicated for contaminated air, soil, rivers, plants, and animals. For example, if governments required that all oil tankers be fitted with double-layered hulls, the damages to fisheries and wildlife from the many oil spills of the 20th century may have been reduced.

What You will Learn in this Course

This course guide tells you briefly what to expect from reading this course materials. The study of pollution is important because pollution has profound effects on vegetation and animal life; including humans. Human in turn; can affect the environment through the alteration of the earth's surface and the introduction of pollutants and chemicals to the environment.

Scientist however points out that there are various factors that are majorly responsible for pollution of the environment and these include: human population explosion, rapid industrialization, deforestation, unplanned urbanization, scientific and technological advancement. Although some environmental pollution is a result of natural causes such as volcanic eruptions.

The effects of pollutants in the environment may be immediate (primary effects) or delayed (secondary effects) .Primary effects of pollution occurs when the effects of such pollutants is felt immediately after contamination occurs, such as the death of marine plants and wildlife after an oil spill at sea. Secondary effects may not be felt immediately after the pollutants may have been released into the environment but be delayed or may persist in the environment far into the future, perhaps going unnoticed for many years.

Humans are at the top of the food chain and they are particularly vulnerable to the effects of pollutants. More recently research has revealed that many chemical pollutants, such as DDT and PCBs, mimic sex hormones and interfere with the human body's reproductive and developmental functions.

Pollution also has a dramatic effect on natural resources. Ecosystems such as forests, wetlands, coral reefs, and rivers perform many important services for Earth's environment such as enhancing water and air quality, provide habitat for plants and animals, and provide food and medicines for man. These ecosystem functions may be impaired or destroyed by pollution. Moreover, because of the complex relationships among the many types of organisms and ecosystems, environmental contamination may have far-reaching consequences that are not immediately obvious or that are difficult to predict.

Another major effect of pollution is the tremendous cost of pollution cleanup and prevention. The global effort to control emissions of carbon dioxide, a gas produced from the combustion of fossil fuels such as coal or oil, or of other organic materials like wood, is one such example. The cost of maintaining annual national carbon dioxide emissions at 1990 levels is estimated to be 2 percent of the gross domestic product for developed countries.

In addition to pollution effects on the economy, health, and natural resources, it also has social implications. Research has shown that low-income populations and minorities do not receive the same protection from environmental contamination as do higher-income communities. Toxic waste incinerators, chemical plants, and solid waste dumps are often located in low-income communities because of a lack of organized, informed community involvement in municipal decision-making processes.

Course Aim

The course aims to provide a good understanding of Land and Water pollution.

Course Objectives

At the end this course, you should be able to:

a) Explain types of pollution and classify pollutants
b) Measure the impacts of pollution
c) Explain types of recycling and materials that can be recycled
d) Discuss on reasons for recycling
e) Explain the different types of resources conservation
f) List and explain types of water pollutants and classify water pollution
g) Explain on types of water pollutants and discuss on Global water pollution episode
h) Discuss on global efforts at controlling pollution

i) Define land and soil pollution and types
j) List and explain different sources of solid waste.
k) Identify the various causes of land pollution and its effects
l) Describe how land pollution can be prevented
m) Explain the effects of hazardous wastes and suggest methods of hazardous waste control
n) Identify the causes and effects of deforestation
o) Explain the implication of deforestation in Nigeria

Working through this Course

This course has been carefully put together bearing in mind the fact that it reflects Land and Water pollution. However, efforts have been made to ensure adequate explanation of various concepts and issues treated in the work. You are enjoined to spend ample of time to study the work and ensure that you attend tutorial session where you can ask questions and share your knowledge with that of your classmates.

Course Materials

You will be provided with the following materials:

A course guide
Study units

At the end of each unit, a list of recommended text books is provided and these are not compulsory for you to acquire or read, but are essentials to give you more insight into the various topics discussed.

Study Units

The course is divided into four modules and these are:

Module 1

Unit 1 What is Pollution?
Unit 2 Pollution and Impact of Pollution on the Environment
Unit 3 Environmental Pollution Control: Recycling
Unit 4 Conservation of Resources

Module 2

Unit 1 Water Pollution
Unit 2 Effects of Water Pollution
Unit 3 Controlling Water Pollution

Module 3

Unit 1 Land Pollution Defined
Unit 2 Causes and Effects of Land Pollution

Module 4

Unit 1 Hazardous Wastes: Effects and Control Measures
Unit 2 Deforestation: Causes and Effects
Unit 3 Forest Degradation as a Case Study in Nigeria

Module 1

In unit one, you will be taken through the various definition of pollution as well as primary and secondary effects of pollution. After this, you will be taken through the various types of pollution namely: Air pollution, Water pollution, Soil pollution and Noise pollution. Pollution and its impacts on the environment will also be looked into after which environmental pollution control through recycling will be evaluated. Our last topic in this module will be conservation of resources and these resources may either be renewable or nonrenewable.

Module 2

Water pollution form the core of unit one along with the classification of water pollution which may either be municipal water pollution, industrial water pollution and agriculture water pollution. Types of water pollutants will also be discussed in this unit as well as global water pollution episode. Also, we will talk on various effects of water pollution to man, plants and the entire environment and finally on this module, we will discuss on controlling water pollution and water quality.

Module 3

In unit one, you will learn about the various definitions of land pollution as well as the composition of land pollution namely solid waste and soil pollution.

In the second unit, the major causes of land pollution such as: increase in urbanization, increase in agricultural land, domestic waste, agricultural activities as well as industrial activities will be discussed. Apart from talking on the causes of land pollution, the various effects of land pollution such as exterminate wild life, acid rain, damage to crop etc will also be looked into, followed by ways by which land pollution can be prevented.

Module 4

Other forms of land pollution such as hazardous waste and deforestation form the basis of this module. In unit one, we will be introduced to various sources of hazardous waste such as: industrial activities, agricultural activities, household activities and medical activities followed by various effects and control measures of hazardous wastes. In the second unit, we will learn about various causes and effects of deforestation and the final unit of module four talked about forest degradation in Nigeria.

Text Books and References

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Schneiderman, Jill S. (2000). *The Earth Around Us:* (1999, 2000). *Maintaining a Livable Planet.* Freeman

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WHO: (1972). *Health Hazards of Human Environment*. Geneva: WHO.

Assessment

There are two components of assessment for this course. They are the Tutor-Marked Assignment (TMA), and the end of course examination.

Tutor-Marked Assignment

The TMA is the continuous assessment component of your course. It accounts for 30% of the total score. The TMAs will be given to you by your facilitator and you will return it after you have done the assignments.

Final Examination and Grading

This examination concludes the assessment for the course. It constitutes 70% of the whole course. You will be informed of the examination date.

Summary

This course intends to provide you with the knowledge of Land and Water pollution. By the end of this course you will be able to answer the following questions:

1. Define the following terms; (i) Pollution (ii)pollutants (iii) Secondary Pollutants (iv) Non-Biodegradable Pollutants
2. List the types of pollution that you know and discuss any two of them.
3. Discuss the impacts of pollution.
4. Define the term Pollutants and its classification.
5. Discuss the impacts of pollution.
6. Explain any four (4) reasons for recycling
7. Discuss any three (3) types of conservation that you know
8. Explain reasons why conservation of resources is necessary
9. Explain in detail any three (3) classes of water pollution that you know.
10. Discuss any four effects of water pollution
11. Discuss the effects of chemical contamination on water
12. Discuss global efforts at controlling pollution
13. What did you understand by water quality

14. What are the causes of land pollution?
15. What are the major effects of land pollution and how can it be prevented?
16. What are the effects of hazardous waste?
17. List and explain five (5) effects of deforestation.
18. What are the implications of deforestation in Nigeria

We wish you success in this course and hope that you will have a better understanding of the agro climatic phenomena in your environment.

Best of luck.

MAIN COURSE

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Headquarters
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Abuja Office
NOUN Building
No 5 Dar es Salam Street
Off Aminu Kano Crescent
Wuse II
Abuja, Lagos

e-mail: centralinfo@nou.edu.ng
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MODULE 1

UNIT 1 WHAT IS POLLUTION?

CONTENTS

1.0 INTRODUCTION

Pollution of the environment is one of the most horrible ecological crises the world is subjected to, today. The environment (Air, Land or Soil and Water) were in the past pure, virgin, undisturbed, uncontaminated and basically most hospitable for living organisms but the situation is just the reverse today. This is however largely due to innovations in science and technology leading to pollution of the environment and serious ecological imbalance which in the long run, may prove disastrous for mankind. Environmental pollution is the result of Urban-Industrial technological revolution and speedy exploitation of resources by man. As the craze of progress in agriculture, industry, transportation and technology are taken as the general criteria for any nations; these activities have created adverse effects on all living organisms in the biosphere. Rapid industrialization has left in its wake polluted air, water and soil, depleted wildlife and exhausted natural resources.

2.0 OBJECTIVES

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

- list different definitions of the term pollution
- explain the terms primary and secondary effects of pollution
- explain the different types of pollution.

3.0 MAIN CONTENT

3.1 Pollution Defined

A number of definitions have been proffered in explaining what pollution is. These include:

- Pollution is the unfavourable alteration of our environment because of human activities,
- It is the deliberate or accidental contamination of the environment.
- It is a deviation from the natural composition of a part of the environment, resulting in adverse effects on man.
- It is an undesirable change in physical, chemical or biological characteristics of water, air and soil that may harmfully affect human, animal and plant life, industrial progress, living conditions and cultural assets.
- Pollution is also viewed as the release of substances and energy as waste product of human activities which results in harmful changes within the natural environment.

Modern ecologists however points out that there are various factors such as human population explosion, rapid industrialization, deforestation, unplanned urbanization, scientific and technological advancement etc are mainly responsible for the pollution crises on earth.

3.2 Primary and Secondary Effects of Pollution

The effects of pollutants may be immediate or delayed.

3.2.1 Primary Effects of Pollution

Primary effects of pollution occur immediately after contamination occurs, such as the death of marine plants and wildlife after an oil spill at sea.

3.2.2 Secondary Effects of Pollution

Secondary effects may be delayed or may persist in the environment into the future, perhaps going unnoticed for many years. DDT, a non-degradable compound, seldom poisons birds immediately, but gradually accumulates in their bodies. Birds with high concentrations of this pesticide lay thin-shelled eggs that fail to hatch or produces deformed offspring. These secondary effects, threatened the survival of species such as the bald eagle and peregrine falcon, and aroused public concern over the hidden effects of non-degradable chemical compounds.

3.3 Types of Pollution

(a) Air Pollution

Human contamination of Earth's atmosphere can take many forms and has existed since humans first began to use fire for agriculture, heating, and cooking. During the Industrial Revolution of the 18th and 19th centuries, however, air pollution became a major problem. Urban air pollution is commonly known as smog. The dark smog is generally a smoky mixture of carbon monoxide and organic compounds from incomplete combustion (burning) of fossil fuels such as coal, and sulfur dioxide from impurities in the fuels. As the smog ages and reacts with oxygen, organic and sulfuric acids condense as droplets, increasing the haze. Smog developed into a major health hazard by the 20th century. In 1948, 19 people died and thousands were sickened by smog in the small U.S. steel-mill town of Donora, Pennsylvania. In 1952, about 4,000 Londoners died of its effects.

A second type of smog, photochemical smog is caused by combustion in car, truck, and airplane engines, which produces nitrogen oxides and releases hydrocarbons from unburned fuels. Sunlight causes the nitrogen oxides and hydrocarbons to combine and turn oxygen into ozone, a chemical agent that attacks rubber, injures plants, and irritates lungs. The hydrocarbons are oxidized into materials that condense and form a visible, pungent haze.

Eventually most pollutants are washed out of the air by rain, snow, fog, or mist, but only after travelling and covering large distances, sometimes across continents. As pollutants build up in the atmosphere, sulfur and nitrogen oxides are converted into acids that mix with rain. This acid rain falls in lakes and on forests, where it can lead to the death of fish and plants, and damage entire ecosystems. Eventually the contaminated lakes and forests may become lifeless. Regions that are downwind of heavily industrialized areas, such as Europe and the eastern United States and Canada, are the hardest hit by acid rain. Acid rain can also

affect human health and man-made objects; it is slowly dissolving historic stone statues and building facades in London, Athens, and Rome.

One of the greatest challenges caused by air pollution is global warming, an increase in Earth's temperature due to the buildup of certain atmospheric gases such as carbon dioxide. With the heavy use of fossil fuels in the 20th century, atmospheric concentrations of carbon dioxide have risen dramatically. Carbon dioxide and other gases, known as greenhouse gases, reduce the escape of heat from the planet without blocking radiation coming from the Sun. Air pollution can also damage the upper atmospheric region known as the stratosphere. Excessive production of chlorine-containing compounds such as chlorofluorocarbons (CFCs) (compounds formerly used in refrigerators, air conditioners, and in the manufacture of polystyrene products) has depleted the stratospheric ozone layer, creating a hole above Antarctica that lasts for several weeks each year. As a result, exposure to the Sun's harmful rays has damaged aquatic and terrestrial wildlife and threatens human health in high-latitude regions of the northern and southern hemispheres.

(b) Water Pollution

The demand for fresh water rises continuously as the world's population grows. From 1940 to 1990 withdrawals of fresh water from rivers, lakes, reservoirs, and other sources increased fourfold. Sewage, industrial wastes, and agricultural chemicals such as fertilizers and pesticides are the main causes of water pollution. In developing nations, more than 95 percent of urban sewage is discharged untreated into rivers and bays, creating a major human health hazard.

Water runoff, a nonpoint source of pollution, carries fertilizing chemicals such as phosphates and nitrates from agricultural fields and yards into lakes, streams, and rivers. These combine with the phosphates and nitrates from sewage to speed the growth of algae, a type of plantlike organism. The water body may then become choked with decaying algae, which severely depletes the oxygen supply. This process, called eutrophication, can cause the death of fish and other aquatic life. Agricultural runoff may be to blame for the growth of a toxic form of algae called *Pfiesteria piscicida,* which was responsible for killing large amounts of fish in bodies of water from the Delaware Bay to the Gulf of Mexico in the late 1990s. Runoff also carries toxic pesticides and urban and industrial wastes into lakes and streams.

Erosion, the wearing away of topsoil by wind and rain, also contributes to water pollution. Soil and silt fine sediment) washed from logged

hillsides, plowed fields, or construction sites, can clog waterways and kill aquatic vegetation. Even small amounts of silt can eliminate desirable fish species. For example, when logging removes the protective plant cover from hillsides, rain may wash soil and silt into streams, covering the gravel beds that trout or salmon use for spawning.

The marine fisheries supported by ocean ecosystems are an essential source of protein, particularly for people in developing countries. Yet pollution in coastal bays, estuaries, and wetlands threatens fish stocks already depleted by overfishing. In 1989, 260,000 barrels of oil spilled from the oil tanker *Exxon Valdez* into Alaska's Prince William Sound, a pristine and rich fishing ground. In 1999 there were 8,539 reported spills in and around U.S. waters, involving 4.4 billion liters (1.2 billion gallons) of oil.

(c) Soil Pollution

Soil is a mixture of mineral, plant, and animal materials that form during a long process that may take thousands of years. It is necessary for most plant growth and is essential for all agricultural production. Soil pollution is a buildup of toxic chemical compounds, salts, pathogens (disease-causing organisms), or radioactive materials that can affect plant and animal life.

Unhealthy soil management methods have seriously degraded soil quality, causing soil pollution, and enhanced erosion. Treating the soil with chemical fertilizers, pesticides, and fungicides interferes with the natural processes occurring within the soil and destroys useful organisms such as bacteria, fungi, and other microorganisms. For instance, strawberry farmers in California fumigate the soil with methyl bromide to destroy organisms that may harm young strawberry plants. This process indiscriminately kills even beneficial microorganisms and leaves the soil sterile and dependent upon fertilizer to support plant growth. This results in heavy fertilizer use and increases polluted runoff into lakes and streams.

(d) Noise Pollution

Unwanted sound, or noise, such as that produced by airplanes, traffic, or industrial machinery, is considered a form of pollution. Noise pollution is at its worst in densely populated areas. It can cause hearing loss, stress, high blood pressure, sleep loss, distraction, and lost productivity.
Sounds are produced by objects that vibrate at a rate that the ear can detect. This rate is called frequency and is measured in hertz, or vibrations per second. Most humans can hear sounds between 20 and 20,000 hertz, while dogs can hear high-pitched sounds up to 50,000

hertz. While high-frequency sounds tend to be more hazardous and more annoying to hearing than low-frequency sounds, most noise pollution damage is related to the intensity of the sound, or the amount of energy it has. Measured in decibels, noise intensity can range from zero, the quietest sound the human ear can detect, to over 160 decibels. Conversation takes place at around 40 decibels, a subway train is about 80 decibels, and a rock concert is from 80 to 100 decibels. The intensity of a nearby jet taking off is about 110 decibels. The threshold for pain, tissue damage, and potential hearing loss in humans is 120 decibels. Long-lasting, high-intensity sounds are the most damaging to hearing and produce the most stress in humans.

Solutions to noise pollution include adding insulation and sound-proofs to doors, walls, and ceilings; using ear protection, particularly in industrial working areas; planting vegetation to absorb and screen out noise pollution; and zoning urban areas to maintain a separation between residential areas and zones of excessive noise.

4.0 CONCLUSION

Pollution, contamination of Earth's environment with materials that interfere with human health, the quality of life, or the natural functioning of ecosystems (living organisms and their physical surroundings). Although some environmental pollution is as a result of natural causes such as volcanic eruptions, most is caused by human activities.

5.0 SUMMARY

In this unit we have learnt that:

- Environmental pollution is one of the most horrible ecological crises the world is subjected today.
- The greatest challenges caused by air pollution is global warming
- Sewage, industrial wastes, and agricultural chemicals such as fertilizers and pesticides are the main causes of water pollution
- Soil pollution is a buildup of toxic chemical compounds, salts, pathogens (disease-causing organisms), or radioactive materials that can affect plant and animal life.
- Ecosystem functions may be impaired or destroyed by pollution.

6.0 TUTOR -MARKED ASSIGNMENT

1. Define the following terms; (i) Pollution (ii)pollutants (iii) Secondary Pollutants (iv) Non-Biodegradable Pollutants
2. List the types of pollution that you know and discuss any two of them.
3. Discuss the impacts of pollution.

7.0 REFERENCES/FURTHER READING

Chandler, Gary, and Kevin Graham. (1996). *Protecting Our Air, Land, and Water.* Twenty-First Century.

Hoff, Mary, and Mary M. Rodgers. *Our Endangered Planet: Groundwater.*

McNeil, J. R. (2000, 2001). *Something New Under the Sun: An Environmental History of the Twentieth-Century World.* Norton.

Miller, G. T. Jr. (2002). *Living in the Environment: Principles, Connections, and Solutions.* 12th ed. Brooks/Cole.

UNIT 2 POLLUTANTS AND THEIR IMPACT ON THE ENVIRONMENT

CONTENTS

1.0 INTRODUCTION

Pollution is usually brought about by the addition of waste products of human activities to the environment. When the waste products are not efficiently assimilated, decomposed or otherwise removed by the natural, biological and physical processes of the biosphere, adverse effects may result as the pollutants accumulate or get converted into more toxic substances. *Thus, the materials which cause pollution of the environment are called Pollutants.* It could also be defined as a harmful solid, liquid or gaseous substance present in such concentration in the environment which tends to be injurious for the whole biota

2.0 OBJECTIVES

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

- explain the term pollutants
- identify pollutants
- explain the impacts of pollution.

3.0 MAIN CONTENT

3.1 Classification of Pollutants

Pollutants can be classified in a number of ways:

3.1.1 Classification by the Forms they exist in the Environment after Their Release

On this basis, pollutants can be:

(a) **Primary Pollutants:** These substances are emitted directly from an identified source. These pollutants exist as such after being added or released to the environment. Examples are sulphur dioxide, nitrogen oxides, etc.

(b) **Secondary Pollutants:** These are substances derived from primary pollutants by chemical reaction e.g. primary pollutants such as hydrocarbons and nitrogen oxides, particularly in the environment react in the presence of sunlight to form a group of nitrous compounds like peroxyacetyl nitrate (PAN) as the secondary pollutant.

3.1.2 Classification from the Ecosystem Point of View

The pollutants may be classified as Biodegradable and Non-Biodegradable Pollutants.

(a) **Biodegradable Pollutants:** These include domestic sewages, heat etc. These are pollutants that can readily decompose by natural process or by engineered process (such as municipal sewage treatment plant) which enhance capacity of nature to decompose and recycle.

(b) **Non-Biodegradable Pollutants:** These are pollutants such as aluminium, iron, mercury salt etc which are usually not present in the environment. These either do not degrade or degrade only very slowly or partially and thereby pollute the environment. Such pollutants are harmful even in low concentration. These pollutants not only accumulate, but are often biologically magnified as they move in biological cycles and along food chains. They may also react with other compounds present in the environment to produce even more toxic additional products.

3.2 Impacts of Pollution

Because humans are at the top of the food chain, they are particularly vulnerable to the effects of nondegradable pollutants. This was clearly illustrated in the 1950s and 1960s when residents living near Minamata Bay, Japan, developed nervous disorders, tremors, and paralysis in a mysterious epidemic. More than 400 people died before authorities discovered that a local industry had released mercury into Minamata Bay. This highly toxic element accumulated in the bodies of local fish and eventually in the bodies of people who consumed the fish. More recently research has revealed that many chemical pollutants, such as DDT and PCBs, mimic sex hormones and interfere with the human body's reproductive and developmental functions.

Pollution also has a dramatic effect on natural resources. Ecosystems such as forests, wetlands, coral reefs, and rivers perform many important services for Earth's environment. They enhance water and air quality, provide habitat for plants and animals, and provide food and medicines. Any or all of these ecosystem functions may be impaired or destroyed by pollution. Moreover, because of the complex relationships among the many types of organisms and ecosystems, environmental contamination may have far-reaching consequences that are not immediately obvious or that are difficult to predict. For instance, scientists can only speculate on some of the potential impacts of the depletion of the ozone layer, the protective layer in the atmosphere that shields Earth from the Sun's harmful ultraviolet rays.

Another major effect of pollution is the tremendous cost of pollution cleanup and prevention. The global effort to control emissions of carbon dioxide, a gas produced from the combustion of fossil fuels such as coal or oil, or of other organic materials like wood, is one such example. The cost of maintaining annual national carbon dioxide emissions at 1990 levels is estimated to be 2 percent of the gross domestic product for developed countries.

In addition to its effects on the economy, health, and natural resources, pollution has social implications. Research has shown that low-income populations and minorities do not receive the same protection from environmental contamination as do higher-income communities. Toxic waste incinerators, chemical plants, and solid waste dumps are often located in low-income communities because of a lack of organized, informed community involvement in municipal decision-making processes.

4.0 CONCLUSION

Plants and animals require water that is moderately pure, and they cannot survive if their water is loaded with toxic chemicals or harmful microorganisms. If severe, pollution can kill large numbers of fish, birds, and other animals, in some cases killing all members of a species in an affected area. The environment has become contaminated, undesirable and therefore, harmful for the health of living organisms, including man.

5.0 SUMMARY

In this unit, we have learnt that:

- Pollutants can be defined as a harmful solid, liquid or gaseous substance present in such concentration in the environment which tends to be injurious for the whole biota
- Humans are at the top of the food chain, they are particularly vulnerable to the effects of nondegradable pollutants
- Pollution also has a dramatic effect on natural resources
- In addition to its effects on the economy, health, and natural resources, pollution has social implications

6.0 TUTOR -MARKED ASSIGNMENT

1. Define the term Pollutants and its classification.
2. Discuss the impacts of pollution.

7.0 REFERENCES/FURTHER READING

Miller, G. T., Jr. (2002). *Living in the Environment: Principles, Connections, and Solutions.* 12th ed. Brooks/Cole

Chandler, Gary, and Kevin Graham. (1996). *Protecting Our Air, Land, and Water.* Twenty-First Century.

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Chandler, Gary, and Kevin Graham. (1996). *Protecting Our Air, Land, and Water.* Twenty-First Century

UNIT 3 ENVIRONMENTAL POLLUTION CONTROL: RECYCLING

CONTENTS

1.0 INTRODUCTION

Recycling is the collection, processing, and reuse of materials that would otherwise be thrown away. Materials ranging from precious metals to broken glass, from old newspapers to plastic spoons, can be recycled. The recycling process reclaims the original material and uses it in producing new products.

2.0 OBJECTIVES

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

- describe the term recycling
- explain types of recycling
- describe the different types of materials that can be recycled
- explain the reasons for recycling.

3.0 MAIN CONTENT

3.1 Internal and External Recycling

Recycling can be done internally (within a company) or externally (after a product is sold and used).

3.1.1 Internal Recycling

Internal recycling occurs in the paper industry, for example, when leftover stock and trimmings are salvaged to help make more new product. Since the recovered material never left the manufacturing plant, the final product is said to contain preconsumer waste.

3.1.2 External Recycling

External recycling occurs when materials used by the customer are returned for processing into new products. Materials ready to be recycled in this manner, such as empty beverage containers, are called postconsumer waste.

3.2 Types of Materials Recycled

Just about any material can be recycled. On an industrial scale, the most commonly recycled materials are those that are used in large quantities —metals such as steel and aluminum, plastics, paper, glass, and certain chemicals.

Steel

There are two methods of making steel using recycled material: the *basic oxygen furnace* (BOF) method and the *electric arc furnace* (EAF) method. The BOF method involves mixing molten scrap steel in a furnace with new steel. About 28 percent of the new product is recycled steel. Steel made by the BOF method typically is used to make sheet-steel products like cans, automobiles, and appliances. The EAF method normally uses 100 percent recycled steel. Scrap steel is placed in a furnace and melted by electricity that arcs between two carbon electrodes. Limestone and other materials are added to the molten steel to remove impurities. Steel produced by the EAF method usually is formed into beams, reinforcing bars, and thick plate. Approximately 64 percent of all steel is recycled; making it one of the worlds's most recycled materials.

Aluminum

The overall recycling rate of all forms of aluminum is about 35 percent. Cans brought to collection centers are crushed, baled, and shipped to regional mills or reclamation plants. The cans are then shredded to reduce volume and heated to remove coatings and moisture. Next, they are put into a furnace, melted, and formed into ingots, or bars, weighing 10,000 kg (30,000 lb) or more. The ingots go to another mill to be rolled into sheets. The sheets are sent to a container plant and cut into disks

from which new cans are formed. The cans are printed with the beverage makers' logos and are shipped (with tops separate) to the filling plant.

Plastics

Plastics are more difficult to recycle than metal, paper, or glass. One of the problems is that any of the seven categories of plastics can be used for containers alone. For effective recycling, the different types cannot be mixed. Most states require that plastic containers have identification codes so that they can be more easily identified and separated. The code assigns a particular number to each of the seven plastics used in packaging. Number 1 refers to polyethylene teraphthalate (PET) and number 2 refers to high-density polyethylene (HDPE). PET can be made into carpet, or fiberfill for ski jackets and clothing. HDPE can be recycled into construction fencing, landfill liners, and a variety of other products. Plastics coded with the number 6 are polystyrene (PS), which can be recycled into cafeteria trays, combs, and other items.

The recycling process for plastic normally involves cleaning it, shredding it into flakes, then melting the flakes into pellets. The pellets are then melted into a final product. Some products work best with only a small percentage of recycled content. Other products, such as HDPE plastic milk cases, can be made successfully with 100 percent recycled content. The plastic container industry has concentrated on weight reduction and source reduction. For example, the one-gallon HDPE milk container that weighed about 120 gm (about 4.2 oz) in the 1960s weighed just 65 gm (about 2.3 oz) in 1996.

Paper and Paper Products

Paper products that can be recycled include cardboard containers, wrapping paper, and office paper. The most commonly recycled paper product is newsprint.

In newspaper recycling, old newspapers are collected and searched for contaminants such as plastic bags and aluminum foil. The paper goes to a processing plant where it is mixed with hot water and turned into pulp in a machine that works much like a big kitchen blender. The pulp is screened and filtered to remove smaller contaminants. The pulp then goes to a large vat where the ink separates from the paper fibers and floats to the surface. The ink is skimmed off, dried and reused as ink or burned as boiler fuel. The cleaned pulp is mixed with new wood fibers to be made into paper again.

Glass

Scrap glass taken from the glass manufacturing process, called cullet, has been internally recycled for years. The scrap glass is economical to use as a raw material because it melts at lower temperatures than other raw materials, thus saving fuel and operating costs.

Glass that is to be recycled must be relatively free from impurities and sorted by color. Glass containers are the most commonly recycled form of glass, and their colors are flint (clear), amber (brown), and green. Other glass, such as window glass, pottery, and cooking utensils, are considered contaminants because they have different compositions from glass used in containers. The recycled glass is melted in a furnace and formed into new products.

Chemicals and Hazardous Waste

Household hazardous wastes include drain cleaners, oven cleaners, window cleaners, disinfectants, motor oil, paints, paint thinners, and pesticides. Most municipalities ban hazardous waste from the regular trash. Periodically, citizens are alerted that they can take their hazardous waste to a collection point where trained workers sort it, recycle what they can, and package the remainder in special leak-proof containers called lab packs, for safe disposal. Typical materials recycled from the collection drives are motor oil, paint, antifreeze, and tires.

Business and industry have made much progress in reducing both the hazardous waste they generate and its toxicity. Although large quantities of chemical solvents are used in cleaning processes, technology has been developed to clean and reuse solvents that used to be discarded. Even the vapors evaporated from the process are recovered and put back into the recycled solvent. Some processes that formerly used solvents no longer require them.

Nuclear Waste

Certain types of nuclear waste can be recycled, while other types are considered too dangerous to recycle. Low-level wastes include radioactive material from research activities, medical wastes, and contaminated machinery from nuclear reactors. Nickel is the major metal of construction in the nuclear power field and much of it is recycled after surface contamination has been removed.

High-level wastes come from the reprocessing of spent fuel (partially depleted reactor fuel) and from the processing of nuclear weapons. These wastes emit gamma radiation, which can cause birth defects,

disease, and death. High-level nuclear waste is so toxic it is not normally recycled. Instead, it is fused into inert glass tubes encased in stainless steel cylinders, which are then stored underground.

3.3 Reasons for Recycling

Rare materials, such as gold and silver, are recycled because acquiring new supplies is expensive. Other materials may not be as expensive to replace, but they are recycled to conserve energy, reduce pollution, conserve land, and to save money.

Resource Conservation

Recycling conserves natural resources by reducing the need for new material. Some natural resources are renewable, meaning they can be replaced, and some are not Paper, corrugated board, and other paper products come from renewable timber sources. Trees harvested to make those products can be replaced by growing more trees. Iron and aluminum come from nonrenewable ore deposits. Once a deposit is mined, it cannot be replaced.

Energy Conservation

Recycling saves energy by reducing the need to process new material, which usually requires more energy than the recycling process. To make aluminum can from recycled metal takes only 5 percent of the total energy needed to produce the same aluminum can from unrecycled materials, a 95 percent energy savings. Recycled paper and paperboard require 75 percent less energy to produce than new products. Significant energy savings result in the recycling of steel and glass, as well.

Pollution Reduction

Recycling reduces pollution because recycling a product creates less pollution than producing a new one. For every ton of newspaper recycled, 7 fewer kg (16 lb) of air pollutants are pumped into the atmosphere. Recycling can also reduce pollution by recycling safer products to replace those that pollute. Some countries still use chlorofluorocarbons (CFCs) to manufacture foam products such as cups and plates. Many scientists suspect that CFCs harm the atmosphere's protective layer of ozone. Using recycled plastic instead for those products eliminates the creation of harmful CFCs.

Land Conservation

Recycling saves valuable landfill space, land that must be set aside for dumping trash, construction debris, and yard waste. Landfills fill up quickly and acceptable sites for new ones are difficult to find because of objections by neighbours to noise and smells, and the hazard of leaks into underground water supplies. The two major ways to reduce the need for new landfills are to generate less initial waste and to recycle products that would normally be considered waste. Solid waste can also be burned instead of buried in the ground.

Economic Savings

Recycling in the short term is not always economically profitable or a break-even financial operation. Most experts contend, however, that the economic consequences of recycling are positive in the long term. Recycling will save money if potential landfill sites are used for more productive purposes and by reducing the number of pollution-related illnesses.

4.0 CONCLUSION

In general, using recycled materials to make new products costs less and requires less energy than using new materials and recycling can also reduce pollution, either by reducing the demand for high-pollution alternatives or by minimizing the amount of pollution produced during the manufacturing process. Recycling decreases the amount of land needed for trash dumps by reducing the volume of discarded waste.

5.0 SUMMARY

In this unit, we have learnt that:

- Recycling is the collection, processing, and reuse of materials that would otherwise be thrown away
- The most commonly recycled materials are those that are used in large quantities
- Recycling conserves natural resources by reducing the need for new material
- Recycling saves energy by reducing the need to process new material, which usually requires more energy than the recycling process
- Recycling reduces pollution because recycling a product creates less pollution than producing a new one
- Recycling saves valuable landfill space, land that must be set aside for dumping trash, construction debris, and yard waste

6.0 TUTOR -MARKED ASSIGNMENT

19. Write short note on the followings:

(i) Recycling
(ii) Internal Recycling
(iii) External Recycling

20. List and explain any four (4) materials that can be recycled
21. Explain any four (4) reasons for recycling

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UNIT 4 CONSERVATION OF RESOURCES

CONTENTS

1.0 INTRODUCTION

Conservation is sustainable use and protection of natural resources including plants, animals, mineral deposits, soils, clean water, clean air, and fossil fuels such as coal, petroleum, and natural gas.

2.0 OBJECTIVES

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

- explain the term conservation
- identify the difference between renewable and non-renewable resources
- explain the different types of resources conservation
- list the reasons for resource conservation
- explain the term conservation conflict.

3.0 MAIN CONTENT

3.1 Renewable and Non-renewable Resources

3.1.1 A Renewable Resource

A renewable resource is one that may be replaced over time by natural processes, such as fish populations or natural vegetation, or is inexhaustible, such as solar energy. The goal of renewable resource conservation is to ensure that such resources are not consumed faster than they are replaced.

3.1.2 Non-Renewable Resources

Nonrenewable resources are those in limited supply that cannot be replaced or can be replaced only over extremely long periods of time. Nonrenewable resources include fossil fuels and mineral deposits, such as iron ore and gold ore. Conservation activities for nonrenewable resources focus on maintaining an adequate supply of these resources well into the future.

3.2 Types of Conservation

(a) Biodiversity Conservation

Biodiversity, or biological diversity, denotes the number and variety of different organisms and ecosystems in a certain area. Preserving biodiversity is essential for ecosystems to respond flexibly to damage or change. For example, a single-species corn crop may be quickly destroyed by a certain insect or disease, but if several different species of corn are planted in the field, some of them may resist the insect or disease and survive. The same principle applies to natural areas, which adapt to natural environmental changes such as wildfire, drought, or disease because of the biodiversity that has evolved in the area over thousands, or even millions, of years. Some trees, such as lodge pole pine, may even require fire to aid in reproduction. These trees produce cones that are opened by extreme heat. The fire opens the cones and the seeds are then released into the soil.

Humans benefit greatly from the many medicines, crops, and other products that biodiversity provides. It has been noted that as many as 40 percent of our modern pharmaceutical medicines are derived from plants or animals. For instance, a small plant from Madagascar, the rosy periwinkle, produces substances that are effective in fighting two deadly cancers, Hodgkin's disease and leukemia.

Unfortunately, human activities have greatly reduced biodiversity around the world. The 20th century encompasses one of the greatest waves of extinction, or elimination of species, to occur on the planet. The greatest threat to biodiversity is loss of habitat as humans develop land for agriculture, grazing livestock, industry, and habitation. The most drastic damage has occurred in the tropical rain forests, which cover less than seven percent of the Earth's surface but contain well over half of the planet's biodiversity.

Several nations have laws protecting endangered species. An international treaty, the Convention on International Trade in

Endangered Species of Wild Fauna and Flora (CITES), went into effect in 1975 and outlawed trade of endangered animals and animal parts.

(b) Forest Conservation

Forests provide many social, economic, and environmental benefits. In addition to timber and paper products, forests provide wildlife habitat and recreational opportunities, prevent soil erosion and flooding, help provide clean air and water, and contain tremendous biodiversity. Forests are also an important defense against global climate change. Through the process of photosynthesis, forests produce life-giving oxygen and consume huge amounts of carbon dioxide, the atmospheric chemical most responsible for global warming. By decreasing the amount of carbon dioxide in the atmosphere, forests may reduce the effects of global warming.

However, huge areas of the richest forests in the world have been cleared for wood fuel, timber products, agriculture, and livestock. These forests are rapidly disappearing. The tropical rain forests of the Brazilian Amazon River basin were cut down at an estimated rate of 14 million hectares (35 million acres) each year. The countries with the most tropical forests tend to be developing and fast becoming the overpopulated nations in the southern hemisphere. Due to poor economies, people resort to clearing the forest and planting crops in order to survive. While there have been effective efforts to stop deforestation directly through boycotts of multinational corporations responsible for exploitative logging, the most effective conservation policies in these countries have been efforts to relieve poverty and expand access to education and health care.

In 2005 the Food and Agriculture Organization of the United Nations issued a major report, titled "Global Forest Resources Assessment 2005," on the status of the world's forests. Based on a five-year study, the report found that forested areas throughout the world were continuing to decline at a rate of about 7.3 million hectares (18 million acres) per year, an area equivalent in size to Panama or Sierra Leone. However, the rate of decline had slowed in comparison with the period from 1990 to 2000, when the world lost about 8.9 million hectares (22 million acres) of forested area per year. Africa and South America continued to have the largest net loss of forests, while forest loss also continued in North and Central America and the Pacific Islands. Only Europe and Asia showed a net gain in forested areas due to forest planting, landscape restoration, and expansion of natural forests. China, in particular, reported a large-scale afforestation effort. In 2005 the world's total forest area was just less than 4 billion hectares (10 billion acres).

(c) Soil Conservation

Soil, a mixture of mineral, plant, and animal materials, is essential for most plant growth and is the basic resource for agricultural production. Soil-forming processes may take thousands of years, and are slowed by natural erosion forces such as wind and rain. Humans have accelerated these erosion processes by developing the land and clearing away the vegetation that holds water and soil in place. The rapid deforestation taking place in the tropics is especially damaging because the thin layer of soil that remains is fragile and quickly washes away when exposed to the heavy tropical rains. Globally, agriculture accounts for 28 percent of the nearly 2 billion hectares (5 billion acres) of soil that have been degraded by human activities; overgrazing is responsible for 34 percent; and deforestation is responsible for 29 percent.

In addition to reducing deforestation and overgrazing, soil conservation involves reforming agricultural soil management methods. Some of the most effective methods include strip-cropping, alternating strips of crop and uncultivated land to minimize erosion and water runoffs; contour farming, planting crops along the contours of sloping lands to minimize erosion and runoff; terracing, which also reduces erosion and runoffs on slopes; growing legumes, such as clover or soybeans, to restore essential nitrogen in the soil and minimizing tillage, or plowing, to reduce erosion.

(d) Water Conservation

Clean freshwater resources are essential for drinking, bathing, cooking, irrigation, industry, and for plant and animal survival. Unfortunately, the global supply of freshwater is distributed unevenly. Chronic water shortages exist in most of Africa and drought is common over much of the globe. The sources of most freshwater supplies—groundwater (water located below the soil surface), reservoirs, and rivers—are under severe and increasing environmental stress because of overuse, water pollution, and ecosystem degradation. Over 95 percent of urban sewage in developing countries is discharged untreated into surface waters such as rivers and harbors.

About 65 percent of the global freshwater supply is used in agriculture and 25 percent is used in industry. Freshwater conservation therefore requires a reduction in wasteful practices like inefficient irrigation, reforms in agriculture and industry, and strict pollution controls worldwide.
In addition, water supplies can be increased through effective management of *watersheds* (areas that drain into one shared waterway).

By restoring natural vegetation to forests or fields, communities can increase the storage and filtering capacity of these watersheds and minimize wasteful flooding and erosion. Restoration and protection of wetlands is crucial to water conservation. Like giant sponges, wetlands stabilize groundwater supplies by holding rainfall and discharging the water slowly, acting as natural flood-control reservoirs.

(e) Energy Conservation

All human cultures require the production and use of *energy*—that is, resources with the capacity to produce work or power. Energy is used for transportation, heating, cooling, cooking, lighting, and industrial production. The world energy supply depends on many different resources including traditional fuels such as firewood and animal waste, which are significant energy sources in many developing countries. Fossil fuels account for more than 90 percent of global energy production but are considered problematic resources. They are nonrenewable—that is, they can be depleted, and their use causes air pollution. In particular, coal plants have been one of the worst industrial polluters since the beginning of the Industrial Revolution of the 19th century. Moreover, mining or drilling for fossil fuels has caused extensive environmental damage.

There is a global need to increase energy conservation and the use of renewable energy resources. Renewable alternatives such as waterpower (using the energy of moving water, such as rivers), solar energy (using the energy from the sun), wind energy (using the energy of the wind or air currents), and geothermal energy (using energy contained in hot-water deposits within the Earth's crust) are efficient and practical but largely underutilized because of the ready availability of inexpensive, nonrenewable fossil fuels in industrial countries.

While some countries, such as France and Japan, depend heavily on nuclear energy (energy produced by atomic fission, or splitting of the atom), it is still not a major energy source. Excessive production costs, serious safety concerns, and problems with the handling of the dangerous radioactive wastes have virtually eliminated it as a viable energy source.

In addition to using alternative energy resources such as solar and wind power, energy conservation measures include improving energy efficiency. In the household, energy can be conserved by turning down thermostats, switching off unnecessary lights, insulating homes, and using less hot water.

3.3 Reasons for Conservation

The challenge of conservation is to understand the complex connections among natural resources and balance resource use with protection to ensure an adequate supply for future generations.

To Reduce Natural-Resource Consumption

Consumption of natural resources rises dramatically every year as the human population increases and standards of living rise. From 1950 to 2000 the world population more than doubled to 6 billion people, with nearly 80 percent living in developing, or poorer, nations. The large, developed nations, however, are responsible for the greatest consumption of natural resources because of their high standards of living. For instance, the average American consumes as much energy as 27 Filipinos or 370 Ethiopians. Conservation education and the thoughtful use of resources are necessary in the developed countries to reduce natural-resource consumption. For example, reducing the high demand for tropical hardwoods such as teak and mahogany in the United States and Japan would slow the rate of tropical forest destruction.

To Protect Natural Resources from Pollution

Conservation of Natural Resources is done in order to protect natural resources from pollution. Here, all the stake holders involved (Individuals, industries, and governments) have many obligations. These include prohibiting or limiting the use of pesticides and other toxic chemicals, limiting wastewater and airborne pollutants, preventing the production of radioactive materials, and regulating drilling and transportation of petroleum products. Failure to do so results in some countries have been implicated for contaminated air, soil, rivers, plants, and animals. For example, if governments required that all oil tankers be fitted with double-layered hulls, the damages to fisheries and wildlife from the many oil spills of the 20th century may have been reduced.

To Reduce Waste

In many cases it is possible to reuse or recycle resources to reduce waste and resource consumption and conserve the energy needed to produce consumer products. For example, paper, glass, freon (a refrigerant gas), aluminum, metal scrap, and motor oil can all be recycled. A preventative measure called recycling, a general term for designing more durable, recyclable products such as reusable packaging, encourages reuse.

To Prevent Valuable Resource from Misuse

Some resources are so unique or valuable that they are protected from activities that would destroy or degrade them. For example, protecting national parks and wilderness areas from logging or mining because such activities would reduce the economic, recreational, and aesthetic values of the resource. Forests and wetlands (areas with high soil moisture or surface water) may be protected from development because they enhance air and water quality and provide habitat for a wide variety of plants and animals. Unfortunately, these areas are often threatened with development because it is difficult to measure the economic benefits of cleaner air, cleaner water, and the many other environmental benefits of these ecosystems (the plants and animals of a natural community and their physical environment).

3.4 Conservation Conflicts

Conservation conflicts arise when natural-resource shortages develop in the face of steadily increasing demands from a growing human population. Controversy frequently surrounds how a resource should be used, or allocated, and for whom. For example, a river may supply water for agricultural irrigation, habitat for fish, and water-generated electricity for a factory. Farmers, fishers, and industry leaders vie for unrestricted access to this river, but such freedom could destroy the resource, and conservation methods are necessary to protect the river for future use.

Conflicts worsen when a natural resource crosses political boundaries. For example, the headwaters, or source, of a major river may be located in a different country than the country through which the river flows. There is no guarantee that the river source will be protected to accommodate resource needs downstream. In addition, the way in which one natural resource is managed has a direct effect upon other natural resources. Cutting down a forest near a river, for instance, increases erosion, the wearing away of topsoil, and can lead to flooding. Eroded soil and silt cloud the river and adversely affect many organisms such as fish and important aquatic plants that require clean, clear freshwater for survival.

4.0 CONCLUSION

Natural resources are conserved for their biological, economic, and recreational values, as well as their natural beauty and importance to local cultures. For example, tropical rain forests are protected for their important role in both global ecology and the economic livelihood of the local culture; a coral reef may be protected for its recreational value for scuba divers; and a scenic river may be protected for its natural beauty.

5.0 SUMMARY

In this unit, we have learnt that:

- Conservation is sustainable use and protection of natural resources
- A renewable resource is one that may be replaced over time by natural processes
- Nonrenewable resources are those in limited supply that cannot be replaced or can be replaced only over extremely long periods of time
- Preserving biodiversity is essential for ecosystems to respond flexibly to damage or change
- Humans benefit greatly from the many medicines, crops, and other products that biodiversity provides
- Forests provide many social, economic, and environmental benefits
- Soil, a mixture of mineral, plant, and animal materials, is essential for most plant growth and is the basic resource for agricultural production
- Global supply of freshwater is distributed unevenly
- There is a global need to increase energy conservation and the use of renewable energy resources
- Conservation education and the thoughtful use of resources is necessary in the developed countries to reduce natural-resource consumption
- Conservation of Natural Resources is done in order to protect natural resources from pollution
- Some resources are so unique or valuable that they need to be protected from activities that would destroy or degrade them
- Conservation conflicts arise when natural-resource shortages develop in the face of steadily increasing demands from a growing human population

6.0 TUTOR -MARKED ASSIGNMENT

1. Write short notes on the followings:

(i) Conservation of resources
(ii) Renewable resources

(iii) Non-Renewable resources
(iv) Conservation conflict

2. Discuss on any three (3) types of conservation that you know
3. Explain on reasons why conservation of resources is necessary

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MODULE 2

Unit 1 Water Pollution
Unit 2 Effect of Water Pollution
Unit 3 Controlling Water Pollution

UNIT 1 WATER POLLUTION

CONTENTS

1.0 INTRODUCTION

Water pollution occurs when a body of water is adversely affected due to the addition of large amounts of materials to the water. When it is unfit for its intended use, water is considered polluted. Water Pollution is the contamination of streams, lakes, underground water, bays, or oceans by substances harmful to living things. Water is necessary to life on earth and all organisms contain it; some live in it; some drink it. Pollution makes streams, lakes, and coastal waters unpleasant to look at, to smell, and to swim in. Fish and shellfish harvested from polluted waters may be unsafe to eat. People who ingest polluted water can become ill, and, with prolonged exposure, may develop cancers or bear children with birth defects.

2.0 OBJECTIVES

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

- describe the difference between point and nonpoint sources of water pollutants
- identify and explain types of water pollutants
- describe water pollution
- identify and explain types of water pollutants
- explain Global water pollution episode.

3.0 MAIN CONTENT

3.1 Sources of Water pollutants

3.1.1 Point Source

This occurs when harmful substances are emitted directly into a body of water. An example of a point source of water pollution is a pipe from an industrial facility discharging effluent directly into a river. Point-source pollution is usually monitored and regulated, at least in Western countries, though political factors may complicate how successful efforts are at true pollution control. The technology exists for point sources of pollution to be monitored and regulated, although political factors may complicate matters.

3.1.2 Nonpoint Source

Nonpoint source — delivers pollutants indirectly through transport or environmental change. Nonpoint sources are much more difficult to monitor and control, and today they account for the majority of contaminants in streams and lakes. Nonpoint sources are more difficult to recognize. Pollutants from these sources may appear a little at a time from large areas, carried along by rainfall or snowmelt. For instance, the small oil leaks from automobiles that produce discolored spots on the asphalt of parking lots become nonpoint sources of water pollution when rain carries the oil into local waters or when fertilizer from a field is carried into a stream by rain, in the form of run-offs. Most agricultural pollution is nonpoint since it typically originates from many fields. Pollution arising from nonpoint sources accounts for a majority of the contaminants in streams and lakes.

3.2 Classifying Water Pollution

The major sources of water pollution can be classified as municipal, industrial, and agricultural.

Municipal Water Pollution

Municipal water pollution consists of waste water from homes and commercial establishments. For many years, the main purpose of treating municipal wastewater was simply to reduce its content of suspended solids, oxygen-demanding materials, dissolved inorganic compounds, and harmful bacteria. In recent years, however, more stress has been placed on improving means of disposal of the solid residues from the municipal treatment processes. The basic methods of treating municipal wastewater fall into three stages: primary treatment, including grit removal, screening, grinding, and sedimentation; secondary treatment, which entails oxidation of dissolved organic matter by means

of using biologically active sludge, which is then filtered off; and tertiary treatment, in which advanced biological methods of nitrogen removal and chemical and physical methods such as granular filtration and activated carbon absorption are employed

Industrial Water Pollution

The characteristics of industrial waste waters can differ considerably both within and among industries. The impact of industrial discharges depends not only on their collective characteristics, such as biochemical oxygen demand and the amount of suspended solids, but also on their content of specific inorganic and organic substances. Three options are available in controlling industrial wastewater. Control can take place at the point of generation in the plant; wastewater can be pretreated for discharge to municipal treatment sources; or wastewater can be treated completely at the plant and either reused or discharged directly into receiving waters.

Agriculture Water Pollution

Agriculture, including commercial livestock and poultry farming, is the source of many organic and inorganic pollutants in surface waters and groundwater. These contaminants include both sediment from erosion cropland and compounds of phosphorus and nitrogen that partly originate Agriculture, including commercial livestock and poultry farming, is the source of many organic and inorganic pollutants in surface waters and groundwater. These contaminants include both sediment from erosion cropland and compounds of phosphorus and nitrogen that partly originate in animal wastes and commercial fertilizers. Animal wastes are high in oxygen demanding material, nitrogen and phosphorus, and they often harbor pathogenic organisms. Wastes from commercial feeders are contained and disposed of on land; their main threat to natural waters, therefore, is from runoffs and leaching. Control may involve settling basins for liquids, limited biological treatment in aerobic or anaerobic lagoons, and a variety of other methods.

3.3 Types of Water Pollutants

The major water pollutants are chemical, biological, or physical materials that degrade water quality. Pollutants can be classed into eight categories, each of which presents its own set of hazards.

Petroleum Products

Oil and chemicals derived from oil are used for fuel, lubrication, plastics manufacturing, and many other purposes. These petroleum products get into water mainly by means of accidental spills from ships, tanker trucks, pipelines, and leaky underground storage tanks. Many petroleum products are poisonous if ingested by animals, and spilled oil damages the feathers of birds or the fur of animals, often causing death. Land-based petroleum pollution is carried into waterways by rainwater runoffs. This includes drips of oil, fuel, and fluid from cars and trucks; dribbles of gasoline spilled onto the ground at the filling station; and drips from industrial machinery.

Pesticides and Herbicides

Pesticides that get applied to farm fields and roadsides—and homeowners' lawns—run off into local streams and rivers or drain down into groundwater, contaminating the fresh water that fishes swim in and the water we humans drink. It's tempting to think this is mostly a farming problem, but on a square-foot basis, homeowners apply even more chemicals to their lawns than farmers do to their fields! Still, farming is a big contributor to this problem.

Chemicals used to kill unwanted animals and plants, for instance on farms or in suburban yards, may be collected by rainwater runoffs and carried into streams, especially if these substances are applied too lavishly. Some of these chemicals are biodegradable and quickly decay into harmless or less harmful forms, while others are nonbiodegradable and remain dangerous for a long time.

When animals consume plants that have been treated with certain nonbiodegradable chemicals, such as chlordane and dichlorodiphenyltrichloroethane (DDT), these chemicals are absorbed into the tissues or organs of the animals. When other animals feed on these contaminated animals, the chemicals are passed up the food chain. With each step up the food chain, the concentration of the pollutant increases. This process is called bio-magnification. Animals at the top of food chains may, as a result of these chemical concentrations, suffer cancers, reproductive problems, and death.

Many drinking water supplies are contaminated with pesticides from widespread agricultural use.

Heavy Metals

Heavy metals, such as copper, lead, mercury, and selenium, get into water from many sources, including industries, automobile exhaust, mines, and even natural soil can pollute the water resources. Like pesticides, heavy metals become more concentrated as animals feed on plants and are consumed in turn by other animals. When they reach high levels in the body, heavy metals can be immediately poisonous, or can result in long-term health problems similar to those caused by pesticides and herbicides. For example, cadmium in fertilizer derived from sewage sludge can be absorbed by crops. If these crops are eaten by humans in sufficient amounts, the metal can cause diarrhea and, over time, liver and kidney damage. Lead can get into water from lead pipes and solder in older water systems; children exposed to lead in water can suffer mental retardation.

Hazardous Wastes

Hazardous wastes are chemical wastes that are either toxic (poisonous), reactive (capable of producing explosive or toxic gases), corrosive (capable of corroding steel), or ignitable (flammable). If improperly treated or stored, hazardous wastes can pollute water supplies. PCBs, a class of chemicals once widely used in electrical equipment such as transformers, can get into the environment through oil spills and can reach toxic levels as organisms eat one another.

Excess Organic Matter

Fertilizers and other nutrients used to promote plant growth on farms and in gardens may find their way into water. At first, these nutrients encourage the growth of plants and algae in water. However, when the plant matter and algae die and settle underwater, microorganisms decompose them. In the process of decomposition, these microorganisms consume oxygen that is dissolved into the water. Oxygen levels in the water may drop to such dangerously low levels that oxygen-dependent animals in the water, such as fish, die. This process of depleting oxygen to deadly levels is called eutrophication.

Sediment

Sediment, soil particles carried to a streambed, lake, or ocean, can also be a pollutant if it is present in large enough amounts. Soil erosion produced by the removal of soil-trapping trees near waterways, or

carried by rainwater and floodwater from croplands, strip mines, and roads, can damage a stream or lake by introducing too much nutrient matter. This leads to eutrophication. Sedimentation can also cover streambed gravel in which many fishes, such as salmon and trout, lay their eggs.

Infectious Organisms

Many disease-causing organisms that are present in small numbers in most natural waters are considered pollutants when found in drinking water. Such parasites as *Giardia lamblia* and *Cryptosporidium parvum* occasionally turn up in urban water supplies. These parasites can cause illness, especially in people who are very old or very young, and in people who are already suffering from other diseases.

Thermal Pollution

Water is often drawn from rivers, lakes, or the ocean for use as a coolant in factories and power plants. The water is usually returned to the source warmer than when it was taken. Even small temperature changes in a body of water can drive away the fishes and other species that were originally present, and attract other species in place of them. Thermal pollution can accelerate biological processes in plants and animals or deplete oxygen levels in water. The result may be fishes and other wildlife deaths near the discharge source. Thermal pollution can also be caused by the removal of trees and vegetation that shade and cool streams.

3.4 Global Water Pollution Episode

Estimates suggest that nearly 1.5 billion people lack safe drinking water and that at least 5 million deaths per year can be attributed to waterborne diseases. With over 70 percent of the planet covered by oceans, people have long acted as if these very bodies of water could serve as a limitless dumping ground for wastes. Raw sewage, garbage, and oil spills have begun to overwhelm the diluting capabilities of the oceans, and most coastal waters are now polluted. Beaches around the world are closed regularly, often because of high amounts of bacteria from sewage disposal, and marine wildlife is beginning to suffer.

Perhaps the biggest reason for developing a worldwide effort to monitor and restrict global pollution is the fact that most forms of pollution do not respect national boundaries. The first major international conference on environmental issues was held in Stockholm, Sweden, in 1972 and was sponsored by the United Nations (UN). This meeting, at which the United States took a leading role, was controversial because many

developing countries were fearful that a focus on environmental protection was a means for the developed world to keep the undeveloped world in an economically subservient position. The most important outcome of the conference was the creation of the United Nations Environmental Program (UNEP).

UNEP was designed to be the environmental conscience of the United Nations, and in an attempt to allay fears of the developing world, it became the first UN agency to be headquartered in a developing country, with offices in Nairobi, Kenya. In addition to attempting to achieve scientific consensus about major environmental issues, a major focus for UNEP has been the study of ways to encourage sustainable development increasing standards of living without destroying the environment. At the time of UNEP's creation in 1972, only 11 countries had environmental agencies. Ten years later that number had grown to 106, out of which 70 were in developing countries.

4.0 CONCLUSION

Clearly, the problems associated with water pollution have the capabilities of disrupting life on our planet to a great extent. Congress has passed laws to try to combat water pollution thus acknowledging the fact that water pollution is, indeed, a serious issue. But the government alone cannot solve the entire problem. It is ultimately up to us, to be informed, responsible and involved when it comes to the problems we face with our water. We must become familiar with our local water resources and learn about ways for disposing harmful household wastes so they do not end up in sewage treatment plants that can't handle them or landfills not designed to receive hazardous materials. In our yards, we must determine whether additional nutrients are needed before fertilizers are applied, and look for alternatives where fertilizers might run off into surface waters. We have to preserve existing trees and plant new trees and shrubs to help prevent soil erosion and promote infiltration of water into the soil. Around our houses, we must keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains. These are just a few of the many ways in which we, as humans, have the ability to combat water pollution. As we head into the 21st century, awareness and education will most assuredly continue to be the two most important ways to prevent water pollution. If these measures are not taken and water pollution continues, life on earth will suffer severely.

Global environmental collapse is not inevitable. But the developed world must work with the developing world to ensure that new industrialized economies do not add to the world's environmental problems. Politicians must think of sustainable development rather than

economic expansion. Conservation strategies have to become more widely accepted, and people must learn that energy use can be dramatically diminished without sacrificing comfort. In short, with the technology that currently exists, the years of global environmental mistreatment can begin to be reversed.

5.0 SUMMARY

In this unit, we have learnt that:

- Water Pollution is the contamination of streams, lakes, underground water, bays, or oceans by substances harmful to living things.
- Point source pollution occurs when harmful substances are emitted directly into a body of water.
- Nonpoint source pollution occurs when pollutants are indirectly introduced into the environment through transport or environmental change.
- Major water pollutants are chemical, biological, or physical materials.

6.0 TUTOR -MARKED ASSIGNMENT

1. List and explain the two sources of water pollutants.
2. Explain in detail any three (3) classes of water pollution that you know.
3. Explain on any four types of water pollutants

7.0 REFERENCES/FURTHER READING

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UNIT 2 EFFECTS OF WATER POLLUTION

CONTENTS

1.0 INTRODUCTION

Virtually all types of pollution are harmful to the health of humans and animals. Pollution may not damage our health immediately but can be harmful after long term exposure. Different forms of pollutants affect the health of animals in different ways.

2.0 OBJECTIVE

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

- identify water pollution effects.

3.0 MAIN CONTENT

3.1 Water Pollution Effects

Water pollution effects can be categorized namely:

3.1.1 Waterborne Infectious Diseases

Human infectious diseases are among the most serious effects of water pollution, especially in developing countries, where sanitation may be inadequate or non-existent. Waterborne diseases occur when parasites or other disease-causing microorganisms are transmitted via contaminated water, particularly water contaminated by pathogens originating from excreta. These include typhoid, intestinal parasites, and most of the

enteric and diarrheal diseases caused by bacteria, parasites, and viruses. Amongst the most serious parasitic diseases are amoebiasis, giardiasis, ascariasis, and hookworm. Every year there are thousands of beach closings wordwide, and outdated monitoring methods may in some cases leave beachgoers vulnerable to a range of illnesses. Polluted beach water can cause rashes, earaches, pink eye, respiratory infections, hepatitis, encephalitis, gastroenteritis, diarrhea, vomiting, and stomach aches.

3.1.2 Nutrient Pollution

The Woods Hole Oceanographic Institution calls nutrient pollution the most widespread, chronic environmental problem in the coastal ocean. The discharges of nitrogen, phosphorus, and other nutrients comes from agriculture, waste disposal, coastal development, and fossil fuel use. Once nutrient pollution reaches the coastal zone, it stimulates harmful overgrowths of algae, which can have direct toxic effects and ultimately result in low-oxygen conditions. Developed countries have started monitoring for toxic algal blooms, closing fisheries as necessary. This has reduced the incidence of related human illness but has had the obvious economic cost of lost income for fishermen and related businesses. Nutrient-pollution-driven blooms of non-toxic algae and seaweed can also cause problems by reducing water clarity, making it hard for marine animals to find food and blocking the sunlight needed by sea grasses, which serve as nurseries for many important fish species.

When the algal overgrowths finally die, they sink to the bottom and begin decomposing. This process uses oxygen from the surrounding water. In some cases, the decomposition process takes enough oxygen out of the water that the level falls too low to support normal aquatic life and the region becomes a coastal dead zone. Finally, nutrient pollution can trigger unusual outbreaks of fish diseases.

3.1.3 Chemical Contamination

Over the years, many types of chemicals have gotten into our waterways —and they continue to do so today. Chemical water pollution typically occurs because:

1. the chemicals were dumped into the water intentionally;
2. the chemicals seeped into groundwater, streams, or rivers because of failing pipes or storage tanks;
3. the chemicals catastrophically contaminated waterways because of industrial accidents;
4. the pollution settled out of polluted air (or was precipitated out of polluted air); or
5. chemicals were leached out of contaminated soil.

The above types of chemical contamination are considered "point sources" of water pollution. Non-point-source chemical pollution also occurs via pesticide runoffs from farm fields and homeowners' lawns, as well as runoffs of automotive fluids and other chemicals from roads, parking lots, driveways, and other surfaces.

It's beyond the scope of this course to document the effect of every chemical that has ever polluted water, but it's easy enough to point out a few things:

- Severe chemical spills and leaks into surface waters usually have an immediate effect on aquatic life (kills fishes, etc.).
- Chronic lower-level chemical pollution has more subtle effects, with problems manifesting over a long period of time and sometimes being difficult to tie directly to the water pollution.
- The human effects of chemical pollution in water can generally be viewed the same way as any other form of chemical contamination—water is just the delivery mechanism.

There are a few broad categories of water pollution effects related to chemicals that are worth exploring further, which we do below.

Pesticides

Pesticides are carried in rainwater runoffs from farm fields, suburban lawns, or roadside embankments into the nearest creeks and streams. Occasionally they are even intentionally sprayed into waterways as part of a pest-control effort.

Here are some noteworthy examples of the effects of pesticide water pollution:

- Atrazine (the most commonly used herbicide in the US) causes feminization of male frogs even at concentrations in water as low as 0.1 parts per billion. Atrazine water pollution has been noted in many countries, including South Africa, Germany, and Denmark. Studies indicate the chemical may be linked to a number of human cancers, including prostate cancer and non-Hodgkin's lymphoma, as well as hormonal problems that could disrupt reproductive and developmental processes.

- Glyphosate (Roundup), another of the world's most common herbicides, was found to cause a 70% decline in frog biodiversity and an 86% decline in the total mass of tadpoles when the glyphosate got into water.

- Pesticides have been found in well water in countries such as India, The Netherlands, Italy, Israel, Japan, Canada and Australia. Pesticide contamination of drinking water is a perculiar problem in rural agricultural areas where pesticide use is heavy and drinking water supplies come directly from groundwater or surface water.

- Pesticides can migrate via water into the food chain as well, ultimately being consumed by humans or animals in food.

- In the most infamous case of pesticide pollution, widespread use of the insecticide DDT polluted waterways, contaminating fish, and ultimately poisoning bald eagles (and other animals) that ate the fish. DDE, the principal breakdown product of DDT, built up in the fatty tissues of female eagles and prevented sufficient calcium being released to produce strong egg shells. The thin shells would break when the parents sat on the eggs to keep them warm. DDT affected many other species as well.

- In terms of general human health effects, pesticides can

1. affect and damage the nervous system;
2. cause liver damage;
3. damage DNA and cause a variety of cancers;
4. cause reproductive and endocrine damage;
5. Cause other acutely toxic or chronic effects.

Oil and Petroleum Chemicals

When oil pollution gets in water, some of the components are degraded and dispersed by evaporation, photochemical reactions, or bacterial degradation, while others are more resistant and may persist for many years, especially in shallow waters with muddy sediments.

- Though much scientific work remains to be done on the effect petroleum pollution has on plants and animals, we do know a few things: Exposure to oil or its constituent chemicals alter the ecology of aquatic habitats and the physiology of marine organisms.

- Scientists know that oil (or chemical components of oil) can seep into marsh and sub-tidal sediments and lurk there for decades, negatively affecting marsh grasses, marine worms, and other aquatic life forms that live in, on, or near the sediment.

Evidence strongly suggests that components of crude oil, called polycyclic aromatic hydrocarbons (PAHs), persist in the marine environment for years and are toxic to marine life at concentrations in

the low parts-per-billion range. Chronic exposure to PAHs can affect development of marine organisms, increase susceptibility to disease, and jeopardize normal reproductive cycles in many marine species.

Mercury

Mercury finds its way into water primarily through air pollution from coal-fired power plants and some other industrial processes. In the water, the elemental mercury is converted to methylmercury by certain bacteria, after which it moves up the food chain of fish gobbling each other up. In the end, the larger fish may end up on your dinner plate—swordfish, sea bass, marlin, halibut, or tuna, for example.

The effects of mercury on humans are already pretty well understood. However, the more we learn, the worse the news gets. Exposure to mercury in the womb can cause neurological problems, including slower reflexes, learning deficits, delayed or incomplete mental development, autism, and brain damage. Mercury in adults is also a problem, causing:

1. central nervous system effects like Parkinson's disease, multiple sclerosis, and Alzheimer's disease;
2. heart disease; and, in severe cases,
3. causing death or irreversibly damaging areas of the brain.

Animals in any part of the food chain affected by the bioaccumulation of mercury can also suffer the effects of mercury pollution. Possible effects include death, reduced reproduction, slower growth and development, and abnormal behavior.

Other Chemicals

Tens of thousands of chemicals are used in industrial processes and are found in car-maintenance products, household cleaners, toiletries, and many other consumer products. Our current regimes for controlling whether these chemicals get into the environment are not sufficient for keeping them out of the water, and the potential myriad effects are worrisome.

More generally, the effects of hormone-disrupting chemicals include interrupted sexual development; thyroid system disorders; inability to breed; reduced immune response; and abnormal mating and parenting behavior. In humans, endocrine disruptors are thought to lead to degraded immune function, mental impairment, decreased fertility, and increases in some types of cancers.

3.1.4 Mining

There are a number of negative water-pollution effects from mining operations:

Acid mine drainage: When rain or surface water flows over exposed rock and soil, it can combine naturally causing sulfur to form sulfuric acid. The acidified rainwater eventually finds its way to streams and groundwater, polluting them and impacting local aquatic life. Some streams can become so acidic—more acidic than car-battery acid—the aquatic ecosystem is completely destroyed. The same leaching process that causes acid mine drainage can impart heavy-metal pollutants from the soil and rock as well.

Spills and leaks: Whether it's a leak in the containment system of a cyanide leach heap or a breach in a coal-slurry impoundment dam, the result is the same—pollution of streams, rivers, and groundwater, killing aquatic life and poisoning drinking water

Mountaintop Removal Mining: In this technique, the tops of coal-rich mountains are removed and the overburden is dumped into nearby valleys, burying stream habitats altogether, with the obvious catastrophic effect on whatever life forms lived in or around the stream.

3.1.5 Marine Debris

Marine debris is basically trash in the ocean. Trash fouls inland waterways too, for sure, but trash seems to be a particular problem in our seas. The Ocean Conservancy calls marine debris one of the world's most pervasive marine pollution problems. The debris includes escaped inland trash and garbage thrown overboard by ships and boaters—plastic bottles and bags, six-pack rings, cigarette butts, Styrofoam, etc. Marine animals can swallow the trash items, which often look similar to prey they would normally eat, or the trash item may have barnacles or other delectables attached and is inadvertently ingested with the food. For instance, sea turtles will eat a plastic bag believing it to be a jellyfish. The bag can cause an intestinal blockage and sometimes death.

A new and potentially devastating effect of marine debris is emerging. After years of degradation at sea, plastic breaks up. The plastic has not biodegraded but rather has disintegrated into very small pieces. Marine animals near the bottom of the food chain are now ingesting these teeny-tiny little pieces of plastic pollution. How far up the food chain the stuff will go is unknown.

Discarded or lost fishing gear—line, rope, nets—and certain trash items can get wrapped around marine animals fins or flippers, causing

drowning or amputation. Marine debris can also degrade coral reefs, sea grass beds, and other aquatic habitats.

3.1.6 Thermal Pollution

It's easy enough to see how discharging the heated-up water from a power plant into a river could cause problems for aquatic organisms used to having their water home stay at a fairly specific temperature. Indeed, industrial thermal pollution is a problem for our waterways—fish and other organisms adapted to a particular temperature range can be killed from thermal shock, and the extra heat may disrupt spawning or kill young fish.

- Additionally, warmer water temperatures lower the dissolved oxygen content of the water. That's a double-whammy to aquatic organisms, since the warmer water also causes them to increase their respiration rates and consume oxygen faster. All this increases aquatic organisms' susceptibility to disease, parasites, and the effects of toxic chemicals.

- Global warming is imparting extra heat to our oceans, which have absorbed about 20 times as much heat as the atmosphere over the past half-century. The ocean is a complex system, and scientists don't know yet what all of the effects of this type of "water pollution" will be, but here are some likely ones: Sea levels will rise (because of thermal expansion and melting ice), increasing coastal flooding and inundation.

- There will be more intense hurricanes as they gather additional strength from warmer surface waters.

- Temperature-sensitive species like corals will see tougher times. The Pew Oceans Commission notes that an increase in the mean sea-surface temperature of only 2 degrees F could cause the global destruction of coral reef ecosystems.

4.0 CONCLUSION

With almost 80 percent of the planet covered by oceans, people have long acted as if those bodies of water could serve as a limitless dumping ground for wastes. However, raw sewage, garbage, and oil spills have begun to overwhelm the diluting capabilities of the oceans, and most coastal waters are now polluted, threatening marine wildlife. Beaches around the world close regularly, often because the surrounding waters contain high levels of bacteria from sewage disposal.

5.0 SUMMARY

In this unit, we have learnt that:

- Pollution may not damage our health immediately but can be harmful after long term exposure
- Human infectious diseases are among the most serious effects of water pollution, especially in developing countries, where sanitation may be inadequate or non-existent
- Discharges of nitrogen, phosphorus, and other nutrients come from agriculture, waste disposal, coastal development, and fossil fuel use
- Pesticides are carried in rainwater runoffs from farm fields, suburban lawns, or roadside embankments into the nearest creeks and streams
- When oil pollution gets in water, some of the components are degraded and dispersed by evaporation, photochemical reactions, or bacterial degradation
- Exposure to mercury in the womb can cause neurological problems, including slower reflexes, learning deficits, delayed or incomplete mental development, autism, and brain damage
- Industrial thermal pollution is a problem for our waterways—fish and other organisms adapted to a particular temperature range can be killed from thermal shock, and the extra heat may disrupt spawning or kill young fish

6.0 TUTOR-MARKED ASSIGNMENT

1. Discuss on any four effects of water pollution
2. Discuss the effects of chemical contamination on water

7.0 REFERENCES/FURTHER READING

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UNIT 3 CONTROLLING WATER POLLUTION

CONTENTS

1.0 INTRODUCTION

Global environmental collapse is not inevitable. But the developed world must work with the developing world to ensure that new industrialized economies do not add to the world's environmental problems.

2.0 OBJECTIVES

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

- explain global efforts at controlling pollution
- describe Water quality.

3.0 MAIN CONTENT

3.1 Controlling Water Pollution

Because of the many environmental tragedies of the mid-20th century, many nations instituted comprehensive regulations designed to repair the past damage of uncontrolled pollution and prevent future environmental contamination. International agreements have played a role in reducing global pollution. The Montréal Protocol on Substances that Deplete the Ozone Layer (1987) set international target dates for reducing the manufacture and emissions of the chemicals, such as CFCs, known to deplete the ozone layer. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1989) serves as a framework for the international regulation of hazardous waste transport and disposal.

Since 1992 representatives from more than 160 nations have met regularly to discuss methods to reduce greenhouse gas emissions. In

1997 the Kyōto Protocol was devised, calling for industrialized countries to reduce their gas emissions by 2012 to an average 5 percent below 1990 levels. The Kyōto Protocol went into force in February 2005 with more than 130 countries haven ratified it. Under the administration of President George W. Bush, however, the United States, a major producer of greenhouse gases, refused to submit the treaty for ratification. In 2006 the Global Carbon Project reported that carbon dioxide emissions were increasing at an annual rate of 2.5 percent in the first five years of the 21st century, compared with an annual increase of 1 percent in the 1990s.

Regulations and legislation have led to considerable progress in cleaning up some air and water pollution in developed countries. Vehicles in the 21st century emit fewer nitrogen oxides than those in the 1970s did; power plants now burn low-sulfur fuels; industrial stacks have scrubbers to reduce emissions; and lead has been removed from gasoline.

Developing countries, however, continue to struggle with pollution control because they lack clean technologies and desperately need to improve economic strength, often at the cost of environmental quality. The problem is compounded by developing countries attracting foreign investment and industry by offering cheaper labor, cheaper raw materials, and fewer environmental restrictions. The *maquiladoras,* assembly plants along the Mexican side of the Mexico-U.S. border, provide jobs and industry for Mexico but are generally owned by non-Mexican corporations attracted to the low-wage labor and lack of pollution regulation. As a result, this border region, including the Río Grande, is one of the most heavily polluted zones in North America. To avoid ecological disaster and increased poverty, developing countries will require aid and technology from outside nations and corporations, community participation in development initiatives, and strong environmental regulations.

Nongovernmental citizen groups have formed at the local, national, and international level to combat pollution problems worldwide. Many of these organizations provide information and support for people or organizations traditionally not involved in the decision-making process. The Pesticide Action Network provides technical information about the effects of pesticides on farmworkers. The Citizen's Clearinghouse for Hazardous Waste, established by veterans of the Love Canal controversy, provides support for communities targeted for hazardous waste installations. A well-organized, grassroots, environmental justice movement has arisen to advocate equitable environmental protections. Greenpeace is an activist organization that focuses international attention on industries and governments known to contaminate land, sea, or atmosphere with toxic or solid wastes. Friends of the Earth

International is a federation of international organizations that fight environmental pollution around the world.

3.2 Water Quality

Water quality is closely linked to water use and to the state of economic development. In industrialized countries, bacterial contamination of surface water caused serious health problems in major cities throughout the mid 1800s. By the turn of the century, cities in Europe and North America began building sewer networks to route domestic wastes downstream of water intakes. Development of these sewage networks and waste treatment facilities in urban areas has expanded tremendously in the past two decades.

However, the rapid growth of the urban population (especially in Latin America and Asia) has outpaced the ability of governments to expand sewage and water infrastructure. While waterborne diseases have been eliminated in the developed world, outbreaks of cholera and other similar diseases still occur with alarming frequency in the developing countries. Since World War II and the birth of the chemical age, water quality has been heavily impacted worldwide by industrial and agricultural chemicals.

Eutrophication of surface waters from human and agricultural wastes and nitrification of groundwater from agricultural practices has greatly affected large parts of the world. Acidification of surface waters by air pollution is a recent phenomenon and threatens aquatic life in many area of the world. In developed countries, these general types of pollution have occurred sequentially with the result that most developed countries have successfully dealt with major surface water pollution. In contrast, however, newly industrialized countries such as China, India, Thailand, Brazil, and Mexico are now facing all these issues simultaneously.

4.0 CONCLUSION

Government must think of sustainable development rather than economic expansion. Conservation strategies have to become more widely accepted, and people must learn that energy use can be dramatically diminished without sacrificing comfort. In short, with the technology that currently exists, the years of global environmental mistreatment can begin to be reversed.

5.0 SUMMARY

In this unit, we have learnt that:

- Environmental tragedies of the mid-20th century, has made many nations to institute comprehensive regulations, designed to repair the past damage of uncontrolled pollution and prevent future environmental contamination
- Regulations and legislation have led to considerable progress in cleaning up some air and water pollution in developed countries
- Developing countries, however, continue to struggle with pollution control because they lack clean technologies and desperately need to improve economic strength, often at the cost of environmental quality
- To avoid ecological disaster and increased poverty, developing countries will require aid and technology from outside nations and corporations, community participation in development initiatives, and strong environmental regulations
- Water quality is closely linked to water use and to the state of economic development
- While waterborne diseases have been eliminated in the developed world, outbreaks of cholera and other similar diseases still occur with alarming frequency in the developing countries
- Acidification of surface waters by air pollution is a recent phenomenon and threatens aquatic life in many areas of the world

6.0 TUTOR -MARKED ASSIGNMENT

1. Discuss on global efforts at controlling pollution.
2. What did you understand by water quality.

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MODULE 3

Unit 1 Land Pollution Defined
Unit 2 Causes and Effects of Land Pollution

UNIT 1 LAND POLLUTION DEFINED

CONTENTS

1.0 INTRODUCTION

Land pollution is a common and destructive phenomenon today. Read on to learn about its various causes and effects. Pollution is a global problem. It has affected the lives of millions of people and caused several deaths and health problems. Land pollution is one of the types of pollution.

2.0 OBJECTIVES

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

- describe land and soil pollution and types
- list and explain different sources of solid waste.

3.0 MAIN CONTENT

3.1 Land Pollution Defined

A number of definitions have been proffered in explaining what land pollution is. These include:

Land pollution basically is about contaminating the land surface of the Earth through dumping of urban waste matter indiscriminately, dumping

of industrial waste, mineral exploitation, and misusing the soil by harmful agricultural practices.

Land pollution includes visible litter and waste alone with the soil itself being polluted. The soil gets polluted by the chemicals in pesticides and herbicides used for agricultural purposes along with waste matter being littered in urban areas such as roads, parks, and streets.
Land pollution is the degradation of the Earth's land surface through misuse of the soil by poor agricultural practices, mineral exploitation, industrial waste dumping, and indiscriminate disposal of urban wastes. It includes visible waste and litter as well as pollution of the soil itself.
Land pollution is pollution of our planet's land surface.

3.2 Composition of Land Pollution

3.2.1 Solid Waste

Solid wastes are unwanted solid materials such as garbage, paper, plastics and other synthetic materials, metals, and wood. Semisolid or solid matters that are created by human or animal activities, and which are disposed because they are hazardous or useless are known as solid waste. Most of the solid wastes, like paper, plastic containers, bottles, cans, and even used cars and electronic goods are not biodegradable, which means they do not get broken down through inorganic or organic processes.

Thus, when they accumulate they pose a health threat to people, plus, decaying wastes also attract household pests and result in urban areas becoming unhealthy, dirty, and unsightly places to reside in. Moreover, it also causes damage to terrestrial organisms, while also reducing the use of the land for other, more useful purposes. Billions of tons of solid waste are thrown out annually. Waste from developed countries typically contains a high percentage of synthetic materials that take longer to decompose than the primarily biodegradable waste materials of developing countries.

Areas where wastes are buried, called landfills, are the cheapest and most common disposal method for solid wastes worldwide. But landfills quickly become overfilled and may contaminate air, soil, and water. Incineration, or burning, of waste reduces the volume of solid waste but produces dense ashen wastes (some of which become airborne) that often contain dangerous concentrations of hazardous materials such as heavy metals and toxic compounds. Composting, using natural biological processes to speed the decomposition of organic wastes, is an effective strategy for dealing with organic garbage and produces a material that can be used as a natural fertilizer. Recycling, extracting

and reusing certain waste materials, has become an important part of municipal solid waste strategies in developed countries. Expanding recycling programs worldwide can help reduce solid waste pollution, but the key to solving severe solid waste problems lies in reducing the amount of waste generated. Waste prevention, or source reduction, such as altering the way products are designed or manufactured to make them easier to reuse, reduces the high costs associated with environmental pollution.

Some of the sources of solid waste that cause land pollution are:

(a) **Wastes from Agriculture:** This comprises of waste matter produced by crop, animal manure, and farm residues.
(b) **Wastes from Mining:** Piles of coal refuse and heaps of slag.
(c) **Wastes from Industries:** Industrial waste matter that can cause land pollution includes paints, chemicals, and so on.
(d) **Solids from Sewage Treatment:** Wastes that are left over after sewage has been treated, biomass sludge, and settled solids.
(e) **Ashes:** The residual matter that remains after solid fuels are burned.
(f) **Garbage:** This comprises of waste matter from food that are decomposable and other waste matter that are not decomposable such as glass, metal, cloth, plastic, wood, paper, and so on.

3.2.2 Soil Pollution

Soil pollution is the buildup in soils of persistent toxic compounds, chemicals, salts, radioactive materials, or disease-causing agents, which have adverse effects on plant growth and animal health. As of now, soil pollution is not widespread. Although the application of fertilizers containing the primary nutrients, nitrogen, phosphorus, and potassium, has not led to soil pollution, the application of trace elements has. The irrigation of arid lands often leads to pollution with salts. Sulfur from industrial wastes has polluted soils in the past, as has the accumulation of arsenic compounds in soils following years of spraying crops with lead arsenate. The application of pesticides has also led to short-term soil pollution.

Unhealthy soil management methods have seriously degraded soil quality, caused soil pollution, and enhanced erosion. Treating the soil with chemical fertilizers, pesticides, and fungicides interferes with the natural processes occurring within the soil and destroys useful organisms such as bacteria, fungi, and other microorganisms. Soil pollution is chiefly caused by chemicals in pesticides, such as poisons that are used to kill agricultural pests like insects and

herbicides that are used to get rid of weeds. Hence, soil pollution results from:

a. Unhealthy methods of soil management.
b. Harmful practices of irrigation methods.

4.0 CONCLUSION

As human populations increase and their encroachment on natural habitats expands, humans are having detrimental effects on the very ecosystems on which they depend. The survival of natural ecosystems around the world is threatened by many human activities: bulldozing wetlands and clear-cutting forests—the systematic cutting of all trees in a specific area—to make room for new housing, road construction and agriculture, all lead to land pollution

5.0 SUMMARY

In this unit, we have learnt that:

1. Land pollution is contaminating the land surface of the Earth through dumping urban and industrial waste indiscriminately as well as mineral exploitation, and misusing the soil by harmful agricultural practices
2. Solid wastes are unwanted solid materials such as garbage, paper, plastics and other synthetic materials, metals, and wood
3. Areas where wastes are buried are called landfills and are the cheapest and most common disposal method for solid wastes worldwide
4. Expanding recycling programs worldwide can help reduce solid waste pollution, but the key to solving severe solid waste problems lies in reducing the amount of waste generated by individuals
5. Soil pollution is the buildup in soils of persistent toxic compounds, chemicals, salts, radioactive materials, or disease-causing agents, which have adverse effects on plant growth and animal health
6. Unhealthy soil management methods have seriously degraded soil quality, caused soil pollution, and enhanced erosion

6.0 TUTOR-MARKED ASSIGNMENT

1. What is land pollution?
2. Differentiate between solid waste and soil pollution.

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UNIT 2 CAUSES AND EFFECTS OF LAND POLLUTION

CONTENTS

1.0 INTRODUCTION

The effects of pollution on the land are not limited to the terrestrial ecosystem, because the synthetic chemicals are not degraded by the normal processes of life. From there, the pollution can travel through the roots of plants into any herbivore which consumes the plant and on and on and on until it reaches the highest organisms in the food web: humans.

2.0 OBJECTIVES

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

- identify the various causes of land pollution
- list the effects of land pollution
- describe how land pollution can be prevented.

3.0 MAIN CONTENT

3.1 Causes of Land Pollution

The following are the major causes of land pollution:

I. Increase in urbanization. Construction uses up forestland. More constructions means increase in demand for raw materials like timber. This leads to the exploitation and destruction of forests. There is more demand for water. Reservoirs are built leading to the loss of land.

II. Increase in agricultural land. As the human population grew there was a greater demand for food. This caused more land to be allocated to agriculture. Forests were cut down for this purpose.

III. Domestic waste. Every single day, tons and tons of domestic waste are dumped ranging from huge pieces of rubbish such as unused refrigerator to fish bones. If all these wastes are not disposed of properly, the damage they can do to the environment and humankind can be devastating. While waste collected from homes, offices and industries may be recycled or burnt in incinerators, a large amount of rubbish is neither burnt nor recycled but is left in certain areas marked as dumping grounds. We throw away more things today and this causes an increase in the quantity of solid waste. This has given rise to new dumping grounds being sought after.

IV. Agricultural activities. Besides domestic waste, pesticides and herbicides used by farmers to increase crop yields also pollute the land when they are washed into the soil.

V. Industrial activities. These are also are a contributing factor to land pollution. For example, in open cast mining, huge holes are dug in the ground and these form dangerously deep mining pools. Heaps of mining waste are left behind and these waste often contain several poisonous substances that will contaminate the soil.

Pollution sources include plastic factories, chemical plants, oil refineries, nuclear waste disposal activity, large animal farms, coal-fired power plants, metals production factories and other heavy industries.

3.2 Effects of Land Pollution

There are a number of adverse effects of land pollution, such as:

a. exterminates wild life
b. acid rain that kills trees and other plants.
c. vegetation that provides food and shelter is destroyed.
d. it can seriously disrupt the balance of nature, and, in extreme cases, can cause human fatalities.
e. pesticides can damage crops; kill vegetation; and poison birds, animals, and fishes. Most pesticides kill or damage life forms other than those intended. For example, pesticides used in an effort to control or destroy undesirable vegetation and insects often destroy birds and small animals. Some life forms develop immunity to pesticides used to destroy them.
f. Causes problems in the respiratory system
g. Causes problems on the skin

h. Leads to birth defects
i. Causes various kinds of cancers

The toxic materials that pollute the soil can get into the human body directly by:

p) Coming into contact with the skin
q) Being washed into water sources like reservoirs and rivers
r) Eating fruits and vegetables that have been grown in polluted soil
s) Breathing in polluted dust or particles

3.3 How can Land Pollution be Prevented?

- People should be educated and made aware about the harmful effects of littering
- Items used for domestic purposes ought to be reused or recycled
- Personal litter should be disposed properly
- Organic waste matter should be disposed in areas that are far away from residential places
- Inorganic matter such as paper, plastic, glass and metals should be reclaimed and then recycled
- encourage organic farming
- reduce use of herbicides and pesticides

4.0 CONCLUSION

The nature of the industrial revolution and the lack of a sustainable development model for industrial progress have allowed the creation of chemicals and products which may serve the idea of convenience or productivity or efficiency, however, the concept of environmental stewardship is largely an afterthought. This has led to long-lasting chemicals which persist in the environment and are potentially toxic to life.

5.0 SUMMARY

In this unit, we have learnt that:

1. The effects of pollution on the land are not limited to the terrestrial ecosystem, because the synthetic chemicals are not degraded by the normal processes of life.
2. Pesticides and herbicides used by farmers to increase crop yields also pollute the land when they are washed into the soil.
3. People should be educated and made aware about the harmful effects of all forms of pollution

6.0 TUTOR-MARKED ASSIGNMENT

1. What are the causes of land pollution?
2. What are the major effects of land pollution and how can it be prevented?

7.0 REFERENCES/FURTHER READING

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MODULE 4 OTHER FORMS OF LAND POLLUTION

UNIT 1 HAZARDOUS WASTES: EFFECTS AND CONTROL MEASURES

CONTENTS

1.0 INTRODUCTION

Hazardous Wastes, solid, liquid, or gas wastes can cause death, illness, or injury to people or destruction of the environment if improperly treated, stored, transported, or discarded. Substances are considered hazardous wastes if they are *ignitable* (capable of burning or causing a fire), *corrosive* (able to corrode steel or harm organisms because of extreme acidic or basic properties), *reactive* (able to explode or produce toxic cyanide or sulfide gas), or *toxic* (containing substances that are poisonous). Mixtures, residues, or materials containing hazardous wastes are also considered hazardous wastes.

2.0 OBJECTIVES

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

- describe hazardous waste
- list sources of hazardous wastes
- explain the effects of hazardous wastes
- identify methods of hazardous waste control.

3.0 MAIN CONTENT

3.1 Sources of Hazardous Wastes

Industrial Activities

Hazardous wastes are generated by nearly every industry; those industries that themselves generate few hazardous wastes nonetheless use products from hazardous waste generating industries. For example, in the computer software industry, writing software generates little hazardous waste, but the manufacture of computers involves many industrial processes. Making a computer circuit board generate spent electroplating baths that contains metal salts, and the production of computer chips uses acids, other caustic chemicals, and solvents. Other hazardous wastes are generated in the manufacture of fiber optics and copper wire used in electronic transmission, as well as magnetic disks, paper for technical manuals, photographs for packaging and publicity, and trucks for transportation of the finished product.

Agricultural Activities

Industry is not alone in generating hazardous wastes. Agriculture produces such wastes as pesticides and herbicides and the materials used in their application. Fluoride wastes are by-products of phosphate fertilizer production. Even soluble nitrates from manure may dissolve into groundwater and contaminate drinking-water wells; high levels of nitrates may cause health problems.

Household Activities

Household sources of hazardous wastes include toxic paints, flammable solvents, caustic cleaners, toxic batteries, pesticides, drugs, and mercury from broken fever thermometers. Local waste-disposal systems may refuse these items. If they are accepted, careful monitoring may be required to make sure soil or groundwater is not contaminated. The householder may be asked to recycle or dispose of these items separately.

Renovations of older homes may cause toxic lead paint to flake off from walls. Insulation materials on furnace pipes may contain asbestos particles, which can break off and hang suspended in air; when inhaled, they can cause lung disease and cancer.

Medical Sources

Hospitals use special care in disposing of wastes contaminated with blood and tissue, separating these hazardous wastes from ordinary waste. Hospitals and doctors' offices must be especially careful with needles, scalpels, and glassware, called “sharps.” Pharmacies discard outdated and unused drugs; testing laboratories disposal of chemical wastes. Medicine also makes use of significant amounts of radioactive isotopes for diagnosis and treatment, and these substances must be tracked and disposed of carefully.

3.2 Effects of Hazardous Wastes

Hazardous wastes may pollute soil, air, surface water, or underground water. Pollution of soil may affect people who live on it, plants that put roots into it, and animals that move over it. Sludge from municipal sewage disposal may contain toxic elements if industrial waste is mixed with domestic sewage. If the sludge is used as a fertilizer, these elements may contaminate fields. Toxic substances that do not break down or bind tightly to the soil may be taken up by growing plants; the toxic substances may later appear in animals that eat crops grown there and possibly in people who feed also on the crop or even on the animals that feeds from there..

Air may become contaminated by direct emission of hazardous wastes. Evaporation of toxic solvents from paints and cleaning agents is a common problem. The air above hazardous waste may become dangerously contaminated by escaping gas, as can occur in houses built on mine tailings or old dump sites. Basements of homes built over uranium mine tailings often contain high levels of radioactive radon gas escaping from the radioactivity below.

Rivers and lake pollution, if it is toxic enough, may kill animals and plant life immediately, or it may injure them slowly. For example, fluoride concentrates in teeth and bone, and too much fluoride in water may cause dental and bone problems. Compounds such as dichlorodiphenyltrichloroethane (DDT), PCBs, and dioxins are more soluble in fats than in water and therefore tend to build up in the fats within plants and animals. These substances may be present in very low concentrations in water but accumulate to higher concentrations within algae and insects, and build up to even higher levels in fishes. Birds or people that feed on these fishes are then exposed to very high levels of hazardous substances. In birds, these substances can interfere with egg production and bone formation.

Even pollution that is not toxic can kill. Phosphates and nitrates, usually harmless, can fertilize the algae that grow in lakes or rivers. When algae grows, in the presence of sunlight, they produce oxygen.

But if algae grow too much or too fast, they consume great amounts of oxygen, both when the sun is not shining and when the algae dies and begins to decay. Lack of oxygen eventually suffocates other life; some living things may be poisoned by toxins contained in the algae. This process of algal overgrowth, called *eutrophication*, can kill life in lakes and rivers. In some cases, particular algae can also poison the drinking water humans and livestock.

Underground pollutants can be carried by underground water flow. These wastes form underground plumes (long, featherlike columns) of contaminants, which may reach the surface if the water emerges in a spring or is pumped from wells. Especially dangerous are solvents that may have leaked from underground storage tanks or may have been carelessly poured on the ground. Toxic metal ions may also be present in these waste plumes.

3.3 Hazardous-Waste Control Measures

Source Reduction

The best way to eliminate hazardous wastes is not to generate them in the first place. For example, improvements have been made in the production of integrated circuits: The toxic chlorinated hydrocarbons commonly used in the 1970s were replaced in the 1980s by less toxic glycol ethers and in the 1990s by low-toxicity esters and alcohols.

Recycling

Recycling is the recovery of usable materials from waste, for example; approximately 15 percent of sulfuric acid is recycled in chemical manufacturing. In the past, most sulfur used for sulfuric acid production was mined; now the amount of sulfur recovered from smelters (facilities that remove metals from ores), refineries (facilities that purify substances), and manufacturers is more than double that produced by mining.

Treatment

Wastes may be made less hazardous by physical, chemical, or biological treatment. For example, sodium hydroxide has been used to treat acid wastes at integrated-circuit plants. Sulfuric acid wastes, if not recycled, can be treated with ammonia wastes from the same plant, forming ammonium sulfate, a fertilizer.
Incineration has been used since human beings learned to control fire. It is the preferred method of handling infectious medical wastes. Solidification of wastes involves melting them and mixing them with

a binder, a substance that eventually hardens the mix into an impenetrable mass.

Disposal

Surface impoundment (placing liquid or semi liquid wastes in unlined pits) keeps waste in long-term storage, but it is not considered a method of final disposal. About 8 percent of hazardous waste is injected into deep wells; 21 percent enters *landfills* (large, unlined pits into which solid wastes are placed) as its ultimate resting place.

4.0 CONCLUSION

Many dangerous substances can be used only with special precautions that decrease their risks. When discarded, these substances are no longer under the direct control of the user and may pose special hazards to people or other organisms that come in contact with them. Because of such potential risks, hazardous wastes are processed separately from ordinary wastes.

5.0 SUMMARY

In this unit, we have learnt that:

- Hazardous Wastes can cause death, illness, or injury to people or destruction of the environment if improperly treated, stored, transported, or discarded
- Hazardous wastes are generated by nearly every industry
- Household sources of hazardous wastes include toxic paints, flammable solvents, caustic cleaners, toxic batteries, pesticides, drugs, and mercury from broken fever thermometers
- Hospitals use special care in disposing of wastes contaminated with blood and tissue, separating these hazardous wastes from ordinary waste
- Hazardous wastes may pollute soil, air, surface water, or underground water
- River and lake pollution, if it is toxic enough, may kill animal and plant life immediately, or it may injure them slowly
- The process of algal overgrowth, called *eutrophication*, can kill life in lakes and rivers
- The best way to eliminate hazardous wastes is not to generate them in the first place
- Recycling is the recovery or reuse of usable materials from waste

- Wastes may be made less hazardous by physical, chemical, or biological treatment

6.0 TUTOR -MARKED ASSIGNMENT

1. Define the term Hazardous waste and explain on any three sources of hazardous waste.
2. What are the effects of hazardous waste?
3. How can hazardous waste be controlled?

7.0 REFERENCES/FURTHER READING

Miller, G. T., Jr. *Living in the Environment: Principles, Connections, and Solutions.* 12th ed.

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UNIT 2 DEFORESTATION: CAUSES AND EFFECTS

CONTENTS

1.0 INTRODUCTION

Deforestation has been generally regarded as an act of indiscriminate cutting or over-harvesting of trees for lumber or pulp, or to clear the land for agriculture, ranching, construction, or other human activities. Although humans have been practicing deforestation since ages, it was in the mid-1800s that forests began to be destroyed at an unprecedented rate. As a matter of fact, throughout the earlier part of the medieval age, Europeans used to live amongst vast areas of forested land. But later, they began deforestation at such a high rate that they started to run out of wood for cooking and heating. Also, due to the depletion of their natural habitat, wild game too began disappearing, which the Europeans largely depended upon for their nutritional requirements. Today, parallels can clearly be observed in the deforestation that is occurring in most developing countries.

One of the most worrying factors today is the massive destruction of the rainforests of the world, which is affecting the biodiversity adversely, as well as being one of the major contributory factors of the Holocene mass extinction that is ongoing.

2.0 OBJECTIVES

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

- explain the term deforestation
- identify the causes of deforestation
- explain the effects of deforestation.

3.0 MAIN CONTENT

3.1 Causes of Deforestation

The destruction of the forests is occurring due to various reasons, one of the main reasons being the short term economic benefits. Given below are some more common causes of deforestation:

Urban growth and construction activities: The cutting down of trees for lumber that is used for building materials, furniture, and paper products. Forests are also cleared in order to accommodate expanding urban areas.

Agricultural practices: Forests are also cut down in order to clear land for growing crops and / or in order to create land for grazing cattle.

Fuel: Trees are cut down in developing countries to be used as firewood or turned into charcoal, which are used for cooking and heating purposes.

Other Causes: clearing forests for oil and mining exploitation; to make highways and roads; slash and burn farming techniques; wildfires; and acid rain.

3.2 Effects of Deforestation

There are a number of adverse effects of deforestation, such as:

Erosion of Soil: When forest areas are cleared, it results in exposing the soil to the sun, making it very dry and eventually, infertile, due to volatile nutrients such as nitrogen being lost. In addition, when there is rainfall, it washes away the rest of the nutrients, which flow with the rainwater into waterways. Because of this, merely replanting trees may not help in solving the problems caused by deforestation, for by the time the trees mature, the soil will be totally devoid of essential nutrients. Ultimately, cultivation in this land will also become impossible, resulting in the land becoming useless. Large parts of land will be rendered permanently impoverished due to soil erosion.

Disruption of the Water Cycle: Trees contribute in a large way in maintaining the water cycle. They draw up water via their roots before it is released into the atmosphere. A large part of the water that circulates in the ecosystem of rainforests, for instance, remains inside the plants. When these trees are cut down it results in the climate getting drier in that area.

Loss of Biodiversity: The unique biodiversity of various geographical areas is being lost on a scale that is quite unprecedented. Even though tropical rainforests makes up just 6 percent of the surface area of the Earth, about 80-90 percent of the entire species of the world exist here. Due to massive deforestation, about 50 to 100 species of animals are being lost each day. The outcome of which is the extinction of animals and plants on a massive scale.

Flooding and Drought: One of the vital functions of forests is to absorb and store great amounts of water quickly when there are heavy rains. When forests are cut down, this regulation of the flow of water is disrupted, which leads to alternating periods of flood and then drought in the affected area.

Climate Change: It is well known that global warming is being caused largely due to emissions of greenhouse gases like carbon dioxide into the atmosphere. However, what is not known quite as well is that deforestation has a direction association with carbon dioxide emissions into the atmosphere. Trees act as a major storage depot for carbon, since they absorb carbon dioxide from the atmosphere, which is then used to produce carbohydrates, fats, and proteins that make up trees. When deforestation occurs, many of the trees are burnt or they are allowed to rot, which results in releasing the carbon that is stored in them as carbon dioxide. This, in turn, leads to greater concentrations of carbon dioxide in the atmosphere.

4.0 CONCLUSION

Trees are one of the most important aspects of the planet we live in. Trees are vitally important to the environment, animals, and of course for us humans. They are important for the climate of the Earth, they act as filters of carbon dioxide, they are habitats and shelters to millions of species, and they are also important for their aesthetic appeal. However, the trees on our planet are being depleted at a very fast rate. According to some estimates, more than 50 percent of the tree cover has disappeared due to human activity.

5.0 SUMMARY

In this unit, we have learnt that:

- Deforestation, indiscriminate cutting or over-harvesting of trees leads to high concentration of carbon dioxide
- Forests are also cut down in order to clear land for growing crops. Forests are cut down in order create land for grazing.
- Trees are cut down to be used as firewood.

- deforestation which includes; soil erosion, water cycle disruptions, flood and drought, climate change and others.has some effects

6.0 TUTOR-MARKED ASSIGNMENT

1. Describe 3 reasons for deforestation.
2. List and explain five (5) effects of deforestation.

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Cherrington, Mark. (1992). *Degradation of the Land.* Chelsea House.

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UNIT 3 LANDS DEGRADATION IN NIGERIA

CONTENTS

1.0 INTRODUCTION

One of the main causes of land pollution is deforestation. Forests and their biological wealth are among the most important natural assets of the world. Forests are important for many reasons. They protect the soil from erosion, which is the habitat of millions of species of plants and animals. They also help to moderate the climate, as they are a major factor in carbon exchange with the atmospheric carbon, and they provide the supply of timber, wood and food. Deforestation is a major problem in Africa. The rate of the destruction of the African tropical rain forest is particularly very high. It was estimated that between 1930 and 1970 about 25% to 30% of the African tropical rainforests was destroyed.

Another study estimated about 7.3 million hectares of the world's tropically closed forests were cleared annually between 1976 and1980 with the vast majority (6.1 millions hectares per year) being tropically moist forest. In Africa, about 3.68 million hectares of tropical forests and woodlands were destroyed annually over this period. About 1.33 million hectares of tropically closed forests were cleared annually with the vast majority of this area (1.20 million hectares) being tropical moist forest and another 2.34million hectares of open woodlands in the drier tropics were removed (see Table below). In the same study, Cote de voire and Nigeria are estimated to be losing 5.2% of their forests annually. With deforestation also carring the loss of biological diversity. According to one study, 65% of the original wildlife habitat in tropical Africa has been lost.

Table 1: Annual Rates of Tropical Deforestation 1976-1980 (Million of hectares per annum)

	Closed Forests				Open Woodlands	
	All tropical		Moist tropical		% of Area Total	
	Area % of total		Area % of total			
Africa	1.33	0.61	1.20	0.59	2.34	0.48
Asia-Pacific	1.82	0.59	1.51	0.61	0.19	0.61
Latin – America	4.12	0.61	3.30	0.54	1.27	0.59
Total	7.27	0.61	6.11	0.57	3.81	0.52

Source: WRI/IIED/UNEP (1988) World Resource 1988-89.

The causes of deforestation vary in different countries but four major direct causes are generally recognized for tropical deforestation: conversion of forests for agriculture (both commercial and traditional slash and burn cultivation), wasteful and unsustainable commercial logging, over-harvesting of forest for fuel wood and fodder and conversion of forests to cattle pastureland.

2.0 OBJECTIVES

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

- describe deforestation in Nigeria
- explain the implication of deforestation in Nigeria.

3.0 MAIN CONTENT

3.1 Deforestation in Nigeria

Deforestation is a very serious problem in Nigeria. Although the issue of deforestation in the tropics has assumed large political significance on the international level due to the role of the tropical rain forest as a natural sink for greenhouse gases (particularly carbon dioxide), to the average rural dweller the problem of deforestation relates more to the scarcity of firewood for cooking.

Although the extent of deforestation in Nigeria is unknown due to insufficient data, fragmentary information from many sources paints a rather grim picture. According to the World Resources 1990-1991 report, the rate of deforestation in Nigeria in the 1980s was estimated to be 400,000 hectares annually while reforestation was merely of the order of 32,000 hectares. This translates to the rate of forest loss of 2.7%

annually. If that trend continues, it means that all our forest would be gone before the middle of the next century. At present, the country is estimated to have only 30% forest cover. According to Nwoboshi (1986), there were 60 million hectares of forest and woodland in 1897 which had been reduced to about 9.6 million hectares by 1986.

One of the factors responsible for the high rate of deforestation is the uncontrolled cutting of wood for firewood and charcoal. Shortages of firewood which were very critical in most northern states particularly Kano, Jigawa, Katsina, Kaduna, Sokoto, Kebbi, Bauchi and Borno have now become national problem. In the north where 75% of the total cooking fuel is derived from plants, annual deficit of firewood is put at about 5-8 million cubic metres. Another factor is the indiscriminate bush burning by farmers and others. For example, in 1982-83 dry seasons over 1700 hectares of forest plantations were burnt in the country.

There is so much pressure on the forest, due to rising demand for fuel wood, pulpwood, poles, and other types of wood for building purposes. The Federal Government estimated that the annual harvest of sown timber from the high forest was 1.5 million cubic meters in 1975 and at that rate would take between 25 to 30 years to denude the forests of mature timber. Pressure of increasing human population and changing socio-economic circumstances are aggravating the problem of deforestation.

3.2 Implications of Vegetation Degradation

The loss of vegetation has far-reaching consequences in Nigeria. The reason is that vegetation resources provide the basis of livelihoods of a large majority of Nigerians. For instance, people depend on the timber, herbs, animal protein, fruits, fodder and fuel wood, among others, that come from the natural vegetations. The degradation of vegetations thus affects everyone but more fundamentally, the poor who depend directly on nature.

Of the many valuable products from the plant cover, fuel wood is perhaps the most important to majority of people. More than half of households in the country depend on dry wood either as firewood or charcoal for domestic cooking. It is particularly significant as alternative sources are poorly developed or inaccessible. In many rural communities, dry wood is usually the only source of domestic energy. Even in urban areas, the use of wood for cooking cuts across the various strata of the society. The loss of vegetation cover thus touches on the survival of many. All these as earlier noted, also go further to impact on the climate system. For instance, the loss of vegetation impairs the

capacity of the natural system to hold back carbon and so add to the greenhouse effect which is responsible for the global warming.

4.0 CONCLUSION

Deforestation has been found not only to contribute to land pollution but also to global warming. The global emission of carbon dioxide of biotic origin due essentially to the deforestation of the tropics in 1980 was estimated at 1,659 millions of tons of carbon a year.

5.0 SUMMARY

In this unit, we have learnt that:

- One of the main causes of land pollution in Nigeria is deforestation.
- Forests and their biological wealth are among the most important natural assets of the world and need to be protected
- Forest help to keep the climate moderate because they are the major factor in carbon exchange with the atmospheric carbon
- The rate of destruction of the African tropical rain forest is very high
- The extent of deforestation in Nigeria is unknown due to poor data management
- One of the factors responsible for the high rate of deforestation in Nigeria is the uncontrolled cutting of wood for firewood and charcoal and indiscriminate bush burning by farmers

6.0 TUTOR -MARKED ASSIGNMENT

1. Account for deforestation in Nigeria
2. What are the implications of deforestation in Nigeria

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