**COURSE GUIDE**

# EHS 311
# INTRODUCTION TO ENVIRONMENTAL MANAGEMENT

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## INTRODUCTION

The word 'environment' is used in different ways. We talk of the 'home environment', the 'work environment', the 'social environment'. We use the word to describe our physical surroundings, made up of air, trees, grass. It is this latter use that is the subject of this book. Our concern must be for the world as a whole, its 'air, water, land, natural resources, flora, fauna, humans, and their inter-relations' By 'environmental management' we mean keeping control of our activities so that we do what we can to conserve these physical resources and to avoid polluting them. We can apply these controls in our life domestically, in what we buy and what we throw away, but it is usually in our work where the environmental impact of what we do is greatest. Such has been the impact of industrial activity that resources are becoming depleted and environmental damage is increasing (ISO 14001, 2015).

The process, environmental management is related to the rational adjustment of man with nature involving judicious exploitation and utilisation of natural resources without disturbing the ecosystem balance and ecosystem equilibrium. If the natural resources are overexploited, it will affect socio-economic development of a nation. Thus, environmental management must take into consideration the ecological principles and socioeconomic needs of the society i.e., it involves socio economic developments on one hand and maintenance of environmental quality on other hand (Environmental Pollution, 2017).

Environmental management is concerned with the understanding of the structure and function of the earth system, as well as of the ways in which humans relate to their environment. Environmental management is therefore concerned with the description and monitoring of environmental changes, with predicting future changes and with attempts to maximise human benefit and to minimise environmental degradation due to human activities. Yet, characteristically, environmental management is about decision-making – and it is especially concerned with the process of decision-making in relation to the use of natural resources, the pollution of habitats and the modification of ecosystems. Fundamentally, then, environmental management is a political activity because those decisions – about resources, pollution and ecosystems – are never neutral or objective; on the contrary, they are value laden and they reflect the exercise of power by particular groups over others. Moreover, in general, it is naïve to conceive of environmental management as being about simply ‘the management of the environment’ in the sense of humans manipulating and controlling the components and processes of the earth system (CeDep SOAS, 2019).

## WHAT YOU WILL LEARN IN THIS COURSE

In this course, you have the course units and a course guide. The course guide will tell you what the course is all about. It is general overview of the course materials you will be using and how to use those materials. It also helps you to allocate the appropriate time to each unit so that you can successfully complete the course within the stipulated time limit.
The course guide also helps you to know how to go about your Tutor-Marked Assignment which will form part of your overall assessment at the end of the course. Also, there will be regular tutorial classes that are related to this course, where you can interact with your facilitator and other students. Please, I encourage you to attend these tutorial classes.

## COURSE AIM

The aim of the course is to introduce you to the understanding of Environmental Management.

## COURSE OBJECTIVES

To achieve the aim set above, there are objectives. Each unit has a set of objectives presented at the beginning of the unit. These objectives will guide you on what to concentrate / focus on while studying the unit. Please read the objective before studying the unit and during your study to check your progress.

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

- define the term Environmental management
- state Principles of Environmental Management
- discuss Characteristics of Environmental media
- list and explain Environmental Approaches
- discuss Environmental effect of technology

## WORKING THROUGH THIS COURSE

To successfully complete this course, you are required to read each study unit, read the textbooks materials provided by the National Open University. Reading the referenced materials can also be of great assistance. Each unit has self-assessment exercises which you are advised to do and at certain periods during the course you will be required to submit your assignment for the purpose of assessment. There will be a final examination at the end of the course. The course should take you about 17 weeks to complete. This course guide will provide you with all the components of the course how to go about studying and

hour you should allocate your time to each unit so as to finish on time and successfully.

## COURSE MATERIALS

Major components of the course are:

1. Course Guide
2. Study Units
3. Textbooks
4. Assignment
5. Presentation Schedule

## STUDY UNIT

There are four Modules in this course divided into 13 study units as follows:

**Module 1 Introduction to Environmental Management**

Unit 1 Environmental Management
Unit 2 Characteristics of Environmental Media

**Module 2 Effect of Technological Advancement on Environment**

Unit 1 Effects of Technological Advancement on Environment
Unit 2 Effects of Radiations on the Biosphere
Unit 3 Effects Environmental Pollution

**Module 3 Occupational Hygiene, Mycotoxins and Nitro-Compounds in the Environment**

Unit 1 Effects of Mycotoxins in the Environment
Unit 2 Nitro-compounds in the Environment
Unit 3 Occupational Hygiene
Unit 4 Effects of Environmental Degradation

**Module 4 Methods of Environmental Assessment**

Unit 1 Methods of Environmental Assessment
Unit 2 Remote Sensing
Unit 3 Tools for Air, Water and Soil Analyses
Unit 4 Climate change and Remediation Meteorology

There are activities related to the lecture in each unit which will help your progress and comprehension of the unit. You are required to work

on these exercises which together with the TMAs will enable you to achieve the objectives of each unit.

## PRESENTATION SCHEDULE

There is a time-table prepared for the early and timely completion and submissions of your TMAs as well as attending the tutorial classes. You are required to submit all your assignments by the stipulated time and date. Avoid falling behind the schedule time.

## ASSESSMENT

There are three aspects to the assessment of this course. The first one is the Self-Assessment Exercises. The second is the Tutor-Marked Assignment and the third is the written Examination to be taken at the end of the course. Do the exercises or activities in the unit by applying the information and knowledge you acquired during the course. The tutor-marked assignments must be submitted to your facilitator for formal assessment in accordance with the deadlines stated in the presentation schedule and the assignment file. The work submitted to your tutor for assessment will count for 30% of your total course work. At the end of this course, you have to sit for a final or end of course examination of about a three hour duration which will count for 70% of your total course mark.

## TUTOR-MARKED ASSIGNMENT

This is the continuous assessment component of this course and it accounts for 30% of the total score. You will be given four (4) TMAs by your facilitator to answer. Three of which must be answered before you are allowed to sit for the end of course examination. These answered assignments are to be returned to your facilitator. You're expected to complete the assignments by using the information and material in your readings references and study units. Reading and researching into you references will give you a wider via point and give you a deeper understanding of the subject.

1. Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you are not able to complete your assignment, make sure you contact your facilitator before the assignment is due to discuss the possibility of an extension. Request for extension will not be granted after the due date unless there in exceptional circumstances.
2. Make sure you revise the whole course content before sitting or the examination. The self-assessment activities and TMAs will be

useful for this purposes and if you have any comment please do before the examination. The end of course examination covers information from all parts of the course.

## Course Marking Scheme

| Assignment | Marks |
|---|---|
| Assignments 1 – 4 | Four assignments, best three marks of the four count at 10% each–30% of course marks. |
| End of course examination | 70% of overall course marks |
| Total | 100% of course materials. |

## FACILITATORS/TUTORS AND TUTORIALS

Sixteen (16) hours are provided for tutorials for this course. You will be notified of the dates, times and location for these tutorial classes.

As soon as you are allocated a tutorial group, the name and phone number of your facilitator will be given to you.

These are the duties of your facilitator: He or she will mark and comment on your assignment. He will monitor your progress and provide any necessary assistance you need. He or she will mark your TMAs and return to you as soon as possible.

(You are expected to mail your tutored assignment to your facilitator at least two days before the schedule date).

Do not delay to contact your facilitator by telephone or e-mail for necessary assistance if you do not understand any part of the study in the course material. You have difficulty with the self assessment activities. You have a problem or question with an assignment or with the grading of the assignment.

It is important and necessary you acted the tutorial classes because this is the only chance to have face to face content with your facilitator and to ask questions which will be answered instantly. It is also period where you can say any problem encountered in the course of your study.

## SUMMARY

Environmental management entails the control of human activities in order not to cause hazards to our environment and the management of

natural resources. In effect, these control our domestic lives and our work lives. In domestic activities what we buy, what we throw away and how we throw them away and also in the work lives where the environmental impacts seem to be greatest. This includes the industrial activities that are fast depleting the natural resources and increasing the environmental damages. Environmental management tries to create a balance in the ecosystem and ecosystem equilibrium and its relationship with the socio-economic needs of the society, so it is socio-economic developments on one hand and the maintenance of the environment on the other hand. It is also involved with the description and monitoring of environmental changes with attempts to maximise human benefit and to minimise the degradation of the environment by human activities.

I wish you success in this course.

**MAIN COURSE**

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# MODULE 1 INTRODUCTION TO ENVIRONMENTAL MANAGEMENT



## UNIT 1 ENVIRONMENTAL MANAGEMENT

**CONTENTS**



## 1.0 INTRODUCTION

The word 'environment' is used in different ways. We talk of the 'home environment', the 'work environment', the 'social environment'. We use the word to describe our physical surroundings, made up of air, trees, grass. Our concern must be for the world as a whole, its 'air, water, land, natural resources, flora, fauna, humans, and their inter-relations' By 'environmental management' we mean keeping control of our activities so that we do what we can to conserve these physical resources and to avoid polluting them. We can apply these controls in our life domestically, in what we buy and what we throw away, but it is usually in our work where the environmental impact of what we do is greatest. Such has been the impact of industrial activity that resources are becoming depleted and environmental damage is increasing (ISO 14001, 2015).

## 2.0 OBJECTIVE

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

- discuss in detail Environmental management.

## 3.0 MAIN CONTENT

## 3.1 Concept of Environmental Management Definition

Environmental Management has been defined by many Authors. Environmental management can be defined as being a goal or vision, an attempt to steer a process, the application of a set of tools, a more philosophical exercise seeking to identify and establish new outlooks, and much more. Individual environmental managers may have a problem solving, sectoral, local, regional or global focus. They may be academics, regional or national decision makers and planners, non-governmental organization (NGO) staff, company executives, international civil servants, or all sorts of individuals or groups who are environmental stakeholders in some way using natural resources – herders, farmers, fishermen and so on (Barrow, 2005).

The International Organisation for Standardisation (ISO) in its document, ISO 14001 (2015) defined Environmental management as keeping control of our activities so that we do what we can to conserve these physical resources and to avoid polluting them. We can apply these controls in our life domestically, in what we buy and what we throw away, but it is usually in our work where the environmental impact of what we do is greatest. Such has been the impact of industrial activity that resources are becoming depleted and environmental damage is increasing. Environmental management can be said to be the active management of the impact of the society on the environment.

Environmental management is a subject that combines science, policy, and Socio-economic applications. It primarily stresses on finding solution to practical problems that people face in cohabitation with nature, resource exploitation, and waste production. In a purely anthropocentric sense, environmental management is all about dealing with the fundamental issue of how to innovate technology to evolve continuously while limiting the degree to which this process alters natural environment. Thus, Environmental management is closely linked with issues regarding sustainable economic growth, ensuring fair and equitable distribution of resources, and conserving natural resources for future generations.

Environmental management is a response to human actions considering the increasing seriousness and significance of today's disastrous human impact on natural ecosystems. It is comforting to know that with a smaller global population base and a less pervasive use of technology, the environment might be able to recuperate on its own from human misuse and abuse, but it is now widely recognised fact that in many cases positive intervention is necessary if the environment is to recover

in view of the fact that people have bestowed more importance on economic growth than preservation of the natural ecosystems (NEC, 2011).

Going through the various definitions, it will be observed that Environmental management has two major aspects:

- Socio-economic development
- Stability of biosphere in general and stability of the various ecosystems in particular

## 3.2 The Principles of Environmental Management

According to Environmental Pollution (2017) and NEC (2011) there are some guiding principles of environmental management, these principles are helpful in environmental decision making.

### 1. Polluter Pays Principle (PPP)

For the last two decades, many economists have suggested that firms discharging polluting effluents to the environment should somehow be made to pay a price for such discharges related to the amount of environmental damage caused.

The Organisation for Economic Co-operation and Development (OECD) has suggested the Polluter Pays principles (PPP) as a general basis for the environmental policy. It states that if measures are adopted to reduce pollution, the costs should be borne by the polluters. According to the OECD Council, "The principle to be used for allocating costs of pollution prevention and control measures to encourage rational use of scarce environmental resources and to avoid distortions in international trade and investment is the so-called Polluter Pays Principle." The essential concern of this principle is that polluters should bear the costs of abatement without subsidy.

The Polluter Pays Principle, as interpreted by the Supreme Court of India, means that the absolute liability for harm to the environment extends not only to compensate the victims of pollution but also the cost of restoring the environmental degradation. Thus, it includes environmental costs as well as direct costs to people or property. Remediation of the damaged environment is part of the process of sustainable development and as such the polluter is liable to pay the cost to the individual sufferers as well as the costs of reversing the damaged ecology.

The application of this principle depends upon the interpretations, particular cases and situations. This principle has brought more controversial discussions during the Rio Earth Summit 1992. The South has demanded more financial assistance from the North in combating the environmental degradation in the South. There are practical implications on the allocation of economic obligations in relation to environmentally damaging activities, particularly in relation to liability and the use of economic instruments.

### 2. The User Pays Principle (UPP)

It is considered as a part of the PPP. The principle states that all resource users should pay for the full long-run marginal cost of the use of a resource and related services, including any associated treatment costs. It is applied when resources are being used and consumed.

### 3. The Precautionary Principle (PP)

The main objective of the precautionary principle is to ensure that a substance or activity posing a threat to the environment is prevented from adversely affecting the environment, even if there is no conclusive scientific proof of linking that particular substance or activity to environmental damage. The words ‘substance’ and ‘activity’ are the result of human intervention.

The Rio Declaration in its Principle 15 emphasises on this principle, wherein it is provided that where there are threats of serious or irreversible damage. Lack of full scientific certainty shall not be used as a reason for postponing cost effective measures to prevent environmental degradation. Therefore, the principle is essential for the protection of environment and human health by implementing in the field of production and distribution of energy resources.

### 4. Principle of Effectiveness and Efficiency

It is essential that efficiency of resources use may also be accomplished by the use of policy instruments that create incentive to minimise wasteful use. It also applies to various issues of environmental governance by streaming processes and procedures in order to minimise environmental costs.

### 5. The Principle of Responsibility

It is the responsibility of all persons, corporations and states to maintain the ecological processes. Further, access to environmental resources

carries attendant responsibilities to use them in an ecological sustainable economically efficient and socially fair manner.

### 6. The Principle of Participation

It is the duty of all the persons to participate in collectively environmental decision making activities. Some participation areas are related to the use of trees and other plants, minerals, soils, fish and wildlife for purposes such as materials and food as well as for consumptive and non-consumptive recreation. The second issue concerns solid waste i.e. garbage, construction and demolition materials and chemically hazardous waste etc. The third issue of participation is related to pollution generating activities.

### 7. The Principle of Proportionality

The principle of proportionality is based on the concept of balance. A balance is to maintain between the economic development on the one hand and environmental protection on the other hand. It cannot be disputed that no development is possible without some adverse effects on ecology. Therefore, it is essential to adjust the interest of the people as well as the necessity to maintain the environment. Moreover, comparative hardships have to be balanced and benefits to a larger section of the people have to be maintained.

## 4.0 CONCLUSION

Environmental management tries to create a balance in the ecosystem and ecosystem equilibrium and its relationship with the socio-economic needs of the society, so it is socio-economic developments on one hand and the maintenance of the environment on the other hand. It is also involved with the description and monitoring of environmental changes with attempts to maximise human benefit and to minimize the degradation of the environment by human activities.

## 5.0 SUMMARY

Environmental management involves all people to some extent because all human activities ultimately have some sort of environmental impact. However, some individuals are more directly involved with resource use, and some special interest groups are particularly concerned with resource exploitation and with issues related to pollution. Environmental management therefore involves many stakeholders and requires a multidisciplinary perspective.

## 6.0 TUTOR-MARKED ASSIGNMENT

Discuss in detail the "Polluter Pays Principle" as one of the Principles of Environmental Management.

**Solution**

**Polluter Pays Principle (PPP):**

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# UNIT 2 CHARACTERISTICS OF ENVIRONMENTAL MEDIA

**CONTENTS**



## 1.0 INTRODUCTION

Environmental media refer to abiotic components of the natural environment. The environmental media are comprised of Soil, Water and Air. They are the basic natural resources critical to all fish and wildlife habitats and all vegetative communities. Managing the different components of the environmental media will to a large extent help in managing the environment. Most often when we talk of the environment, we refer to the soil, water and air and they carry and support the natural and human resources. So a good understanding of the environmental media will create an in-road into a better management of the natural and human resources.

## 2.0 OBJECTIVE

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

- state the characteristics of environmental media.

## 3.0 MAIN CONTENT

### 3.1 Soil

The soil environment consists of a variety of physical, biological and chemical factors that affect the abundance and diversity of microbes found in the soil (Sylvia, 2005). The soil environment consists of a solid and porous fraction. Within these fractions, a variety of chemical and physical factors are affected by microbes. These include, but are not

limited to texture, temperature, pH, oxygen, cation exchange capacity and redox reactions.

The soil environment directly affects the types of microbes, as well as the rates of processes they perform. For example, microbial activity increases with temperature, which in turn affects rates of decomposition. On the other hand, microbial processes directly affect their environments as well, contributing to the carbon and nitrogen cycles, which are important for microbial and plant health (Brady and Ray, 2010).

**Solid Fraction**

The solid fraction of the soil consists of mineral and organic matter, which is typically about 50% of the soil by volume and it has a dominant influence on heat, water, and chemical transport and retention process (Sylvia, 2005). Most of the solid particles are derived from mineral sources such as decomposed rocks or sediments (Moravec *et al*., 2015). Soil organic matter consists of all of the organic components of a soil, including living biomass, decomposing tissue, and fully decomposed tissue called humus (Brady and Ray, 2010).

**Soil Pores**

The air filled pores of the soil typically have a similar distribution of gases as the atmosphere above the soil, with slightly lower oxygen and slightly more $CO_2$ due to the respiration of microorganisms. The soil atmosphere consists of about 18-20% oxygen near the surface, which decreases with depth. $CO_2$ is around 1%, and $N_2$ is about 78% of the soil air filled pore space (Brady and Ray, 2010).

**Soil Aggregates**

Soil aggregates are groups of soil particles that bind to each other more strongly than to adjacent particles. The space between the aggregates provides pore space for retention and exchange of air and water. Aggregation affects erosion, movement of water, and plant root growth (Todar, 2016).

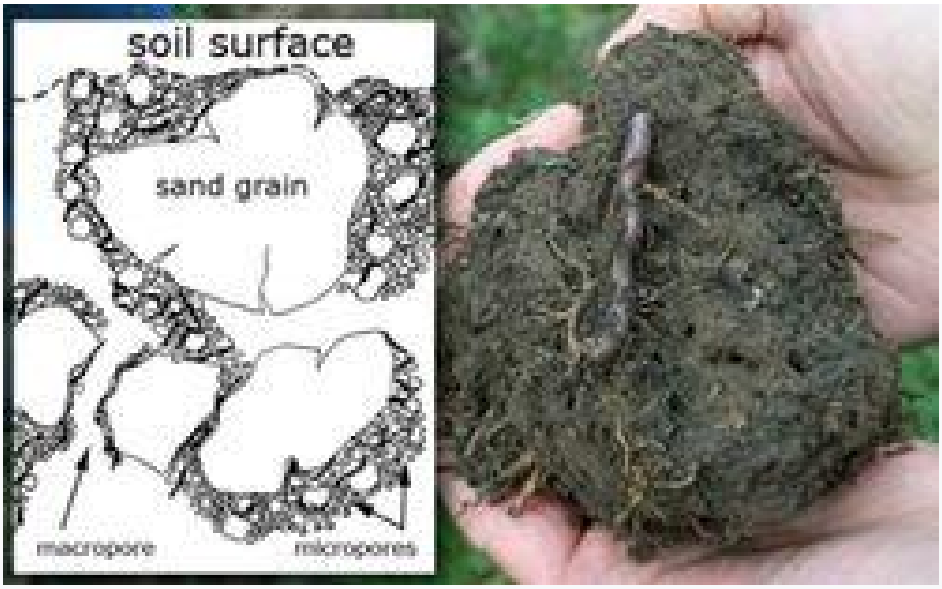


**Fig. 1.1:** A soil aggregate at the micro and macro scale (Soil Structure and Macropores, 2016).

**Texture**

Soil texture is defined as the distribution of sand (0.05-2.0 mm), silt (0.002-0.05mm), and clay (< 0.002mm) in soil. Soil texture indirectly influences properties such as: water holding capacity, porosity, aeration and nutrient availability. Clay particles have a very high surface to volume ratio, which makes them very chemically active and have high nutrient availability. Due to the adhesion of water, soils high in clay will also have a high water holding capacity. Soils with high clay content will often have a very active microbial community, especially in areas of the rhizosphere (Brady and Ray, 2010).

**Salinity**

Soil salinity refers to the salt content in the soil. The concentrations and types of ions in solution in the soil can cause modifications in the dispersion of the clay fraction, degrading the original soil fraction. The sodium ion, being monovalent, increases the width of the diffuse double layer on the surface of the clays, reducing the attractive forces between them with a consequent increase in particle dispersion (Maganhotto and Francisconi, 2012). The consequence of this dispersion of the clay is also shown by a reduction in stability of the soil aggregates, which are thus easily transported by rain or irrigation.

Soil salinization is a big problem for soils in arid or semi-arid regions and agricultural soils throughout the world (Brady and Ray, 2010).

## Bioavailability

Bioavailability assesses what proportion of a contaminant present at a contaminated site is available for uptake by organisms. Bioavailability processes are the biological, chemical and physical processes that result in an organism being exposed to a contaminant present in the soil. These processes are: release of the contaminant from the solid phase, transport of the contaminant to and across a biological membrane and, incorporation into a living organism. Bioavailable molecules must cross a biological membrane, which means the molecules have to interact with the aqueous phase. Therefore, soil properties which control partitioning between the solid phase in soil and the pore water, such as pH, organic matter content, cation exchange capacity (CEC), and the concentration of clay minerals, have a significant impact on bioavailability (Hodson *et al.*, 2011).

## pH

Microbes in the soil consume and release H+ through redox reactions and fermentation. Abiotic processes such as rainfall can also affect the pH of the soil. In areas of high rainfall, acidic soils can be created through leaching of bases from the soil, while more basic soils are typically located in arid environments. pH affects microbial diversity because many microbial species cannot tolerate extreme levels of pH (high or low). Alterations in pH can render essential microbe enzymes inactive and/or denature proteins within the cells and prevent microbial activity from occurring (Sylvia, 2005).

## Temperature

Soil temperature changes with depth: the surface soil (~0-20cm) is highly affected by the solar radiation. Moving deeper (~below 27cm) temperatures are very stable over time. This is because heat moves in soil mainly by conduction, which does not allow much heat to reach deep in the soil profile. Soil temperature is also affected by the soil color, soil cover, and the water content of the soil. A darker soil can absorb more heat compared to lighter color soil. A dry soil is more easily heated than a wet one due to the higher heat capacity of water (Brady and Ray, 2010).

## Oxygen

Oxygen (O2) is a very important component of the productivity of both microbes and plant roots in the soil. Oxygen has a very high electrical potential (Eh), meaning that it has a lot of potential to produce energy when used as an electron acceptor in an oxidation-reduction reaction (Brady and Ray, 2010).

## 3.2 Air

Air is one the media people are easily exposed to. Invariably when it is contaminated it can affect human beings and animals in the environment. Air can be contaminated as a result of stationary sources, natural sources, area sources and mobile sources. Sources of air pollution include combustion, building materials and consumer products. The exposure to air contaminants can be through inhalation and transfer through other media e.g. fomites.

**Properties of Air**

Air is said to be a mixture of gases. Air contains about 80% nitrogen and 20% oxygen. The properties of air are:

- Air occupies space
- Air has weight
- Air can be compressed

## 3.3 Water

The water resources system consisting of water (in rivers, aquifers, and lakes) and water- and land-based ecosystems (watersheds, wetlands, and floodplains) is essential for the sustenance and health of all species. As a source of natural capital, the water resources system provides fundamental input for a whole array of human needs and economic development activities. As a sink, it is used as a receptor for wastewater discharges from point and nonpoint sources of pollution. Fresh water sustains the integrity of the ecosystems that serve important ecological and hydrological functions and that people, especially the poor, often depend on directly. Hence, it is essential to maintain the stability, health, and productivity of the water resources system (Rafik and Hans, 2001).

**Properties of Water**

- Water exists in all three phases – solid, liquid and gas at atmospheric temperatures and pressures.
- Water has high melting and boiling points.
- High heat capacity
- High heat of fusion and vaporization.
- Water is less dense as a solid than as a liquid
- Water has high surface tension
- Dissolves other compounds easily
- Facilitates most chemical reactions in living systems.

## 4.0 CONCLUSION

Managing the different components of the environmental media will to a large extent help in managing the environment. The environmental media constitutes the natural resources. An imbalance in the equilibrium of any of the medium could cause hazards to the lives of humans, animals and plants.

## 5.0 SUMMARY

In this unit, we discussed and learnt the Environmental media to be made up of soil, air and water, their interplay that could affect the ecosystem and cause changes in the quality of lives of humans, animals and plants. We also discussed some of the qualities of the soil, the properties of air and water.

## 6.0 TUTOR-MARKED ASSIGNMENT

Outline the properties of water

**Solution**

- Water exists in all three phases – solid, liquid and gas at atmospheric temperatures and pressures.
- Water has high melting and boiling points.
- High heat capacity
- High heat of fusion and vaporization.
- Water is less dense as a solid than as a liquid
- Water has high surface tension
- Dissolves other compounds easily
- Facilitates most chemical reactions in living systems.

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# MODULE 2 EFFECTS OF TECHNOLOGICAL ADVANCEMENT ON THE ENVIRONMENT



## UNIT 1 EFFECTS OF TECHNOLOGICAL ADVANCEMENT ON ENVIRONMENT

**CONTENTS**



## 1.0 INTRODUCTION

The advances in technology in the wake of the twentieth century mark a landmark and a very important era in the lives of individuals, organizations and industries all over the world. The technology driven world has made life easy and comfortable. Industries, Academics, Health Sectors and all other areas of human endeavour can achieve more in a short time making use of technology and technology-driven facilities.

These technological accessories and machineries are located in our homes, offices, hospitals, schools (universities and colleges), laboratories, libraries, farms and every other place in our environmental premises, such technological accessories and machineries consumes various quantities of energy, but as a whole are not operating at optimal efficiency. The inefficient use and disposal of these technological by-products within our environment do not occur in the most environmentally sound manner possible, thus resulting in diverting unwanted places to landfills or storing them for extended periods of time (Kwazo *et al.*, 2014).

## 2.0 OBJECTIVE

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

- identify and discuss the effects of Technological Advancement on the Environment.

## 3.0 MAIN CONTENT

### 3.1 Negative Effects of the Advances in Technology

According to Environmental Issues (2019), many of the technologies we use every day consume a lot more resources and power than they need to, and using and manufacturing them can create a mess. Here are a few of the ways that technology can harm the environment:

- Pollution - Air, water, heat and noise pollution can all be caused by producing and using technology
- Depletion of natural resources – including precious metals like gold, is used to make technology. Many others, such as coal, are consumed to generate the electricity to use technology. Even some renewable resources, like trees and water, are becoming contaminated or are used up faster than they can renew themselves because of technology.
- Wastes - Manufacturing technology creates large amounts of wastes, and used computers and electronics get thrown out when they break or become outdated. They are called technotrash. These electronics contain all sorts of hazardous materials that are very unsafe for the environment. They need to be disposed of using special methods.
- Disrupting ecology - Clearing land where animals used to live to build factories and allowing pollution to contaminate the food chain can greatly affect the environment's natural cycles.
- Health hazards – Some of the technologies are manufactured using materials that can be toxic which in turn can have serious health implications or even cause cancer, and technology addiction can lead to other health problems like obesity and carpal tunnel syndrome. The health effects can through the production of hazardous by-products. The most obvious example of technology usage producing harmful by-products is the greenhouse gases and other toxic emissions from transportation technology. Refrigeration technology produces hazardous gases than can damage the ozone layer and produce toxic liquid effluents that make their way into drainage ways and poison water animals. Even appliances like the clothes washer create

microplastic-laden wastewater that winds up in the ocean, where it can be eaten by birds and sea animals (Gellert, 2018).

## 3.2 Positive Effects of the Advances in Technology

In as much as there are many obvious negative effects of the advances in technology, yet there are positive effects of the advances of technology to man and environment. Environmental Issues (2019) listed some of these benefits.

- It helps to develop and produce new materials and technologies that are sustainable and do not harm the environment.
- It allows the monitoring and studying of the environment to better understand how it works and the impact of human activities on it.
- It helps to create smarter technologies that respond to usage and adjust themselves to reduce their environmental impact, such as lights that can sense when no one is in the room and automatically turn off
- It helps to have a worldwide virtual laboratory, so that experts from all fields can share their research, experience and ideas to come up with better, smarter solutions. Not only does this allow people far away from each other to work together, but it also reduces the environmental impact people would normally cause from traveling to meet with each other
- It allows for paperless communication like email and online bill paying to reduce the amount of paper being used which means less cutting down of trees.
- It allows companies to reduce shipping and manufacturing impact and to reach a broader audience.

## 3.3 Types of Technology

Kwazo *et al*., 2014 outlines different types of technology which include:
**Construction technology**: It covers the basic elements of substructure (site works, settings out and foundations) and superstructure (flooring and roofs, simple finishes, fittings and fixtures) as well as basic services such as water, gas electricity and drainage, and considers low-rise framed industrial and commercial buildings. Throughout the world, construction technology is responsible for high levels of pollution as a result of the energy consumed during extraction, processing and transportation of raw materials (Adalbert, 1996).

**Medical /Health Technology**: It refers to any intervention that may be used for safe and effective prevention, diagnosis, treatment and rehabilitation of illness and diseases (WHO, 2013). This includes the

pharmaceuticals, devices, procedures and organisational systems used in health care (INAHTA, 2009).

**Agricultural Technology**: This is the application of techniques to control the growth and harvesting of plants and animal products. It refers to agricultural machinery that is used in the operation of an agricultural area or farm.

Agricultural technology focuses on technological processes used in agriculture, to create an understanding of how processes, equipment and structures are used with people, soil, plants, animals and their products, to sustain and maintain quality of life and to promote economic, aesthetic and sound cultural values.

**Biotechnology**: This is the use of any technique that makes use of biological systems, living organisms or their derivatives to develop, make or modify useful products, to improve plants or animals, or to develop micro-organisms for specific purposes (NABDA, 2002).

**Nanotechnology**: This is the engineering of functional systems at the molecular scale. It is the manipulation of matter on an atomic, molecular, and supramolecular scale.

**Environmental Technology**: Environmental technology (envirotech), green technology (greentech) or clean technology (cleantech) is the application of one or more of environmental science, green chemistry, environmental monitoring and electronic devices to monitor, model and conserve the natural environment and resources, and to curb the negative impacts of human involvement.

**Information Communication Technology (ICT):** This is the application of computers and telecommunications equipment to store, retrieve, transmit and manipulate data (Daintith, 2009). ICT is universally regarded as essential tools in enhancing environmental problems (such as environmental pollution). Today, it is commonly accepted that; ICTs has significant impacts on the environment.

**Resource-Intensive Technology**

Some categories of technology, such as electronics, require resources that are difficult to acquire without harming the environment. For example, the advanced batteries in hybrid cars are composed of nickel and rare-earth metals. Mining these materials is a significant source of harmful emissions, including solvent vapors, sulfuric acid and coal dust. Acid-laden water discharges kill all plant and animal life around nearby

waterways and have sickened and killed nearby rural residents (Gellert, 2018).

## 3.4 Technology Disposal

New advances in technology often render old technology useless. Discarding outdated or worn out technological goods is a significant source of environmental damage. For example, contemporary compact fluorescent light bulbs contain mercury, which is toxic to both humans and animals. Old thermometers also contained mercury, as do some batteries manufactured prior to the mid-1990s. Discarded vehicles left in place for long periods eventually leak toxic fluids into the ground, where they kill plants, animals and soil microbes. Rainfall can wash pollutants from the discarded technology into waterways, spreading poisons into natural systems and the human food supply (Gellert, 2018).

## 4.0 CONCLUSION

Advances in technology have both negative and positive impacts in the lives of persons and the environment. Thus, what is needed in the management and manufacturing of recent technology is for the stake holders to strike a balance. This can come by education and public awareness. Also the disposal of used and worn-out technological equipment and gadgets should be done having in the principles of environmental management.

## 5.0 SUMMARY

In this unit, we learnt the negative and positive effects of advances in technology. We also learnt the different types of technology and disposal of sued technological equipment.

## 6.0 TUTOR-MARKED ASSIGNMENT

Carefully discuss the positive effects of the advances in technology to the lives of persons and environment.

**Solution**

In as much as there are many obvious negative effects of the advances in technology, yet there are positive effects of the advances of technology to man and environment. Environmental Issues (2019) listed some of these benefits.

- It helps to develop and produce new materials and technologies that are sustainable and do not harm the environment.

- It allows the monitoring and studying of the environment to better understand how it works and the impact of human activities on it.
- It helps to create smarter technologies that respond to usage and adjust themselves to reduce their environmental impact, such as lights that can sense when no one is in the room and automatically turn off
- It helps to have a worldwide virtual laboratory, so that experts from all fields can share their research, experience and ideas to come up with better, smarter solutions. Not only does this allow people far away from each other to work together, but it also reduces the environmental impact people would normally cause from traveling to meet with each other
- It allows for paperless communication like email and online bill paying to reduce the amount of paper being used which means less cutting down of trees.
- It allows companies to reduce shipping and manufacturing impact and to reach a broader audience.

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# UNIT 2 EFFECTS OF RADIATIONS ON THE ENVIRONMENT

**CONTENTS**



## 1.0 INTRODUCTION

There are many forms of radiation. Some forms of radiation are found in the natural environment and others are due to modern technology. Whether natural or man-made, radiation can be both harmful and beneficial to the environment. The sun, for example can have positive and negative effects on plant and animal life. At low levels, radiation can be beneficial to the environment. On the other hand ionized radiation such as x-rays, gamma rays, alpha and beta particles can be particularly harmful in excessive amounts.

## 2.0 OBJECTIVES

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

- discuss the effects of radiation on the Environment.

## 3.0 MAIN CONTENT

### 3.1 Sources of Radiation

According to a World Health Organisation (2016) publication on Ionizing radiation, health effects and protective measures, People are exposed to natural radiation sources as well as human-made sources on a daily basis. Natural radiation comes from many sources including more than 60 naturally-occurring radioactive materials found in soil, water and air. Radon, a naturally-occurring gas, emanates from rock and soil and is the main source of natural radiation. Every day, people inhale and ingest radionuclides from air, food and water.

People are also exposed to natural radiation from cosmic rays, particularly at high altitude. On average, 80% of the annual dose of background radiation that a person receives is due to naturally occurring terrestrial and cosmic radiation sources. Background radiation levels vary geographically due to geological differences. Exposure in certain areas can be more than 200 times higher than the global average. Human exposure to radiation also comes from human-made sources ranging from nuclear power generation to medical uses of radiation for diagnosis or treatment. Today, the most common human-made sources of ionizing radiation are medical devices, including X-ray machines.

## 3.2 Ionizing Radiations

According to the United States Environmental Protection Agency, ionizing radiations are radioactive materials that decay spontaneously producing ionizing radiation, which has sufficient energy to strip away electrons from atoms (creating two charged ions) or to break some chemical bonds. Any living tissue in the human body can be damaged by ionizing radiation. The body attempts to repair the cellular damage, but sometimes the damage is of a nature that cannot be repaired or it is too severe or widespread to be repaired. Also mistakes made in the natural repair process at the cellular level can lead to cancerous cells. The most common forms of ionizing radiation are alpha and beta particles, and gamma and X-rays.

## 3.3 Forms of Ionizing Radiation

The Washington Department of Health listed ionizing radiation to include:

1. Alpha particles: Helium nuclei consisting of two protons and two neutrons are emitted from radioactive elements such as uranium, plutonium, and radium. It cannot penetrate the skin, so only are dangerous if inhaled or swallowed and radiation is emitted inside the body.
2. Beta particles: fast-moving electrons. They are emitted by many radioactive elements, such as iodine 131 and cesium 137. It is more penetrating than alpha particles, but can be easily shielded. All beta emitters, depending on the amount present, can pose a hazard if inhaled, ingested or absorbed into the body. In addition, energetic beta emitters are capable of presenting an external radiation hazard, especially to the skin.
3. Gamma rays: high-energy beams (similar to X-rays)
   They are emitted by many radioactive elements, such as uranium, iodine 131, and cesium 137.

They are very penetrating

It damages or kills cells

## 4.0 CONCLUSION

Radiation is often beneficial to animals and plant growth especially the non- ionizing radiation. It is necessary for many plants to receive some form of non-ionizing radiation. Radiation that produces light in order for photosynthesis to occur and the early morning sun radiation to animals are positive effects that radiation has on plant and animal lives. However, the ionizing radiation has a very serious negative effect on the environment and the lives of plants and animals.

## 5.0 SUMMARY

In this unit we understood the meaning of radiation, the sources of radiation, different forms of radiation and ionizing radiation and its effects on the environment, plants and animal lives.

## 6.0 TUTOR-MARKED ASSIGNMENT

Discuss the different forms of ionizing radiation

**Solution**

1. Alpha particles: Helium nuclei consisting of two protons and two neutrons are emitted from radioactive elements such as uranium, plutonium, and radium. It cannot penetrate the skin, so only are dangerous if inhaled or swallowed and radiation is emitted inside the body.
2. Beta particles: fast-moving electrons. They are emitted by many radioactive elements, such as iodine 131 and cesium 137. It is more penetrating than alpha particles, but can be easily shielded. All beta emitters, depending on the amount present, can pose a hazard if inhaled, ingested or absorbed into the body. In addition, energetic beta emitters are capable of presenting an external radiation hazard, especially to the skin.
3. Gamma rays: high-energy beams (similar to X-rays)
   They are emitted by many radioactive elements, such as uranium, iodine 131, and cesium 137.

They are very penetrating

It damages or kills cells

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# UNIT 3 EFFECTS OF POLLUTION ON THE ENVIRONMENT

**CONTENTS**



## 1.0 INTRODUCTION

The pollution of the environment has negatively affected the life of both plants and animals. It can be said that almost all of the gains in the fields of industrial progress, science and technology had be achieved at the expense of the health of man, animals and plants found in the environment, even the flora and fauna were found to be threatened with extinction. This effect is not only in Nigeria but in India, Europe, USA and all over the world. Environmental pollution is not caused come through the smoke from the automobiles, other vehicular traffic, insecticides, and nitrogen only by the industries but even individuals up to the home level. These fertilizers and synthetic detergents also cause environmental pollution.

## 2.0 OBJECTIVES

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

- discuss the term pollution; sources of pollution, types of pollutions and its effect on the environment.

## 3.0 MAIN CONTENT

### 3.1 Definition of Pollution

Pollution has been defined by many Authors. Berg (2017) defined pollution in this way; the term "pollution" refers to any substance that

negatively impacts the environment or organisms that live within the affected environment. According to Mehta (2018), the dictionary explains pollution as "the presence in or introduction into the environment of a substance which has harmful or poisonous effects." Wiki explains pollution as "the introduction of contaminants into the natural environment that causes adverse change." Simply put, Environmental Pollution is something that brings harm to our environment and in turn to the people who exist based on the environment.

So, Pollution can be defined to be any substance that negatively affects the environment and the organisms that can be found in that environment.

It can be seen from the foregoing that pollution is both an "act" and a "thing". An act in that we can cause pollution by what we are doing, the thing that was dropped or released is itself pollution.

## 3.2 Sources of Pollution

Mehta (2018) outlined the major sources of pollution to include:

**Dumping solid wastes:** Wastes from households and commercial centers pollute the environment when not properly disposed.

**Burning of fossil fuels:** The use of fossil fuels by automobiles, vehicles and power generating machines pollute the air, the soil and the water with noxious gases such as $CO_2$ and CO.

**Agricultural waste:** The use of fertilizers and pesticides in agriculture are major sources of environmental pollution.

**Industrial activities:** The activities of industries that produce smoke, gases, industrial effluents and technological wastes cause health hazards, pollute and contaminate both air and water. The improper disposals of industrial wastes are the sources of soil and water pollution. Chemical waste resulting from industry can pollute lakes, rivers and seas and soil.

**Vehicles:** The carbon dioxide and carbon monoxides emitted by vehicles using petrol and diesel and the cooking coal also pollutes the environment. The harmful smoke of these vehicles causes air pollution. Further, the sounds produced by these vehicles cause noise pollution.

**Rapid urbanisation:** The rapid urbanization throughout the whole world is also another source environmental pollution which affects plants and animals.

**Population explosion:** Due to the increase in population, particularly in developing countries, there has been surge in demand for basic food, occupation and shelter. The world has witnessed massive deforestation to absorb the growing population and their demands.

## 3.3 Point and Non Point Sources

### Point Source Pollution

According to Hill (1997), the US Environmental Protection Agency defines Point source pollution as "any single identifiable source of pollution from which pollutants are discharged, such as a pipe, ditch, ship or factory smokestack"

Industries, factories and sewage treatment plants are common types of point sources. The factories, including oil refineries, pulp and paper mills, and chemical, electronics and automobile manufacturers, typically discharge one or more pollutants in their effluents. Some factories discharge their effluents directly into a waterbody. Others treat it themselves before it is released, and still others send their wastes to sewage treatment plants for treatment. Sewage treatment plants treat human wastes and send the treated effluent to the stream or river.

### Nonpoint Source Pollution

Nonpoint source pollution is a combination of pollutants from a large area rather than from specific identifiable sources such as discharge pipes. According to Wikipedia, most nonpoint source water pollution occurs as a result of surface water runoff When rain or melted snow moves over and through the ground, the water absorbs and assimilates some of the pollutants with which it comes into contact. Following a heavy rainstorm for example, water will flow across a parking lot and pick up oil left by cars driving and parking on the asphalt when you see a rainbow-colored sheen on water flowing across the surface of a road or parking lot, you are actually looking at non-point source water pollution.

## 3.4 Types of Pollution

Bradford (2018) in Live Science publication listed the types of pollution as follows:

### Land Pollution

Land can become polluted by household garbage and by industrial waste. In 2014, Americans produced about 258 million tons of solid

wastes, according to the U.S. Environmental Protection Agency. A little over half of the waste — 136 million tons— was gathered in landfills. Only about 34 percent was recycled or composted.

**Water Pollution**

Water pollution happens when chemicals or dangerous foreign substances are introduced to water, including chemicals, sewage, pesticides and fertilizers from agricultural runoff, or metals like lead or mercury. According to the Environmental Protection Agency (EPA), 44 percent of assessed stream miles, 64 percent of lakes and 30 percent of bay and estuarine areas are not clean enough for fishing and swimming. The EPA also states that the United States most common contaminants are bacteria, mercury, phosphorus and nitrogen. These come from the most common sources of contaminates, that include agricultural runoff, air deposition, water diversions and channelization of streams.

**Air Pollution**

The air we breathe has a very exact chemical composition; 99 percent of it is made up of nitrogen, oxygen, water vapor and inert gases. Air pollution occurs when things that aren't normally there are added to the air. A common type of air pollution happens when people release particles into the air from burning fuels. This pollution looks like soot, containing millions of tiny particles, floating in the air.
Another common type of air pollution is dangerous gases, such as sulfur dioxide, carbon monoxide, nitrogen oxides and chemical vapors. These can take part in further chemical reactions once they are in the atmosphere, creating acid rain and smog. Other sources of air pollution can come from within buildings, such as secondhand smoke. Finally, air pollution can take the form of greenhouse gases, such as carbon dioxide or sulfur dioxide, which are warming the planet through the greenhouse effect.

**Noise Pollution**

Noise may not be seen or smelt by humans yet it still affects the environment. Noise pollution happens when the sound coming from planes, industry or other sources reaches harmful levels. Researches have shown that there are direct links between noise and health, including stress-related illnesses, high blood pressure, speech interference, hearing loss.

**Light Pollution**

It has become quite difficult living without the modern convenience of electric lights. For the natural world, though, lights have changed the way that days and nights work. Some consequences of light pollution are:

- Some birds sing at unnatural hours in the presence of artificial light.
- Scientists have determined that long artificial days can affect migration schedules, as they allow for longer feeding times.

**Other types of pollution are:**

- Radioactive material pollution
- Thermal pollution
- Visual pollution

## 3.5 The Effects of Environmental Pollution

According to Mehta (2018), the effects of environmental pollution are:

**Environment Degradation**: Environment is the first casualty for any pollution whether in air or water. The increase in the amount of $CO_2$ in the atmosphere leads to smog which can restrict sunlight from reaching the earth. Thus, preventing plants in the process of photosynthesis. Gases like Sulfur dioxide and nitrogen oxide can cause acid rain. Water pollution in terms of Oil spill may lead to death of several wildlife species.

**Human Health**:

Some of the health dangers of environmental pollution are:

- **Prenatal Effects**

Environmental pollution is believed to cause inflammation and oxidative stress in a mother’s body that subsequently alters the placenta, impairs the transport of oxygen and nutrients to the developing child and may disrupt epigenetic mechanisms important for development. These effects may cause changes in the child's birth weight, immune system and lung function. Exposure to air pollution may cause the development of asthma in the child, and impaired lungs development contributes to infant mortality (CHE, 2018).

- **Cancer**

In 2016, the WHO's International Agency for Research on Cancer (IARC) classified both air pollution and particulate matter in polluted air as Class 1 human carcinogens, concluding that there is sufficient evidence that air pollution and particulate matter each cause lung cancer and that outdoor air pollution is associated with cancer of the urinary bladder (CHE, 2018).

- **Neurocognitive Decline**

A 2012 study found that children and young adults with a genetic predisposition to developing Alzheimer's disease (APOE allele ∈4) who were exposed to significant air pollution developed a greater number of protein markers known to increase the risk of Alzheimer's disease (tau proteins and Aβ plaques). This finding suggests that genetic factors could make a significant number of children exposed to air pollution more prone to developing Alzheimer's disease later in life. A review published in 2015 found associations of air pollution with global cognitive function, verbal and nonverbal learning and memory, and activities of daily living. A 2017 review further revealed that both children and older adults exposed to air pollution exhibited signs of cognitive dysfunction, and that air pollution was associated with exacerbations of neurodegenerative conditions such as Alzheimer's and Parkinson's diseases (CHE, 2018).

- **Mental Health**

Some evidence ties air pollution to an increased risk of a variety of mental health conditions. A 2017 review found an association between air pollution, especially particulates, and suicidality (CHE, 2018).

**Global Warming**: The emission of greenhouse gases particularly $CO_2$ is leading to global warming. Every other day new industries are being set up, new vehicles come on roads and trees are cut to make way for new homes. All of them, in direct or indirect way lead to increase in $CO_2$ in the environment. The increase in $CO_2$ leads to melting of polar ice caps which increases the sea level and pose danger for the people living near coastal areas.

**Depletion of the Ozone Layer**: Ozone layer stops ultra violet rays from reaching the earth. UV exposure in excess can lead to skin cancer. Due to release of CFCs & aerosols in the atmosphere which contributed to the depletion of ozone layer the sheet that protects from the harmful UV-rays.

**Infertile Land**: Constant use of pesticides, insecticides & other chemicals causes the soil to become infertile. Soil is the major and in some cases the only source of nutrition for plants & vegetables. Importance of these can never be overstated. But due to infertile soil, plants will not be able to grow properly. Industrial waste also affects the fertility of the soil.

## 4.0 CONCLUSION

The effects of environmental pollution are many and divers. It ranges from its effects on the environment to its effect to the lives of plants and animals. It is also evidently clear that environmental pollution cannot be eradicated rather can be managed to reduce it and its effects to the barest minimum.

## 5.0 SUMMARY

In this Unit we understood pollution, the sources of pollution, the types of pollution and the effects of environmental pollution.

## 6.0 TUTOR-MARKED ASSIGNMENT

Discuss in detail the sources of pollution in the environment.
**Solution**

**Dumping solid wastes:** Wastes from households and commercial centers pollute the environment when not properly disposed.

**Burning of fossil fuels:** The use of fossil fuels by automobiles, vehicles and power generating machines pollute the air, the soil and the water with noxious gases such as $CO_2$ and CO.

**Agricultural waste:** The use of fertilizers and pesticides in agriculture are major sources of environmental pollution.

**Industrial activities:** The activities of industries that produce smoke, gases, industrial effluents and technological wastes cause health hazards, pollute and contaminate both air and water. The improper disposals of industrial wastes are the sources of soil and water pollution. Chemical waste resulting from industry can pollute lakes, rivers and seas and soil.
**Vehicles:** The carbon dioxide and carbon monoxides emitted by vehicles using petrol and diesel and the cooking coal also pollutes the environment. The harmful smoke of these vehicles causes air pollution. Further, the sounds produced by these vehicles cause noise pollution.

**Rapid urbanisation:** The rapid urbanisation throughout the whole world is also another source environmental pollution which affects plants and animals.

**Population explosion:** Due to the increase in population, particularly in developing countries, there has been surge in demand for basic food, occupation and shelter. The world has witnessed massive deforestation to absorb the growing population and their demands.

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# MODULE 3 MYCOTOXINS, OCCUPATIONAL HYGIENE, AND NITRO-COMPOUNDS IN THE ENVIRONMENT



## UNIT 1 EFFECTS OF MYCOTOXINS IN THE ENVIRONMENT

**CONTENTS**



## 1.0 INTRODUCTION

Fungi are a group of eukaryotic organisms that can be microscopic in nature though some can be seen as macroscopic, e.g. Mushrooms and Rhizopus. Filamentous fungi produce secondary metabolites known as mycotoxins. These mycotoxins are poisonous chemical compounds. There are many such compounds in the environment but only a few of them are often found in food materials, grains and seeds. The presence of mycotoxins in food stuffs has great significance in the health of humans and livestock. Mycotoxins are associated with diseased or deteriorating crops. At times, the presence of the fungi that leads to the production of mycotoxins can easily be visible and some other times they are not visible.

## 2.0 OBJECTIVE

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

- explain the concept of Mycotoxins and how it can be controlled or prevented.

# 3.0 MAIN CONTENT

## 3.1 The Concept of Mycotoxin

Mycotoxins are toxic compounds that are naturally produced by certain types of moulds (fungi). Moulds that can produce mycotoxins grow on numerous foodstuffs such as cereals, dried fruits, nuts and spices. Mould growth can occur either before harvest or after harvest, during storage, on/in the food itself often under warm, damp and humid conditions. Most mycotoxins are chemically stable and survive food processing.

Several hundred different mycotoxins have been identified, but the most commonly observed mycotoxins that present a concern to human health and livestock include aflatoxins, ochratoxin A, patulin, fumonisins, zearalenone and nivalenol/deoxynivalenol. Exposure to mycotoxins can happen either directly by eating infected food or indirectly from animals that are fed contaminated feed, in particular from milk (WHO, 2018). A scientific expert committee jointly convened by WHO and the Food and Agriculture Organization of the United Nations (FAO) – called JECFA – is the international body responsible for evaluating the health risk from natural toxins including mycotoxins.

International standards and codes of practice to limit exposure to mycotoxins from certain foods are established by the Codex Alimentarius Commission based on JECFA assessments (WHO, 2018).

## 3.2 Types of Mycotoxins

According to Bennet and Klich (2003), some of the major types of mycotoxins are as follows:

### Aflatoxins

The aflatoxins were isolated and characterized after the death of more than 100,000 turkey poults (turkey X disease) was traced to the consumption of a mold-contaminated peanut meal The four major aflatoxins are called $B_1$, $B_2$, $G_1$, and $G_2$ based on their fluorescence under UV light (blue or green) and relative chromatographic mobility during thin-layer chromatography. Aflatoxin $B_1$ is the most potent natural carcinogen known and is usually the major aflatoxin produced by toxigenic strains.

### Citrinin

Citrinin was first isolated from *Penicillium citrinum* prior to World War II subsequently, it was identified in over a dozen species

of *Penicillium* and several species of *Aspergillus* (e.g., *Aspergillus terreus* and *Aspergillus niveus*), including certain strains of *Penicillium camemberti* (used to produce cheese) and *Aspergillus oryzae* (used to produce sake, miso, and soy sauce) More recently, citrinin has also been isolated from *Monascus ruber* and *Monascus purpureus,* industrial species used to produce red pigments.

**Ergot Alkaloids**

The ergot alkaloids are among the most fascinating of fungal metabolites. They are classified as indole alkaloids and are derived from a tetracyclic ergoline ring system. Lysergic acid, a structure common to all ergot alkaloids, was first isolated in 1934. The clavines have ergoline as a basic structure but lack peptide components; the lysergic acid alkaloids include ergotamine and lysergic acid amide (ergine).

**Fumonisins**

Fumonisins were first described and characterized in 1988.The most abundantly produced member of the family is fumonisin $B_1$. They are thought to be synthesized by condensation of the amino acid alanine into an acetate-derived precursor. Fumonisins are produced by a number of *Fusarium* species, notably *Fusarium verticillioides* (formerly *Fusarium moniliforme* = *Gibberella fujikuroi*), *Fusarium proliferatum,* and *Fusarium nygamai,* as well as *Alternaria alternate*.

**Ochratoxin**

Ochratoxin A was discovered as a metabolite of *Aspergillus ochraceus* in 1965 during a large screen of fungal metabolites that was designed specifically to identify new mycotoxins. Shortly thereafter, it was isolated from a commercial corn sample in the United States and recognized as a potent nephrotoxin. Members of the ochratoxin family have been found as metabolites of many different species of *Aspergillus*,

**Patulin**

Patulin, 4-hydroxy-4H-furo[3,2c]pyran-2(6H)-one, is produced by many different molds but was first isolated as an antimicrobial active principle during the 1940s from *Penicillium patulum* (later called *Penicillium urticae*, now *Penicillium griseofulvum*). The same metabolite was also isolated from other species and given the names clavacin, claviformin, expansin, mycoin c, and penicidin.

**Trichothecenes**

The trichothecenes constitute a family of more than sixty sesquiterpenoid metabolites produced by a number of fungal genera, including *Fusarium*, *Myrothecium*, *Phomopsis*, *Stachybotrys*, *Trichoderma*, *Trichothecium*, and others. The term trichothecene is derived from trichothecin, which was the one of the first members of the family identified. All trichothecenes contain a common 12,13-epoxytrichothene skeleton and an olefinic bond with various side chain substitutions. They are commonly found as food and feed contaminants, and consumption of these mycotoxins can result in alimentary hemorrhage and vomiting; direct contact causes dermatitis.

Zearalenone

Zearalenone (6-[10-hydroxy-6-oxo-*trans*-1-undecenyl]-B-resorcyclic acid lactone), a secondary metabolite from *Fusarium graminearum* (teleomorph *Gibberella zeae*) was given the trivial name zearalenone as a combination of *G. zeae*, resorcylic acid lactone, -ene (for the presence of the C-1′ to C-2 double bond), and -one, for the C-6′ ketone. Almost simultaneously, a second group isolated, crystallized, and studied the metabolic properties of the same compound and named it F-2. Much of the early literature uses zearalenone and F-2 as synonyms; the family of analogues is known as zearalenones and F-2 toxins, respectively.

## 3.3 Prevention and Control of Mycotoxins in Stored Grains and Seeds

The toxicity of Mycotoxins to man and animals can be prevented or controlled using the following methods.

**Dry the grain:** Proper drying of the grains prevents the growth of fungi on the food stuff there preventing the production of mycotoxins. The critical water content for safe storage corresponds to a water activity ($a_w$) of about 0.7. Maintenance of foods below 0.7 $a_w$ is an effective technique used for controlling of mycotoxins in stored food.

**Avoid grain damage:** Grain damage creates opportunity for the fungi to penetrate the grains and start growing, so avoiding damage keeps the fungi away. Most of the time, the damage is caused by insects. So keeping the insects away especially before harvest will help.

**Proper storage conditions:** A good storage condition will be helpful in controlling the growth of fungi. Fungi grow if the humidity is high.

**Detecting mycotoxins:** Monitoring the presence of mycotoxins will help in controlling mycotoxins.

## 4.0 CONCLUSION

The presence of mycotoxins in food stuffs and grains has serious health impact on both human beings and animals. It also has serious economic implication on any nation if its farm produce contains mycotoxins. In fact it is one of the reasons if not the major reason why Nigerian exportation of groundnuts in the sixties collapsed.

## 5.0 SUMMARY

In this Unit, we have understood the concept of mycotoxins and its implications to the health of man and animals and ways it can be prevented or controlled.

## 6.0 TUTOR-MARKED ASSIGNMENT

Discuss the various ways mycotoxins can be prevented or controlled
**Solutions**

## 7.0 REFERENCES/FURTHER READING

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# UNIT 2 OCCUPATION HYGIENE

## CONTENTS



## 1.0 INTRODUCTION

The word hygiene is derived from the name of the Greek goddess of health known as Hygeia. She was the daughter of Asklepios and sister to Panacea. While her father and sister were connected with the treatment of existing disease Hygeia was regarded as being concerned with the preservation of good health and the prevention of disease (IOHA, 2006). Occupational hygiene takes care of activities such as food production, extraction of raw materials, manufacturing of goods, energy production which can, to a greater or lesser extent, create hazards to the health of workers and those in nearby communities, as well as to the general environment.

However, the generation and release of harmful agents in the work environment can be prevented, through adequate hazard control interventions, which not only protect workers' health but also limit the damage to the environment often associated with industrialization. If a harmful chemical is eliminated from a work process, it will neither affect the workers nor go beyond, to pollute the environment (Encyclopedia of Occupational Health and Safety, 1998).

## 2.0 OBJECTIVE

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

- discuss occupational hygiene.

## 3.0 MAIN CONTENT

## 3.1 Concept of Occupational Hygiene

In the World Health Organisation (WHO) Declaration on occupational health for all, the preamble reads: "The Second Meeting of the WHO Collaborating Centers in Occupational Health, which was held in Beijing, People's Republic of China, II-14 October 1994, discussed and adopted a proposal for a WHO Global Strategy for 'Occupational Health for All'. In adopting the strategy, the meeting recognized the urgent need to develop occupational health at a time when rapid changes in working life are affecting both the health of workers and the health of the environment in all countries of the world. The meeting also adopted a proposal for action aimed at implementation of the strategy" (WHO, 1994).

**Definition**

IOHA (2006) defines Occupational as the discipline of anticipating, recognising, evaluating and controlling health hazards in the working environment with the objective of protecting worker health and well-being and safeguarding the community at large.

Occupational Hygiene has also been defined as the practice of identifying of hazardous agents; chemical, physical and biological; in the workplace that could cause disease or discomfort, evaluating the extent of the risk due to exposure to these hazardous agents, and the control of those risks to prevent ill-health in the long or short term.
The British Occupational Hygiene Society (BOHS) defines that "occupational hygiene is about the prevention of ill-health from work, through recognising, evaluating and controlling the risks" (BOHS, 2009).

According to Wikipedia, The profession of occupational hygiene uses strict and rigorous scientific methodology and often requires professional judgment based on experience and education in determining the potential for hazardous exposure risks in workplace and environmental studies.

## 3.2 The Practice of Occupational Hygiene

According to the Encyclopedia of Occupational Health and Safety (1998), the classical steps in occupational hygiene practice are as follows:

- The recognition of the possible health hazards in the work environment
- The evaluation of hazards, which is the process of assessing exposure and reaching conclusions as to the level of risk to human health
- Prevention and control of hazards, which is the process of developing and implementing strategies to eliminate, or reduce to acceptable levels, the occurrence of harmful agents and factors in the workplace, while also accounting for environmental protection.

The ideal approach to hazard prevention is "anticipated and integrated preventive action", which should include:

- Occupational health and environmental impact assessments, prior to the design and installation of any new workplace
- Selection of the safest, least hazardous and least polluting technology ("cleaner production")
- Environmentally appropriate location: proper design, with adequate layout and appropriate control technology, including for the safe handling and disposal of the resulting effluents and waste
- Elaboration of guidelines and regulations for training on the correct operation of processes, including on safe work practices, maintenance and emergency procedures.

## 3.3 The Socio-economic Role of Occupational Hygiene

According to Wikipedia, the profession of Occupational hygiene have been involved in time past with changing the perception of society about the nature and extent of hazards and preventing exposures in the workplace and communities. Many occupational hygienists work day-to-day with industrial situations that require control or improvement to the workplace situation.

Many of these issues have required the coordination over a number of years of a number of medical and para professionals in detecting and then characterizing the nature of the issue, both in terms of the hazard and in terms of the risk to the workplace and ultimately to society.

## 3.4 The Difference between Industrial Safety and Industrial Hygiene

Industrial hygiene is concerned with identifying, analysing, and controlling the stressors in a work environment that could lead to injury, illness, or impairment. These stressors can be physical, chemical, biological, ergonomic, or psychosocial in nature and can range from

noise levels and temperature extremes to radiation and repetitive motions. Industrial hygienists use rigorous scientific methodology to identify potential hazards and evaluate the level or risk and exposure.
Industrial safety, on the other hand, refers to the policies and plans that organizations put in place to meet the challenges identified by industrial hygienists. These include general safety concerns common to all workers, specific concerns relevant to the industry, safety aspects associated with the process and production process, and building and structural safety. Employers must ensure that all relevant laws, regulations, and stipulations are adhered to in order to minimise safety concerns for employees (Safeopedia, 2019).

## 4.0 CONCLUSION

Occupational hygiene takes care of activities such as food production, extraction of raw materials, manufacturing of goods, energy production which can, to a greater or lesser extent, create hazards to the health of workers and those in nearby communities, as well as to the general environment.

## 5.0 SUMMARY

In this unit, you understood what is meant by occupational hygiene

## 6.0 TUTOR-MARKED ASSIGNMENT

Define the term Occupational hygiene

**Solution**

IOHA (2006) defines Occupational as the discipline of anticipating, recognising, evaluating and controlling health hazards in the working environment with the objective of protecting worker health and well-being and safeguarding the community at large.

Occupational Hygiene has also been defined as the practice of identifying of hazardous agents; chemical, physical and biological; in the workplace that could cause disease or discomfort, evaluating the extent of the risk due to exposure to these hazardous agents, and the control of those risks to prevent ill-health in the long or short term.

The British Occupational Hygiene Society (BOHS) defines that "occupational hygiene is about the prevention of ill-health from work, through recognising, evaluating and controlling the risks” (BOHS, 2009).

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# UNIT 3 NITRO-COMPOUNDS IN THE ENVIRONMENT

**CONTENTS**



## 1.0 INTRODUCTION

According to Wikipedia, the nitro compounds are organic compounds that contain one or more nitro functional groups ($-NO_2$). Its presence in a compound makes it to be explosive and it is used all over the world as explosives. The nitro group is also known to be electron-withdrawing in an atom. Nitro groups are rarely found in nature, being almost invariably produced by nitration reactions using nitric acid as the starting agent.

Effect of Nitro compounds in the Environment is believed to retard the lowering of the oxidation- reduction potential of the sewage to the region favorable for development of the sulphate- reducing anaerobes.

## 2.0 OBJECTIVES

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

- discuss Nitro compounds and its effect in the environment.

## 3.0 MAIN CONTENT

### 3.1 Description of Nitro-compounds

Encyclopedia Britannica describes Nitro compounds as any of a family of chemical compounds in which the nitro group (—O—N=O) forms part of the molecular structure. The most common examples are organic substances in which a carbon atom is linked by a covalent bond to the nitrogen atom of the nitro group. Nitro compounds are polar, and those with no other chemically reactive grouping are colourless or pale yellow

liquids that are only slightly soluble in water. Many nitro compounds are commercially produced for use as explosives, solvents, or chemical intermediates (substances valued as raw materials in further chemical processing).

A nitro compound ordinarily is made by the reaction, called nitration, between nitric acid and an organic compound. Nitration of aromatic compounds, such as benzene or toluene, is commonly effected by treating them with a mixture of nitric and sulfuric acids at temperatures of 100° C or lower. These temperatures are not high enough for nitrating aliphatic compounds; propane, however, is commercially converted to a mixture of nitromethane, nitro-ethane, 1-nitropropane, and 2-nitropropane by allowing it to react with nitric acid vapors at temperatures of about 400° C. The mixture is then separated into its components by fractional distillation.

The most important reaction of aromatic nitro compounds is their reduction, which can be brought about by a wide variety of agents. Under acidic conditions, reduction almost always produces an amine. In neutral media, reduction may yield a hydroxylamine. In alkaline solution, compounds containing nitrogen-to-nitrogen bonds (azo, hydrazo, or azoxy compounds) are formed.

## 3.2 Effects of Nitro Compounds on the Environment

Nitrogen compounds occur in excess in the air, water, soil and food, which unfavourably affects the lives man animals causing a number of diseases. Nitrates and nitrites cause intoxications, especially of infants and of children, manifesting themselves by methemoglobinemia, anaemia and decreased content of vitamin A in the liver. Besides, nitrates and nitrites participate in the formation of strong nitrogen carcinogenic compounds, which may lead to stomach cancer. Due to harmfulness of nitrogen compounds in the environment, efforts should be made in lowering the concentration in the environment (Grabek, 1993).

According to SRU (2015), the excessive release of nitrogen compounds into the environment is one of the biggest problems of our time. Nitrogen compounds, such as nitrogen oxides and ammonia, pollute the environment and endanger human health in numerous and complex ways:

- Nitrogen-induced eutrophication and acidification contribute to biodiversity loss.

- Nitrogen oxides in ambient air have a direct detrimental impact on human health and together with ammonia form hazardous particulate matter and contribute to ground level ozone.
- Nitrate in drinking water and food endangers human health; nitrosamines are suspected to be carcinogenic.
- Nitrous oxides damage the ozone layer and contribute to climate change.

Kovacic and Somanathan (2014) opined that vehicular pollution is an increasing problem in the industrial world. Aromatic nitro compounds comprise a significant portion of the threat. The class includes nitro derivatives of benzene, biphenyls, naphthalenes, benzanthrone and polycyclic aromatic hydrocarbons, plus nitroheteroaromatic compounds with their numerous toxic.

## 3.3 Measuring of Nitrogen Oxides

According to Queensland (2016), nitrogen oxides are measured with a technique known as 'chemiluminescence', which is a chemical reaction that emits energy in the form of light.

This particular reaction is the oxidation of nitric oxide (NO) to nitrogen dioxide ($NO_2$) by ozone ($O_3$) as shown below:

$NO + O_3 > NO_2^* + O_2$

It is an exothermic (heat generating) reaction, which produces an activated molecule of $NO_2^*$. When these $NO_2^*$ molecules return from the activated state to normal state, some energy is emitted in the form of a small amount of light. A photomultiplier tube measures the intensity of the emitted light.

Since 1 NO molecule is required to form 1 $NO_2$ molecule, the intensity of the chemiluminescent reaction is directly proportional to the NO concentration in the sample. The analyzer measures the amount of light emitted and converts this to a concentration.

## 4.0 CONCLUSION

The effects of nitro compounds on the environment are many which include its effects on the lives of man and animals to the effects of the interaction of human activities and the nitrogen cycle that affects agriculture.

## 5.0 SUMMARY

In this Unit, we have learnt the concept of nitro compounds, the effects of nitro compounds on the environment and how to measure nitrogen oxides.

## 6.0 TUTOR-MARKED ASSIGNMENT

Describe the processes involved in the measurement of nitrogen oxides.

**Solution**

According to Queensland (2016), nitrogen oxides are measured with a technique known as 'chemiluminescence', which is a chemical reaction that emits energy in the form of light.

This particular reaction is the oxidation of nitric oxide (NO) to nitrogen dioxide ($NO_2$) by ozone ($O_3$) as shown below:

$NO + O_3 > NO_2^* + O_2$

It is an exothermic (heat generating) reaction, which produces an activated molecule of $NO_2^*$. When these $NO_2^*$ molecules return from the activated state to normal state, some energy is emitted in the form of a small amount of light. A photomultiplier tube measures the intensity of the emitted light.

Since 1 NO molecule is required to form 1 $NO_2$ molecule, the intensity of the chemiluminescent reaction is directly proportional to the NO concentration in the sample. The analyzer measures the amount of light emitted and converts this to a concentration.

## 7.0 REFERENCES/FURTHER READING

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# UNIT 4 EFFECTS OF ENVIRONMENTAL DEGRADATION

**CONTENTS**



## 1.0 INTRODUCTION

Human health might be at the receiving end as a result of the environmental degradation. Areas exposed to toxic air pollutants can cause respiratory problems like pneumonia and asthma. Millions of people are known to have died of due to indirect effects of air pollution.

## 2.0 OBJECTIVE

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

- explain the effects of Environmental degradation.

## 3.0 MAIN CONTENT

### 3.1 Loss of Biodiversity

Biodiversity is important for maintaining balance of the ecosystem in the form of combating pollution, restoring nutrients, protecting water sources and stabilising climate. Deforestation, global warming, overpopulation and pollution are few of the major causes for loss of biodiversity.

### 3.2 Ozone Layer Depletion

Ozone layer is responsible for protecting earth from harmful ultraviolet rays. The presence of chlorofluorocarbons, hydro chlorofluorocarbons in

the atmosphere is causing the ozone layer to deplete. As it will deplete, it will emit harmful radiations back to the earth.

## 3.3 Loss for Tourism Industry

The deterioration of environment can be a huge setback for tourism industry that rely on tourists for their daily livelihood. Environmental damage in the form of loss of green cover, loss of biodiversity, huge landfills, increased air and water pollution can be a big turn off for most of the tourists.

## 3.4 Economic Impact

The huge cost that a country may have to borne due to environmental degradation can have big economic impact in terms of restoration of green cover, cleaning up of landfills and protection of endangered species The economic impact can also be in terms of loss of tourism industry.

As you can see, there are a lot of things that can have an effect on the environment. If we are not careful, we can contribute to the environmental degradation that is occurring all around the world. We can, however, take action to stop it and take care of the world that we live in by providing environmental education to the people which will help them pick familiarity with their surroundings that will enable to take care of environmental concerns thus making it more useful and protected for our children and other future generations.

## 4.0 CONCLUSION

Human health might be at the receiving end as a result of the environmental degradation. Areas exposed to toxic air pollutants can cause respiratory problems like pneumonia and asthma.

## 5.0 SUMMARY

Millions of people are known to have died of due to indirect effects of air pollution.

## 6.0 TUTOR-MARKED ASSIGNMENT

What are the effects of environmental degradation?

**Solution**

**Loss of Biodiversity**

Biodiversity is important for maintaining balance of the ecosystem in the form of combating pollution, restoring nutrients, protecting water sources and stabilising climate. Deforestation, global warming, overpopulation and pollution are few of the major causes for loss of biodiversity.

**Ozone Layer Depletion**

Ozone layer is responsible for protecting earth from harmful ultraviolet rays. The presence of chlorofluorocarbons, hydro chlorofluorocarbons in the atmosphere is causing the ozone layer to deplete. As it will deplete, it will emit harmful radiations back to the earth.

**Loss for Tourism Industry**

The deterioration of environment can be a huge setback for tourism industry that relies on tourists for their daily livelihood. Environmental damage in the form of loss of green cover, loss of biodiversity, huge landfills, increased air and water pollution can be a big turn off for most of the tourists.

**Economic Impact**

The huge cost that a country may have to borne due to environmental degradation can have big economic impact in terms of restoration of green cover, cleaning up of landfills and protection of endangered species. The economic impact can also be in terms of loss of tourism industry.

## 7.0 REFERENCES/FURTHER READING

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# MODULE 4 METHODS OF ENVIRONMENTAL ASSESSMENT



## UNIT 1 METHODS OF ENVIRONMENTAL ASSESSMENT

**CONTENTS**



## 1.0 INTRODUCTION

Environmental Assessment has been defined as an activity designed to identify and predict the impact on the biogeochemical environment and on man's health and well-being of legislative proposals, policies, programs, projects and operational procedures and to interpret and communicate information about the impact.

## 2.0 OBJECTIVES

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

- explain Environmental Assessment.

## 3.0 MAIN CONTENT

### 3.1 Concept of Environmental Assessment

Hence, Environmental Assessment is a planning tool, a formal study problem used to predict the environmental consequences of a proposed major development project. EIA thus epitomises the value of holistic approach to studying environmental problems and a clear example of the

emphasis on preventive, holistic, strategic approaches to environmental protection which acknowledge environmental limits. Recognizes that an integrated approach (to environmental management) ensure that all problems, at least those known but also those foreseen are put on table at the same time and the linkages established as far as the eye can see before recommending or adopting solutions. Hence, an EIA study agenda of a resource proposal would consider impacts upon natural economic efficiency, income redistribution, preservation and aesthetics, political equity as well as environmental control. Various authors have expatiated on what should be the concern of an EIA. A synthesis of shows that EIA should be all encompassing. It should consider both the biophysical and socio-cultural environments. Hence, an EIA is designed to concentrate on the problems, constraints that could affect the viability of the project. It examines impacts of proposed projects on people, homelands, physical and biophysical resources, livelihoods and nearby developments.

## 4.0 CONCLUSION

Environmental Assessment has been defined as an activity designed to identify and predict the impact on the biogeochemical environment and on man's health and well-being of legislative proposals, policies, programs, projects and operational procedures and to interpret and communicate information about the impact.

## 5.0 SUMMARY

Hence, Environmental Assessment is a planning tool, a formal study problem used to predict the environmental consequences of a proposed major development project.

## 6.0 TUTOR-MARKED ASSIGNMENT

Define Environmental Assessment.

**Solution**

Environmental Assessment has been defined as an activity designed to identify and predict the impact on the biogeochemical environment and on man's health and well-being of legislative proposals, policies, programs, projects and operational procedures and to interpret and communicate information about the impact.

Hence, Environmental Assessment is a planning tool, a formal study problem used to predict the environmental consequences of a proposed major development project. EIA thus epitomizes the value of holistic

approach to studying environmental problems and a clear example of the emphasis on preventive, holistic, strategic approaches to environmental protection which acknowledge environmental limits.

## 7.0 REFERENCES/FURTHER READING

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# UNIT 2 REMOTE SENSING

## CONTENTS



## 1.0 INTRODUCTION

Remote Sensing is the science of deriving information about the earth's land water areas form images acquired at a distance. It relies upon measurement of electromagnetic energy reflected or emitted from the features of interest.

Remote Sensing can also be defined as the science or art of obtaining information about an object, area or phenomenon through the analysis of the data acquired by a device that is not in contact with the object, area or phenomenon under investigation. Regardless of the orientation of the various definitions of Remote Sensing, the acquisition of images of earth surface features, using sensors, through the electromagnetic spectrum, the synoptic view advantage and Remote Se using's ability to provide data for scientific technological and sustainable management and monitoring of the environment offer a convergence. The Electro-magnetic spectrum (EMS) is the physical basis for Remote Sensing. It is an abstract idea and diagram of forms of electromagnetic energy for illuminating earth surface features. The source of energy is divided according to wavelengths. The most widely used part of the spectrum is the visible portion (O.4u-O.7u) where the presence of atmospheric window reduces attenuation of energy to a considerable level.

The process of Remote Sensing involves making observation using sensors (camera, scanners, radiometers, radar, and lasers) mounted on platforms (ground, aircraft, satellites, balloons) which may be at considerable height from the earth surface. Then, recording the observations on a suitable medium (photographic films and ma genetic tapes) or transmitting/down linking the data to a ground receiving station where the data are corrected for geometric and radiometric distortions. Output products can be provided in computer compatible tapes (CC T) for users that made requests for the data.

Remote sensing serves as a tool for environmental resources (biotic, abiotic and cultural) assessment and monitoring. Remote sensing has some fundamental advantages that make it a veritable tool in environmental monitoring and management and impact studies.

- A capability for recording more permanently detected patterns
- Play-back facility at different speeds

- Opportunity for automatic (objective) analysis of observations to minimize personal peculiarities of observers

- Means of enhancing images to reveal or highlight selected phenomena

- The synoptic view advantage offered by raised platforms is the ability to record data on otherwise inaccessible areas

- Ability to produce accurate data on large areas at desired time intervals and at relatively lower cost compared to the cost that would be incurred through ground survey methods

- Ability to record images in multispectral fashion at different stages, at different scale and spatial resolutions

- Remote sensing data also possess high geometric precision detail, consistency, cost effectiveness and adaptation to highly difficult terrains.

All these combine to make Remote Sensing a veritable tool for obtaining baseline information for establishing baseline conditions of an area at the pre-project analysis stage, as well as monitoring changes in the environmental conditions of such area after the project has been de-commissioned.

## 3.1 Geographical Information System (GIS)

The application of Geographic Information Systems (GIS) in the Environmental Impact Assessment (EIA) process has gained substantial momentum over the past few years. Even so, the misconception exists that GIS involves mapping only, and many companies are still unaware of the robust solutions and cost savings this tool has to offer, when correctly implemented.

The SRK Natal team has been at the forefront of developing the applied specialist skills required to integrate the use of GIS as spatial information, decision-making tool in EIAs internationally. The focus

here is on applied integration, as it requires the person undertaking the analysis to understand the project, the potential environmental issues associated with it, and how the GIS can assist in obtaining the desired results. Accessibility to good quality, up-to-date spatial information has improved significantly and data is becoming more accurate. Inferior quality spatial data still exists, however, and it is essential that the GIS user is familiar with the quality of the spatial data prior to use.

In addition to identifying and analyzing potential impacts, a GIS is also a powerful spatial planning tool. For example, a GIS is often used to identify sites suitable for establishing cemeteries and waste disposal facilities. Overlaying several spatial datasets (soil type, vegetation, ground and surface water, geology etc.), with specific assessment criteria for each, can produce a map indicating suitable and unsuitable areas. SRK is currently undertaking a similar exercise identifying potential corridors suitable for establishing a 250-kilometer section of powerline on the Makhathini Flats in northern KwaZulu-Natal. The powerline will traverse areas of pristine and highly protected sand forest species. In this instance a GIS is being used to calculate the shortest possible route, taking into consideration the environmental issues in the area. This method has already led to time savings on the project and has achieved a significant cost saving for the client.

## 4.0 CONCLUSION

The process of Remote Sensing involves making observation using sensors (camera, scanners, radiometers, radar, and lasers) mounted on platforms (ground, aircraft, satellites, balloons) which may be at considerable height from the earth surface. Then, recording the observations on a suitable medium (photographic films and ma genetic tapes) or transmitting/down linking the data to a ground receiving station where the data are corrected for geometric and radiometric distortions.

## 5.0 SUMMARY

Remote sensing serves as a tool for environmental resources (biotic, abiotic and cultural) assessment and monitoring. Remote sensing has some fundamental advantages that make it a veritable tool in environmental monitoring and management and impact studies.

## 6.0 TUTOR-MARKED ASSIGNMENT

Write on Remote sensing.

**Solution**

Remote Sensing is the science of deriving information about the earth's land water areas form images acquired at a distance. It relies upon measurement of electromagnetic energy reflected or emitted from the features of interest.

Remote Sensing can also be defined as the science or art of obtaining information about an object, area or phenomenon through the analysis of the data acquired by a device that is not in contact with the object, area or phenomenon under investigation. Regardless of the orientation of the various definitions of Remote Sensing, the acquisition of images of earth surface features, using sensors, through the electromagnetic spectrum, the synoptic view advantage and Remote Se using's ability to provide data for scientific technological and sustainable management and monitoring of the environment offer a convergence. The Electro-magnetic spectrum (EMS) is the physical basis for Remote Sensing. It is an abstract idea and diagram of forms of electromagnetic energy for illuminating earth surface features. The source of energy is divided according to wavelengths.

## 7.0 REFERENCES/FURTHER READING

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# UNIT 3 TOOLS FOR AIR, WATER AND SOIL ANALYSES

**CONTENTS**



## 1.0 INTRODUCTION

Analytical Labs across the globe that perform environmental testing for air, water and soil count on the right techniques and technologies to analyze their samples. Our portfolio of environmental solutions is designed for traditional testing or for regulatory methods to meet agency and industrial regulations.

## 2.0 OBJECTIVE

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

- state the tools used for Air, Water and soil analysis.

## 3.0 MAIN CONTENT

## 3.1 Environmental Technologies and Applications

- For air monitoring, our Clarus GC, GC/MS and Turbo Matrix ATD systems are the world's most reliable for detecting air toxics, ozone precursors and soil/vapor intrusions.
- Installed in over 70% of U.S. state water testing labs, our NexION ICP-MS instruments remain the first choice for determining trace metals in drinking water.
- From complex contamination to farmland pesticide analysis, our instruments and applications for both organic and inorganic soil analysis deliver reliable results sooner to enable fast decisions.

Indoor and outdoor air monitoring requires accurate, reliable volatile and/or semi-volatile organic compound analysis. We have demonstrated global leadership in providing the most sophisticated air monitoring systems and methods available anywhere in the world.

- Automated thermal desorption and GC technologies to measure ozone precursors, to identify air toxins, to test for soil vapor intrusion
- Unique, turnkey fence line monitoring solutions for measuring and reporting harmful emissions
- Innovative, portable GC/MS technology for rapid on site analysis

Our water analysis solutions help customers worldwide analyze even the most difficult matrices and time-sensitive samples of drinking water, surface and ground water and waste water to ensure regulatory compliance aiding in our world-wide goal for contamination-free water. We have the most reliable, proven ICP-MS, ICP-OES, GC/MS, and UV/VIS/NIR technologies for water testing.

- Superior ICP-MS technology for lead testing and other trace metals to ensure compliance with EPA, EU and APAC regulations
- Accurate and fast GC/MS technology for organic testing using enhanced sample prep and sample introduction applications
- Simple and effective tools to demonstrate regulatory compliance and identify the causes of non-compliance
- Durable, unparalleled stability and reliability for standard testing, emerging micro plastics applications and detection of nanoparticles

From standard nutrient testing to complex contamination monitoring of high-risk sites, we have the soil analysis solutions for your specific areas of focus. Detect the smallest concentrations of contaminants required by regulations or identify unknown pollutants.

- Inorganic elemental analysis of samples using ICP-OES, ICP-MS and AA technology
- Detection of trace levels of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) using our gas chromatography solutions
- In-field soil testing using our portable GC/MS

## 3.2 Management of Degraded Environment

This interdisciplinary unit aims to develop understanding of some aspects of the impact of human activities on the environment and

remedial actions which can be taken. Topics may include one or more of: urban and industrial environmental remediation; rural landscape degradation processes and pathways; remediation techniques in rural landscapes; river rehabilitation; environmental flows; catchment management strategies; and mine site rehabilitation. This unit is a combination of evening classes, weekend field days, and web, library and field-based individual research.

**Reforestation**

Reforestation refers to the replanting of trees on land that has previously had trees, but where these were cut down recently. This is not to be confused with afforestation, which also refers to the planting or replanting of trees, however it refers to the planting of trees in an area where trees have not recently been cut down. The principle difference between the two definitions is time.

**Erosion Control**

**Erosion control** is the practice of preventing or controlling wind or water erosion in agriculture, land development, coastal areas, river banks and construction. Effective erosion controls handle surface runoff and are important techniques in preventing water pollution, soil loss, wildlife habitat loss and human property loss.

**Integrated Vector Management**

Integrated Vector Management is a decision-making process focused on protecting public health through the environmentally sound management of vector populations and reducing or interrupting the transmission of vector-borne pathogens

**Integrated Waste Management**

Rising energy prices and increasing worldwide commitment to reducing greenhouse gas emissions and landfill are driving the development of new approaches to the management of solid waste.

**Pollution Control**

Pollution control is the process of reducing or eliminating the release of (contaminants, usually human-made) into the environment. It is regulated by various environmental agencies that establish limits for the discharge of into the air, water, and land.

## 4.0 CONCLUSION

From standard nutrient testing to complex contamination monitoring of high-risk sites, we have the soil analysis solutions for the specific areas of focus.

## 5.0 SUMMARY

In this Unit, we learnt Environmental technologies and applications and the management of the degraded environment.

## 6.0 TUTOR-MARKED ASSIGNMENT

Write on environmental technologies and applications.

**Solution**

- For air monitoring, our Clarus GC, GC/MS and Turbo Matrix ATD systems are the world's most reliable for detecting air toxics, ozone precursors and soil/vapor intrusions.
- Installed in over 70% of U.S. state water testing labs, our NexION ICP-MS instruments remain the first choice for determining trace metals in drinking water.
- From complex contamination to farmland pesticide analysis, our instruments and applications for both organic and inorganic soil analysis deliver reliable results sooner to enable fast decisions.

## 7.0 REFERENCES/FURTHER READING

Agrawala, S. T. (2003). Development and Climate Change in Bangladesh: Focus on Coastal Flooding and the Sundarbans. Paris: OECD.

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# UNIT 4 CLIMATE CHANGE AND REMEDIATION METEOROLOGY

## CONTENTS



## 1.0 INTRODUCTION

Climate change caused by greenhouse gas emissions is, by its very nature, a global issue. A common strategy and binding targets must therefore be defined on a planetary scale. This is the aim of the international climate change conferences held in Rio, Copenhagen and, in December 2015, Paris. The solutions then need to be implemented locally.

Recently these extreme phenomena have caused serious damages in our country and the elimination of the consequences has constituted difficult and complex technical rescue tasks.

Through the analysis of the catastrophe situations that have most frequently occurred in the recent past and the operations performed in order to eliminate the consequences, it has become perceivable that the phenomena tend to occur at higher intensity; intervention is necessary at several venues at the same time; several organisations may need to coordinate their activities.

Large emphasis must be laid on prevention; unfortunately, the catastrophe situations caused by the extreme meteorological phenomena cannot be prevented (meteorological catastrophes) but it is possible to prepare for rapid and complex remediation and mitigation of the damages.

## 2.0 OBJECTIVE

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

- discuss extensively climate change and remediation meteorology.

## 3.0 MAIN CONTENT

In most cases, remediation is performed by units of the professional organisations specialised in the elimination of damages (e.g. the fire department) with their own equipment; however, the municipalities and the citizens are obliged to help defense works.

The fire-fighters intervene with their special fire engines and professional equipment. In case of this activity, the efficiency of coordination is of crucial importance, just as the expertise and experience of the personnel performing the intervention. The elimination of the damages starts the moment the report is received. Reports are received by the county operations management centers or, in case of Budapest, the metropolitan operations management center. The decision regarding the determination of the alert level is largely dependent on the types of information the responsible person (operations management officer) receives from the reporter of the event and the experience he already has from earlier remediation activities. The reporter of the event must be questioned in a targeted way about all the important information related to the incident because the lack of these data may result in sub-optimal alert level, which in turn will later impact remediation.

Of course we often cannot get an answer to all of our questions because reporters of the incidents are nervous, tend to rush and hang up too early. After evaluating the report, instructions are given to the relevant remediation unit, where the forces and equipment are alerted. When the alert is issued, the following factors must be considered: size of the endangered zone, life danger, evacuation tasks and the extent the elements of critical infrastructure is jeopardised.

After the incident has occurred, a report can also be made at the mayor’s offices. This is what often happens in smaller settlements. In many cases, especially out of office hours, reporters contact no other than the mayor. Following a quick on-the-spot survey, if the extent of the damages justifies it, the mayor must contact the professional remediation organisations. It is very important that the Mayor’s Office should have a list with the contact information of the professional organisations involved in damage elimination and those of the local security committee members. Copies of the forms recording the basic

data must also be retained here. If the Mayor's office receives the report, the defense officer in charge is in a decision-making situation immediately after reporting the case because he/she must determine if there is enough time to wait for the professional units or if urgent action is required. In certain obvious situations when fast intervention seems unavoidable (defense works affect several settlements, the professional units are overburdened and they cannot start remediation activities within a short time), damage elimination actions must be started.

## 3.1 The Steps of Remediation

After the alert has been initiated, the units have to approach the venue of the incident using the shortest route. After arriving at the venue of the incident, the commanding officer performs the duties of controlling the rescue operations with sole responsibility. When arriving at the venue, the fire engines must be parked at a safe place where the vehicles suffer no damage; otherwise they could not be moved and deployed later on. First of all, before determining the tasks, a thorough and broad survey must be conducted, considering the nature of the incident, wearing the appropriate protective clothes.

During the survey, special attention must be paid to the following:

- Establishing the necessity of personal rescue; the number of endangered persons must be determined,
- Based on the visible signs (damages to buildings, excess water, fallen trees, snow-drift, etc.), the expectable consequences (danger of fire or explosion) must be determined.
- The condition of the public utilities,
- Whether further information from or assistance by the providers of public utilities is needed,
- The determination of the possibilities of enclosing the dangerous zone (declaring it a closed area),

After performing the above survey, the tasks can be determined and the remediation of the damages can be started. In case of incidents affecting a vast area, the partner organisations must also be involved in the procedure. The most important tasks of the police include securing the closed areas and directing the traffic on alternative routes.

Civil protection has a role in organising the possible evacuation and ensuring the availability of shelters for the evacuated population.
In case of incidents involving collapsed buildings resulting in multiple injuries or mass catastrophes, the special rescue organisations must be deployed in addition to the ambulance.

It is advisable that the fire department and the other organisations participating in the rescue operations should perform the rescue tasks with extreme attention and in the previously agreed order of precedence. The tasks of the various organisations must be clearly established, as well as the issues of control and communication. The leader of the rescue operations controls the partner organisations operating on the venue of the incident through his unit commanders.

In many cases, the interventions must be performed under extreme conditions. These incidents usually result in extreme circumstances, thus the remediation of such incidents is not performed the usual way. It is extremely important to preserve the physical integrity of the personnel performing the intervention so the safety rules must be observed.

## 3.2 Flood-Like Rains

Flood-like rains typically mean that an extreme amount of precipitation fall within a short period of time, which the canal system is unable to manage so the accumulated rainwater occurs as excess water in several parts of the populated areas. The excess water can be drained using trenches and pumps in many places; however there may be parts of the town where protection will involve using sandbags. If the precipitation occurs outside the populated areas, trenches must be used to prevent the water from affecting populated areas.
The major steps of protection are as follows:

- Prevention of immediate danger of life and accident risk.
- Tasks of protection and value preservation.
- Getting the equipment (sand, sandbags, hand tools, etc.) needed for protection to the venue.
- Ensuring the drainage of water.
- Ensuring the continuous operation of the transportation equipment and the machinery.
- In case of lengthy remediation operations, ensuring the supply and recreation of the intervening forces and other logistics tasks.
- Continuously providing information to the population and evacuation if necessary.

## 3.3 Gale-Force Winds

In most cases gale-force winds can be predicted so the population must be informed in advance about the preventive measures. It is a typical characteristic of gale-force winds that they make their impact in relatively shorter periods of time, uprooting trees, tearing off roofs, damaging the electric and telephone network and causing accidents both

on the railways and the roads. Remediation activities are mostly performed by units of the professional organisations but municipal governments and the population also play an important part in the mitigation of damages. The most important tasks of protection are as follows:

- The intervention must be performed while continuously monitoring the changes on the venue and without endangering the physical integrity of the personnel,
- Immediate danger of life must be eliminated in all cases and the affected people must be placed in safety,
- Continuous communication with providers of the public utilities,
- Prevention of unwanted conditions,
- Ensuring the logistic background, transportation vehicles, other machinery and devices,

## 3.4 Heat-Waves

Besides many other factors, the Green Book issued by the European Committee draws the attention to the health damaging effects of heat-waves. Therefore, in order to protect the population, it is especially important to elaborate a program of measures for the event of heat-wave alerts.

Attention must also be paid to the risk-free organisation of outdoor sports events and other programs during heat-waves and the health prevention of people working outdoors, including the supply of water, relaxation in the shade and the proper work clothes. Regarding the environment and environmental health issues, priority is given to such public utility and communal services that may favorably or unfavorably impact not only the quality of the environment but also the life conditions of the population during heat-waves.

Regarding the supply of electricity, the needs of all consumers can be satisfied including a 2-3 hours long shutdown at the time of heat-waves. As Hungary is a transit country, the dangers affecting the transportation sector must also be considered in case of heat-waves. The railways, the motorways and the public roads can all be sources of risks. The frequent removal of communal waste is important during heat-waves because this was we can prevent the danger of infections. In most cases heat-waves can be predicted so the population must be informed about the preventive measures in order to preserve health. Tasks related to the elimination of damages include:

- Attention must be paid to the reports issued by the Meteorological Service and statements of the National Public Health and Medical Officer Service (ÁNTSZ),
- Continuous information provided to the population, which must include the necessity of consuming ample amounts of liquids, staying in shaded areas and the dangers of leaving their homes,
- Ensuring the liquid supply and, if needed, medical supervision of the personnel performing the intervention,
- In case of high daily average temperatures for longer periods, continuous communication with the providers of drinking water in order to ensure the appropriate supply of water for the public organisations and the civil population,
- Ensuring drinking water for the injured and affected in case of mass accidents.
- Releasing the drinking water reserves.
- Operation of vehicles transporting drinking water and distributing drinking water to the population at the assigned venues.
- Continuous operation of watering carts along the most important routes,
- Opening the air-conditioned facilities for the population,

## 4.0 CONCLUSION

Recently these extreme phenomena have caused serious damages in our country and the elimination of the consequences has constituted difficult and complex technical rescue tasks.

Through the analysis of the catastrophe situations that have most frequently occurred in the recent past and the operations performed in order to eliminate the consequences, it has become perceivable that the phenomena tend to occur at higher intensity; intervention is necessary at several venues at the same time; several organisations may need to coordinate their activities.

## 5.0 SUMMARY

Climate change caused by greenhouse gas emissions is, by its very nature, a global issue. A common strategy and binding targets must therefore be defined on a planetary scale. This is the aim of the international climate change conferences held in Rio, Copenhagen and, in December 2015, Paris. The solutions then need to be implemented locally.

## 6.0 TUTOR-MARKED ASSIGNMENT

Write on flood-like Rains.

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- In case of lengthy remediation operations, ensuring the supply and recreation of the intervening forces and other logistics tasks.
- Continuously providing information to the population; evacuation if necessary.

## 7.0 REFERENCES/FURTHER READING

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