DEPARTMENT OF ENVIRONMENTAL SCIENCE

ESM 346: ENVIRONMENTAL PLANNING AND MANAGEMENT

NATIONAL OPEN UNIVERSITY OF NIGERIA

COURSE CODE: ESM 346

COURSE TITLE: ENVIRONMENTAL PLANNING AND MANAGEMENT

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INTRODUCTION

ESM346: Environmental Planning and Management, is a three (3) credit units course designed for undergraduate students of Environmental Science and taken at ~~in~~ 300 level.

This course is made up of five modules with 21 units. The course will expose the students to a clear understanding of the planning and management of most of the resources and problems in our environment. The knowledge gained will also assist the students and all those who may come across the material involving environmentally-~~-~~oriented problems and proffer solutions to them. It covers those topics on Environmental Planning and Management which directly affects human existence on the face of the earth.

~~The course is divided into five (5) modules.~~ Module one of this course deals with the philosophy of planning, the n~~N~~ature of p~~P~~lanning, p~~P~~lanning and the e~~E~~nvironment, history of e~~E~~nvironmental p~~P~~lanning and t~~T~~ypes of p~~P~~lanning and trends in the formation of urban centres. Module two is on process of planning and environment, models of urban land use planning, stages of the planning process, community facility planning and urbanization and environment.

Module three is on environmental pollution such as air, soil, water and noise pollution Module four is on waste management systems and practices, ~~and~~ the different types of solid wastes and waste ~~the~~ disposal methods. Module five deals on environmental hazards such as earthquakes, volcanic eruption, floods and droughts.

WHAT YOU WILL LEARN IN THIS COURSE:

ESM 346: Environmental planning and Management consists of five (5) main components arranged in the form of modules and units. The course is structured in such a way that the students are exposed to the planning of the environment and types of planning and the management of some

environmental issues. In short the course covers environmental issues such as natural resources management, processes, tools and standards for environmental management. The course also covers waste management systems and practices. The causative factors and management of some basic natural hazards such as pollution, flood, drought and earthquakes..

COURSE AIMS

The aim of this course is to expose the students to environmental planning and the management of some basic pressing needs of the environment. The course provides information on environmental planning and management as panacea for national development and for the management of some ecological problems and to provide solutions to the growing and increasing environmental problems due to urbanization and population explosion.

COURSE OBJECTIVES

In addition to the aims of this course, the following objectives are achieved in this course, to:

1. Stimulate your interest in environmental planning and management.
2. Enhanced the student ability and skills of identifying and analyzing environmental problems of development planning in the society.
3. Equip the students with the skills required in the practice of environmental planning and management.

[4.] Enable the students serve as teachers, ~~and~~ environmentalists, planners, personnel officers, administrators, politicians and etc.

4.[5.] Analyse the causes and provide solutions to some basic ecological problems like flooding, pollution, solid wastes, drought and etc.

[6.] Create awareness among the students on how to optimally manage resources of the environment without jeopardi~~z~~sing the needs of future generation.

5.[7.] The students will be exposed to some environmental laws and practices in Nigeria.

6.[8.] Students will acquaint themselves with the different types of solid waste and how to optimally manage them.

COURSE REQUIREMENTS

To complete this course, students are required to read each study unit of the material and other textbooks, journals or any other relevant material that may be provided by the National Open University of Nigeria (NOUN). Each unit contains questions, self-assessment exercise in most cases and at certain points in the course; you would be required to submit assignments for assessment purpose. At the end of the course, there is a final examination. The course should take a total of about 17 weeks to be completed.

COURSE MATERIAL

Students will be provided the following materials for this course:

1. Course guide: The material you are reading now is called course guide which introduces you to the course

[2.] Study guide: This is the textbook prepared for the purpose of this course by the National ~~open~~Open University of Nigeria. You will be given a copy of the book for your personal use.

[3.] Textbooks: –At the end of each module/unit, list of textbooks are provided for your consultation. Students are not restricted to the listed text books alone though most of the texts used in preparing this course materials were adapted from the referenced books.

MODULE I: THE PHILOSOPHY OF PLANNING

Unit I: The Nature of Planning

Unit 2: Planning and the Environment

Unit 3: History of Environmental Planning and Types of Planning

Unit 4: Trends in the Formation of Urban Centre

MODULE 2: THE PROCESS OF PLANNING AND ENVIRONMENT

Unit 1: Models of Uurban Land Uuse Ppplanning

Unit 2: Stages of the Planning Process

Unit 3: Community Facility Planning

Unit 4: Urbanisszation and Environment

MODULE 3: SOLID WASTE

UNIT 1: Types of Solid Waste

UNIT 2: Solid Waste Management

UNIT3: Causes of Solid Waste Pollution

UNIT 4: Disposal Methods of Solid Waste

MODULE 4: ENVIRONMENTAL POLLUTION

Unit 1: Air pollution

Unit 2: Soil Pollution

Unit 3: Wwater Pollution

Unit 4: Noise Ppollution

MODULE -5: NATURAL HAZARDS

Unit 1 - Earthquakes

Unit 2 - Volcanic Eruptions

Unit 3 - Floods

Unit 4 - Droughts

Unit 5 - Landslides and Avalanche

A number of exercises are provided at the end of each unit to enable the students to brainstorm. This will enable the students to evaluate themselves on the level of understanding of the various units discussed.

Textbooks and References

The following textbooks will provide further useful information regarding the areas covered in the course. Students are advised to consult more recent textbooks.

Aziengbe, F. I. (2004). *The Basics of Geomorphology*. Nono Publishers. Benin City, Edo State

Ajith Sankar, R. N. (2015). *Environmental Management*. Oxford University Press. India.

Akpofure, Rim-Rukeh (2009). *Environmental Science., An Introduction*. Kraft Books Limited. Ibadan, Oyo State.

Ayoade, J. O. (2003). *Tropical Hydrology and water Resources*. Agbo Areo Publishers. Ibadan.

Basorun, J.O. (2004). *Basic Elements of Urban and Regional Planning.* Shalom Publishers. Akure, Ondo State.

Cunningham, W.P. and (Cunningham, M. A. (2011) *Principles of Environmental Science. Inquiry and Applications*. Sixth Edition. McGraw Hill Publishers. United States.

Eseigbe, J.O. (2019). *Foundation Topics in Fluvial Geomorphology and Hydrology*. DD Concept Publishers, Ekpoma, Edo State.

Ivbijaro, F. A. (2012). *Sustainable Environmental Management in Nigeria*. Edited by Matt. F. A. Ivbijaro and Akintola, F. Second Edition. Book Builders Editions Africa. Ibadan, Nigeria.

Ojeifo, M. O. (2005). *Elements of Planning and Design*. Easy-Way Publishers. Benin City, Edo State.

Praveen, K. P., Subha, G. and Rajesh, W. (2017). Environmental Pollution and Safety Measures: International Issues and Its Global Impact in *Global Progress in Development of Sustainable Environment*. Discovery Publishing House PVT.Ltd. India.

Santosh Kumar Garg (2010). *Ecology and Environmental Studies*. Khanna Publishers. Indian

Stridhar, M.K.C. (2012). *From Urban Wastes to Sustainable Management in Nigeria. A Case Study in Sustainable Environmental Management in Nigeria.* Second edition, Edited by Ivbijaro, F.A. and Akintola, F. Published by the Book Builders. Ibadan.

Suresh, K. Dhameja (2013). *Environmental Science*. S.K. Kataria and Sons Publishers. India.

Surrender Singh (2015). *Geography*. McGraw Hill Education (India) New Delhi.

ESM 346: Environmental planning and management is a course designed for students of the Department of Environmental Science. By the time you finish studying this course, you will be able to answer basic questions regarding planning and the management of our environment.

ESM 346: Environmental Planning and Management

MODULE I: THE PHILOSOPHY OF PLANNING

Unit I: The Nature of Planning

Unit 2: Planning and the Environment

Unit 3: History of Environmental Planning and Types of ~~Planning~~Planning

Unit 4: Trends in the Formation of Urban Centre

Unit 1: The Nature of Planning

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1.0 Introduction

Environmental planning and management are strategic challenges confronting humanity in the 21st century. All through the life time of man, he is in constant need of basic items which are needed for his survival. Apart from clothes, shelter, food and water, man requires comfort and personal development for optimum adaptation to the environment. Man does this by exploring the resources of the environment.

2.0 Objectives

By the end of this unit and the relevant readings, candidates should be able to:

(a) Give different definitions of planning
(b) Draw and analyse a conceptual framework for planning
(c) Have a full knowledge of how to plan for environmental features/resources
(d) Familiarize with some planning terminologies.

1.0[3.0] Main Body

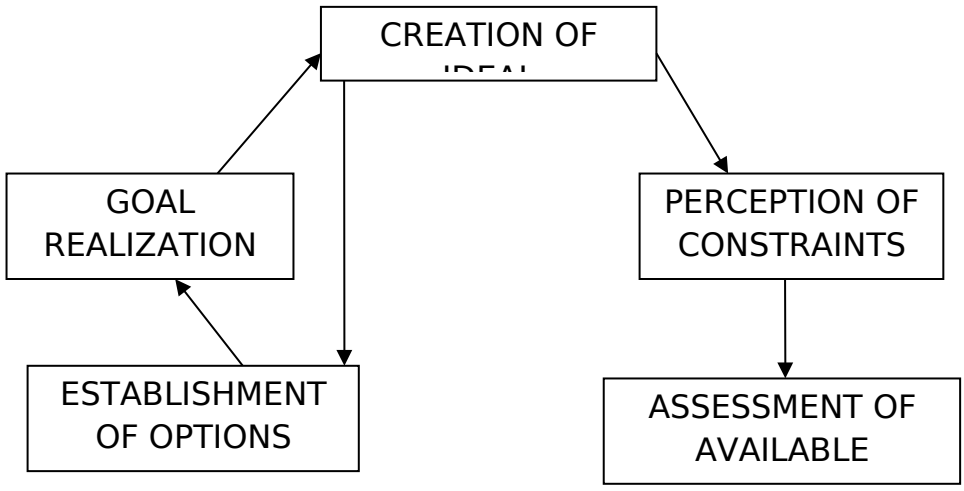
3.1 Definitions of Planning

To plan means to prepare a scheme of events, to arrange beforehand or the procedure for carrying out an activity. In this regards, planning involves sequence of stages in achieving set goals. Ordinarily, planning could mean a blue print for the future. On the other hand, it could mean policy actions set out in a chronological order to regulate an activity. It could also mean a systematic arrangement of things to be done. Planning can as well be regarded as a process whereby our knowledge of the world and the mechanisms of our memory help to control our rational social actions in realizing a desirable end.

Planning is also a process which involves a method or doing something. It could also mean an orderly sequence of action that will lead to the achievement of a stated goal or goals.

3.2 Conceptual framework for a Systematic Planning

Planning is an important motivator of behaviour. As one desires to develop, certain patterns of bahaviour which are related to the satisfaction of the basic needs evolve. These behaviours patterns to a large extent, are founded on decisions which entail choice making among alternatives. Planning embraces the simple process of determining appropriate future action through a sequence of choices (Basorun, 2004). On this note, five fundamental points are necessary in a systematic approach to effective planning as illustrated below.



Source:?

~~**Conceptual Framework for a Systematic Planning**~~

In environmental planning and management studies, several terms are used to describe various aspects of resources and their management. Such terms include analysis, assessment, evaluation, appraisal, planning, management and development. Assessment, evaluation and appraisal are usually used

synonymously to convey the process of finding out or deciding, the amount of value of a resource for a particular purpose. This is a component part of resource analysis. A resource analysis seeks to understand the fundamental characteristics of a resource as well as the process through which the resource is allocated and utilisz~~z~~ed (Ayoade, 2003). Resource development represents the actual exploitation of a resource to satisfy human needs. During the process of development, the natural resources are transformed into ~~a~~ usable commodit~~iesy~~ or service~~s~~. Resource management is concerned with the control or direction of resource development. It represents the actual decision concerning policy or practice as to how resources are allocated and under what circumstances resources may be developed.

Resource management and resource planning are closely related. There can be no proper management without planning. Resource planning in turn depends on proper resource analysis. So resources analysis, planning and management are all interrelated. Planning is a part of management, for example, water resources planning aims at achieving an orderly development of water resources to meet present and future demands. It essentially resolves in three issues: the availability of water, the future requirements of water for various uses and how these can be met. Planning can be described as a set of procedures for determining appropriate future action through sequences of choices.

Planning is purely an idea that transcends all the facets of human endeavo~~u~~rs that involve human efforts. Man is the manager and administrator of his limited resources. This motivates man to incorporate a sense of planning. That is, he tries to first identify his needs, looks at the opportunities available and by power of his reasoning, makes use of what he has to achieve what he wants. Man engages in a number of occupation ranging from farming, manufacturing, trading, mining, construction, ~~to~~ vocational and civil services in order to acquire basic needs like food, clothes and shelter, as well as material wealth. The only problem is scarcity

which is the major problem man ~~is met to~~ faces at all times. In some cases therefore, the desire for a particular want warrants the setting of a series of options from which the most preferred is selected, based on the quantity of available resources.

The issue of planning extends beyond the scope of choice making, to the resultant processes of resources allocation. Though planning is a way of making choice among options that appear open for the future, it also entails securing the implementation which depends on the allocation of the necessary resources. These resources could be natural (in renewable and non-renewable forms) or human in terms of technology, artifacts, capital, culture and population. The allocation of these resources in the most effective way is crucial to successful planning implementation.

3.3 The Need for Planning

Man plans to be able to solve his immediate problems and to advance solutions to the problems that may crop up in the future so as to guarantee human existence on the earth surface. Planning is important to any successful environmental management systems. Planning offers a way to optimization of resources. Planning leads to preventive measures and anticipation of future environmental changes. It positions organizations to take competitive advantage rather than responding only to challenges as they occur.

Effective planning also smoothens out implementation and minimizes environmental burden since many of the sources of environmental burdens would have been anticipated and addressed.

Planning also helps address “what if” or the sensitivity analysis questions. Thus different scenarios and alternatives will be anticipated, investigated and prototypes booked as to identify at least good solution that may not

necessarily be optimal but give a good resolution to the environmental problems.

We also plan to tackle the problems of outward and upward growth of towns and cities, traffic congestion in our towns, ~~to tackle the problem of~~ building decay, waste disposal, air and water pollution. Other areas that require adequate planning are population control measures, food, clothing and shelter. These needs are required by man to ensure optimum adaptation to the environment to which he belongs.

4.0 Conclusion

In this unit, we examined the different definitions of planning, the conceptual framework for a systematic planning and the need for us to plan for both physical and human resources of the environment.

5.0 Summary

(a) Planning is the systematic arrangement of things to be done. It could also mean a blueprint, for the future.

(b) The conceptual framework for a systematic planning involves – creation of idea, perception of constraints, assessment of available resources, establishment of options and goal realis~~z~~ation.

(c) The need for planning is ~~bore~~borne out of the desire for man to be able to meet his requirements in the area of shelter, air, clothing, food and to manage the resources of the environment optimally.

6.0 Tutor-M~~m~~arked Assignment

(a) List and discuss with a simple illustration, the fundamental issues considered in a systematic approach to planning. ~~with a simple illustration.~~

(b) List and explain the need for effective planning.

7.0 References

Ayoade, J. O. (2003). ***Tropical Hydrology and water Resources***. Agbo Areo Publishers. Ibadan.

Basoru, J. O. (2004). ***Basic Elements of Urban and Regional Planning***. Shalon Publishers. Akure, Ondo State.

Ivbijaro,F. A. (2012). Sustainable Environmental Management in ***Nigeria***. ~~.~~Edited by Matt. F. A. Ivbijaro and Akintola, F. Second Editions. Book Builders Editions Africa. Ibadan, Nigeria.

Unit 2: Planning and the Environment

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4.0 Conclusion

5.0 Summary

[6.0] Tutor M~~m~~arked Assignments

6.0[7.0] Self-Assignment

7.0[8.0] References

1.0 Introduction

Planning is as old as man himself. Man in this context refers to men, women and children, whose needs, interests and wishes together determine the essence of planning. The activities of man are more complex compared to other animals. MThe man is capable of modifying the environment to suit his needs and aspirations. Some of these activities by man have constituted a imply because of the activities of man, he is made to constitute some nuisance to the environment in the areas of pollution, congestion in terms of housing, traffic and competition. The environment generally is made up of the ecosystem. And so the feelings, attitudes and emotions of people are managed in such a way that proposed plans are carried out basically so as to achieve maximum satisfaction.

2.0 Objectives

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

- Understand what is planning and the environment.
- Appreciate the eEnvironmental imbalances caused by human activities.
- Understand the iIrreversible impact of human activities on the environment.
- Understand the nNeed for suitable development.

3.0 Main Body

3.1 Planning and the Environment

We have already known what planning and environment are all about in the preceding sectionsparagraphs. What is now relevant is, what are the things we plan for in the environment?. The Centre for African Settlement Studies and Development (CASSAD, 1997) see the environment as comprising:

1. Air, land and water
2. Plant and animal life, including man

3. The social, economic and cultural conditions that influence the life of man or a community.
4. Any buildings, structures, machines or other devices made by man.
5. Any solid, liquid, gas, odour, heat, sound vibration or radiation resulting directly or indirectly from the activities of man or the community.
6. Any part or combination of the forgoing and the inter-relationships between any two or more of them.

The Environment is more or less a compound of so many elements which are either natural or artificial or manmade. These elements as exemplified by CASSAD (,–1997), and require adequate planning so as to enhance sustainability of the resources and the quality of the environment. A good example is when you have a stream in a place we must use such a stream sustainably so that the stream will stand the test of time, enhance its quality. This will require ,–**dredg**ing e–**it occasionally to avoid silt**ation, avoid ~~ing of the water, avoid~~ **dumping refuse or waste into it and to avoid carrying out human activities like farming, building, amongst others on the stream.**

3.2 Environmental imbalance caused by Human Activities

Human activities and technological advancements, made for people to enjoy luxurious life, have caused severe irreversible imbalances in the natural environment. The various human activities that have caused severe alterations in the ecosystems and the pollution of the environment in general are categorized into the following five major types:

1. Agriculture

[2.] Industrialisz~~z~~ation

[3.] Urbanisz~~z~~ation

2.[4.] Transportation

3.[5.] Mining

3.2.1. Agriculture: The development of agriculture has been the most important single event in the history of man and the evolution of human culture. With the development and increase in human population, ~~the~~ agriculture from time immemorial has ~~on more and more land, has~~ been practiced to grow crops. Initially, ~~the~~ human beings~~s~~ have grown only the food crops to eat and quench their hunger; but later on, they ~~have~~ started growing several kinds of cash crops. Consequently, a ~~Not only they have brought a~~ large part of the forest land has come under agriculture. We have also seen the use of both organic and chemical fertilizers ~~, but also they have started using fertilizers~~ and pesticides to increase crop production per unit of agricultural area.

Over the years, man has converted major portions of the forest land to agricultural land and damaged the ecosystem and the environment in general. Additional destruction of the forest land for agriculture always has serious consequences on climate, water cycle and mineral balance on earth. We are also witnessing the extinction ~~This man also lead to extinction~~ of plants and animals if not well planned for and managed.

3.2.2. Industrialization: Industriali~~s~~z~~z~~ation means, development of industries of various kinds. These industries cause maximum environmental imbalance and instability by polluting water, air and land to such an extent that all these issues need detailed discussions. The Industrial Revolution started around the middle of the 1700s. The world's population exploded reaching 1 billion by 1800 and by the beginning of the the 21st Century had grown to 6 billion. There are primarily four primary impact of industrialisation on the environment:

i. .

end of the Students are advised to read more materials.

3.2.3. Urbanisz~~z~~ation: The urbanisz~~z~~ation is the process of urban development, under which mass migration of people from rural areas to the industrialisz~~z~~ed urban areas, take place due to increased job opportunities. It is simply the increase in the proportion of the people living in the urban centres due to massive rural to urban migration. The urbanisz~~z~~ation is thus accompanied with industrialisz~~z~~ation. Urbanisz~~z~~ation can lead to increased population, production of enormous quantity of sewage and domestic waste, waste water, pollution (air, land and water). Urbanisz~~z~~ation can also lead to a process whereby the nearby areas undergo considerable modifications. For example, the mining of sand for construction in urban centers is usually done in nearby villages and towns.

3.2.4. Transportation: The movement of persons from one place to another and the means by which such movement is accomplished, is referred to as transportation. In olden days, people used to travel largely on foot or on bullock carts or horse carts or on bicycles. For long overseas journeys, water transport by~~through~~ boats or ships was being used though on a very small scale and mostly unmechanised. All these non-mechanized modes of transportation were largely non-polluting as they were causing little adverse impact on the environment. Later the trains started plying using wood and coal to generate heat for producing stream to run them along with smoke to cause air pollution and noise. With the discovery of oil, and ways of extraction, the use of petrol and diesel became more prominent in rail~~n~~ transport, besides the advent of buses and trucks plying on roads for public use. The use of high speed cars and aircrafts changed the complexity of transportation in the 20th Century. ~~After which people started using cars for transportation which became mind boggling. After which air transportation came on board.~~ The seemingly modernisation of the transportation sector ~~is today~~ to satisfy human wants, has resulted in ~~to~~ some adverse impact on the environment.

The adverse impact of ~~road~~ transportation which requires adequate planning can be grouped into:

- Energy consumption- The transport sector is the major user of energy as it utilised most of the world petroleum, coal and gas.
- Land consumption
- Loss of agricultural land
- Loss of wild life habitat-biodiversity loss and biosecurity risks.
- Air pollution-transportation degrade air quality. The emissions of pollutants like CO_2, particulates matter, nitrous oxide, etc from exhaust of vehicles and generators are a major concern in the world today.
- Water and land pollution-transportation leads to degradation of both water and land resources
- Noise pollution
- Increase threat of global climate change through emission of greenhouse gases.

- **3.2.5.**

Mining–– Mining is the extraction of minerals and ores from the earth's crust. The large scale industrial and urban growth that has happened around the world in the last decades would not have been made possible without the increased output of our mineral resources. Mining provides us coal for energy requirements, metals for making machines and engines, ores for making chemicals and fertilizers, rocks and stones for buildings, bridges and dams, gold, diamond and other precious stones for Jewry making. In response to the increase demand due to industriali~~s~~sz~~z~~ation, urbani~~s~~sz~~z~~ation and moderni~~s~~sz~~z~~ation, the exploitation of mineral resources has increased tremendously.

3.3 Irreversible Impact of Human Activities on the Environment

Any undesirable change in the physical, chemical and biological properties of the environment is called environmental pollution. Many natural occurrences can lead to environmental pollution. For example, volcanic eruption can release enormous amount of dust particles and poisonous gases into the environment which can result into drastic environmental change. A good example is the volcanic eruption of Cameroon Mountain in August 1986, which affected the environment with the emission of ~~by~~ toxic substances that killed about ~~emissions killing~~ 1700 people and causing serious health challenge to over 10,000 p~~P~~ersons. Similarly, other natural hazards that can cause environmental imbalance in an area, include:

Earthquakes, Tsunamis, Cyclone, Floods, Landslides and Avalanches, Forest fire Droughts and Desertification.

~~Man made~~Man-made activities that can lead ~~bring~~ to adverse effects on ~~changes to~~ our environment that may not ~~cannot~~ be easily reversed, include; ~~are:~~

i. **Conversion of forest land into agricultural land.**
ii. **Release of extra ordinary amounts of Co_2 and CFS into the atmosphere**
iii. Increased human population which further increases pressure on the ecosystems in the areas of forest, rivers, oceans etc.

3.4 The Need for Sustainable Development

In order to avoid large scale impact of human activities on the environment, there is need to thoroughly study the ~~adverse~~ impacts before carrying out ~~taking up~~ any major activity. In order to assess such possible adverse environmental impact of a proposed developmental activity, an Environmental Impact Assessment (EIA) is prepared along with ~~preparing~~ an environmental management plan towards mitigating ~~initiate~~ the possible environmental problems that may emanate from the execution of such a proposed activity. The entire aim is to attain sustainable development which

is to meet the needs of the present without compromising the needs of future generation.

Sustainable development is defined as that development which is free from environmental degradation, poverty and depletion of natural resources base. Sustainable development is that development which meets the needs of the present without compromising the ability of the future generations to meet their own needs. This definition of sustainable development was infact promulgated for the first time by ~~in~~ the United ~~.~~Nations (UN) in its~~.~~ report titled "Oo~~o~~ur Cc~~o~~mmon Ff~~f~~uture" and presented in 1987 by the World Commission on Environmental and Development~~"~~. The UN report ~~document presented by the commission titled "Our Common Future"~~ has created a consciousness of the~~is~~ need to harmonize environmental protection with economic development on a global scale.

The necessity of sustainable development will therefore help to solve the following problems:

- It will compel industrialists and government agencies to consider all aspects of their developmental proposals as to minimize the use of natural resources and adverse environmental impacts.
- The implementation of the 4^{rs} of resource utilization~~: such as:~~ recycling, reuse, reduce and restoration
- The concept will also force engineers, scientists and all stakeholders to develop technologies which are efficient, productive and profitable.
- The concept will also put into consideration their impacts on health, environment, resource and energy conservation, waste management and social impacts such as the public inconveniences, unemployment, crime and etc.

4.0 Conclusion

In this unitstudy, we examined planning and the environment, environmental imbalance caused by human activities, irreversible impact of human activities on the environment and the need for sustainable development.

5.0 Summary

A) Human activities affect the environment in many ways. Most of the things we plan for in the environment include among others: -aAir, land and water; plants and animals; socio-economic and cultural conditions. Pollution affecting man, and any buildings, structure, machines or any devices made by man

B) Man's activities that lead to eEnvironmental imbalance caused by man which include; : aAgricultural practicesе, industrialiszation, urbaniszation, transportation and mining.

C) Irreversible impacts of human activities on the environment which include release of extra ordinary amounts of COо$_2$ and CFCs into the atmosphere. Also, rapid growth in increased human population has further led to pressure on the ecosystems.

D) Emphasis on the The need for sustainable development which will help to compel industrialists and government agencies to abide by the rules and regulations of that set setting them up in the first place.

E). The ; the implementation of the 4^{rs} of resources utilization (refuse, reduce, reuse, recycle) is necessary to ensure sustainable use of resources. This will make ; force engineers and scientists to develop technologies that will foster developments and the consideration of their impact on the health, environment, resources and energy conservation available.

6.0 Tutor-Marked Assignment

1. List and explain the main things in our environment that require adequate planning.

2. With suitable examples, discuss the various human activities that have caused severe alteration in the ecosystems.

3. Give reasons why we need sustainable development of our resources.

7.0 Self-Assessment Exercise

What is planning?

What is Sustainable Development?

References

Santosh Kumar Garg (2010). ***Ecology and Environmental Studies***. Khanna Publishers. New Delhi,

Basorun, J. O. (2004). ***Basic Elements of Urban and Regional Planning***. Shalom Publishers, Akure, Ondo State

Unit 3: Trends in the Formation of Urban Community

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2.0 Objectives
3.0 Main Body
    3.1 Man in the Neolithic times
    3.2 Band
    3.3 Village
    3.4 City/Urban
4.0 Conclusion
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1.0 Introduction

The pattern of human settlements shows that the development has been a gradual process over a time span and a product of two main changes. The first is the transition from hunting and fishing to agriculture in the Neolithic era, when people started to constitute groups (small communities) on the basis of mutual dependence and concern. The second is the emergence of growth centers (urban centres) at specific locations. However, this part of the lecture intends to highlight on the morphological structure or sequence of stages of urban formation and the need to plan for them at different stages.

2.0 Objectives

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

[i.] ~~X~~ **Know the development of a city center from a band.**

[ii.] ~~X~~ **Differentiate between settlement patterns**

[iii.] ~~X~~ **Know the characteristic features to differentiate a village, town or city**

iv. ~~X~~ Know the basic functions of every settlement pattern

3.1 Man in the Neolithic Era

Quite a number of investigations carried out about the history of man, have yielded findings which have helped and are still helping us to understand how the stages of development of man's ~~his~~ intelligence have greatly influenced changes in his environmental conditions. Common knowledge of the world about the existence of man and the emergence of human society stems from the discoveries of the Craddle of Civilisation by Dr. Louis Leakey. This great Kenyan Paleoanthropologist and Archaeologist's pioneer archaeological works ~~'s pioneer excavations~~ at Olduvai G~~e~~orge in Northern Tanzania, demonstrated that humans evolved in Africa. This was a result of the discovery by Dr, Leakey and his wife of hominids millions of years old that were linked to human evolution. This findings is the basis of the

argument that ~~, in about one-and-half to two million years ago, the basis upon which it was suggested that~~ Africa, indeed, may have been the birthplace of humanity.

Through th~~e~~ese findings, an entirely adequate ground was established to show that the early types of men (Hominids), a little different from ourselves, were first discovered in Africa. These hominids, about 1.35 metres tall, were in the likeness of man and found in small groups on lake shores in Savannah countries. They were slightly wiser than the apes and could interact more easily but the small brains behind their massive faces could not let them learn to come to terms quickly with their environment in a manner as to maintain a state of equilibrium. Attempts to distinguish themselves from other animals led to eventual emergence of the ability to make crude stone tools in form of choppers' which they used to do some minor works.

About a million year ago, a breakthrough was recorded as man transformed the choppers to double-edged hand axe, scrapper and a hammer stone. This invention enhanced man's ability to hunt, improve his food supply by killing other animals, and confidentially live in large groups. Thereafter, some other species of man developed all over the world such as, the "Neanderthal' in North Africa, Europe and Asia, and the "Rhodesiods" in South of the equator in Africa.

3.2 Hamlet~~Band~~

This is the first and in fact, the starting point of community formation. It represents the original form of the local group at the lowest level of social organization. At this elementary stage, a group of persons, sometimes of the same social or economic background combine to live together under a leader and for a common purpose. These could be migratory hunters, farmers, fishermen and nomads whose primary objective is to carry out the same duty around a single location. For the mere fact that this group lacks

organized set of habits that will enable them meet the challenges of their new environment more effectively, the community is characterized by temporary structures, erected to provide tentative shelter. As activities of members become regular each day thereafter the decision to settle permanently is held by majority to be able to raise a family and put an end to wandering.

Characteristics

1. The community is purely a small group
2. In most cases, the group comprises mainly males
3. The community is made up of a very small group, usually lesser than ten people.
4. The settlement lacks permanent structures because of the uncertainty of tenure
5. By this nature, the community hardly attracts development in terms of social infrastructure like good road, electricity, potable water and entertainment.

3.3 Village

The village is a transitional community, which marks the beginning of permanent settlement. It is different from the hamlet~~band~~ in many respects, looking at the developmental state at any one time. The community can best be described as a cluster of local people within a small geographical confine, shearing a feeling of togetherness interacting in an organized context, and enjoying similar style of living with a limited range of occupation. One significant fact about the village is that, people have come to accept their environment, and take over responsibility, particularly farming for their own survival. Because of the constancy in the practices of agriculture therefore, there is gradual progress in the development of farming skills and erection of permanent structures.

Some pre-conditions are necessary for this kind of community to emerge. These include:

(a) The physical environment must be such that would support plant and animal life even to the point of providing agricultural surpluses.
(b) The environment must be able to accommodate and support a reasonable population on a relatively little land area.
(c) The area should be able to encourage certain level of permanence of settlement in terms of food production through domestication of plants and animals to sustain a complete life circle.

With all these pre-conditions in place a social organization in the form of a village is subsequently established, abstracting many of the essential features of a rural setting. As a social group on a low scale each individual receives recognition, understanding and co-operation in the performance of those duties relevant for the community to function more satisfactorily.

Characteristics

The community comprises people who are mainly agrarians.

1. As a local territory, it covers relatively small area of land
2. The settlement is associated with garden plots located in-between houses for the purpose of food production.

[3.] The community is a collection of very small homogenous population ranging from six to sixty families ~~or maximum of five thousand population~~.

3.[4.] The spiritual and ritual inclination of people is undefined as each household worships its own god or shrine

[5.] The social structure of the community allows only, the traditional head and the elders to have responsibility of ensuring morality and social justice among the people as well as organi~~s~~sing the affairs of the community.

[6.] People in this locally enjoy a feeling of neighbourhoodliness, which encourages collective participation in the execution of community projects like construction of markets, road maintenance and etc.

4.[7.] The community operates periodic market, whereby market days are spaced in time to allow effective demand for commodities produced in the locality.

[8.] On account of financial constraints, the village lacks essential social amenities and services like; electricity, pipe-borne water, telecommunication etc. that are required nearly to raise the living standard of people.

5.[9.] The community experiences poor transport services as activities of people are located within working distance to ensure proximity and reduce amount of energy spent on commuting.

Both the Hamlet and the Village are refered generally as rural areas. A rual area is a community with few homes or buildings with relatively small population and with low population density. A rural area can be defined in terms of the functions performed or in terms of the population size. According to the United Nations (UN), a rural area is a settlement with a population of less than 20,000 people. A rural area can also be defined on the basis of the functions performed by the settlement. In this regard, it is taken to mean an area where majority of the people are involved in agrarian livelihoods or in mining.

3.4 Town

The word town is so flexible in definition. This flexibility is to the extent that there are as many towns as there are enough parameters to describe them. Whichever way it is perceived, evidence from various sources have certainly confirmed it to be an offshoot of the village, and indeed an intermediate point of transition between the village and the city in other words, it is an aerial unit that is less in size than that of a city constituted by people who

are culturally conditioned through time and spatial relationship, with a sub-urban outlook. In a town, the population is more heterogeneous than a village. The town is usually a place where many secondary (processing of raw materials to manufactured goods) and tertiary (services industry) economic activities take place.

In planning, the importance of town is not underestimated. It has remained the home of every man to which he claims a strong tie. As the basis of all human life, it produces quite a complex pattern of activities that ~~which~~ approximate~~s~~ more and more closely to that which is desired for planning purpose. It is an area of specific location which is in some ways distinctive from other areas. First, it is independent on its own in one part and dependent on metropolitan jurisdiction on the other. Second, it is a community of relatively larger space, holding larger population that has come through a gradual development in agricultural technology, transport and communication, as well as exchange of goods among village communities. Invariably, the town is a product of some basic conditions which include:

(i) Surplus of food production.
(ii) Effective management of the group of food producers
(iii) Existence of class of traders and merchants
(iv) Availability of market space and
(v) Effective transportation.

Improvement in local transport for instance, makes it possible for food surplus to be assembled in the town. Effective management of traders and merchants bring about proper co-ordination of exchange of goods also in town as new social institutions eventually emerge to make the food surplus available to urban dwellers. The moment a community attains this status, attention of government is given to the provision of local trade centres, social services like schools, health centres, water, electricity etc to sustain

its benefit and survival. On this note, the emergence of town cannot be viewed solely as a culmination of economic phenomenon, but social changes in the localities within which it is established.

In the discussion of the structure of existing African towns, planners have been able to distinguish the traditional town from the modern town. Typical of the traditional towns are majority of the old towns in Nigeria, which had existed before the advent of colonial rule. Many of these towns were founded in response to security needs, while others were in response to geographical and or historical factors. These communities were unplanned. A; at the main core is usually the location of the central market and the King's palace. In other parts of such towns are residential quarters of various sizes and shapes, all in a cluster form without reference to any road network. The modern towns on the other hand, include the new or satellite towns, and those founded by the European powers during colonial rule which were planned fromorm the onset, with sufficient space for streets to accommodate modern vehicular traffic. In any case, wherever a town exists, different economic bases are exhibited with a mixture of different social groups and classes, which stimulate its growth.

Characteristics

(i) As a relatively larger community, it constitutes the nucleus or focal point of activities for other smaller communities in its region.

(ii) The town usual has a population of between twenty and hundred thousand people.

(iii) It represents a socio-political unit on its own, with a well-defined administrative structure and cultural traits.

(iv) The geographical limit of the town is often delineated by the extent of homogeneity of the cultural dialects.

(v) The town dominates central goods and services like, schools, health care and communication, which it distributes to its rural hinterland.

(vi) Contrary to what obtains in the village, the town witnesses pronounced division of labour as each person concentrates on that activity from which he enjoys the highest output.

3.5 City/Urban

The city ~~or urban settlement~~ is a spectacular level of development on the continuum of community. It is perceptually different from the extended scope and complexity of the environment, which makes possible further development of complicated pattern of physical, social and economic attributes. On the basis of the processes involved in its formation as previously discussed, it does not imply any other identity more than a relatively large, dense and permanent settlement of socially heterogeneous individuals.

Generally, a city is considered a place with a relatively large population that has a certain legal status, granted by the national or provincial government, and that is associated with specific administrative or local government structures. City development is not only a pre-colonial, but also a post-independence phenomenon especially in Nigeria. We see through series of investigations, time and again concrete evidence that the town begins to metamorphose into city at a point when those physical and economic factors involved in its growth start to manifest. For instance, during the colonial era, this development was caused by the selection of a few of the existing towns as centres of administration from which the colonial officials could govern the territory under their control. These towns were linked by roads and railways to enable them constitute commercial centres, with those along the coast, as major ports.

The restructuring of the national economy with the introduction of National Development Plans, aided the post-independence re-organization process as attention was on industrialization of the ~~towns (~~administrative centres~~)~~, which eventually developed into urban areas. In Nigeria, there were only

four major urban centres which represented regional headquarters as at the time of independence in 1960. These include; Ibadan, Lagos, Enugu and Kaduna. By 1963, the number rose to five with Benin City as new headquarters of Mid-western region. The number further rose to thirteen in 1967 when the country was reconstituted into twelve states. In 1976, the number went up to twenty with the then nineteen states. Today Nigeria has seven cities with a population of over 1 million people, 80 cities with a population of between 100,000 and 1 million people (World Population Review, 2019). With the present thirty six states, one can think of about twenty five cities or urban centres all over the country that have attained the United State standard of one hundred thousand population. For the purpose of identification, scholars in various disciplines have evolved three broad perspectives for the definition of urbanity in recent years. These include:

(a) Legal and administrative perspectives
(b) Definition using minimum population
(c) Functional definition

From the legal and administrative angle, the urban community is defined based on the charter granted by authority of the government within whose jurisdiction the place is located. That is, once a particular place meets the minimum requirements set (by the act of parliament, bill or decree of the government of a region or nation, it automatically derives its legal recognition as an urban centre. Using population criterion, a measure of intensity of certain phenomena are considered which covers, population, housing units, families, percent of land occupied by buildings, employment per given area etc. to qualify a place as urban. The functional description is associated with; social, cultural, industrial, commercial, religious, artistic, educational, military, political and administrative activities, which are all grouped as urban functions.

These urban centres have persistently attracted many people from the rural areas taking advantage of their strategic locations. In their various capacities as either national, regional or local government headquarters, they have witnessed tremendous increase in the provision of social and or infrastructural facilities, industries, urban services as well as expansion of economic and administrative functions. School leavers and others, move into the city in search of elusive white-collar jobs. The basic amenities and higher order services in these areas have equally remained a major attraction for better living. On account of the weak and depressed nature of rural economy rural-urban migration therefore, becomes a regular occurrence. As urban population increases, many families in a desperate bid to satisfy the appetite for self-contained accommodation put up buildings in the outskirts. This process continues in a sporadic manner only for the spatial organization of the city to assume a magnificent dimension.

Characteristics of a Town

(1) It spreads over a relatively large space of land as a result of the rapid physical development of a number of quarters or sectors that group around separate nuclei which constitute the Central Business District (CBD).

(2) The urban centre has always remained the seat of government or administrative headquarters for the region within which it is located.

(3) Majority of the urban centres represent industrial places where different categories of workers are employed in manufacturing occupations.

(4) It is often characterized with congestion or over-crowding, being the definite end of rural migrants, and having accommodated a substantial population, usually over a hundred thousand people who engage in non-agricultural occupation.

(5) It is a community with high economic advancement in terms of numerous commercial activities and high productive efficiency of

goods which are re-distributed to other smaller communities in its religion.

(6) It is a major location of the 'elites' and other skilled workers where advanced training re acquired in various fields.

[(7)] It is equally a community of higher order services such as tertiary institutions, specialist hospital, pharmaceutical institutes, stadium, amusement parks, radio and television stations and etcetera. ~~etc~~.

(7)[(8)] It is a place where rarest articles are found example of which are, vehicles, heavy machinery and plants, sophisticated electronics and so on.

(8)[(9)] It is a major transport co-coordinating centre such as, airports, sea-ports, railway terminal, motor parks, bus stop and traffic lights.

(9)[(10)] It is the base for certain sensitive activities like; defense and security, military barracks, prisons and police headquarters.

4.0. -Conclusion

In this unit, we examined trends in the formation of an urban centre. This starts from man in the Neolithic times, through band, village, town, and urban/city centre.

There is a growing realis~~z~~ation of the need to pay more attention to these developmental trends, especially as it borders on the spatial implication of the urban economy both at the national and state levels. The study helps us to appreciate that changes in the status of these communities help in the transformation of the socio-spatial structures of their productive capacities, and the continuity from the past and their contemporary changes in time and space.

Human communities are indifferent all over. The truth of this lies in the fact that, there is a strong relationship between a place and the number of people that settle therein. That is, the higher the number of people, the higher the relative size of the settlement. The trends in the formation of urban communities, as we have them today, began with man in the Neolithic era. It is evident that each of the stages identified in order of precedence has its own peculiar characteristics, which change throughout the transition period.

Indeed, it has to be understood that unless we have adequate knowledge of classifying these communities, we will not be able to understand the differences in their structural systems, which is strategic to planning. The manner in which a planner undertakes his planning depends decisively on the size of the community, the people concerned, their attitudes and the anticipated reactions to planning approaches.

5.0 Summary

Man in the Neolithic era represents the starting point of man in his quest to live on the earth's surface. It was the period of dark ages when man tried to distinguish himself from other animals through some basic inventions like conversion of crude stones to make simple tools~~choppers~~.

A hamlet ~~band~~ is the starting point of community development made up of small group not more than ten persons.

A village is a transitional community, which makes the beginning of permanent settlement. The population is not usually more than 5000 persons.

A town is the home of every man, the population is usually between twenty and hundred thousand.

An urban centre is the spectacular level of development in a community. The city centre is made up of population of over a hundred thousand persons with all the characteristic features like functions and administrative qualities on a high standing.

6.0 Tutor Marked Assignments

A. Distinguish between human settlement in the Neolithic era and a band.
B. List and explain the basic features of rural areas
C. Outline and discuss the three broad perspectives for the definition of urban city.

Self-Assessment Exercise

[iv.] What is a Hamlet~~Band~~?
iv.[v.] What is a Village?
v.[vi.] What is a Town?
vi.[vii.] What is a City?

7.0 References

Basorun, J.O. (2004). *Basic Elements of Urban and Regional Planning*. Shalom Publishers. Akure, Ondo State.

Onokerhoraye, A.G. and Omua, G. ed (1986). *Urban Systems and Planning*. The Geography and Planning Series, University of Benin, Benin City.

World Population Review (2019), List of Nigerian Cities by Population.

Unit 4: History of Environmental Planning and Types of Planning

1.0 Introduction
2.0 Objective
3.0 Main Body

3.1 Evolution of Planning
3.2 Types of Planning
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignments
7.0 References

1.0 Introduction:

Evolution and History of Environmental Planning entails the beginning of planning till date. This unit will acquaint the students of where we are coming from regarding environmental planning, general ~~and~~planning and what is currently obtainable. The different types of planning are also enumerated.

2.0 Objectives

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

1. Trace the history of environmental planning
[2.] Identify t~~T~~he types of planning
2.[3.] Identify the major planning tasks associated with the medieval and renaissance times
3.[4.] Know the social and economic problems that prompted environmental planning at the time of industrial revolution in the 18th century.

3.0 Main Body

3.1 Evolution of Urban Planning

Urban planning is known to have passed the following five evolutionary passes namely, medieval, baroque, renaissance, industrial and contemporary phases.

a. Medieval Period

Settlement patterns and types during this period were detected by the need for ~~inclined to~~ defence, ~~consideration~~ hence settlements were small and, ~~buildings~~ were compact with narrow streets, congested buildings without open spaces and without any form of protection against fire outbreak, epidemics, earthquakes etc. and when any of these thus happen large part of the cities were~~are~~ destroyed.

b. Baroque Period

Defence was not only an important element during this period, it was a period characterized by progressive energy, which was otherwise channeled towards improvement of parts of towns and settlements. It was also a period that conscious effort was made to combat hygiene through increase of knowledge in science and technology. Significantly, the discovery of the roman vault for the channelization of sewage, drainage and water was developed. Finally, the baroque witnessed a significant progress in landscape architecture where large expanse of land were acquired by kings, princes, army generals, wealthy nationals an aristocratic class for development of houses, mansions and residential areas.

c. Renaissance Period

This was a period of re-discovery. It was a time man discovered that he could subdue nature. It was a time of increase in the knowledge of science and technology. It was a time human limitation and inhibition were been removed and all creative energy was released. Consequently great artists, architects and engineers were discovered and commissioned to prepare development plans, create large express ways for ceremonies. Taking into cognizance the discovery of the wheel cart and the growth in inter communal trade, great houses were built for kings and emperors. All these helped to sharpen settlements, widened ~~-~~streets ~~widened~~ and ensure ~~there was~~ a more organized and sustainable utilization of space. It was at this time the foundation of town planning was laid, b. ~~B~~ecause of the need to

improve public environmental hygiene. A ~~,~~ new consciousness of ~~to~~ landscape maintenance was born. Selected areas of towns such as king palaces and religious centres were developed. This was also a period that the philosophy of town planning began.

d. Industrial R~~r~~evolution Period

The industrial re~~v~~s~~s~~olution of 1760 to 1790 resulted in innovations, which sharpened the discipline of planning. It was a period of unlimited increase in industrial production and the concentration of large factories. It was also a period for the discovery of railways, st~~r~~eam engines and motor cars. The industrial revolution period had two impacts on settlements.

[(a)] It helped to improve and widen streets and hence a better appreciation of open space and~~.~~

(a)[(b)] It led to the clearance of large expanse of land for the building of factories, industries and buildings.

The construction of factories and industries led to massive movement of people from the rural areas to the urban areas leading to population and building~~congestion of buildings by people~~ congestion. The resultant habitable conditions were so deplorable that London was referred to as "smoking city" in the latter part of the 18th and early part of the 19th C~~c~~entur~~iesy~~. It was a time factories were located in residential areas, ~~to houses,~~ markets and railway stations. B~~ b~~ecause of this~~,~~ incompatibility of land use, the gains that were recorded during the renaissance period were wiped away. However, the discovery of motor cars and railway led to the dispersal of population and settlements ~~and population~~ which, decongested ~~helped to decongest~~ the big cities as at that time. Since the discovery of railway and motor cars, it became ~~has made it~~ easier for people to travel from their place of residence to their working places.

e. Contemporary Period

It was in the industrial revolution period that city managers, architects and engineers became more concerned about the importance of cities. Consequently people like Pane Gannier, Robert Owen, Thomas Moore and James Burkinham began to philosophize on how to make the cities more habitable. It was at that time that concepts and principles of town planning began to crystallize. It was at this time also that appreciation of the concept; principles that were hitherto applied to king palaces were applied to cities. Significantly, it was the Second World War that modified the birth and presence of town and country planning. Town and country planning was introduced to Africa in the early 1940's. In Nigeria, it was introduced in 1946 through the first town and country ordinance modeled after the British Ttown and Ccountry Pplanning.

3.2 Types of Planning

Four types of planning can easily be identified. They are; physical, economic social and environmental planning.

i. *Physical Planning*

Physical planning, sometimes referred to as land-use planning, is concerned with the spatial arrangement (organiszation) or urban and rural land-uses for the purpose of creating functionally efficient and aesthetically pleasing physical environment for living, working, circulation and recreation. Land subdivision plans, master plans and, local plans are examples of physical plans. Physical planning is more closely associated with panning at the regional, urban and local scale. It, it involves intervening in, controlling market mechanism and reconciling public and private objectives towards achieving good spatial qualities and relationships of development.

ii. Economic Planning

Economics is the science of the management of resources. Economic planning involves the calculating and controlling the allocation of resources.

It is primarily concerned with facilitating the working of the market forces. In a federalism like that of Nigeria, where there is a central government and state governments, or national and regional governments, there could be national and regional approach to economic planning. ~~Economic planning is considered to be a national and regional approach.~~ National economic policies on industrial development, housing subsidy and health expansion programmes are bound to be put into practice within the resources available to government. The resources are required to be equitably distributed for the overall wellbeing of the citizenry. The process of the distribution and management of these resources is what is termed economic planning.

iii. Social Planning

Social planning is concerned with improving the social conditions of the people. It is more appropriately seen as the organization of resources to combat problems such as poverty, discrimination or deprivation. Social issues that require planning include education, health, water, housing, and employment.

iv. Environmental Planning

Environmental planning is concern with those plans meant to preserve or improve the quality of the environment. Environmental planning is done in the process of project establishment. It is required that impact assessment is carried out to determine the amount of harm or success a project is likely to cause to the environment. If the establishment is not environmentally friendly as it is with most oil exploratory~~y~~, appropriate measures aimed at reducing the amount of harm are taken in the process of development and operation. In the process of project development, impact assessment is

carried out to evaluate the degree or amount of damage that is likely to be done to the environment and what the impact of these damage would be felt by the inhabitants of the area in relation to the derivable advantages. This is what is referred to as Environmental Impact Assessment (EIA).

4.0 Conclusion

We have seen clearly in this chapter that environmental planning is a separate activity on its own, meant ~~which came up~~ to enhance the quality of human surroundings. We have seen how the first public Health Acts was introduced in the early 19th Century in Britain to foster this. We have equally sent e evolution of planning and the different types of planning in this context.

5.0 Summary

A. The medieval period – settlement pattern was based on defense on defense of the area. This resulted to congested buildings and small settlements. There was n~~N~~o recourse to environmental disaster such as epidemics, earthquakes, tsunami etc.

B. Baroque period – This was a period of defense, increased knowledge to combat epidemics, control of waste water and ~~the~~ adequate land use planning.

C. Renaissance Period – This was the period of discovery. There was high knowledge in the area of S~~s~~cience and Technology.

D. Industrial Revolution Period – Resulted in innovations that led to the widening of streets and clearance of large pieces ~~expense~~ of land for construction of factories.

E. Contemporary period – when professionals (Architects, Geographers, Planners, Engineers) became more interested about the importance of cities.

F. Types of Planning range from physical, Economic, Social and Environment Planning.

6.0 Tutor-Marked Assignments

1. List and discuss the major planning tasks that were associated with the Mmedieval and Rrenaissance Pperiods.

2. What are the social and economic problems that prompted environmental planning?.

Self-Assignment

Students should know the different stages in the development of environmental planning.

7.0 References

Basorun, J.O. (2004). *Basic Elements of Urban and Regional Planning.* Shalom Publishers. Akure, Ondo State.

Ojeifo, O.M. (2005). *Elements of Planning and Design.* Donald Publishers. Benin, Benin City.

MODULE 2: THE PROCESS OF PLANNING AND ENVIRONMENT

Unit 1: Models of urban Land use planning

Unit 2: Stages of the Planning Process

Unit 3: Community Facility Planning

Unit 4 Urbanization and Environment

Unit 1: Models of Urban Land use Planning

1.0 **I**ntroduction

2.0 Objectives

3.0 Main Body

3.1 Types of models

[3.2] ~~3.2~~ **Models of urban land use**

4.0. C~~c~~**onclusion**

5.0. **Summary**

6.0. **Tutor marked Assignments**

7.0 References

1.0 Introduction

There is no universal agreed definition of the term model. In the field of applied sciences, it is analogous to theory and concept. Theories are established relationships, while concepts are new ideas conceived by someone. On the other hand, models are skeletal representation of reality. However, the world model is used merely to refer to an established object or action that conveys information in reality. It is an abstraction from reality which is used to gain conceptual clarity in order to reduce the variety and complexity of the real world to a level we can understand and clearly specify.

2.0 Objectives

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

i. **Know most of the models commonly used for land use study**
ii. Relate the present day city built-up to the models
iii. Differentiate the different models using simple illustration.

3.0 Main Body

3.1 Types of Models

Various discussions on the types of model such as are given in some tests, render sufficient basis in this context. Actually, there is a clear difference in the way models are made. Apart from the fact that, they are in different relationship with the situations they represent, they do not occupy the same space at the same time. We may in some instances, notice a kind of similarity in the shape of two or more models, but on a closer look, it is inevitable that differences will appear in the information they offer. Generally, three broad types of model have been identified; iconic, analogue and symbolic models.

[(a)] Iconic Model: –Iconic model which is more of pictorial model, is the exact representation of the original. It shows the main features and exhibit specific relationship to what it represents. Paintings and drawings, especially of two and three dimensional designs of buildings, sculptures and photographs of structures or scenes are good examples of this type of model, which are quite useful in planning researches.

[(b)] Analogue model: –The distinctive feature of this model is that, it considers only, the significant characteristic of what is to be represented and presents them with appropriate and concise elements as are necessary to express the essential parts of the phenomenon of a very wide range. For instance, one can easily

construct the picture of a country or state on a map. Likewise the land use or road network pattern of a city or region. In this case, abstractions of outlines, contours and graphical representations introduced on map are genuinely related to those aspects of the real situation which they symbolize. This model, just like the iconic model, is regarded as 'physical model' on account of the concrete posture.

(a)[(c)] Symbolic model: This model is of mathematical orientation. The approach which is a little complex is built on mathematical concept which was derived from real life situations. Upon the knowledge of the significance of certain parts of an activity or object, some numerical statements or equations are developed to established a satisfactory relationship between them e.g.

$$X = \frac{\Sigma fx}{\Sigma f}$$

i.e. mean = $\frac{\text{total number of cases}}{\text{total number of occurrences}}$

or

Volume of a cube = Length x breadth x height

It is absolutely an 'abstract model' because, in most cases, the model is represented with conventional symbols, which are subsequently subjected to mathematical manipulations to enable the researcher, comprehends the reality of the situation investigated. The mathematical model can be categorised into three viz:

(i) Descriptive models
(ii) Predictive models
(iii) Planning models

According to him, *descriptive models* "are of scientific value because they reveal much about the structure of the environment, reducing the apparent complexity of the observed world to the coherent and rigorous language of

mathematical relationship". As the name implies, they are basically meant for description of a particular circumstance, a term reasonable evaluation of the variables concerned. The models have not been found suitable for forecasting; as they tend not to supply adequate information about the future.

Predictive models, on the other hand, are purely 'forecasting models'. Being future oriented models, they try to reveal possible change in the future after thorough analysis especially through 'extrapolation techniques' of the present situation as dictated by the past events. The models which could be 'deterministic' or 'probabilistic' in nature are useful in simulating future rather than current situations. Specifically, they are essential tools applied to issues that relate to population forecast and land use planning.

The *planning models* are also known with three other different names; prescriptive, normative and optimizing models. They are called normative models because they set the norms against which societal behaviour may be compared. They are concerned with "what ought to be" "rather than "what is" and to this extent they are prescriptive in nature. As planning models, they help to communicate ideas and opinion about what is desirable or the impacts of a policy decision on a subject matter or a system of interest. Although the notion of prescription in this context, is not entirely uncontroversial, however, there is sufficient common understanding that the models are useful for planning.

By using models to study phenomena, a problem is translated into more family or convenient terms such that a useful model involves a more simplified, accessible, observable, controllable, rapidly developing or easily formulated phenomenon from which conclusions can be deduced, which in turn can be re-applied to the original system or real world.

3.2 Models of Urban Land Use Planning

Consequent upon series of studies conducted on the nature of urban land use structure by pioneer urban analysis, a number of approaches have emerged in the form of models, attempting to describe the internal structure of contemporary cities. The rationale behind each concert may make sense to some extent, especially when the substantive developmental; stages are keenly followed. Those ones we shall examine below, were worked on in much greater details, and will no doubt serve as vehicle for most of our intensive sustained focus on the realities, reasoning skills and techniques designed to help students acquire basic planning background on city development. Emphasis shall be laid on the five major ones for now i.e. the concentric, sector, multi-nuclei, population density gradients and the land value models.

a. The Concentric Ring Theory

This is one of the theories used to describe urban land use patterns today. Ernest W. Burgess developed this theory in 1925 in his study of Chicago City in the United States. This model was developed as an application to urban land use of Von Thunen's earlier theory relating to rural land around a city. The main thrust of the model is that a city extends radially from its center to form zones outward (Basorun, 2004). He explained the composition of each zone as follows:

Zone I: The Central Business District – This zone is the headquarters of economic, social civic and political life. The heart of this district is the down town retail district with its department stores, smart shops, office buildings, clubs, banks, hotels and museums.

Zone II: The zone in Transition. – Areas of residential deterioration caused by the encroachment of business and industry from zone I. A zone in transition with a factor, an outer ring of retrogressing neighborhoods, of firs settlement immigrant colonies, of rooming house district, of homeless-men areas, resorts of gambling, sexual vice and breeding place of crime. As

families and individuals prosper, the escape from this area into zone III beyond, leaving behind as marooned a residuum of the defeated, leaderless and helpless.

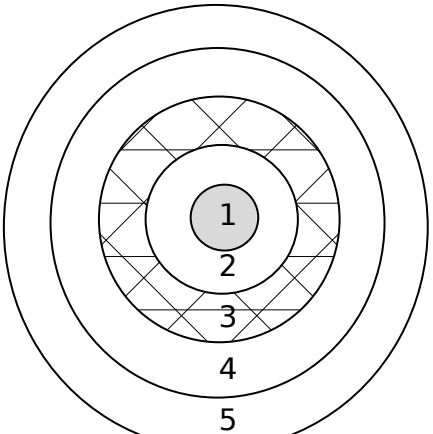
Zone III: This is the zone of independent workingmen's home largely constituted by neighborhood of second immigrant settlement. Its residents are those who desire to live close but not too close to their work.

Zone IV: This is the zone where middle class resides mostly such as small businessmen, professional people, clerks and sales men.

Zone V: The commuter's zone – This is a ring of encircling small cities, towns, hamlets and suburbs.

An illustrative diagram of the concentric model with several revolting circles was designed by Burgess in 1925. The zones according to him are not clear-cut and were in parties not circular.

However, this theory has been criticized by scholars like Fiery (1945) on the ground that there is hardly any urban center that is truly concentric in nature and where land uses would be arranged in a manner suggested by the theory as distinct land uses such as shops, offices, factories, housing and waste site are difficult to come by instead they are close to each other.



Concentric Ring Model

1. Central Business District
2. Zone of Transition
3. Zone of Working Mains Home
4. Zone of Better Residence
5. Commuters Zone

b. ~~3.3~~ *Sector Model*

The tremendous impact of transportation infrastructure on city growth was emphasized in this model by Hoyt. As an economist, he is of different opinion from the Burgess concept and argues that the spatial development of any society or city depends, to a large extent, on the nature and structure of the transportation networks inside it. He was concerned with discovering how the housing market operated in America so as to advise the American government on mortgage policy. He believes there is a strong correlation between 'rent' and 'housing' situation. Using retail value therefore, as a surrogate of housing quality, Hoyt demonstrated how residential land uses tended to be arranged in sectoral pattern, radiating outwards from the city centre along transport routes.

According to him, thirty American cities where sampled and arrangements of housing units were found to be in organized pattern of rent; the basis on which the following facts are established:

(a) Highest rental areas stretch continuously outwards from the city center in sectoral pattern.

(b) The high rent areas' extension usually occurs along racial lines or transport routes from the center to the outermost part of the city.
(c) Middle-range rental areas often encloses or bounds the highest rental areas.
(d) In most cases, the middle-range rental areas, demarcate the high-rent and low-rent residential areas.
(e) Normally, the low-rent areas of the city frequently locate opposite the high-renal areas.

In conclusion, he maintains that the sectoral development of the city is a function of the established lines of travel which facilitate movement to the CBD, for enhancement of economic activities as well as social interactions.

c. ~~3.4~~ Multi nuclei Model

It could be argued that the attempt to marry the principles of concentric and sector models together, led to the emergence of multi-nuclei concept. The concentric model for instance, at its best, is operational especially at the early stage of city formation. It stimulates existing communal function to such an extent in the city as to warrant the designation of a centre of nucleus. The subsequent expansion of the city and the complexity of the total environment make possible further development of new centers at the periphery. Perhaps, on this note, Harris and Ullman developed the multi-nuclei model, to suggest that the city with its extended geographical region, comprises as many segments as possible, each grouping a round a separate nucleus or center.

At this point, it is necessary to examine more closely the nature and functions of these centers so as to understand the key factors responsible for their creation. "Although most of the centres are similar, various areas that constitute them have developed some specialized functions which make each a completely different order. It could be argued however, that four

basic actors are crucial to the development of these separate nuclei as enumerated thus:

(a) Certain activities concentrate at specific locations because of the presence of specialized facilities required to function. A good example is a quarry located near rock outcrops; just as furniture workshops often group around sawmills or timber sheds.
(b) Closely related functions tend to locate in close proximity because of the profit that could be derived from such act. For instance, it is common to find the welder, painter, motor mechanics and vehicle spare parts sellers operating in the same environment due to the complementary nature of their jobs.
(c) Conversely, conflicting activities that are likely to be detrimental to each other, just like the residential and industrial districts will need to be located in opposite direction for the sake of convenience.
(d) On account of the variation in rents in different parts of the city, the most desirable site therefore is dependent upon the ability of prospective developers to pay for the price.

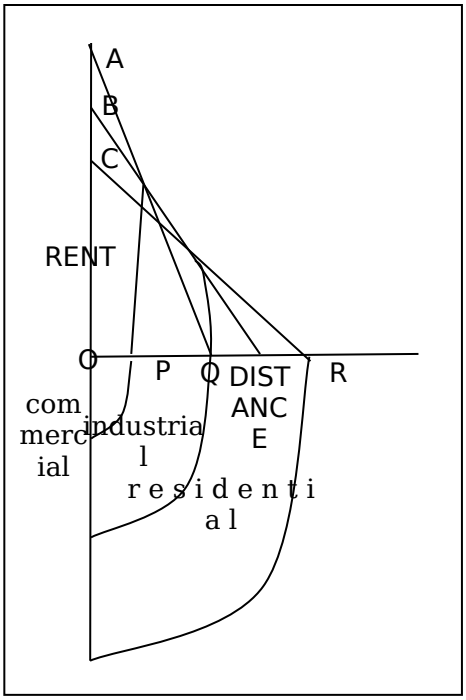
What this illustration has demonstrated is that, various nuclei are formed spontaneously as the city develops. When differ areas of specialized activities are stimulated, specific central functions are evoked. The number increase as the existing ones are absorbed only for the others to be created at the outer zone. This gives a perspective of development from the spatial to the full understanding of the process as an exercise in spatial perception.

d. 3.5—Land Value Model

This model focuses on land value, and shows the basic structure of business activities and residential land use in relation to the population density gradient of the city. To some extent, the relative strength of a city reflects the purchasing power of its own residents – a large number of whom depends directly or indirectly on trading.

Usually, its trade is drawn from its rural hinterland, its urban yield, its service and market areas which are still considered as its ‘sphere’ of influence. Retail and wholesale functions which need to be central to their market, and offices often eyed by the labour pool are concentrated in the central part of the city where the transport systems are focused. The result of this is the development of series of zones in which major land uses like, commercial, industrial and residential terminate, based on rent parable on land and transport services form the city center.

The model, which was fashioned out of the theory of Land rent by Alonso, is an extension of Von Thunen’s Model of Agricultural land use. It sees the core of the city as the most desirable location for which the commercial entrepreneur make competitive bids on account of the high price it commands. Generally, the main streets in the area are the chief shopping areas, traditionally occupied by private business such as hotels etc. Following this zone are industrial activities. More and more, as industries develop, houses are built to supply the rising demand for accommodation. Apart from a few builders of model cottages near their mills, all other builders are speculators operating in the market arena.



Hypothetical Rent-Distance Relations ~~Within~~within a City.

Alonso was resolutely skeptical about land value, which he claimed has a direct correlation with rent. Different activities compete for locations at various distances from the center. Since the value accorded the central site, makes it more attractive to economic ventures, residences are therefore located at the outskirt not principal as a result of land which is in short supply at the center, but because residential uses in most cases attach less value to centrality.

All the models as we can see help to analyse the totality of the urban environment, and have come to discover the essential features, which are actually present and operating in it. The scientific understanding derived from the theoretical concepts, no doubt will assist in developing ideas about

existing conditions and make elaboration of abstractions as well as analysis of urban cases.

4.0 Conclusion

In this unit, the models discussed have identified in system terms, the elements or importance in the structuring organizations and have related them in actual terms to the urban development process. This will enable us take informed decisions in our planning approaches especially in urban areas.

5.0 Summary

We have iconic, analogue and symbolic models. Concentric model suggests that the city is a complex entity which often exhibit concentric pattern of growth of six notable zones.

- Sector model explains the impact of transportation infrastructure on city growth as exemplified by Hoyt.
- Multi-nuclei model: This a~~A~~n attempt to marry the concentric and sector model led to the multi-nuclei model. The model suggests that the city with its extended geographical region is made up of many segments as possible and each grouping around a centre.
- Land value model- This model shows the basic structure of business activities and residual land use in relation to the density of population of the cit.

6.0 Tutor-Marked Assigned

1(a) What is a model?

(b) Discuss briefly any ~~the~~ three types of model.

2. Using suitable illustrations, discuss the concentric pattern of the urban growth as conceived by Ernest W. Burgess~~Burges~~.

Self-Assignment

(1) Distinguish between sector and multiple nuclei models.

(2) What is land value model all about?

8.0 References

Basorun, J.O. (2004). *Basic Elements of Urban and Regional Planning*. Shalom Publishers. Akure, Ondo State.

Ojeifo, O.M. (2005). *Elements of Planning and Design*. Donald Publishers. Benin, Benin City.

Unit 2: Stages of the Planning Process

1.0 Introduction

2.0 Objectives

3.0 Main body

3.1 Stages of the planning process

4.0 Conclusion

5.0 Summary

6.0 Activity

7.0 References

1.0 Introduction

Planning is necessary to bring change in the behavior of man when it becomes very necessary. Virtually all aspects of man's way of life to bring development in all sectors require adequate planning. Examples of areas where we require adequate planning are: Traffic Control, Agriculture, Infrastructural development, industrial development and so on. And so anything man does requires continuous planning in nature with some systematic framework within which certain elements of control and

monitoring are put in place to ascertain the effectiveness of planning. The process of doing this is what this unit is all about.

2.0 Objectives

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

i. **List the process involve for effective planning of any project.**
ii. **Justify the need for effective planning.**
iii. Justify the need for monitoring and review after plan implementation.

3.0 Main Body

3.1 Stages of the Planning Process

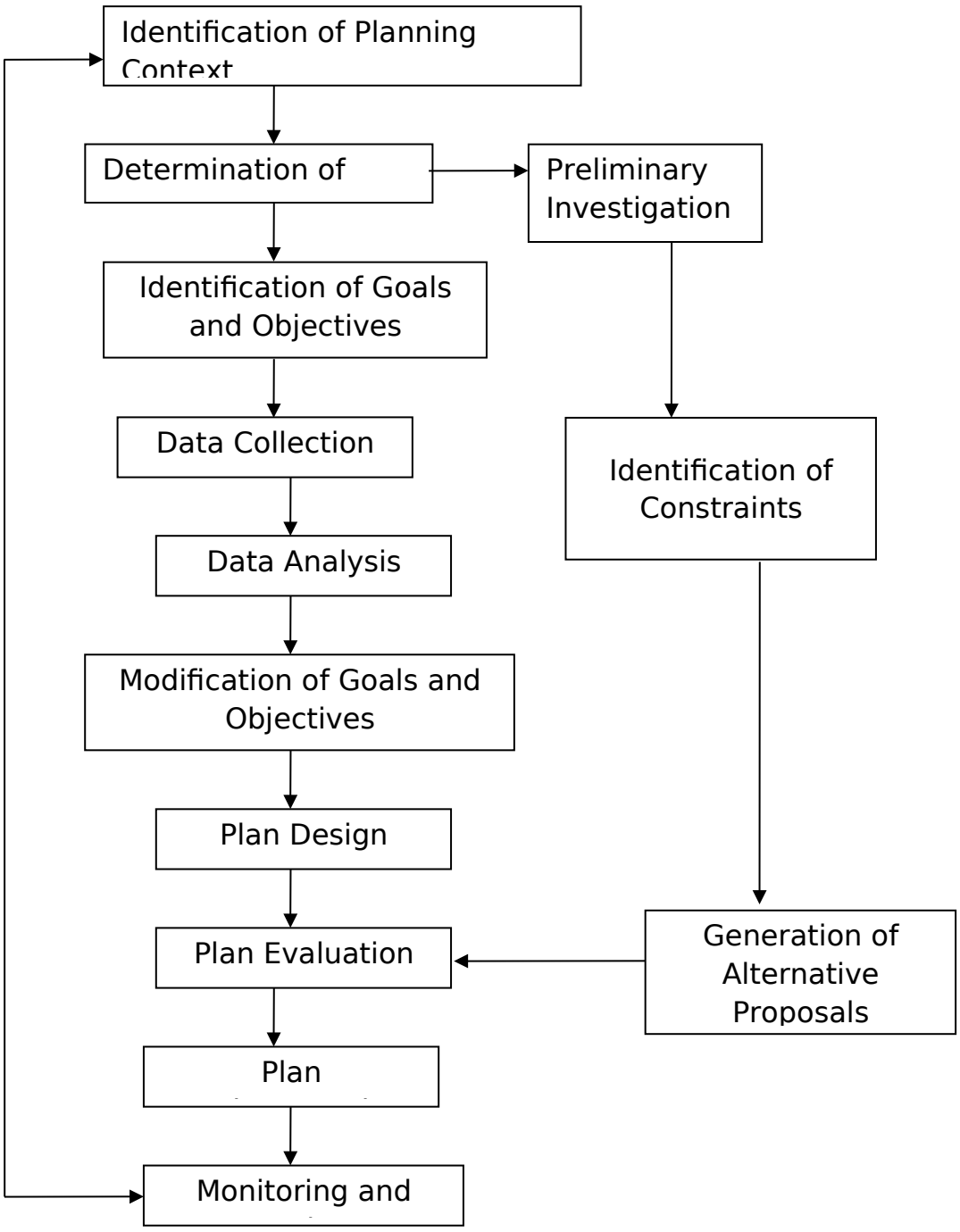
Ideally, one should aim at making the planning process as meaningful as possible. There need arrange the stages in a logical order, so that a common principle is maintained, and that the changes envisaged in a particular situation will have the potentiality of transfer to related situations. As a matter of fact, concepts of the planning process do not apply uniformly to different circumstances; they are formed out of the planner's experience of grappling with the numerous aspects of the environment. A particular planning task or problem dictates the techniques to be adopted as information required at each stage are not likely to be the same. This therefore, suggests that an appropriate process is that which is relevant to the situation at hand, and in sufficient variety to ensure the realization of a specific goal.

In general, especially as it applies to land use planning, the process could be broken down into a series of simple sequential stages as indicated in the diagram below. These stages are designed to present information and at the same time evoke a response in the desired direction. Moreover, the sequential presentation of the material will no doubt enable the planner

make appropriate prediction in advance of plan implementation and effect correction where necessary.

Stage I: Identification of planning context

This is the first step of the panning process, where the planning task or problem is recognized and identified. A true problem is in the form of certain deficiency or difficulty caused by people in an environment, which might appear to be unexpected, abnormal and or unacceptable. One problem so identified, can never be similar to another or a previous one. Each is usually unique in relation to the people the timing and the context, hence, demands a different solution. For example, a cluster of settlements might be considered for establishment of educational institution, based on the population and the location to an existing one, far way. This does not necessarily imply that the same type of institution will be proposed for similar settlings elsewhere. What is important however is that the identification of problem should be closely dependent upon the circumstances and the significance to the society in question. It is the central point around which planning activities or the panning processes are meant to revolve.



The Planning Process

Stage 2: Determination of Scope

Actually, the ability to plan successfully underlies the ability of the planner to think logically. A particular problem cannot spread over an unlimited space, neither can it be indefinite. This suggests that the planner must be able to classify his problem unambiguously and recognize the criteria for demarcating the affected area. Having discovered that an area lacks a specific facility, there is need to embark on preliminary investigation perhaps, through reconnaissance survey, to identify the affected settlements and determine the geographical coverage. The best way by which one can approach this, is to group the area into a unit, using common traits like; dialect historical and political affiliation, as well as relationship between people preferably, a base map of the area may be procured at this stage or a new one prepared incase none exists, for perfect demarcation. Thereafter, the particular type of facility (educational, health, transportation, welfare and etc.) that is so required is equally determined. The essence of determination of scope therefore, is to mark the limit of study, establish a ground for a true understanding of the gravity of the problem and to demonstrate convincingly the need for a particular proposal or planning research.

Stage 3: Establishment of Goal and Objectives

Establishment of goal originates from scope determination. It is the specific aim one hopes to achieve after identifying the needs, problems and aspirations of the people. It is, indeed, a broad statement of the planner's intention which is objectively defined. Still using the current example, the preliminary investigations might reveal that the area in question requires a secondary school. This remains the overall goal, which is based on simple perceptual appearance, and considered necessary to improve the standard of education in the area. To accomplish this goal, certain objectives are set out, representing more precise means through which the goal could be

achieved. Considering the significance of these objectives to the evaluation process, key are often stated in testable manner and in logical sequence, such that the desired end is gradually realised. On the proposed secondary school, the objectives might therefore include:

(a) To examine the level of illiteracy in the area;
(b) To identify the existing primary schools and people with elementary education that will service the high school and
(c) To provide secondary education for the people.

All these are extrapolated from the existing situation. The planner is now able to reason by hypothesis, or rather propositions as he tries to imagine the relations between relevant variables, without necessarily establishing the relationships until the evaluation stage.

Stage 4: Data Collection

Planning data are facts or information required when a phenomenon is being examined for decision making. Data collection stage is essentially structured for the gathering of statistical information about the past and present state of the event under investigation. This enables the planner to have a full knowledge of the circumstances surrounding his research and make, a generalisation about the population of interest. The success of any survey to a great extent depends upon data collected, the systematic organization and the manner in which they are serially analysed for the projection of a meaningful design. Numerous procedures exist for data collection. A researcher might decide to embark on total, purposive or scientific sampling, just as time and scope of research permit. In any case, it is important to note that, the framework of collection must be closely related to the planning activity, and be skillfully designed so that a satisfactory result is eventually obtained. There are four broad sources of field data

(i) The primary source

(ii) The semi-secondary source

(iii) The secondary source

(iv) Use of Satellite and Geographic Information System (GIS)

Satellite is quite useful in collecting data relating to physiographic, geological and hydrological studies. GIS on the other hand, is the current fastest growing segment of computer technology, introduced in the form of maps to provide information and data about land, the environment and natural resources. For instance, 'in the United States of America, geographical data in government represents as much as 85% of the total governmental database. It is estimated that between 60% and 80% of all data held by government departments in Britain is geo-spatial.

Secondary sources refer to data already collected, processed, analysed, sometimes interpreted and reconstructed by other researchers, which are usually presented in tables, diagrams, figures and charts. Others include textbooks, extracts from newspapers, journals, reports and monographs. The GIS and the electronic media, in a way, belong to this category. The semi-secondary sources are similar to the secondary sources except that, the information so collected are still left in the raw form unprocessed for proper planning. Examples include, registration of marriages, births, and deaths kept in separate files in the local government councils or hospitals.

The primary source relates to fresh or raw data obtained by the researcher directly from the field. This is usually done through the use of questionnaires, research schedule, observations and controlled experimentations, interviews and the use of electronic and photographic equipment. The set of questions contained in the questionnaire are prepared in connection with the study. These are unambiguously stated and produced in many copies for the target population to obtain information that will guide in decision making. The questionnaires are administered

through the mail, telephone or face-to-face contact with the respondents. The interview method is more of verbal interaction between the researcher and the respondents. In this case, the researcher prepares well framed questions, goes to the field, asks the respondents, and records responses himself. This is very useful, especially when the target population is elite. Observation method is actually an on-the-site situation investigation, for the purpose of ascertaining to exact position of the study area, in terms of location, the inhabitants (people), vegetation, climate, topography, and other barriers like rivers, rocks, hills, gullies and so on. The point of view here tallies with the preliminary investigation carried out in stage two. Through data collection, the researcher can easily identify legal and political constraints as well as other severe limitations in respect of land acquisition. This is necessary particularly in transportation planning, environmental planning and land use planning.

Stage 5: Data Analysis

This is a stage, where researcher carefully separates the data already collected into parts, in order to understand and explain in details the results of his study. In urban and regional planning, there are three broad techniques of data analysis, which include:

[(i)] Using descriptive statistics, by organiszing numerical data for simple calculation and graphic display. Here data are summariszed or grouped only to determine either the mean, mode, median, standard deviation or variance after which they may be presented in tables, charts and graphs.

[(ii)] Using inferential statistics, whereby the researcher can make a generaliszation or draw an inference from a segment of population in respect of any existing trends or relationships between key variables of research. The method involves the use of advanced

statistics like; Chi-squared, Student's T-Test, Correlation Analysis, Linear and Multiple Linear Rregression Analysis.

(i)[(iii)] Using quantitative models, which are mathematical in approach, for testing existing theories that have been applied in the research. The models which are descriptive, predictive, prescriptive and analytical in nature provide the basis for understanding what prompts what, in a real life situation. This technique is very useful in transportation planning.

It is necessary to emphasiszes that, the method of analysis to be employed in any research should be determined by the type of data collected, the information required and the planning task above all.

Stage 6: Modification of Goals and Objectives

It is essential that a detailed study is always made to help in a problem-involving activity by judicious use of data analysis. Such analysis, to a considerable length, must have taken into account, the logical connections between research variables. If eventually, the result of the analysis varies greatly with the common goal earlier established, the need therefore arises for modification of the goal as well as the objectives to make them more acceptable and realistic. For instance, the analysis of data collected on the proposed secondary school might indicate that about 65% of people in the area were in the age-bracket 30-40 years, which by all standards are above secondary-school going age. Invariably, the initial goal becomes irrelevant together with the objectives. At this point, the modification might warrant a complete change of proposal to teaching of vocational skills with new set of objectives. If on the other hand, it was discovered that 80% had elementary education out of which 75% are in 10-20 years age group, then the proposal is in order, while only the objectives may be modified in scope to accommodate new findings. This goes a long way to reduce conflicts among the objectives and help to determine alternatives to achieving the goal.

Stage 7: Plan Design

At this stage, the planner decides on the general arrangement of the different parts of the proposed plan during which alternative proposals are generated. The alternatives will show how to achieve the same end by using so many means. Actually, there is not just only one solution to a particular problem. In reference to the constraints identified during field survey, possible solutions are set forth preferably in maps or charts, each having the chance of being selected. Cost of execution, public participation and other planning rules which are supposed to guide against irregularities, are related to data analysis, and enables the planner to be consistent about many of them, even though they are clearly fairly complex. By this, the planner will, of course, establish that he understands the picture of his plan before attempting to implement it. In a nutshell, the alternative concepts initiated at this stage are meant to represent land use or development policies or the existing or envisaged physical or spatial, social or economic problems in the human environment.

Stage 8: Plan Evaluation

The idea of evaluation springs from a particular view of the planning process. That is, the realisźation of a workable plan, the alternative plans, even though well-conceived, are bound to have different implications on the set goal in terms of short and long term consequences. On this note, it is necessary to ashes their merits, on the basis of the advantages and disadvantages of each. Assessment in this context means evaluation, whereby all the courses of action or alternative ways of realisźing plan are compared and measured, using such sophisticated techniques like Cost-Benefit Analysis, Goal Achievement Matrix, Cost-Goal Analysis and etc., to be able to form opinion about the amount, value and quality of each, after which the best is chosen, being obviously acceptable. Physical attributes of the different plans are converted to mathematical values that can easily be

measured and computed. The significance of this is that, it enables the researcher to develop good judgement ability, and decides on appropriate solution when presented with a type of problem.

Stage 9: Plan Implementation

This is a crucial sage of the planning process where plan actions, activities or proposals that have been officially decided are executed. It involves the planner becoming aware of the nature of the accepted proposal and becoming competent enough in applying it to the relevant situation. It is important to note that, although the initiation of a proposal is essential, it is useless as long as it cannot be implemented. It should be a solution of real-life problem that could be executed within a specific framework. Planning Authority (in respect of public development)0 and private sector to be involved at this stage are clearly specified with strict development control measures put in a place to ensure good co-ordination for plan realisation. What was initially an objective action is now transformed into concrete activity. Eventually, thee planner will see how these is ideas are working out in practice, and when, and where to make necessary adjustment in the process.

The logical structure of most plans usually demands phasing of activities at theis implementation stage. This technique allows for the attainment of project gradually in stages over a period of time. Most often, these stages of development are scheduled to overlap so that as a particular phase of development is in progress, the demand for a new one to take off is stimulated based on its relevance to the former. Volume of work and period of completion of the phases are made to vary in a way that the proposals could be realisable within the plan period. The sensitive nature of this stage, argues the need for a great deal of experience, as well as adoption of a consistent technique so that cases of inadequacies and abandonment are avoided in project execution.

Stage 10: Monitoring and Review

The two elements involved at this final stage have a similar focus. They offer approaches which help to assess whether the implementation is successful or has failed completely. Monitoring and review which are simultaneously carried out at this level, imply total appraisal of plan regularly, to ascertain the effectiveness of the implementation strategy. The first consideration is to determine the extent to which the goal and objectives have been achieved. Secondly, is the decision on the level at which the target population has been directly or indirectly affected by the plan. If an appreciable progress has been noticed, then the plan could be regarded as a normal one. If on the other hand, it is evident that the process has failed to yield the expected results, then it is essential to return to an earlier stage re-assess the planning context, re-state the goal and objectives and begin a review of activities in some or all the stages again.

4.0 Conclusion

This unit 2 underpins the way in which planning for any project should be structured and provides approaches to designing and implementing planning projects. Though the approaches provided are not absolute but they provide the framework or a meaningful planning.

5.0 Summary

The process of planning entails 10 sages though not in absolute terms. These are: Identification of Problem, Scope Determination, Goals and Objective, Data Collection, Data Analysis, Modification of goals and Objectives Plan design, Evaluation, Implementation, Review and Monitoring.

6.0 Activity/Tutored Marked Assignment

1. List and briefly explain with illustrations, the process of planning.

2. Whyat is monitoring and review necessary after plan implementation?

Self-Assessment Exercise

Choose a project of your choice, and list the planning process to attain the desired aim and objectives.

7.0 References

Basorun, J.O. (2004). *Basic Elements of Urban and Regional Planning*. Shalom Publishers. Akure, Ondo State.

Ojeifo, O.M. (2005). *Elements of Planning and Design. Donald Publishers.* Benin, Benin City.

Unit 3: Community Facility Planning

1.0 Introduction
2.0 Objectives
3.0 Main Body
    3.1 Preparation of Community Facility Plan
    3.2 Planning Requirements for Community Facility
    [3.3] Factors that Ddetermine the Llocation of Ffacilities in Urban Areas
    3.3[3.4] Location of Service Centres in Urban Areas
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References

1.0 Introduction

There is usually a need to plan the location of facilities in community centres. The community centres are those service centres that are provided in a community of 2-6 neighbourhoods. These facilities include among

others: schools (from Nursery, Primary and secondary schools), postal AAgency, aA police station, market, library, museum, bBanks, hHospitals and recreation centres. The requirements and , factors that determine the location of facilitiesa cities in urban areas and the location of service centres are all discussedlooked into in this unit.

2.0 Objectives

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

i. **Prepare a community facility plan.**

ii. Explain

Explain the factors that determine the location of facilities in urban areas.

iii. Identify t**The requirements from effective community facility**

iv. Understand the reasons for t**The location of service centres in urban areas.**

3.0 Main Body

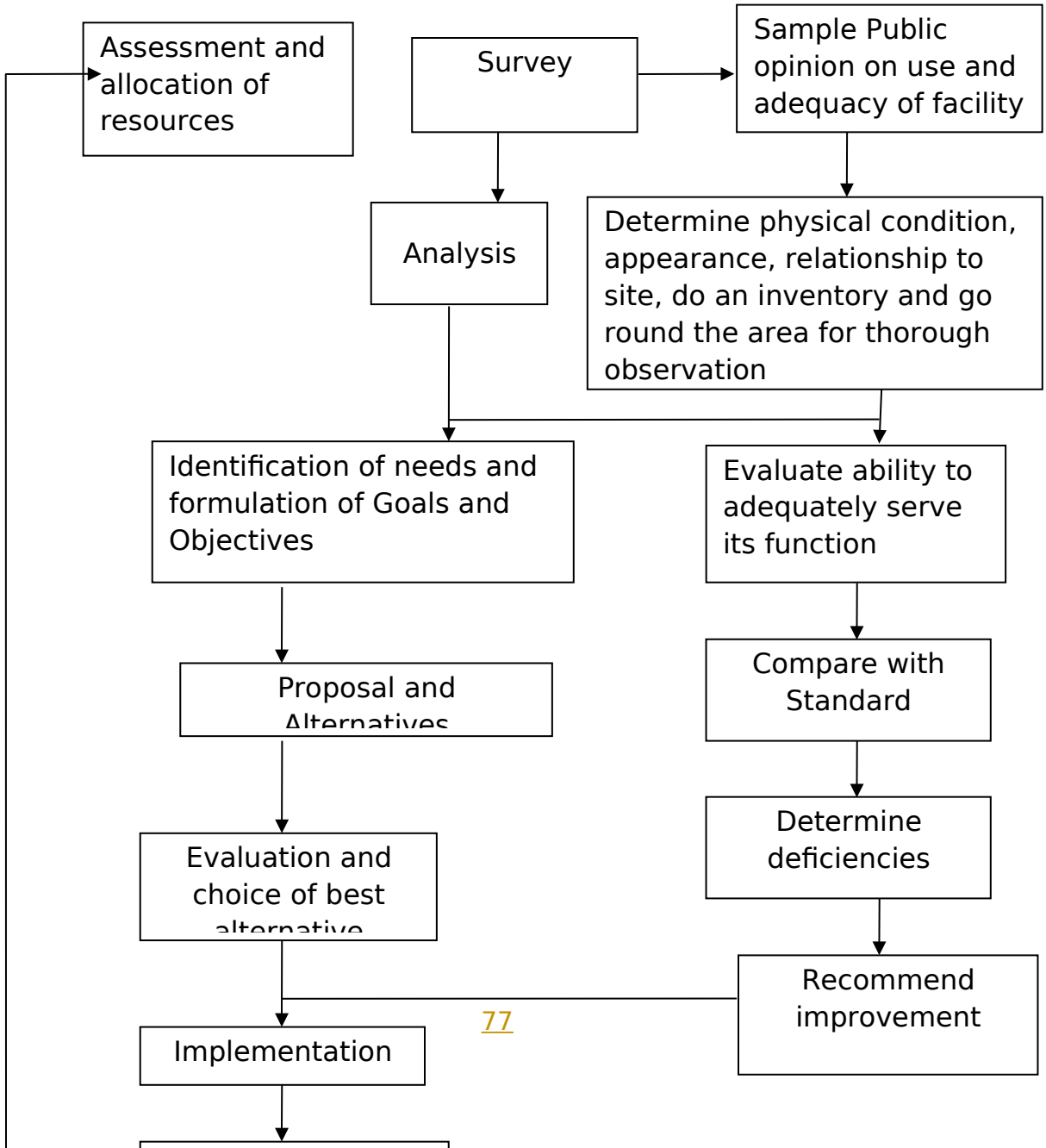
3.1 Preparation of community Facility Plan

The planning process, is more or less an organiszed structure of planning that enables us to direct our course and meet new problems of different nature more effectively. It tries to establish a principle which can be applied to various environmental problems, with a few modifications in some cases. Restructuring of this process as indicated below helps to illustrate alternative way of preparing a community facility plan, especially, when it has become increasingly evident that an existing facility is in short supply.

This model is activated by growth and environmental changes that now affect the structural components of the community. From the viewpoint of treating the community as a whole, which is consistent with modern

planning, a comprehensive survey is first conducted on the existing facility that is considered inadequate. This could be; water, electricity, roads, health centres, churches, libraries and etc. The reactions of people to the need for such facility during survey; describes the way in which the inadequacy has affected their economic or social system. Through appropriate data collection process, a considerable amount of information is gathered on the existing facility and the possible causes of shortage. The present population is examined and later projected to a plan period, to establish the need, for improvement and or extension as the case may be, the basis for which goals and objectives are formulated.

Apparently, this method involves placing people in unique position of deciding what they want. Genuine regard for their feelings, leads to generation of alternative proposals in line with existing planning standards. The proposals are evaluated and recommendations subsequently made with designs for implementation, preferably in phases, and in tune with the allocated resources. The results obtained from this process are consistent with those of the former. As can be seen from (Fig. 5 and 6), the predominant process in the two texts, even though differently arranged, are of similar intention of gaining adequate control over the process of urban development. Not that alone, the illustrations are means of raising our understanding of analytic and interpretive strategies, identifying the material facts, the key issues, and relevant routines that fit the area of environmental planning.


Assessment and allocation of resources
Survey
Sample Public opinion on use and adequacy of facility
Analysis
Determine physical condition, appearance, relationship to site, do an inventory and go round the area for thorough observation
Identification of needs and formulation of Goals and Objectives
Evaluate ability to adequately serve its function
Proposal and Alternatives
Compare with Standard
Evaluation and choice of best alternative
Determine deficiencies
Recommend improvement
Implementation

3.2 Planning Requirements for Community Facilities

The following planning requirements are essential in the location of community facilities. They are discipline, system sizing, design parameters and cost.

a. Discipline

This identifies who is being planned for and also who is responsible for the provision of the facility. Largely, we plan for the people and government in most cases is responsible for the provision of facility. In planning the facility therefore, the people that make up the area must first be considered. What is considered about the people are their demographic structure, which ~~that~~ is the population dynamics, sex and age structure and the economic base. Also considered are the employment structure and dynamics and lastly the pattern of settlement.

b. System Sizing and Design Parameters

The three factors that must be considered here are:

(a) The Ultimate Extent of Service Area: Here we consider the geographic area or spatial area the facility is expected to cover.

Also the number of the years that the facility is expected to provide optimum services is considered.

(b) The Ultimate Area Service Population: The present and the expected total population the facility is to serve are considered. Also considered are the population structure and dynamics as well as the expected demand changes.

(c) The Project Per Capital Service Level requirement: Here we consider socio-economic changes and prospects of the people, changes in social and economic values such as changes in incomes, occupation and etc. of the individuals or groups can largely influence the planning of facilities. A rise in the per capital income of people would mean a change in their tastes and preferences.

c. Cost

Cost is a vial instrument in the planning and location of any facility. Costs considered area; cost of development, future operating cost and replacement cost.

(a) Cost of Development: This is the actual cost required for the provision of the facility. These include the cost of buying the materials locally or cost of importation of the materials, amount spent on technical knowledge, inform of training of local people, labour, and cost of construction.

(b) Future Operating Cost: This include the cost of running the facility in terms of the materials, personnel, and the general length of time that a facility would be used before replacement.

(c) Replacement Cost: These include the technology required for replacement and the cost of meeting frequent breakdowns.

Generally there are three types of costs that are expected to be borne by the people in the provision of community facilities; these are economic cost, physical cost and social cost.

1. Economic Cost: This refers to the economic implication of the provision of facilities. Usually, the resources used in the provision of facilities come from the state. These resources are partly from the taxpayer, therefore how much is required for the location of a facility vis-à-vis the effect on the resources of the state and the burden on taxpayer is considered under economic cost.
2. Physical Cost: This is the cost of altering the stability of the physical environment. In other words we must count the cost of damage done to the soil, vegetation, water and even air in the provision of a facility.
3. Social Cost: Social cost involves that cost that is imposed on the individual and the community in the process of providing the facility. For example, the inability to use a road because of the construction of underground channel or the disruption of water flow due to the construction of roads is counted as social cost. When a community shrine is made to give way for the construction of a good road, it can be counted as social cost on the community.

The location of these services either at the neighborhood or community level requires easy accessibility and adequate space (land) allocation.

3.3 Factors Determining the Location of Service Facilities in Urban Areas

a. Demographic Factor

The demographic factors considered in the location of urban facility include the total population of the urban area, the structure of that population, its age and sex structure, birth and death rate, dependency ratios, net migration, rate of urbanisz~~z~~ation and etc. these could determine the type and

the amount of facility to be located. In the location of health and educational facilities for instance, what must be considered are the total population size and its ~~their~~ distribution. This will enable the planners to know the exact numbers of such faculties needed and where they should be located. Also with the understanding of the age and sex structure, it becomes very easy to know the type of facilities to be located. Generally there are the infants (less than 1 year) and adolescents (10-14 years)~~of between 0-4 and 0-19 years~~, there are the adults of between 14~~5~~-59 and 15-64 years and there are the aged of 60 or 65 years and above. In the location of facilities, if the population of the urban area constitute more infants and adolescents , if the population of the urban area constitute more infants and adolescents, it would mean that certain basic facilities needed for the development of youths may be located, for example childcare centres, nursery and primary schools.

The sex structure determines the composition of male and female population. If more females constitute the urban population female oriented facilities such as maternity homes, children hospital, skill acquisition and women centres may be located.

b. Accessibility Factor

Accessibility is considered vital i~~I~~n the location of public facilities. ~~, accessibility must be considered.~~ According to Moseley (1979), accessibility is the ease with which people in an area obtain or reach necessary services. Accessibility is the major factor that determines the size and extent of interaction between dwellers and facilities. The physical dimension of accessibility should be the major concern of the planner, this is meant by the position, time and spatial distance that separate the individual from the facility. Accessibility depends on the individual capacity to incurred movement cost in term of transport cost, or the cost of using his time.

Facilities must therefore be located in such a way that minimum distance would separate the facility from the intended users.

c. Economic Considerations

This consideration includes the general economy of the area, the occupation, incomes, financial cost of materials and provision, the distributive system and the technology. Essentially any urban facility to be located must be financed by the provider. If the government, which provides most of the urban facility, is not financially buoyant, then some needed facilities are not likely to be located. For example there are some facilities that are beyond the finances of the local government e.g. telephone services and hospitals. The cost of provision, maintenance and continuous service of these facilities is borne by the people. A very weak economy obviously would not be able to pay for or sustain ~~for~~ certain services. This may amount to these facility not located in certain areas or may be located in fewer numbers.

To a large extent, the location of certain facilities in an urban area would depend on the income and occupation of the people. Urban centres with mainly secondary and tertiary activities and with high incomes, would attract a good number and types of specialized facilities.

d. Political Consideration

The political arrangement of an area determines to a great extent the ease and convenient with which services are located and administered for the overall welfare, growth and development of the populace. In this regard we may wish to determine or establish whether it is decentralized, secular or fragmented. We may also wish to determine and establish whether the political arrangement is dictatorial or democratic. These differences could influences the ease with which policies on urban facility location can be

made and implemented. The political consideration may also do with the intentions of the government of the day. When the plight of the people is upper most in their minds, then the location of facilities becomes easy. Also political stability and administrative processes are essential in the location of urban facilities.

e. Physical and Environmental Factors

In the location of a city in the urban, the physical and environment factors that must be considered include the topography of the area, soil, climate, land and vegetation. Urban areas with very bad terrain or undulating relief may become difficult for the location of facilities. The difficulty may be in terms of cost of provision. Except the provider has the financial resources or the technology to overcome the imposing constraint, otherwise such areas may either avoided. Soil is another factor that may be considered. Marshy soil or flooded land areas may not be a good choice for the location of urban facilities.

f. Expected Attendance Pattern

Patronage is a very vital factor in the location of urban faculties. It refers to the number of people ready and willing to use a facility this depends on the nature of the facility, the population, location and accessibility. If the nature of a facility is that which the people desire, for example, schools, hospital and maternity~~'s~~, it is expected that attendance would be high. Also the population of the area can determine the level of patronage of a facility. I~~f~~ the population is large, there is certainly going to be good patronage. For instance, if the population of children ~~infants~~ and adolescents is large in an area, it is sure to favour the location of nursery, primary and secondary schools. The other factors is accessibility. If the area of choice of location is that which is too far away from the population or on a rugged terrain, this may affect accessibility and hence the level of patronage.

3.4 Location of Service Centres in Urban areas

Urban areas serve as areas for the location of services. Such services include; The location for service centres can be in any one or more of the following urban areas:

A schoolsnursery school, primary school, shopping malls, centre or markets, a number of retail shops, at good locations, neighbourhood parks, for informal outdoor locations, health centres, places of worship, post officesal agency, banks, insurance companies, police stations, post offices, service industries, libraries and etc. y and any other places in and around the urban centre. There is the a need to properly plan for the location of these service centres in order to have a sustainable environment devoid of diseases, traffic and other related problems in urban areas.

4.0 Conclusion

In this unit, we have looked at the way in which community facility plans are prepared. Also, the requirements and factors necessary for urban facility plan. The essence is that this knowledge will help to manage waste, pollution, soil erosion, drought and desertification and all other ecological problems confronting any modern society.

5.0 Summary

Community facility plan entails putting people in sensitive positions so as to determine what they want. Genuine regards for their feelings will help in the development of community facility plan. Also, the requirements for community facilities are dDiscipline, system sizing and design, and cost. On the other hand, the factors that determine the location of community facilities are demographic, accessibility, economic, political, physical and environmental factors.

6.0 Tutor Marked Assignment

1. Explain the process for preparing a community facility plan.

2. List and explain the factors that determine the location of community facility plans.

Self-study exercise

Why do we need Community Facility plan?

7.0 References

Basorun, J.O. (2004). *Basic Elements of Urban and Regional Planning.* Shalom Publishers. Akure, Ondo State.

Ojeifo, O.M. (2005). *Elements of Planning and Design.* **Donald Publishers**. Benin, Benin City.

Unit 4: Urbanisation and Environment

1.0 Introduction
2.0 Objectives
3.0 Main Body
3.1 Factors that can lead to the location of settlement
[3.2] Urbanisation and Environmental Quality
3.2[3.3] Urban Renewal Strategies
3.3[3.4] Housing
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References

1.0 Introduction

The economic activities that are located in a place goes a long way to determine their potentials. These economic activities range from commerce,

education, entertainment, personal service and professions. The difference between a hamlet~~band~~, village, town and a city is based on the main ~~available~~ economic activities of an area. For detailed knowledge of the difference between hamlet~~land~~, village, town and city, students are advised to see module one of this course.

2.0 Objectives

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

iv. Factors that have led to the growth of settlements
v. Urbanization and Environmental quality
vi. Urban renewal strategies
vii. Qualities of good housing.

3.0 Main Body

3.1 Location of Settlements

A close look at the towns and cities reveal that they have certain advantages of site and position which have enabled them to grow. The site of a town or city is its topographical location. The following are some of the more favourable combinations of site and situation which have led to the establishment and growth of settlements.

i. **Fertile alluvial plain:** The basic requisite of human existence is food and water. A fertile alluvial plain traversed by rivers is the best for raising food crops and maintaining a secure water supply. A level plain also facilitates the movement of people and goods. It is an ideal situation for the exchange of products ideas.

ii. **A natural focus of routes:** These are the nodal towns. By virtue of their geographical location in relation to the region, many towns assume prominence as centers of road, rail, or water and communication. People congregate to provide commercial and social services that passing travelers

can make use of. Ibadan and Kano (both in Nigeria) owe much of their importance to their respective central locations in flourishing farming regions with trade routes both by rail and by road converging on them.

iii. Sites for generating hydroelectric power: Waterfalls are natural sites for generating hydroelectricity. Where such a site occurs, the availability of cheap power attracts industrial concerns. These require labour and provisions and a settlement is very likely to grow up, taking advantage of the cheap power. For example New Bussa which is close to Kainji Dam of Nigeria.

iv. Along Water Courses: Rivers and ~~By the side of Lakes:~~ Lakes provide fish, water and a means of inland transport. Some of the known tourist centers are located on or near lakes because of their scenic beauty and recreational facilities. Entebbe is a lakeside town of Lake Victoria in Uganda whose importance is further enhanced by its proximity to the capital, Kampala.

v. Mineral Sites~~weekly~~: Settlements have grown to considerable size purely because of the presence of minerals. For example, Jos, Enugu and Ajaokuta (Nigeria) owe their development and growth to Tin, Coal and Iron Ore respectively. The discovery minerals in certain locations have led to the growth of a number of towns all over the world. ~~grew as a result of the discovery of tin on the Jos Plateau.~~

vi. Good site for defense: This was a deciding factor in ancient times when defensive strategy, executed at the right moment, could save the whole community. Some of the older towns that grew up with defensive sites include Penj~~k~~ing, the ancient and present capital of China. Ibadan the administrative capital of Oyo State in ~~(~~Nigeria~~)~~ is sited on seven hills which provided protection for the early settlers during the years of Yoruba warfare of the eighteen and nineteenth centuries.

vii. Urbanisation and its Dynamics

Urbanisation is the increase over time in the population of cities in relation to the region's rural population. In terms of place, urbanisation means increased spatial scale and/or density of settlement and/or business and other activities in the area over time. The process could occur either as natural expansion of the existing population, the transformation of peripheral population from rural to urban, incoming migration or a combination of these. Historically, urbanisation is closely associated with industrialisation. When more and more inanimate sources of energy were use enhance lump productivity (industrialisation), surpluses resulted in both agriculture and industry.

viii. Reasons for Urbanisation

In 1800, only about 2 percent of the world's population lived in urban areas. The world's urban population has grown from 2 percent to nearly 50 percent of all people. The most striking example of urbanisation trend is United States of America. –In the United States, about 5 percent of the population lived in cities in 1800, but about 50 percent of the population lived in cities by 1920. Throughout the 19th century, the US was urbanising. Today, about 80 percent of the US population live in cities and suburbs.

3.2 Urbanisation and Environmental Quality

Urbanisation has significantly improved the economic prospects and quality of life for a large and increasing proportion of the people of the area. Despite this benefit of urbanisation, many policy makers continue to view the cities/towns with concern. They cite the profound effect on cultural modifications, difficulty in maintaining public infrastructure and services, the proliferation of slums (informal settlement), worsening environmental

conditions, and increasing social problems associated with unemployment and underemployment. Details of some these effects are:

a. Distortion of the land use pattern: The rapid rate of urban population growth has remarkable effects on the pattern of land use within the urban centers in the country. Studies of pre-colonial land use pattern in traditional Nigerian cities for example indicate that there was harmony and orderliness, but modern growth says otherwise.

[b.] Urban solid waste management: One environmental feature associated with rapid urbanisz~~z~~ation is the rising volume of solid wastes generated in the urban areas. Although comprehensive studies of the nature of solid wastes in Nigerian cities have not been undertaken, there is evidence that the volume has been quite high in the major urban centers.~~.~~ In the urban centers in Nigeria, heaps of garbage at almost every busy junction are ~~is a~~ **common s**ightsi~~te~~**. Th**ere ~~is~~ **is clear evidence that the rate of urban solid waste generation far exceeds the rate of waste** management~~evacuation.~~ **Accumulated waste is a major public health issue and a vital factor affecting the quality of the environment.**

[c.] Urban transportation: Modern forms of transportation are associated with urban growth in Nigeria. In fact, the rapid development of some urban centers such as Lagos, Port-Harcourt, Kaduna, and Aba to mention but a few, **is explained largely by their strategic location with respect to modern means of air, water, rail** and- road~~land~~ **transport**ion**. Transportation within urban areas and between them and other towns and cities in Nigeria have remarkable environmental implications for urban dwellers.**

———One major means of modern transport with remarkable impact on the urban environmental in Nigeria is road transport (motor vehicle). One of the primary sources of environmental problems associated with motor vehicle transportation in most urban areas relates to unavailability of good road network. This has led to motor vehicle traffic concentrated on the few available roads and the resulting traffic jam that has seriously contributed to the deteriorating urban physical environment of most large cities. Another source of urban environmental deterioration associated with the motor vehicle transportation especially in Nigeria is the haphazard parking of vehicle along the few major roads in the urban centers and the parking of vehicles on sidewalks and pedestrian crossing. Another visible problem occasioned by motor vehicle transport is the littering of virtually any available space by unserviceable and accident (junk) vehicles.

[d.] Urban air quality: Air pollution has been regarded as a problem associated with urban centers especially in advanced and developing countries where the level of industrialiszation is quite high. Generally most air pollution in urban areas comes from the combustion of fossil fuels, in industrial process, for heating and electricity generation and by motor vehicles. High levels of air pollution have serious health implications for man. For example, high levels of carbon monoxide have the potential of causing oxygen starvation and if prolonged may result to death.

[e.] Urban water quality: Adequate and clean water supply for drinking, personal hygiene and other domestic purposes is essential to public health and wellbeing. Urban sources of water include springs, streams, hand-dug wells, borehole, rainwater from roots of buildings using pots and other

containers. In Nigeria for example, rapid urban growth, increasing economic and technological development and social change have brought so much pressure on the available source of water supply. As a result water supplies are irregular and unreliable, and people are forced to resort to collect water from unclean sources such as po~~u~~nds. The health implications of using polluted water are quite obvious. Water related diseases such as dysentery. Cholera, typhoid, guinea worm and bilharzias common in Nigeria.

[f.] Urban environmental noise: Noise as an urban environmental nuisance is largely associated with the increasing pace of social change and industrialization. Indiscrimin**ate blasting of motor vehicle horns, the use of gigantic loud speakers fixed to mosques and churches, mobile music record sellers, mobile advertisers, and indiscriminate increase in volume of household electronic gadgets are major sources of environmental noise. The overall effects of the combination of these sources of urban noise have been the emergence of noise pollution in most centers especially in developing countries such as Nigeria. The health impact of noise on urban inhabitants is now being given more serious attention and its effects range** from **stress** to ~~and~~ **loss of hearing.**

[g.] Urban flood and environmental quality: In rapidly urbanis~~z~~**ing cities such as Port Harcourt and Lagos, flood and flash floods are common sights. The intensity of flood**-related ~~-~~**problem**s **over time and space in Nigerian urban cent**res~~ers~~ are ~~is~~ **closely related to the rapid rate of urban expansion, especially where the provision for an adequate urban water runoff system is lacking and if available, it is usually blocked by solid waste. Urban flood results in disasters such as structural and**

erosional damage, disruption of socioeconomic activities, transport, communications, loss of lives and property, displacement of people and destruction of the urban environment in general.

[h.] Loss of sense of communal livelihood~~ity:~~: In urban centers, there is a loss of a sense of community. In many places, people stay within their homes and do not routinely walk through the neighbourhood. This pattern of behaviour reduces human interactions, isolates people from their neighbours and greatly reduces the sense of community.

[i.] Loss of open space: One of the important features of a pleasing urban landscape is the presence of open space for recreation**. Open fields and parks allow people to visually escape from the congestion of the city. Urbani~~s~~zation has consequently taken up all available spaces for the purpose of development.**

3.3 Urban Renewal Strategies

The challenge of urban environmental management in developing countries during the coming decades will be enormous with the continuing urban population growth. Nigeria as a developing country, needs a sound philosophy of environmental management in the urban centres located in various states. Such a philosophy should aim at the radical redirection of the pattern of urban growth as well as the creation of an urban environment which satisfies basic human needs and values.

a. Development of efficient public transportation system: One major source of urban air pollution is automobiles. A situation where an individual car with its single occupant going to work,

to shop or to eat a meal, is a constant source of air pollution in the urban centres. However, this source of air pollution can be reduced through the provision of an efficient public transportation system. This can be achieved through the provision of major urban mass transit systems such as buses, good road network and railways.

b. Utilization of the low-cost, non-polluting energy sources: One of the major sources of atmospheric turbidity is vehicular emissions and domestic sources. To reduce the release of atmospheric pollutants from these sources, people should be encouraged to walk or use small, low-speed energy efficient vehicles such as bicycles, motorized tricycles, etc. for local trips. Also, efficient energy sources such as natural gas should be used at the domestic levels.

c. Urban solid wastes management: The challenge of urban solid wastes disposal in urban centers is enormous in view of the continuing rapid rate of urban population growth. The basic problem in urban solid wastes management in developing countries today is that solid wastes are generated faster than they can be satisfactorily disposed of. Two major policy issues that can be employed in solving this problem are: the development of an institutional framework for solid wastes disposal and the application of reuse and recycling technology. Such institutional framework should involve:

(i) ~~(i)~~ **involvement of federal authority in urban solid waste management,**

(ii) ~~(ii)~~ **construction of a sanitary landfill for the disposal and management of such wastes,**

(iii) ~~(iii)~~ **involvement of local communities in solid wastes management and**

(iv) ~~(iv)~~ **the introduction of user-charge payment.**

[d.] Controlled rural-urban migration: Urbanis~~z~~**ation is associated with industriali**s~~z~~**ation and the creation of employment opportunities in the urban centres. Consequently, people move to the cities where they believe there are better opportunities for employment and better living conditions. With the present situation, rural-urban migration will continue to increase in Nigeria except an effect is made to improve conditions in the rural areas. In this respect, a programme of integrated rural development should be adopted and implemented. Two major issues should be emphasized in any programme of integrated rural development. The first relates to the importance of encouraging the development of medium-size towns in rural areas to facilitate the distribution of social amenities to rural dwellers. A second policy issue in integrated rural development is in the need of improving the income of rural dwellers through major investments in agricultural modernization, including mechanization, cooperative land tenure reforms, the provision of credit facilities to farmers, and use of fertilizers.**

d.[e.] Upgrading of slums and squatter settlements: To date, very little attention has been paid by public authorities to the problems of improving the environment of the low quality residential areas in urban centres. A large proportion of the housing in the identified slums can be improved byre-roofing, enlarging windows, painting, landscaping and introducing better air circulation and sanitation. The worst part of the slum areas could be cleared to provide space for roads, schools, markets, open space and **etc.**

e.[f.] Urban land use management: The present patterns of land ownership and land transfer in Nigeria's major cities are grossly unsuitable for proper urban development and land use control. In major urban centres in Nigeria, land is associated with individuals and groups of families rather than the community at large. This system of land ownership subjects properly developers to carry out uncoordinated land development in the cities. A major urban land policy option in this regard relates to the effective implementation of the Land Use Act of 1978 which vested the ownership of all land in public authorities.

f.[g.] Participatory approaches: Development approaches in the last two decades in the world have moved from top-down strategy to bottom-up approaches. This is concerned with the need to involve local community institutions and individuals in routine management decisions that affect them. Citizen participation is an essential element in solving urban environmental problems because they are direct receivers of environmental problems and generators of urban wastes.

h. **Environmental education:** The single most important activity that will enhance environmental management and sustainable development in the medium to long term, is to raise well-informed future generations with a strong commitment to sustained management of natural resources. Thus, environmental education should be an integral component of the formal and informal education system. A comprehensive programme of environmental education and awareness to provide people with information on the nature of Nigeria's urban environment, sources and causes of environmental pollution as well as the implications of some attitudes to the

environment should be developed. Information on the environment may be communicated.

3.4 Housing

The Universal Declaration of Human Rights Article 25 states that “everyone has the right to standard and adequate living conditions, health and wellbeing of himself and of his family including housing”. Suitable shelter is commonly accepted as a basic human need. A house is a building or structure, which is made up of a room or group of rooms for the purpose of living or sleeping by human occupants.

3.4.1. Quantities of Good Housing

Any housing unit, which is intended for use of living, sleeping, cooking and eating must meet the minimum standards. ~~An example of a good house is shown *fig. 9.5.*~~ This is because good housing conditions create a foundation for healthy, social, economic and political development. The following are the minimum conditions that a housing unit must possess:

a. Sanitary services: Every good house should have adequate sanitary services such as toilets, bathrooms and cooking space. The importance of such sanitary services cannot be overemphasized. Good toilets such as water.

Hydrologic drought: This is defined in terms of reduction of stream flow, reduction in lake or reservoir storage and lowering of ground water levels.

Water management drought: This type of drought is defined by water supply shortages caused by the failure of water management practices or facilities such as an integrated water supply system and surface or subsurface storage to bridge normal or abnormal dry periods and equalize the water supply throughout the year.

In addition C. W. Thornthwaite, the eminent applied climatologist whose pioneering water balance studies made a major contribution to the understanding of aridity, recognized four types of drought, defined in terms of agricultural requirements. These are:

Permanent drought: Here there is insufficient moisture for anything but the xerophytic plants which have adapted to the arid environment. However, crops can be produced in such areas, but only at great expense or under exceptional circumstances.

Seasonal drought: Arid conditions prevail for part of the year, but are balanced by a distinct wet season. Much of India, the Sahel and the southern parts of Africa experience such seasonal drought. Agriculture is carried out often very successfully during the wet season and even during the dry season if the moisture from the preceding rainy season can be retained.

Contingent drought: There is adequate supply of moisture to meet crop needs. However, irregular and variable precipitation is characteristic of contingent drought and serious agricultural problems arise because the agricultural system is not set to cope with unpredictable and lengthy periods of inadequate precipitation.

Invisible drought: Here crops appear to be growing well, even to the experienced observer, and there is no obvious lack of precipitation. However, moisture requirements are not being met, the crop is not growing at its optimum rate and potential yield from the land is reduced. The effects of invisible drought can only be identified using sophisticated instrumentation and statistical techniques. Invisible drought can be dealt with relatively easily by irrigation. In Eastern Britain, for example, supplementary moisture has been supplied to sugar beet and potato crops since at least the late 1950s to deal with that problem. Also in Northern

Nigeria irrigation is commonly and extensively practiced in their agricultural system.

4.0 Conclusion

In this unit, we have knowledge of the factors that can lead to the emergence of settlements which require planning, the quality of an environment, strategies for urban renewal and housing quality requirements. All these require proper planning in order to have a sustainable environmental quality.

5.0 Summary

The factors that can lead to the growth of settlements are: fertile soil, natural routes systems, sites for generating hydroelectricity, presence of minerals and so on. Also, distortion of land use pattern, slums, wastes, transportation, pollution of air, water and land, flood and loss of open space are discussed as factors of environmental quality. Factors of urban renewal strategies include: use of nonpolluting energy like solar, development of efficient transport, proper waste management, controlled rural-urban migration and so on. And quality housing which include provision of good sanitary service, good ventilation, basic facilities at home and use of quality materials.

6.0 Tutor Marked Assignment

A. What is a settlement? Discuss the conditions that promote location of settlements.
B. List and discuss the possible strategies that can be used to manage urban environment.

7.0 References

Basorun, J.O. (2004). *Basic Elements of Urban and Regional Planning.* Shalom Publishers. Akure, Ondo State.

MODULE THREE: SOLID WASTE

UNIT 1: Types of Solid Waste

UNIT 2: Solid Waste Management

UNIT3: Causes of Solid Waste Pollution

UNIT 4: Disposal Methods of Solid Waste

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Unit 1: Types of Solid Waste

1.0 Introduction*
2.0 Objectives
3.0 Main Body
3.1 Classification of solid wastes
[3.2] Types of solid Wastes
4.0 Conclusion

5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References

1.0 Introduction

Waste is anything which is no longer relevant to the disposer. Waste could also be defined as unavoidable material which results from an activity without immediate economic demand and which must be disposed. Wastes are normally classified into three which are: solid waste, liquid waste and gaseous waste. Liquid wastes are effluents from industrial activities, domestic liquid, acid waste and waste oil from workshops. On the other hand, gaseous wastes are waste substances like air. They are neither liquid nor solid that move freely to fill any available space in the atmosphere. Examples of gaseous wastes are waste from gas flaring, particulate dust, cement factories, quarrying and cigarette fumes.

Solid waste, which is the focus of this module, is defined as the non-gaseous and non-liquid waste resulting from the activities of the inhabitants of a particular residential area. The activities of man on domestic, commercial and industrial processes give rise to undesirable effects on land, sea, air and water which are pollutants of all kinds. The term solid waste includes all those solid and semi-solid materials that are discarded through human activities. The solid waste generated through domestic and commercial activities is classified as municipal solid waste and it is also called refuse.

2.0 Objectives

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

i. **Know what solid waste is about**

ii. Class

~~Class~~ify solid waste

iii. Identify ~~Determine~~ **the different types of solid waste**

3.0 Main Body

3.1. Classification of Solid waste

Solid waste can be classified based on a number of factors. On the basis of physical property, wastes can be classified using parameters such as combustibility and degradability. There are biodegradable wastes like agricultural wastes. These are materials that are broken down overtime by the action of micro-organisms such as aerobic and anaerobic bacteria. Non-degradable wastes are materials that are not broken down by biological processes and thus persist for a long time in the medium in which they are disposed. Examples are mining and mineral wastes, plastics and bottles.

On the basis of utility, wastes can also be classified as re-useable (recyclable or convertible) and non-reusable ones. On the basis of environmental risk, solid wastes have been classified according to the risk or danger they pose to man, the fauna and flora. Such wastes may be lethal of medium risk, toxic or hazardous. There are also non-toxic and non-hazardous wastes. The indiscriminate disposal and dumping of industrial, commercial and household wastes such as food waste, paper, polythene, textiles, scrap metals, glasses, wood and plastic on street corners and gutter is still very common in Nigerian cities

3.2 Types of Solid Waste in Nigeria

In Nigeria**,** we have different types of solid waste. The most common ones are discussed in the preceding paragraphs:

a. Municipal solid wastes: In Nigeria, municipal domestic solid wastes have heavy content of food waste, leaves, polythene,

rags, tin and bottles. It is important to mention here that the composition of domestic waste in Nigeria varies from season to season and from the food items in great demand. For example, between March and April (the peak of mango harvest) solid wastes in Nigeria urban centers have high content of mango seeds and fruits. But between May and August (season of maize and pear) domestic wastes in urban centers have high composition of leaves mainly from corn cobs.

b. Industrial solid wastes: These include cartons, boxes, building materials, crates, woods and celluloid materials, chemical wastes such alcohol, organic acids, fats and oils of vegetal and animal origins, materials containing ammonia, phosphates, nitrates (these are inorganic substance). Industrial wastes may be hazardous and non-hazardous wastes.

c. Agricultural Solid Wastes: In Nigeria most urban centers perform agricultural functions. Consequently, waste from animal manure, crop residues like thrashing of grains, cassava tuber peels and various by products of food production like the extracting of palm kernel oil can generate a lot of solid waste that find their way to urban solid waste depots.

d. Mining and mineral wastes: Mining waste include earth rocks, sand, salt, discarded equipment that result from ore processing and mineral refining plants like slag, ash and mine water.

e. Construction and demolition wastes: These are generated from building, civil and Mechanical engineering activities. Construction waste consists of unwanted material produced directly or incidentally by the construction of industries. This includes building materials such as roads, insulation, electrical wiring, tree trumps and rubbles. Construction waste may also include lead, asbestos or other hazardous substances. Others

are wood damaged or unused materials, bricks and concrete. Observational research has shown that this can be as high as 10 to 15% of the materials that go into a building, a much higher percentage than the 2.5-5% usually assumed by quantity surveyor and the construction industry.

Certain components of construction waste are toxic when they decompose in landfill because the leachates in them can cause toxic gas toxic gas because of the hydrogen sulphide which they contain.

[f.] Biomedical ~~Healthcare~~ wastes: One type of solid waste that is not often talked about in Nigeria is hospital waste. Though it is least discussed, it is one of the most hazardous because of the increasing number of public and private clinics. These are wastes from dispensaries, laboratories, clinics, hospitals, nursing homes for the elderly and blood banks. Wastes from hospitals are contaminated materials like bandages, sharp objects like syringes, disposable scalpels, blades and expired drugs.

~~Heath care wastes also include biomedical wastes.~~ The infectious and biomedical wastes from hospitals and nursing homes, although are supposed to be collected and disposed ~~off~~of separately and not mixed with the municipal solid wastes, yet they continue to form part of the municipal waste that are generated in Nigeria. Biomedical wastes are highly infectious and contain a lot of pathogens making these wastes to be hazardous to the soil, air, land and the atmosphere. The polluted soil will again transmit the contaminants to the vegetation that will grow in them which can cause disease to animals and human beings that may have needs for them.

f.[g.] Radioactive (Nuclear) wastes: These wastes emit neutrons, alpha, beta or gamma radiation as result of nuclear decay. Also

included here are exhaustible fumes of cars, machinery, chimney, generation plants, bombs and missiles.

g.[h.] Human and animal wastes: These include excreta, animal dung or droppings, dead human beings and animals.

4.0 Conclusion

As the population of human beings continue to increase coupled with increased human activities, , there is bound to be increase in the amount of solid waste been generated. The classification of these wastes is important so as to meet sustainable development. This is why we have examined the different types of solid waste in this unit.

5.0[4.0] Summary

The different types of solid waste range from hospital waste, mining waste, agricultural waste and so on. The classification can be based on physical, chemical and biological wastes which are degradable and non-degradable.

6.0 **Tutor Marked Assessment**

1. List and discuss, the different types of solid waste generated in Nigeria.

2. Cclassify solid wastes on the basis of the refuse that are generated domestically

7.0 References

Ajith Sankar, R. N. (2015). *Environmental Management*. Oxford University Press. India.

Akpofure, R. (2009). *Environmental Science: An Introduction*. Kraft Publishes. Delta State Nigeria.

Nigeria Institute of Safety Professionals (2003). *Contractor Employee HSE Training Manual.* Level 3 Published by ECNEL Ltd. Port Harcourt.

1.0 Introduction
2.0 Objectives
3.0 Main Body
3.1 **Management of Urban Solid Waste in Nigeria**
3.2 Impact of poor solid waste management
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References

1.0 Introduction

The management of solid waste requires a holistic approach. These wastes are movable objects which the user is ready to dispose off. Solid waste management simply refers to the collection, transfer, treatment, recycling, resource recovery and disposal of solid waste generated.

2.0 Objectives

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

h.[i.] **Suggest the best ways to manage solid waste**
ii.[i.] **The impact of solid waste**
iii.[ii.] The problems of solid waste management

3.0 Main Body

3.1 -Management of Urban Solid Waste in Nigeria

It must be re-emphasized that the volume of solid waste generated does not invariably measure the degree to which the environment or ground water resources will be polluted. Thus if the waste can be evacuated and disposed off satisfactorily and as fast as it is generated and collected, there would be no accumulation and hence no insult, abuse and pollution. It is when evacuation and disposal perpetually lag behind the rate of generation that

solid waste becomes an environmental nuisance. Solid waste management therefore concerns the interplay among generation, storage, presentation, collection and disposal. Though, if not well disposed off can as well as contaminated groundwater resources. no matter how far the wastes are taken to from the city center.

There are two broad systems of solid waste management, namely public and private, the former being the more conventional and traditional. In the public solid waste management system, the waste disposal unit seems to have been the most common arrangement varieties of which have at different times been established. Usually the waste disposal unit is established at the Llocal Government Area council level as an operational section of the Hhealth Ddepartment. Operationally, the unit is responsible for locating public garbage collection depots in different parts of Nigeria where residents dump their solid wastes. However, this arrangement is no longer too functional.

Apparently, in realiszation of the problems and non-performance of Waste Disposal Units in the Llocal Government Areas, councils, solid waste disposal units regarding urban environmental management, the Ministry of Environment is charged with the responsibility of waste management and disposal. In many states in Nigeria, Ministries of Simply because of the fact that the ministry of Environment and Environmental Protection Agencies/BoardsWaste Management Board cannot really meet its statutory obligation as a result of shortage of equipment, funds and personnel. In many states, sSolid waste management and disposal is being contracted out to private companies to join hands with or under the supervision of the Ministries ministry in order to meet the requirements of waste management..

There are four major differences between the public and private systems of waste disposal:

i. ~~in some states as revealed by this study.~~ **First, while the former is provided as an essential public social service, the latter is a contractual arrangement between a private firm, institution or establishment and the individual beneficiary—~~-~~—the refuse generator.**

ii. **Secondly, while in the public arrangement the service is free, the private organi~~s~~z~~z~~ation requires a user-charge.**

iii. **Thirdly, while the public arrangement is supposed to cover the whole area comprehensively or concentrate more where the rate of solid waste generation is higher, the spatial scope of private arrangements depends on affordability. Consequently, the private arrangement is restricted to the government Reservation Areas (GRA) and other medium and high income neighbourhood.**

iv. **Finally, while the public system relies more on the use of the depot as the mode of presenting solid waste for collection, the private system is organized on a house to house basis in places like Benin City in Edo State, The Federal Capital Territory, Abuja and some other states.**

Solid waste management is aimed at strategies ~~adopted~~ to adopt the 4rs of the use of wastes. These 4rs are reduce, reuse, recycling and restoration. Nigeria solid waste which is generated at the rate of about 0.4kg per head per day, is rich in organic matter amounting to between 60 and 80 per cent. Integrated waste management is now in vogue globally. While open dumping of solid waste is practiced all over the country, efforts are been made by the federal government to ensure other viable methods for hygienic disposal by legislation have not been widely achieved. Segregation, recycling, incineration, composting and waste to energy conversion are options that have been adopted. Among the efforts made by previous government in Nigeria in managing solid waste are: Pace Setter Organic

Fertilizer Plant in Ibadan, Oyo State, Forcados in Delta State owned by Shell Petroleum Development Corporation and managed by the appointed contractor, the Alesinloye market solid waste recycling complex in Ibadan is vested in Alesinloye Market traders association. In the early 1970's, Lagos State government acquired incinerators and never used them because of operational cost and inadequate technological knowhow. They were sold almost three decades later. Today, many state governors including Lagos State government have built incinerators, bought mixers, bBagging machines and other equipment required for the proper management of solid waste.

Strategies for solid waste management include:

a. Recycling: This is the process of minimiszing the generation of solid wastes by recovering usable products that might otherwise become waste. Examples are the recycling of plastics, aluminum cans, waste papers, bottles and tyres. The tyre companies have developed plants to recover carbon black gas, oils and other products by destructive distillation of old tyres. Recycling helps to conserve natural resources and eliminate wastages so as to attain sustainable development. Until recently in Nigeria, the emphasis has been on recovery and reuse which has now changed to recover and recycle. The change from reuse to recycle has occurred due to changing life style for healthy living and the attitudes of people to the kinds of products use. Of all the wide variety of recyclable materials that are generated in Nigeria, it is the steel or iron, paper and plastics that get the highest attention.

b. Reuse: Solid wastes can be directly utiliszed. Fly ash and bottom ash from industrial installations can be used as a cement substitute in concrete for dams, highways, and other major constructions. Municipal solid wastes can be used to produce heat or electricity during incineration. Biogas can

also be generated from waste which can be used as a source of energy. Used chemical containers can be returned to the manufacturer for refill.

c. Restoration: Restoration of used dump sites or landfill is key to the management of solid wastes in Nigeria. In some circumstances, valuable materials can be recovered from solid wastes, lessening disposal problems and financial costs. Groups of young men and women are always seen picking out materials that can be useful. Items that have had resale value include rags, newspapers,, cardboard, bottles, rubber, plastics, tin cans, some metals, glass, old radio sets and refrigerators and car scraps. This scavenging business is very unhygienic in nature in Nigeria.

d. Reduce: This is one of the most vital operations in solid waste management if the waste is to be safely and efficiently disposed of and efficient recovery, reuse and recycling are to be undertaken. It involves the reduction in the production of solid wastes by all the generators of the waste. Sseparation of wastes into their various kinds which may include newspaper, metals, plastics, wood, and glass may equally help in this regards.. It can be achieved mechanically or manually. For example, magnetic materials such as iron can be separated from non-magnetic materials by using magnet. In some organiszations, the process of segregation is aided by the provision of coloured bins to reduce the amount of solid wastes so generated. Yellow coloured bin can be used for the collection of special waste such as medical waste and electronic waste, blue bin can be used for the collection of recyclable waste, and green coloured bin used for the collection of domestic wastes. Solid wastes can be greatly reduced if households and producers minimize the use of certain resources. For example, households can reduce the use of non-reusable polythene bags to re-usable and recyclable ones. Producers can as well reduce wastes so generated by adopting various greener production processes including reduction in their packaging so that paper wastes can be minimiszed

3.2[3.3] Impact of Poor Solid Waste Management

The challenge of urban solid waste management are enormous. The volume of solid waste that are visible in our towns and cities today emitting odour and causing aesthetic nuisance is a measure of the extent of failure of the current practice. The environmental effects of poor solid waste management are enumerated below:

Flooding: Solid waste such as refuse can cause serious problem of flooding especially when discharged into drains. It is a common practice in most parts of the country especially developed areas for people to dump refuse into drains whenever it rain. This is done without recourse to what such an action will cause to the people at the low land areas.

Effects on aesthetics: Solid waste such as heaps of refuse scraps and garbage are unsightly. They destroy the beauty of our towns and cities.

Effect on land use: Solid wastes of all kinds occupy land space and hence obstruct land use for farming, recreation, transportation and so on.

Effect on health: The disposal of solid waste can have a long time effect on people. The practice can cause diseases such as cholera, rashes, pollutes water bodies, dysentery, hepatitis and so on. There is a direct link between poor urban solid waste management and public health especially in terms of water related diseases.

Effects on aquatics: When solid wastes are discarded into water bodies such as streams, rivers, lakes and even ocean, it can result into the death of animals. This is because the quality and ~~potability~~portability of the water would have been infringed upon by the wastes.

Effect on transportation. Solid waste most times do cause traffic jam in our towns and cities

.

3.4. Problems of Solid Waste Management

The problems of solid waste management are:

iv.[iii.] Lack of waste data so as to be able to know the record of the amount and type of solid waste been generated.

[iv.] Poor solid waste disposal option is also common in both the urban and ~~non urban~~non-urban areas.

v. Lack of modern technology to manage solid waste

vi. Lack of unified rules and regulations. Even when they are present, the implementation of the laws is always a problem.

vii. Lack of awareness regarding the danger of indiscriminate disposal of solid waste. The traditional institution should be involved in this regard. This will make any available information to trickle down to the grass root properly.

[viii.] Neglect of informal sector like solid waste pickers and buyers. They remove good percentage of the municipal wastes that are generated. So, the work of scavengers should not be commoni~~z~~sed.

4.0 Conclusion

This unit has exposed us to the strategies for the management of solid waste, its impact and the challenges ~~problems~~ of solid waste management

5.0 Summary

To manage solid waste properly, we must put into consideration the 4Rs methods of solid waste management. These are~~.:~~ r~~R~~ecycl~~e~~~~ing~~, reuse, restoration and reduce. P~~The effects of p~~oor solid waste management ~~are on health hazard,~~ destr~~oys uction of~~ the beauty of our environment and ~~,~~ causes traffic crises, flooding and so on. The problem of solid waste

management are lack of ~~waste~~ data on waste, lack of enough disposal options, lack of awareness, lack of modern techniques and so on.

6.0 Tutor-Marked Assignment

1. Discuss the likely problems of solid waste management.
2. List and discuss the ~~best~~ ways of ~~to~~ managinge urban solid wastes.

7.0 References

Ajith Sankar, R. N. (2015). *Environmental Management*. Oxford University Press. India.

Akpofure, R. (2009). *Environmental Science: An Introduction*. Kraft Publishes. Delta State Nigeria.

Nigeria Institute of Safety Professionals (2003). *Contractor Employee HSE Training Manual.* Level 3 Published by ECNEL Ltd. Port Harcourt.

UNIT 3 Causes of Solid Waste Generation and Pollution

1.0. Introduction

There are many reasons for the huge generation and pollution of solid wastes in our towns and cities. The generation of these sometimes is inevitable because of our level of advancement in terms of education and the resources required to dispose off these solid waste so generated.

2.0. Objectives

By the end of this unit, you should be able ~~to provide answers~~ to~~: the following:~~

i. Mention reasons for ~~The reasons for~~ **the huge solid waste been generated in Nigeria**

ii. Understand the

The policies for solid waste management, and. And

iii. Know the The ways to implement the policies regarding solid waste management

3.0. Main Body

3.1 Causes of solid Waste Generation and Pollution

The main reasons for the huge generation and quantity of solid waste noticed in Nigeria today are due to:

(a) ***Over Population***: As the population of people generating wastes keeps increasing, the quantity of solid waste been generated will continue to increase. This is the main reason why the urban centers generate more solid waste than the towns or rural areas.

[(b)] ***Low Technology:*** This is the amount of pollution produced per unit of economic good. Rapidly growing technologies for most economic goods will result to a shift in technology from the returnable packaging to a non-returnable one which results to more solid wastes. Returnable bottles are today been replaced by non-returnable cans, bottles, paper board and plastic containers. Packaging is responsible for the huge volume of pollution of solid waste because packaging materials like plastics and cans are non-biodegradable and can persist in landfills for a long time. Plastics can be recycled to make new ones but recycled materials soon lose strength and then become susceptible to rain and winds.

[(c)] **Affluence is another cause of solid waste pollution**. This is the per capita consumption or production of goods and services. With

affluence, there is a tendency to declare items as been fashionable and not fashionable. The ones that are out of faction are thrown away to constitute part of solid waste.

(b)[(d)] **Poor enforcement of the rules and regulations** regarding solid waste is another factor that can increase solid waste pollution. The laws are there in every local, state and at the national levels but the implementation of the laws has always been the problem.

[(e)] ***Lack of ~~Creation of awareness is also very important~~***. Many people are not aware of the danger of depositing solid waste in unapproved dumps. Other factors are lack of waste data, poor waste disposal options and inefficient waste collection system.

3.2 Solid waste management policy and its implementation n Nigeria

The national waste management policy is embodied in the National Policy on the Environment (NPES formulated in 1989 and revised in 1999) and domiciled –in the Federal Ministry of Environment. The objectives of the policy as ~~ies formulated~~ culled from Federal Ministry of Environment include among others:

- **Study of the most reliable treatment systems that are appropriate for domestic and industrial wastes.**

—De

- ~~De~~sign and specify appropriate waste disposal and management systems that take into account the geological and environmental setting, encourage recycling and guarantee the safety of surface and underground water systems.

—S

- ~~S~~et up and enforce standards for sanitary facilities for the disposal of human and other solid wastes in dwellings, housing estates and public facilities in both urban and rural areas.

—E

- Establish monitoring programmes and stations or the control of the disposal of leachates from dump sites into surface and ground water systems.
- E
- Establish an early warning systems for the identification of potential waste disposal hazards.
- P
- Provide and utilized information on the appropriate methods and technologies for the treatment, reuse and disposal of waste.
- E
- Encourage source reduction, reuse, recycling of wastes and the recovery of valuable products from wastes (the 4rs)
- R
- Regulate, register and ~~licence~~license all major land based waste disposal sites.
- E
- Establish a mechanism for the identification and ~~clean up~~cleanup of abandoned land-based waste dumps.

The implementation of these waste polices in Nigeria is carried out by the Federal, State and Local Gg~~o~~overnment Aa~~r~~reas. At the federal level, it is the Federal Ministry of Environment, which took over from Federal Environmental Protection Agency (FEPA) in 1999. The law establishing the Federal Ministry of Environment focuses on three main principles: (a) precautionary principle or the pollution prevention pays principle, the polluter pays principle and the user pays principle.

The precautionary principle seeks to minimize the level of hazards to public health and to prevent or minimize to the barest minimum the damage that are done to the environment. It is a guiding principle of environmental policies enacted by the government. On the other hand, the polluter pays principle stressed that anyone who damages the environment should be

made to pay for the cost of such damages. This is applicable, where the polluters are identifiable and apprehended otherwise the public pays principle will apply. The public pays principle is the use of public funds to finance solid waste disposal and management. The user pays principles states that those who use environmental equipment and services must pay for the use of such services.

The policy of waste management can be found in (i) ~~the following decrees and guidelines –~~ Federal Government of Nigeria Decree 42 of 1988 makes it a criminal offence to trade in toxic wastes, (ii) ~~. Also, T~~the FEPA, National guidelines and standard for Environmental pollution control in Nigeria (March 1991). This is the main law that helps to monitor and control all forms of solid wastes in Nigeria, (iii) ~~.~~

~~Other related laws regarding solid wastes according to the Ministry of Environment (2012) are:~~ FEPA: Environmental Impact Assessment Decree 86 of 1992. The decree makes it compulsory for any major development project to undergo Environmental Impact Assessment (EIA) (iv) ~~. Also,~~ Environmental Audit Report (EAR) is required for ~~which compel~~ all facilities in operation every three or two years as the case may be. ~~to make available to the Federal Ministry of Environment an environmental audit report regularly every three years for some specified facilities and two years for other facilities that treat hazardous materials.~~ (v) FEPA: Waste Management Regulations of 1991. This regulates the collection, treatment and disposal of solid and hazardous wastes from municipal and industrial sources, and (vi) ~~. And~~ FEPA: Pollution Abatement in Industries and F~~f~~acilities G~~g~~enerating W~~w~~astes. Regulations S.1.9.of 1991 imposes ~~. These regulations impose~~ restrictions on the release of toxic substances so that permissible level is not exceeded.

However, the states and the local governments are to collaborate with the ~~efforts of the~~ Federal government in the implementation of these policies.

They assist in the area of land provision, supervision of solid waste management bye-laws, mobilize grassroots participation in solid waste management and empower sanitary inspectors amongst others.

4.0. Conclusion

The main purpose of any law is to regulate anything that is not properly done or behaviour of people. Solid wastes policies should be properly adhered to in order to avoid solid wastes in our environment. This will help to take care of the factors that cause solid waste in our society.

5.0. Summary

The causes of solid waste are lack of awareness of the people, implementation of the laws regarding solid waste, poor technical knowhow and affluence. The laws or policies necessary for solid waste management include the provision and utilisation of information on the appropriate methods and technologies for the treatment, reuse and disposal of waste. Encourage source reduction, reuse, recycling of wastes and the recovery of valuable products from wastes (the 4r. Regulate, register and license all major land based waste disposal sites, establish a mechanism for the identification and clean-up of abandoned land-based waste dumps amongst others.

6.0. Tutor-Marked Assignment

1. List and discuss, the causes of solid wastes
2. Itemisze the policies regulating solid waste management and disposal in Nigeria

7.0. References

1. Akpofure, R. (2009). *Environmental Science: An Introduction*. Kraft Publishes. Delta State Nigeria.
2. Nigeria Institute of Safety Professionals (2003). *Contractor Employee HSE Training Manual.* Level 3 Published by ECNEL Ltd. Port Harcourt.

UNIT 4: Disposal Methods of Solid Waste

1.0 Introduction

In this unit, attention is mainly on the disposal methods of solid wastes. The nature and kind of a place determines the type of disposal method to be used. The ways to manage solid waste properly are also outline

2.0 Objectives

By the end of this unit, you should know:

- The methods of solid wastes disposal
- The best way to have a sustainable waste disposal
- The best way to advice agencies and government on how to dispose solid waste.

3.0 Main Body

3.1. Solid Waste Disposal Methods in Nigeria

The disposal of solid waste was not a serious issue before the 1960's as earlier pointed out. But as population kept eps increasing, vacant lands to assimilate solid wastes so generated became a major problem. Solid wastes disposal involves the collection, transportation and deposition of the wastes so generated. Solid wastes in Nigeria are collected from houses,, roads, streets, markets and from commercial buildings by the private or municipal sweepers and scavengers with bags and trucks or wheelbarrows. T, the wastes are later sold or discarded depends on the type of solid wastes involved. The choice of a site to dump the wastes is a matter of what is available than what is suitable. Most of the disposal options available in Nigeria for wastes include among others the following:.

i. **Open Dump Sitess:** Open dumps entail the disposal of solid waste along corners, markets, in burrowed pits or in drainage systems. Disposal in open

dump sites is the most commonly practiced method in Nigeria. Open dumps requires low investment, with low operating cost. Open dumps produce health hazards and air pollution problems and it is not an acceptable method of solid waste disposal (Akpofure, 2009). In Nigeria, dump sites are uncovered and used by virtually all wastes collectors. They can cause public health problems by encouraging the growth of bacteria-carrying flies and insects~~population~~, which can cause typhoid fever, cholera, dysentery, tuberculosis, skin diseases amongst others. Open dumps also results to high concentration of leachates as they are exposed to all forms of climatic elements which help to decompose them. The leachates from open dumps sites of solid waste can result into ground water contamination and the impoverishment of soil might also result due to high temperature of the soil.

ii. Composting Methods: Another good method of disposing solid in Nigeria is composting method. Composting of refuse is a biological method of decomposing solid wastes. This can be affected by aerobic or anaerobic condition or both. The end product is manure called compost or humus which is in a great demand in most advanced countries of the World for farming purpose. Composting is considered to be an aerobic process, because it involves piling up of refuse and its regular turning, either manually or by mechanical devices so as to ensure sufficient of air and oxygen during the decomposition by bacteria and fungi.

Composting requires sorting of solid waste into its organic and inorganic components. This can be achieved either at the source by the separate collections of garbage (organic waste) and trash (inorganic waste) or at the receiving facility by using magnetic separators to remove ferrous metal and magnetic separators to remove glass, aluminum and plastic materials. The remaining largely organic waste is grounded, mixed and bulky agents such as sewage sludge, wood chips, sawmills dust are then composted (Akpofure, 2009). Composting can be used for soil improvement. Compost can be rich in nutrient. It is used in garden, landscaping and for farming purpose.

iii. Sanitary landfill: This is a method that involves a carefully prepared land on which waste is spread in thin layers, compacted and covered with fresh layers of soil on a daily basis. The wastes are placed on landfill and are allowed to decompose. Sanitary landfills are land disposal sites for solid waste at which the waste is spread in layers and are compacted by heavy bulldozers before another layer is spread. When the refuse is 3m deep, it is covered by a thin layer of sand which is again compacted at the end of each operating day (Akpofure, 2009). If the sites of sanitary landfill are well sized, it has the advantage of reducing health hazards emanating from wastes. Also, public health problems are reduced and air pollution is minimi~~z~~ed. The main disadvantage of this system is contamination of ground water and even surface water in most cases, a~~.~~ ~~A~~nd it can as well affect the bacteriological activities within the crust of the earth.

iv. Encapsulation Method of Solid Waste disposal can also be used. This involves the use of plastics or concrete to package materials that are not readily degradable and buried in landfills or thrown into the sea. However, dumping them in seas is today being discouraged because of marine life present in the sea.

v. Incineration—. This is a method of waste disposal that involves the burning of refuse at high temperatures to leave ash. The ash produced amount to less of the original solid wastes volume which must still be properly disposed of~~f~~. Though this can result to air pollution, modern incinerators have been developed with air pollution control devices. In general incineration may be considered as an alternative method of treating some non-recoverable wastes. The most important thing is to ensure that the process is well managed. The possibility of recovery of raw materials is very small, although some scraps may be usable by the steel industry after incineration. In Nigeria, most of the dump sites are burnt during the dry season so as to reduce the quantity of solid waste, kill dangerous animals in

the waste especially reptiles, reduce the odour and help to kill bacteria in dump sites.



Burning of Refuse at Ikhueniro Dump Site in Benin City

~~Burning Refuse at Ikhueniro Dump Site in Benin City.~~

Ocean or sea dumping: This method is today highly discouraged. Cities like Lagos and those who live in riverine areas still dump their refuse in oceans and other water bodies. This practice should be discouraged as it can lead to the pollution of both surface and underground water bodies. Akpofure (2009) stressed that life began on the sea and also depends on the sea. Human activities should not lead to the death of the sea animals. The main disadvantages of this system is that the lighter and bulky parts of the refuse do not settle down, instead remains floating and tend to return to the shore especially at high tides. It can also lead to the destruction of the aesthetic nature of the sea.

vi. Underground disposal: This is a method of solid waste disposal that is very good to dispose certain hazardous wastes. There are some wastes that are very poisonous and dangerous to human existence on the earth's surface. Underground waste disposal may be economical and at the same

time environmentally friendly. In fact, disposal of solid waste is one of the major causes of ground water pollution in Nigeria. If the waste materials contains soluble products, they will infiltrate aand percolate the land thereby leading to ground water contamination.

vii. Communal Pit Disposal Option: The simplest solid waste disposal option is where consumers dispose waste directly into a communal pit. The size of this pit will depend on the population of the area. It is rapid to implement and requires little operation and maintenance. The main disadvantage is the danger it normally pose to the environment and the inhabitants. It is more or less for family use.

3.1 Urban Solid Waste Management: The Way Forward

Waste generation, handling and disposal are a daily event. The following suggestions will promote good management system of solid waste:

- Waste should be segregated at source before reuse, recycling, reduction and restored. The method of separation of these wastes make it easier for to manage for whatever purpose.
- The activities of scavengers or waste pickers should be encouraged and legalized
- Recycling plants should be established in all towns and cities.
- Documentation of the amount of solid waste generated is also very important.
- Construction of sanitary landfill is necessary
- Traditional institutions should be involved in the management and disposal of solid waste.

4.0 Conclusion

The proper disposal of solid waste is very important so as to have a sustainable waste management. Hence, we have looked at the different

methods of solid waste disposal and the way forward. Solid waste disposal is a problem in Nigeria with areas of heavy population concentration receiving the greatest impacts. The impacts are measured based on the accessibility to approved dump sites, the way of life of the people, preparation of the commonly consumed food items and location of markets in relation to drainages. The dumping of refuse in residential areas is also disturbing as revealed by this unit.

Summary

The methods of solid wastes disposal are - Sanitary landfill, incineration, composting, encapsulation, community pit method and open dump method. The solution to all these, is segregation of solid waste at source, scavengers or waste pickers should be encouraged and legalized and the use of recycling plants.

5.0 Tutor-Marked Assignment

1. List and discuss the best ways to control solid waste in our towns and cities
2. Discuss the current methods of solid waste disposal in any urban area of your choice

6.0 References

Ajith Sankar, R. N. (2015). *Environmental Management*. Oxford University Press. India.

Akpofure, R. (2009). *Environmental Science: An Introduction*. Kraft Publishes. Delta State Nigeria.

Nigeria Institute of Safety Professionals (2003). *Contractor Employee HSE Training Manual.* Level 3 Published by ECNEL Ltd. Port Harcourt.

MODULE 4: Environmental Pollution

Unit 1 Air pollution

Unit 2 Soil Pollution

Unit 3 water Pollution

Unit 4 Noise pollution

Unit 1 Air pollution

Contents

Unit 1 Air pollution

1.0 Introduction

The major tTypes of Environmental Pollution that we have are:: aAir pollution, wWater pollution, mMarine pollution, sSoil pollution, nNoise pollution, tThermal pollution and rRadioactive pollution. Air pollution problems are generally associated with the arrival of the industrial revolution. Population explosion has led to urban growth, extensive industrial development and automobile revolution, all of which are to be blamed for threatening to make the earth's environment unbearable for future generations.

The release of poisonous gases like carbon monoxide, nitrous oxide and combustion products from industries and automobiles disturb the balance among the air components. Air is i.e. polluted and thus the air so as to affect both the living as well as the nonliving components of the biosphere. Besides these are the natural sources of pollution such as volcanic eruptions, dust-storms, forest fires and etc. which make the environment

detrimental to our health. All these have made it impossible to ignore any longer the serious consequences of air pollution.

2.0 Objectives

By the end of this unit, students should be able to ~~provide solutions to the following~~:

i. ~~X~~ State t~~T~~he meaning of air pollution.

ii. ~~X~~ Explain the causes of air pollution

iii. ~~X~~ State t~~T~~he impact of air pollution to our environment

iv. Explain ways of ~~X The~~ controlling ~~of~~ air pollution

3.0 Main Body

3.1 Meaning of air pollution

Ecosystem is a natural unit of living community (plants and animals) and non-living environment. The biotic and abiotic communities are constantly interacting and exchanging materials and energy between themselves. The life in an ecosystem depends upon the environment which provides energy in the form of sunlight and nutrients for the living components of the ecosystem.

In a homeostatic ecosystem there is a balance between the living organisms and the environment. Disturbance in any component of the environment is likely to have a harmful effect on the ecosystem. Any change in the environment which contributes to its deterioration is called *pollution* of the environment and the agent which causes the pollution is called the *pollutant.* This change in the physical, chemical or biological characteristics of our physical environment (air, water and land) is undesirable and harms human life, other living organisms and cultural assets. The resulting impact on the environment has been so massive with far-reaching consequences

that the very existence of life is threatened. There are many definitions of Air Pollution. Some of the definitions are:

(a) "Air pollution may be defined as any atmospheric condition in which certain substances are present in such concentrations that they can produce undesirable effects on man and his environment."
(b) Air pollution is the excessive concentration of foreign matter in the air which adversely affects the wellbeing of individuals or causes damage to property.
(c) Air Pollution means the presence in the outdoor atmosphere of one or more contaminants such as dust, fumes, gas, mist, odour, smoke or vapour in quantities of characteristics and of duration as to be injurious to human, plant or animal life or to property or which reasonably interferes with the comfortable enjoyment of life and property.

3.2 Causes of Air Pollution

There are two main causes ~~or sources~~ of air-pollution:

(a) Natural
(b) Manmade or Anthropogenic.

i. Natural Causes or Sources

Natural sources cause large scale of air pollution which is beyond the control of man.

(a) Natural contaminants usually present in the air are pollen. Fungal spores, cysts, bacteria and marsh-gas. Methane CH_4 or marsh-gas is a hydrocarbon, which is formed by decay of vegetable matter in marshy places, (i.e. anaerobic decomposition of organic matter).
(b) Carbon monoxide from the breakdown of methane.

(c) Volcanic eruptions release many gas and volcanic ash which cause air pollution.

(d) Forest fires release smoke and harmful trace gases.

(e) Electric storms and solar fares pollute the air by the harmful chemicals they produce.

(f) Salt spray from oceans.

(g) Dust storms.

ii. Manmade or Anthropogenic Causes or Sources

In contrast to the natural causes ~~sources~~ of air pollution manmade or a~~A~~nthropogenic causes ~~sources~~ pose problems se~~rious er~~ enough to endanger life and property. Rapid industriali~~s~~z~~z~~ation, automobile revolution and deforestation are the inevitable consequences of over population.

Industries are the source air pollutants like SO_2 gas, NH_3 NO_2, HF, HCI gas, and H_2S gas besides dust, fumes etc.

Automobiles also cause hazardous pollutants as by-products of the combustion of fossil fuels. Advanced agricultural techniques like spraying of crops for pest and weed control releases many pollutants like chlorinated hydrocarbons, organic phosphates, arsenic and lead etc.

In the race for power, man indulges in many nuclear energy activities involving widespread use of radioactive materials. Nuclear explosions and explosives used in war result in radioactive fallout comprising radioactive pollutant.

3.3. Classification of Air Pollution Sources

3.3.1. The man-made sources of air pollution are broadly categorized into three:

(a) Point or Stationary Sources: the point or stationary sources of air pollution are best exemplified by industries as they add pollutants to the air at particular points from their tall chimneys.
(b) Pollutants from such point-sources affect only restricted areas.
(c) Line or Mobile Sources: The line or mobile sources of air pollution and the automobile as these add pollutants along narrow belts and over long distances.
(d) Area sources: towns and Cities add smoke and gases over wide area and so qualify as area sources of air pollution.

The air pollutants can as well be classified in two different ways according to origin and according to state of matter.

3.3.2. According to Origin

According to their origin the air pollutants are classified into two categories:

(a) Primary Pollutants
(b) Secondary Pollutants

i. Primary Pollutants: Those pollutants that are emitted directly from the sources and are found in the atmosphere in the form in which they were emitted are called primary pollutants.

Examples of primary pollutants are Sulphur Oxides, Nitrogen oxides, hydrocarbons, ash, smoke, dust, fumes, mist, sprays, radioactive compounds and etc.

ii. Secondary Pollutants: —Those pollutants that are formed in the atmosphere by chemical interactions between primary pollutants and atmospheric constituents are called secondary pollutants. These are usually formed by a photochemical reaction or by hydrolysis or oxidation reactions

in the atmosphere. Examples of secondary pollutants are Ozone, sulphur trioxide, peroxyacyl nitrate (PAN), aldehydes, ketones and etc.

3.3.4. According to State of Matter

According to this property the air pollutants can be classified into two main categories:

(a) Gaseous air pollutants
(b) Particulate air pollutants

Gaseous Air Pollutants: These are pollutants occurring in the gaseous state at normal temperature and pressure. Common gaseous pollutants are carbon dioxide (CO_2) nitrogen oxides (NO_x), Sulphur oxides (SO_x), hydrocarbons and photochemical oxidants.

(I) Oxides of Carbon

These include Carbon monoxide (CO) and Carbon dioxide (CO_2)

(A) Carbon monoxide (CO)

Nature

(a) Colourless, odourless, tasteless gas which is chemically inert under normal conditions of temperature and pressure.

(b) Has no effect on life and property at normal concentrations (0.1ppm) but at higher concentration it seriously affects human metabolism.

Effect

~~[(a)]~~ CO has a very high affinity to ~~for~~ haemoglobin and on inhalation, combines selectively with haemoglobin of the blood (Hb) and forms carboxyhaemoglobin (COHb), thereby reducing the oxygen carrying capacity of the blood.

[(b)] This affects the central nervous system causing laziness and exhaustion.

(a)[(c)] CO impairs a person's time interval discrimination, reduces vision and causes cardiovascular disorders.

(b)[(d)] High CO level is potentially deadly and fatal to human life as CO is a very dangerous asphyxiate.

Sources

(a) Transportation sources (Traffic jams)
(b) Solid waste disposal
(c) Forest fires
(d) Coal refuse (charcoal stoves)
(e) Coal mines
(f) Gas heaters

Detection and Analysis: Numerous detection methods are available or both intermittent and continuous sampling of carbon monoxide. These methods use gravimetric, chemical, electrochemical and calorimetric processes. Methods for monitoring ambient air quality standards for CO are gas chromatography, catalytic conversion and flame ionization detection.

Control: Adsorption, condensation and combustion are basic technical control methods for CO and use of these methods can control almost all carbon monoxide emissions. Control of CO at the source is for more desirable than control by dilution in the ambient air.

(B) Carbon Dioxide (CO_2)

The content of CO_2 in the air has increased by approximately 15% during the last century inspite of the fact that photosynthesizing green plants balance the CO_2-O_2 ratio to a large extent. Furthermore, this increase has been accompanied by a corresponding decrease in atmospheric oxygen.

CO_2 is comparatively less dangerous than CO and merely causes nausea and headache. Its major effect is on the climate of the earth. CO_2 absorbs infrared terrestrial radiators and continuous increase in CO_2 concentrations could result in raising the temperature of the earth's surface so significantly that Arctic ice would melt causing a rise in the oceanic level. As a consequence the coastal towns would be flooded.

Sources of CO_2

(a) Fossil fuel combustion
(b) Jet planes use O_2 and release CO_2
(c) Agricultural practices (e.g. Deforestation)
(d) Forestry

(II) Oxides of Nitrogen

These include Nitrogen monoxide (NO) and Nitrogen dioxide (NO_2). Nitrogen monoxide

NO is a colourless, odourless gas which is oxidized to NO_2 through secondary photochemical reactions. Being heavier than air, NO_2 is readily soluble in water and forms nitric acid, which falls out in the rain.

NO is an inert gas but like CO_2, it can also combine with haemoglobin to reduce the oxygen carrying capacity of the blood.

NO It is only moderately toxic as its concentration in the air is not high enough to become a health hazard.

NO_2 is relatively more toxic as it irritates the alveoli of the lungs and high concentrations may even cause acute bronchitis.

Sources of NO_2 Pollution

(a) Fuel combustion in automobile and industries

(b) Lightening

(c) Forest fires

(d) Bacterial decomposition of organic matter

(e) Natural ionizing radiations.

Detection and Analysis: Monitoring for NO requires that nitric oxide first be converted to No_2 and its concentration determined indirectly. New methods for measuring NO and NO_2 have been developed including chemiluminescense, ultraviolet spectrophotometry, electrical transducers and dispersive infrared spectrometry. Other detection techniques use lasers, ion selective electrodes or pulverized ultraviolet fluorescence.

Control: Most control measures for NO_2 emissions have been directed at modification of combustion conditions to decrease NO_2 production and at utilization of various devices to remove NO_2 from exhaust gas streams.

(III) Oxides of Sulphur

These include ~~sulphur~~Sulphur dioxide (SO_2) and Sulphur trioxide (SO_3)

Nature: SO_2 —is a colourless gas having a characteristic sharp, pungent and suffocating odour. It is photochemically oxidized to SO_3 it is highly soluble in water and along with SO_3 —forms sulphuric or sulphurous acid and is quickly washed out of the atmosphere by rain (acid rain).

Effects: -

(a)___—They are power pollutants and tend to irritate the mucous membranes of the respiratory tracts.

(b) Higher concentrations cause bronchitis

(c) They readily attack building materials especially marble, limestone and mortar.

(d) Clothes, leather and paper are also affected.

Plants are particularly sensitive to high concentrations of SO_2 and suffer from chlorosis (disappearance of chlorophyll), metabolic inhibition, plasmolysis and even death.

Sources of SO_2 Pollution

(a) Burning of solid and fossil fuels
(b) Transportation

Direction and Analysis: Continuous and intermittent sampling is commonly used for SO_2 detection. The chlorimetric, conductometric and coulometric methods are the most commonly used direct methods for continuous monitoring. Other direct monitoring techniques for SO_2 are spectroscopic, utilising infrared or ultraviolet absorption as well as flame photometric methods. The methods of control include burning fuel with less sulfur, removing sulfur from fuel, converting coal by liquefaction, cleaning up the combustion products by tall stacks and alternative energy sources

Particulate pollutants are categorised according to size, mode of formation (source) or physical state.

(1) Aerosols: These include all air borne suspensions of solid or liquid particles smaller than 1mm.
(2) Examples of aerosols are dust, smoke, mist and fumes.
(3) Dust: it consists of small solid particles (size 1 to 200mm), which are formed by the breaking up of larger masses of rock and soil either by natural disintegration or by mechanical processes of crushing, grinding or blasting, etc. They remain suspended in air temporarily but ultimately settle under the influence of gravity.
(4) Smoke: It consists of fine solid particles (size 0.1 to 1mm) resulting from the incomplete combustion of organic particles like coal, wood,

tobacco or other chemical process. Depending on the nature of the material burnt, smoke may have different odours.

(5) Fumes: These are fine solid particles (size 0.1 to 1mm) formed by the condensation of vapours of solid materials. They are odorous vapours which may or may not be visible and are usually released from chemical or metallurgical processes.

(6) Mist: It consists of liquid droplets (size smaller than 10mm) formed by the condensation of vapous in the atmosphere or are released from industrial operations (such as formation of surphuric acid mist).

(7) Fog: If the mist is made up of water droplets whose concentration is high or dense enough to obscure vision, then the mist is called a fog.

[(8)] Flyash: This consists of finely divided noncombustible particles present in the gases arising from fuel combustion. It contains inorganic metallic or mineral substances released when the organic part of coal is burnt.

(8)[(9)] Soot: incomplete combustion of carbon containing materials release carbon particles impregnated with 'tar'. A collection of such particles is soot.

(9)[(10)] Natural Particulates: Natural particulates are pollen grains spores bacterial viruses, protozoa, fungal spores and volcanic dust.

3.3 Effects of Air Pollution

Mainly due to rapid industrialization and automobile revolution such high concentrations of the pollutants are discharged into the atmosphere that it is beyond the self-cleansing capacity of the environment to nullify their effect. As a result air pollutants adversely affect the health of humans and animals and damage plants and property.

Effects of Air Pollution on Human Health

Air pollutants have many acute as well as chronic effects on human health. These are:

(a) Irritation of the respiratory tract
(b) Irritation of eye, nose and throat
(c) Lead particulates (from automobile exhausts) cause lead poisoning resulting in convulsions, delirium, coma and even death.
(d) Cadmium particulates (through cigarette smoking) cause cardiovascular diseases, kidney and liver damage and even death.
(e) Nickel particulates (in tobacco smoke) result in respiratory damage.
(f) Mercury (Combustion of fossil fuels, plants) results in nerve, brain and kidney damage.
(g) Radio-active fallout has somatic and genetic effects on future generations.

Effects of Pollutants on Animals

When the animals feed upon the particulate coated plants (especially with Fluorine, Lead, Arsenic) they get affected with Arsenic poisoning (cattle and sheep) and Arsenic poisoning (cattle). Lead poisoning results in bronchitis and lack of appetite in pet animals.

Effects of Pollutants on Plants

Spraying of pesticides, and other agricultural practices have exposed the plants to a large number of air pollutants, adversely affecting their growth and metabolism by destroying chlorophyll and disrupting photosynthesis.

(a) SO_2 bleaches the leaf surface and causes chlorosis (i.e. loss of chlorophyll and yellowing of the leaf) especially in leafy vegetables.
(b) NO_2 causes premature leaf fall (abscission) and suppressed growth of plant resulting in reduced yields of crop plants.
(c) Ozone causes necrosis (dead areas on a leaf structure) and damages leaves.

(d) PAN (peroxyacylnitate) damages leafy vegetables causing premature fall discoloration and curling of sepals.

Effects of Air Pollution on Materials

Materials are affected by air pollutants in the following four ways:

(a) Corrosion.
(b) Abrasion.
(c) Deposition and removal of materials.
(d) Chemical attack.

The damages caused to various materials by air pollutants are:

[(a)] SO_2 –Acid rains and aerosols damage the building materials.
(a)[(b)] Paint are discoloured by SO_2 H_2S and particulates.
[(c)] Metals undergo corrosion and tarnishing by SO_2 –and aAcid gases.
(b)[(d)] Paper becomes brittle and leather undergoes disintegration by SO_2 and Acid gases.
[(e)] Ozone, SO_2 —NO_2 and acid gases discolour, deteriorate and reduce the tensile strength of textiles.

Effect of Air Pollution on Climate

Due to deforestation and fuel combustion in industries and automobiles, CO_2 content of the atmosphere is expected to double by the year 2020.

This increase will change the climate of the earth by changing the factors controlling the climate (e.g. composition of gases). This increase of SO_2 will increase the atmospheric temperature of the earth, resulting in the melting of polar ice, glaciers etc.,- which will consequently cause the flooding of coastal towns (i.e. Green–house effect). Pattern of rainfall, if changed, will affect agricultural output.

The thinning of the ozone layer in the stratosphere by the action of aerosols will increase the penetration of harmful ultraviolet rays to earth and this will cause blindness, sunburn, inactivation of proteins, RNA and DNA.

Effect of Air Pollution on Aesthetic Beauty

The aesthetic beauty of nature is not visible. Reduction in visibility results from scattering of light by air borne particulates (0.1 to 1mm size). This also leads to safety hazards in the haze formed by dust and smoke in the air, industries, automobiles, sewage and garbage heaps emit foul odours causing further loss of aesthetic beauty.

3.4 Control of Air Pollution

The following methods are most effective for dealing with the control of air pollution.

(a) Source Correction Methods
(b) Pollution Control equipment
(c) Diffusion of pollutant in air
(d) Vegetation
(e) Zoning
(f) Enforcement of air pollution standards
(g) Recycling
(h) Modification of combustion process

Source Correction Methods

Industries make a major contribution towards causing air pollution. Formation of pollutants can be prevented and their emission can be minimized at the source itself. By carefully investigating, the early stages of design and development in industrial processes e.g, those methods which have minimum air pollution potential can be selected to accomplish air pollution control at source itself. These source correction methods are:

(I) Substitution of Raw Materials

If the use of a particular raw material results in air pollution, then it should be substituted by another purer grade raw materials which reduces the formation of pollutants. Thus,

[(a)] Low ~~sulphur~~Sulphur fuel which has less pollution potential can be used as an alternative to high Sulphur fuels, and,

(a)[(b)] Comparatively more refined Liquid Petroleum Gas (LPG) or Liquefied Natural Gas (LNG) can be used instead of traditional high contaminant fuels such as coal.

(II) Process Modification

The existing process may be changed by using modified techniques to control emission at source. For example

(a) If coal is washed before pulverization, then fly-ash emissions are considerably reduced.

(b) If air intake of boiler furnace is adjusted, then excess fly-ash emission at power plans can be reduced.

(III) Modification of Existing Equipment

Air pollution can be considerably minimi~~z~~s~~z~~ed by making suitable modifications in the existing equipment.

(a) For example, smoke, carbon-monoxide and fumes can be reduced if open hearth furnaces are replaced with controlled basic oxygen furnaces or electric furnaces.

Diffusion of Pollutants in Air

The dilution of the contaminants in the atmosphere is an approach to the control of air pollution. If the amount of pollutants released into the atmosphere is minute, it may not be noticed since the atmosphere can easily

absorb the pollutants. Unlike when the amount of pollutants are so high that the environment in the area may not be able to absorb.

Recycling

Flue gases should be recycled or used for other processes. For example, Ssulphur oxide removed by the contact process of sulphuric acid should be used up in another process.

4.0 Conclusion

Knowledge about air pollution is very to sustainable environment. If we must have an environment that we can refer to as our own in the near future, then we must plan for air pollution that is increasing everyday as a result of increase in human activities and population.

5.0 Summary

X Air Pollution means the presence in the outdoor atmosphere of one or more contaminants such as dust, fumes, gas, mist, odour, smoke or vapour in quantities of characteristics and of duration as to be injurious to human, plant or animal life or to property or which reasonably interferes with the comfortable enjoyment of life and property

X The causes of air pollution are both natural and manmade. The natural sources are: Fungal spores, cysts, bacteria and marsh-gas. carbon monoxide. volcanic eruptions, forest fires, electric storms and solar fares, salt spray from oceans and dust storms. On the other hand the human causes are rapid industrialization, automobile revolution and deforestation are the inevitable consequences of over population.

X The effects of air pollution are mainly on human health, plants and animals, aesthetic quality of the environment and on climate.. And

X—The control methods of air pollution are: Source correction methods, pollution control equipment, diffusion of pollutant in air, vegetation, zoning, enforcement of air pollution standards, recycling and modification of combustion process

6.0 Tutor marked assignments

1. List and discuss five possible ways we can employ to control air pollution
2. What are the possible effects of air pollution

Self-Assessment

What is air pollution? List the causes of air pollution

7.0 References

AjithSankar, R. N. (2015). *Environmental Management* Oxford University Press. India.

Akpofure, Rim-Rukeh (2009). *Environmental Science : An Introduction*. Kraft Books Limited. Ibadan, Oyo State.

Cunningham, W.P. and (Cunningham, M. A. (2011) *Principles of Environmental Science. Inquiry and Applications*. Sixth Edition. McGraw Hill Publishers. United States.

Praveen, K. P., Subha, G. and Rajesh, W. (2017). Environmental Pollution and Safety Measures: International Issues and Its Global Impact in *Global Progress in Development of Sustainable Environment*. Discovery Publishing House PVT.Ltd. India.

Suresh, K. Dhameja (2013). *Environmental Science.* S.K. Kataria and Sons Publishers. India.

Unit 2 Soil Pollution

Contents

1.0 Introduction

Soil pollution is the reduction in the productivity of soil due to the presence of soil pollutants. Soil pollutants have an adverse effect on the physical, chemical and biological properties of the soil and reduce its productivity.

Pesticides, fertilizers, organic manure, chemicals, radioactivity, wastes, discarded food, clothes, leather goods, plastics, paper, bottles, tins-cans and carcasses – all contribute towards causing soil pollution. Chemicals like iron, lead, mercury, copper, zinc, cadmium, aluminum, cyanides, acids and alkalies etc. are present in industrial wastes and reach the soil either directly with water or indirect through air. (e.g. through acid rain). The improper and continuous use of herbicides, pesticides and fungicides to protect the crops from pests, fungi, etc. alter the basic composition of the soils and make the soil toxic for plant growth.

2.0 Objectives

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

- Determine the sources of soil pollution
- Effects of soil pollution
- The control of soil pollution

3.0 Main Body

3.1 Sources of Soil pollution

Soil pollution are many and they emanate from different sources such as homes, offices, underground storage pipes and tanks, leachates from decomposed solid waste, runoff from refuse dumps or agricultural sites, spillage of crude and pipelines.

Some pollutants from the aforementioned sources are:

i. Agricultural waste. This class of waste contain fertilizers and herbicides.

ii. Metal scraps. These are heavy metals

iii. Crude oil. Product of petroleum exploration

iv. Mining waste. Contain such metals such as lead, zink, phosphorous etc

v. Organic chemicals. These are organic substances such as pesticides, hydrocarbons

vi. Sewage: These are biological waste that can be oxidized by microorganisms.

vii Refuse: These are perishable waste that are combustible or non combustible like papers, plastics, glasses, wood, cans

viii. Garbage: These are purified waste fro food substances such as meat, fish, fruits and all forms of vegetable

3.2 The Effects of soil Pollution

a. Effects on human health

The major concern is that there are many sensitive land uses where people are in direct contact with soils such as residences, farmlands, schools and playground. There is also a broad spectrum of health effects such as headache, nausea, fatigue, eye irritation or skin rash for some soil pollutants such as chlorinated solvent. In addition soil pollutants such as refuse and garbage promote the breeding of disease vectors (such as mosquitoes, rats,). Also, soil pollutants such as broken bottles may inflict injuries on man and make him stand the risk of contamination of diseases.

Lead is especially hazardous to young children, in which group there is a high risk of developmental damage to the brain and nervous system. While to all populations kidney damage is at risk. Chronic exposure to benzene at sufficient concentrations is known to be associated with higher incidence of leukemia. Mercury and cyclodienes are known to induce higher incidences of kidney damage. PCBs and cyclodienes are linked to liver toxicity. Organophosphates and carbamates can induce a chain of responses leading to neuromuscular blockage.

b. Effects on ecosystem:

Not unexpectedly, soil pollutants can have significant, deleterious consequences on the ecosystem. There are radical soil chemistry changes, which can arise from the presence of many hazardous chemicals even at low concentration of the contaminant species. These changes can manifest in the alteration of metabolism of endemic microorganisms, and arthropods. The result can be virtual eradication of some of the primary species. Even if the chemical effect on lower lie forms is small. The lower pyramids levels of the food chain may ingest alien chemicals, which normally become more concentrated for each consuming level of the food chain. For example, the effect of DDT on avian leads to the weakening of egg shells, increased chick mortality and potential species extinction.

c. Effects on agriculture: soil pollutants typically alter plant metabolism, most commonly to reduce crop yields.

d. Effects on aquatic system: Soil pollutants can also be washed into a receiving water body (stream, rivers and lakes) thus affecting the quality of the water body (interferes with the suitability of water for drinking purposes) and may affect marine life.

e. Effects on land use: Soil pollutants such as garbage and refuse and scrap metals occupy land space and hence obstruct land use for farming and other purposes.

f. Effects on aesthetics: Soil pollutants such as heap of garbage and refuses and scrap metals can be unsightly. They litter streets, roadside verges, beaches and leisure areas.

3.3 Soil pollution control

Soils have suffered from several decades of damage on a scale that we must not allow to continue. The reasons for this neglect are many. But, if we are to ensure the protection o global soils into the future there must be much stronger awareness and acceptability among the public, policy makers and land users of the need to preserve soils for current and future generations.

To ensure that this takes place, the following control and mitigation measures are suggested.

i. Use of appropriate cropping/farming practices: Studies on farming practices such as polyculture, crop rotation, intercropping, cover crops, use of natural manure, reduced use of synthetic pesticides and selective tree cutting have been reported to control soil erosion and mitigate the accumulation of soil contaminants.

ii. Reuse and recycling technique: In this era of massive waste generation and diminishing raw material, reuse and recycling should be encouraged. Recycling conserves not only resources but fuel as well. Recycling operations also emit less pollutants than the original process. Examples of recycling operations include the conversion of old newspaper to new paper, spoiled meat can be used to produce animal feeds, saw-dust particles can be used to make particle board. Reuse of plastic containers should also be encouraged.

iii. **Use of sanitary Landfill:** A sanitary landfill is open where garbage and refuse is confirmed to the smallest practical area, and waste reduced to the smallest practical volume. The area is covered with a layer of earth.

iv. **Incineration:** Incineration is a method of disposing waste by a controlled combustion of combustible waste at a very high temperature. The ashes from the incineration need to be disposed into the landfill area.

v. **Composting:** Composting has been defined as the biodegradation of the organic constituents of solid waste through aerobic microbial activity resulting in stable humus-like soil called compost which can be used to provide nutrient and replenish depleted organic matter lost through intensive farming.

4.0 Conclusion

A good soil is the kind that can support the growth of plants, resist soil erosion and reduce negative impacts on associated air and water resources. The importance of soil must not be taken for granted. To understand the fundamental nature of soil pollution, it is necessary to envision the variety of mechanisms for pollutants to become entrained in soil. And so, the causes, effects and control of soil pollution awareness must be created among the citizenry.

5.0 Summary

The causes of soil pollution are garbage, mining waste, organic chemicals, crude oil products and agricultural waste. The effects of soil pollution are mainly on human health, aquatics, land use and on aesthetics. In order to control soil pollution, good awareness must be created, good farming practices, recycling, composting and sanitary landfill.

6.0 Tutor marked assignments

[1.] ~~How are soils polluted?~~ Explain the various Causes ~~sources~~ soil pollution.

[2.] List and explain the appropriate ~~best~~ ways to control soil pollution

7.0 References

Akpofure, Rim-Rukeh (2009). *Environmental Science: ~~.~~ ~~—~~An Introduction*. Kraft Books Limited. Ibadan, Oyo State.

Cunningham, W.P. and (Cunningham, M. A. (2011) *Principles of Environmental Science: ~~—~~Inquiry and Applications*. Sixth Edition. McGraw Hill Publishers. United States.

Praveen, K. P., Subha, G. and Rajesh, W. (2017). Environmental Pollution and Safety Measures: International Issues and Its Global Impact in *Global Progress in Development of Sustainable Environment*. Discovery Publishing House PVT.Ltd. India.

Santosh, K.G. (2010). *Ecology and Environmental Studies*. Khanna Publishers, Indian.

Suresh, K. Dhameja (2013). *Environmental Science.* S.K. Kataria and Sons Publishers. India.

Unit 3 W~~w~~ater Pollution

Contents

1.0 Introduction

Over 97 percent of the entire earth surface is covered with water. Despite the abundance of water less than one percent is available for human use in the form of surface waters. The hydrological cycle begins with condensation of atmospheric water and its precipitation as rain or snow which ultimately falls on the earth's surface. Then it flows into surface sources of water such as lakes, streams, rivers and ponds etc. The rain water or melted snow, which enters the ground by infiltration, constitutes the groundwater which percolates through the subsoil and reaches the aquifers or porous rocks where it accumulates as the underground water source. Underground water

is eventually discharged into surface waters. Evaporation from surface waters returns the water back into the atmosphere to repeat the cycle. At one point or the other both surface and underground water resources are polluted.

2.0 Objectives

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

i. know the causes of water pollution,

ii. know the effects of water pollution and the control methods.

3.0 Main Body

3.1 Causes of Water Pollution

There are two major causes/sources of water pollution, namely point source and diffused sources

Point Sources

Those sources which can be identified at a single location are known as point sources. Infiltration of industrial effluents, municipal sewage etc. contaminates the ground water and cause water pollution.

The water pollution caused by point sources can be minimized if all domestic sewage, industrial effluents, cattle field and livestock wastewaters etc. are centrally collected, treated up to requisite acceptable levels and reused for different beneficial purposes.

Diffused Sources

Those sources whose location cannot be easily identified are called diffuse sources.

In this case, the pollutants scattered on the ground ultimately reach the water sources and cause water pollution, for instance, agriculture (pesticides, fertilizers), minimiszing, construction etc.

The water pollution caused by diffused sources like agriculture can be controlled by changing the cropping patterns, tillage practices and advanced for management practices which do not contaminate the water bodies.

3.2 Effects of Water Pollution

All organisms need water for their metabolic activities. It is even used as a habitat by many organisms. Besides direct consumption (washing, bathing, drinking) man uses water for multitude of purposes like irrigation, industry, navigation, recreation, construction work, power generation and waste disposal.

Different types of water uses require different levels of water purity with the highest level of purity being required for drinking water. Pollutants bring about many physical and chemical changes in water, for instance, suspended particles make water turbid; dyes, chromium and iron compounds change the colour of water; phenols, oils, detergents, hydrocarbons, chlorine, etc. impact an unpleasant taste on water. Generally, the effects of water pollution can be felt more on the following: Aquatic plants, recreation, vegetation and surface water

As it is a vital resource essential for sustaining life, contamination of water has immediate as well as far reaching effects on the health and environment of living organisms. And so the effects can be examined under the following:

- **Effects on aquatic life (Plants and Animals),**
- **Nuisance and aesthetic effects,**
- **Eeutrophication,**
- **Eeffects on recreation and human health**
- **Effects of groundwater pollution are mainly felt on vegetation, human and animal health.**

Health Hazards of Water Pollution

[(a)] Phosphorus and Nitrates from fertilizers and detergents contaminate surface waters where they act as nutrients and promote the growth of oxygen consuming algae which reduce the DO (Dissolved Oxygen) –level of water, killing fish and other aquatic organisms.

(a)[(b)] Industrial effluents result in the addition of poisonous chemicals such as Arsenic, Mercury, Cadmium, Lead etc., which kill aquatic organisms and may reach human body through contaminated food (i.e. fishes etc.).

(b)[(c)] Domestic, commercial and industrial effluents (petroleum refineries, paper mills, breweries, tanneries, slaughter houses) contaminate the water with organic pollutants. These provide nutrition for micro-organisms which decompose the organic matter and consume oxygen and reduce the Do level of the aquatic system thereby killing the aquatic organisms.

(c)[(d)] Non-biodegradable pesticides (especially organochlorines) travel through food chains and ultimately reach humans where they accumulate in the fatty tissues and affect the nervous system.

(d)[(e)] Waterborne infectious enteric diseases like typhoid, bacillary dysentery, cholera and amoebic dysentery are the predominant health hazards arising from drinking contaminated water.

(e)[(f)] Fluoride containing pollutants cause fluorosis i.e. neuromuscular, respiratory, gastro intestinal and dental problems.

(f)[(g)] Thermal pollution of war reduces the DO (Dissolved Oxygen) level for the aquatic system making it incapable of supporting life.

(g)[(h)] Oil pollutants have been known to be responsible for the death of many water birds and fishes.

(h)[(i)] Radio-active pollutants (from mining and refining of Uranium, Thorium and nuclear power plants) enter humans through food and water and accumulated in the blood, thyroid gland, liver, bones and muscles.

3.3 Control Measures of Water Pollution

Water at the domestic or industrial levels has always been contaminated in one way or the other. Most of the methods we can adopt for control are: Primary treatment which includes screening, comminuting, grit remover, skimming tanks, sedimentation, Flotation, and neutralization. Secondly, we have the secondary or biological control treatment. This is a method that involves: Activated sludge process and trickling filters. Thirdly, we have the tertiary or advanced wastewater treatment

Legislation, education and technology can also help in preventing and controlling both surface and ground water pollution. Many other methods exist which are concerned about the point and ~~non point~~non-point methods of control. Non point pollution control include reduction in the need for fertilizers by planting crops that will be able to absorb Nitrogen from the atmosphere, control of grazing because of animal wastes, through afforestation in order to reduce flooding and soil erosion and prevention of storm water pollution. The point pollution control are through clean ups using mechanical, chemical and natural methods. Prevention of sewage is the best method of control of most water pollution that may crop up because of running water that may spread it as fast as possible.

4.0 Conclusion

In this unit, we examined the causes of water pollution, the effect of water pollution and the control measures of water pollution.

5.0 Summary

Water can get contaminated by two major causes/sources, namely point source and diffused sources. The use for which water is put into determines the quality of such water. The knowledge of the physical, chemical and biological characteristics is necessary for determination before water can be used. The control measures of water are through legislation, education, technology, primary and secondary treatment plants

6.0 Tutor Marked Assignments

1. What is water pollution? Discuss, the health implication of water pollution
2. Discuss, the control measures of water pollution on human health

7.0 References

Suresh, K. Dhameja (2013). *Environmental Science*. S.K. Kataria and Sons Publishers. India.

Akpofure, Rim-Rukeh (2009). *Environmental Science: An Introduction*. Kraft Books Limited. Ibadan, Oyo State.

Unit 4 Noise pollution

Contents

1.0 Introduction

Sound, a normal feature of our life, is the means of communication and entertainment in most animals, including human beings. It is also a very effective alarm system. A low sound is pleasant whereas a loud sound is unpleasant and is commonly referred to as ‘noise’. Noise can be defined as an unpleasant and unwanted sound.

Noise is a physical form of pollution and is not directly harmful to the life supporting systems namely air, soil and water. Its effects are more directly on the receiver i.e. man. Noise pollution is the result of modern industrialized urban life and congestion due to over population.

Even though noise pollution is not fatal to human life, yet its importance cannot be overlooked because repeated exposure to noise reduces the sleeping hours and productivity or efficiency of a human being. It affects the peace of mind and invades the privacy of a human beings.

2.0 Objectives

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

- Know the causes or sources of noise pollution

- The effects of noise pollution

- Control of noise pollution

3.0 Main Body

3.1 Sources of Noise Pollution

Major causes/sources of noise pollution are:

(i) Industrial Sources

Progress in technology (industrialiszation) has resulted in creating noise pollution. Textile mills, printing presses, engineering establishments and metal works etc. contribute heavily towards noise pollution.

In industrial cities like Lagos, Port Harcourt, Kaduna, Kano and the rest, ~~etc., often~~ the industrial zones are often ~~-~~not separated from the residential zones of the city especially in the case of small scale industries. These operate from workshops located on the ground floors of the residential areas and cause annoyance, discomfort and irritation to the residents exposed to the noise that is inevitably produced.

(ii) Transport Vehicles

Automobile revolution in urban centres has proved to be a big source of noise pollution. Increasing traffic has given rise to traffic jams in congested areas where the repeated hooting of horns by impatient drivers pierces the ears of all road users. Noise from airplanes constitutes an increasing serious problem in big cities like Lagos and Abuja airport situated in the vicinity of population centres and the air planes pass over residential areas. Heavy trucks, buses trains, jet-planes, motor-cycles, scooters, mopeds, jeeps

– the list of vehicles is endless but the outcome is the same which is noise pollution.

(i) Household

The household is an industry in itself and is a source of many indoor noises such as the banging of doors, noise of paying children, crying of infants, moving of furniture, loud conversation of the inhabitants etc.

Besides these are the entertainment equipment in the house, namely the radio, record-players and television sets.

Domestic gadgets like the mixer-grinders, pressure coolers, desert coolers, air-conditioners, exhaust fans, vacuum cleaners, sewing and washing machines area all indoor sources of noise pollution.

(ii) Public Address System

In Nigeria, people need only the slightest of an excuse for using loud speakers. The reason may be a religious function, birth, death, marriage, elections, demonstration, or just commercial advertising. Public system, therefore, contributes in its own way towards noise pollution.

(iii) Agricultural Machines

Tractors, thrashers, harvesters, tube wells, powered tillers etc., have all made agriculture highly mechanical but at the same time highly noisy. Noise level 90 dB to 98 dB due to running of farm machines have been recorded.

(iv) Defense Equipment

A lot of noise pollution is added to the environment by artillery, tanks, launching of rockets, explosions, exercising of military airplanes and shooting practices.

Screams of jet engines and sonic booms have a deafening impact on the ears and in extreme case have been known to shatter the window panes and old dilapidated buildings.

(v) Miscellaneous Sources

The automobile repair shops, construction-works, blasting, bulldozing, stone crushing etc are other sources of noise pollution.

3.2 Effects of Noise

Noise is generally harmful and a serious health hazard. It has far-reaching consequences and has many physical, physiological as well as psychological effects on human beings.

Physical Effects

The physical manifestation of noise pollution is the effect on hearing ability. Repeated exposure to noise may result in temporary or permanent shifting of the hearing threshold of a person depending upon the level and duration of exposure. The immediate and acute effect of noise pollution is impairment of hearing (i.e. total deafness).

Human ears have sensor cells for hearing. If these cells are subjected to repeated sounds of high intensity before they have an opportunity to recover fully, they can become permanently damaged leading to impairment of earring. Besides the sensory cells, the delicate tympanic membrane or the ear drum can also be permanently damaged by a sudden loud noise such as an explosion.

Physiological effects

The physiological manifestations of noise pollution are several as mentioned below:

(a) Headache by dilating blood vessels of the brain.

(b) Increase in the rate of heart beat.
(c) Narrowing of arteries
(d) Fluctuations in the arterial blood pressure by increasing the level of cholesterol in the blood.
(e) Decrease in heart output.
(f) Pain in the heart.
(g) Digestive spasms through anxiety and dilation of the pupil of the eye, thereby causing eye-strain.
(h) Impairment of night vision.
(i) Decrease in the rate of colour perception.
(j) Lowering of concentration and effect on memory.
(k) Muscular strain and nervous breakdown.

Psychological Effect

The psychological manifestations of noise pollution are:

(a) Depression and fatigue which considerably reduces the efficiency of a person.
(b) Insomnia as a result of lack of undisturbed and refreshing sleep.
(c) Straining of senses and annoyance as a result of slow but persistent noise from motorcycles, alarm clocks, call bells, telephone rings etc.
(d) Affecting the psychomotor performance of a person by a sudden loud sound.
(e) Emotional disturbance.

For a talkative person, the most important effect of noise pollution would invariably be that noise interferes with our conservation.

So, noise is annoying and the annoyance depends on many factors not merely the intensity of the sound but also repetition, because even a sound of small intensity (e.g. dripping tap or clicking of clock) may become annoying, simply by repetition.

3.3 Control at Receiver's End

For people working in noisy installations, ear-protection aids like ear-plugs, ear-muffs, noise helmets, headphones etc. must be provided to reduce occupational exposure.

Suppression of Noise at Source

This is possible if working methods are improved by:

(a) Designing, fabricating and using quieter machines to replace the noisy ones.
(b) Proper lubrication and better maintenance of machines.
(c) Installing noisy machines in sound proof chambers.
(d) Covering noise-producing machine parts with sound-absorbing materials to check noise production.
(e) Reducing the noise produced from a vibrating machine by vibration damping i.e. making a layer of damping material (rubber, neoprene, cork or plastic) beneath the machine.
(f) Using silencers to control noise from automobiles, ducts, exhausts etc. and convey systems with ends opening into the atmosphere.
(g) Using glass wool or mineral wool covered with a sheet of perforated metal for the purpose of mechanical protection.

Other Methods of Controlling Noise Pollution

Increased distance between source and receiver by zoning of noisy industrial areas, bus terminals and railway stations, aerodromes etc. away from the residential areas would go a long way in minimizing noise pollution.

There should be silence zones near the residential areas, educational institutions and above all, near hospitals.

Sound Insulation at Construction Stages

[(a)] Sound travels through the cracks that get left between the door and the wall. For reducing noise, this space (jambp frame gap) should be packed with sound absorbing material.

(a)[(b)] Sound insulation can be done by constructing windows with double or triple panes of glass and filing the gaps with sound absorbing materials.

(b)[(c)] Acoustical tiles, perforated plywood etc. can be fixed on walls, ceilings, floors etc. to reduce noise (especially from sound proof recording rooms etc).

Planting of Trees

Planting green trees and shrubs along roads, hospitals, educational institutions etc. help in noise reduction to a considerable extent.

Legislative Measures

Strict legislative measures need to be enforced to curb the menace of noise pollution. Some of these measures could be:

(a) Minimum use of loudspeakers and amplifiers especially near silence zones.
(b) Banning pressure horns in automobiles.
(c) Framing a separate Noise Pollution Act.

4.0 Conclusion

From the above discussion, it is evident that noise is not merely a nuisance but is a serious environmental problem and a health hazard. Like all other pollutions, noise pollution needs to be controlled by measures which will maintain the acceptable levels of noise pollution for human beings and building. If possible, sound level meter should be

provided by the authorities and wealthy individuals to always determine noise level. It is not expensive anyway.

5.0 Summary

In this unit, we have examined the main causes of noise pollution which range from industrial, vehicular movement, public address system and so on and the effects of noise pollution with the attendant consequences.

6.0 Tutor Marked Assignments

1. List and explain the causes of noise pollution
2. Using local examples, discuss the possible consequences of noise pollution

Self Study

Self-Study assessment

What are the control measures of noise pollution?

7.0 References

Cunningham, W.P. and (Cunningham, M. A. (2011) *Principles of Environmental Science. Inquiry and Applications*. Sixth Edition. McGraw Hill Publishers. United States.

Akpofure, Rim-Rukeh (2009). *Environmental Science:,* An Introduction. Kraft Books Limited. Ibadan, Oyo State.

Praveen, K. P., Subha, G. and Rajesh, W. (2017). Environmental Pollution and Safety Measures: International Issues and Its Global Impact in *Global Progress in Development of Sustainable Environment*. Discovery Publishing House PVT.Ltd. India.

Suresh, K. Dhameja (2013). *Environmental Science.* S.K. Kataria and Sons Publishers. India.

MODULE – 5: NATURAL HAZARDS

Unit 1 - Earthquakes

Unit 2 - Volcanic Eruptions

Unit 3 - Floods

Unit 4 - Droughts

Unit 5 - landslides and Avalanche

Unit 1: Earthquakes

1.0 Introduction

2.0 Objectives

3.0 Main Body

3.1 What is Earthquake?

3.2 Causes of earthquakes

3.3 Magnitude of earthquakes

3.4 Effects of earthquakes

3.5 Distribution of earthquakes

4.0 Conclusion

5.0 Summary

6.0 Tutor marked Assignment

7.0 References

1.0 Introduction

An earthquake is defined as a natural vibration of the ground or the crust of the earth produced by forces called earthquake forces or the seismic forces. Many of these vibrations are very feeble and may not even be felt to any appreciable extent, by human beings. Some other vibrations may be severe and may cause the collapse and rupture of buildings and other structures bringing large scale destruction and disaster in their wake.

2.0 Objectives

By the end of this unit and the relevant study of the texts, candidates should be able to:

- Know what earthquakes are
- Know the causes of earthquakes
- The magnitude of earthquakes
- Effects of earthquakes

- Distribution of earthquakes

3.0 Main Body

3.1 What is Earthquake?

Earthquake is something which causes the shaking of the Earth; and as such, all our buildings and structures erected on the Earth's surface, start trembling, as and when a quake comes. An earthquake, is therefore, defined as natural vibration of the ground (or the Earth's crust) produced by forces, called the earthquake forces or the seismic forces.

Many of these vibrations are very feeble, and may not even be felt to any appreciable extent, by human beings. Some other vibrations, however may be very severe, and may cause the collapse and rupture of buildings and other structures, bringing large scale destruction and disaster in their wake.

3.2 Causes of Earthquakes.

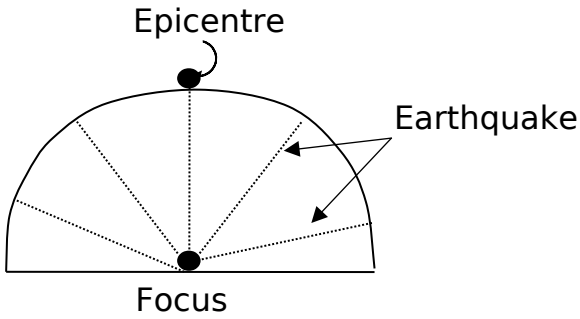
There has remained a lot of controversy on the possible causes of earthquakes, since time immemorial; and various theories have been propagated on the same. However, the latest **theory of tectonic plates** has been able to offer convincing explanations for all types of geological phenomena, like formation of faults and folds in the crystal rocks, eruptions of volcanoes, and occurrences of earthquakes, etc. According to this modern concept of tectonic plates, the upper part of the Earth (up to about 100km depth or so) is made up of a few large shells like bodies, called plates. These plates are made up of solid rigid and cooled rocks of the crust and the mantle, and each plate has its open boundaries. The part of the mantle lying immediately beneath these plates is very hot, flexible, and dynamic. These plates are, thus, floating over this dynamic mantle, and do more in different directions. Due to their movements, these plates are referred to as tectonic plates.

———It should be noted that the continents are not the independent plates, but are usually parts of composite plates that contain both continental and oceanic segments. For example, the North American plate includes North America continent and the adjacent western half of the Atlantic Ocean. Similarly, the **Indian Australian Plate** includes the Australian continent, India (part of Asia Continent) as well as parts of Indian Ocean. The **African Plate,** similarly includes Africa Continent and parts of Indian Ocean, as well as parts of both North and South Atlantic Oceans. As the Earth's plate move, everything on them including features as large as continents and oceans, move with them.

———Aristotle (384-322BC) was the first person to speculate on the possible cause of earthquakes when he said that air was trapped in subterranean cavities and when heated up, the air struggles to escape towards the earth surface. This results to the shaking of the ground which causes earthquakes. Until recently, earthquakes were believed to have been as a result of faults. It was in 1960s that the real cause of earthquakes was discovered that earthquakes were caused by boiling materials in the mantle. These materials are not in any known state (solid, liquid and gas) and are said to be viscous. These materials are forced to move to the surface from a depth of 480-640km as a result of the continuous boiling and viscosity. These materials move in ~~jerkings~~jerking and produce waves with an earthquake appearing if the waves reach the earth surface. The movement of these boiling materials is usually along fissures or cracks within the earth's crust.

Some earthquakes sometimes occur in areas where rocks are nearly at breaking point. In such cases, earthquakes are caused by external factors such as flooding or heavy rainfall, high tides, tremors from other earthquakes away from the area. The main shocks that results from earthquakes are the principle shocks and they last for seconds or at most minutes. This is followed by foreshocks and is followed by other types of

shocks. The foreshocks are usually preliminary, and shatter small obstructions along fissures or lines of movement. The main shocks are then represented by sudden jolts which can also disturb adjoining rocks. It must be noted that the main shocks of major earthquakes are not as destructive as the aftershocks, which continue long after the main shock.



Earthquake, Genesis and Wave Transmission

3.3 Magnitude of earthquakes

Earthquake vibrations are recorded and measured by an instrument known as the seismograph. This instrument detects and records the different waves of an earthquake (i.e. the primary, secondary and transverse waves). The magnitude of earthquake intensity or destructive capability, otherwise referred to as the size of the earthquake, had posed a serious problem until 1935: when a distinguished U.S. Seismographer, Charles F. Richter, devised the Richter scale. This scale determines the quantity of energy that is released by a single earthquake. The Richter scale is therefore a system of numbers, ranging from 0 to 9 which are ascribed to represent the index of earthquake energy at its source (focus). Accordingly therefore, earthquake of a magnitude of 2.5 has released energy of not less than 10 ergs (i.e. the approximate quantity of energy released when 3,800 litres of gasoline is burnt). Most earthquakes are however, minor and not destructive. Such earthquakes measure less than 4.5 on the Richter scale. A severe or

destructive earthquake is that which measures up to 6.0. Earthquakes of up to 7.0 are regarded as major earthquakes.

The highest of 8.6 was recorded in 1964 in Alaska (U.S.A.). The 21st September 1999 earthquake in Taiwan measured 7.1 on the Richter scale; and two weeks earlier another devastating earthquake in Turkey was 6.8.

More than a million earthquakes occur annually. In fact, an earthquake occurs every few seconds on the average. Many of these earthquakes are however minor and very slight. Severe earthquakes averagely occur every two to three weeks. In terms of energy released, one major earthquake may release more than all the thousands of minor earthquakes that occur throughout the year.

3.4 Effects of Earthquakes.

Earthquakes like volcanoes can cause lots of destruction to localities and the surrounding environment, when they are of severe nature. Although minor earthquakes do often occur without causing any prominent adverse effects, but the major earthquakes like the one that occurred in Peru on 31-5-1970 damaging over 85,000sg.km area, cause widespread adverse environmental impacts.

Earthquakes can sometimes raise the ground level, or sink it. Rivers may alter their course, lakes may be destroyed or even created, thereby causing immense adverse impacts on the systems of the environment. Severe earthquakes may also cause severe landslides, blocking rivers, causing abnormal flooding. When very high magnitude earthquakes occur below the floors, they may cause giant waves, called tsunamis**,** which may travel over long distances, causing catastrophic devastation near the sea shores and islands.

———Severe earthquakes of the past have, in fact, caused most catastrophic all over the world. Earthquake in a matter of seconds destroyed large cities

and taken thousand lives. A sixteen century earthquake in China claimed about 8.5 lives. In 1923, an earthquake of magnitude of 8.3 near Akyo (Japan) claimed about 1- 43 lives. In 1976, a catastrophic earthquake of magnitude 8.0 in Tangshan (China) claimed about 3-6 lives. In 1990, a strong earthquake of 7.7 magnitude in Mangil (Northern Iran) consumed around 40,000 lives.

———In summary, the results of earthquakes are: Landslides, tsunamis, fire, sound, flooding, loss of lives and properties, destruction of infrastructure and spread of diseases.

3.5 Distribution of earthquakes

The distribution of earthquakes corresponds largely with the areas of volcanicity. The areas characterized by devastating earthquakes occur within two belts; (i) The primary belt of earthquakes which occurs around the circumpacific belt, and especially around the 'pacific ring of fire'. About 80% of severe earthquakes have so far been recorded within this belt (ii) the second belt, known as the secondary belt of earthquakes, is the Mediterranean-Himalayan belt, which stretches from the Mediterranean area and extends eastward to Asia. More than 15% of severe earthquakes have occurred within this belt. Less than 5% of the earthquakes are thus shared by the other parts of the world.

Generally, no part of the world is completely free from earthquake occurrence, although most places experience slight earth tremors. It should be noted that areas that have witnessed earthquakes before are capable of future occurrence, as repetitions have been found to be inevitable.

4.0 Conclusion

———In this unit, we examine earthquakes as it relates to meaning, causes, magnitude, effects and distribution.

5.0 Summary

———Earthquakes are shaking of the ground which is caused by the breaking and shifting of sub surface rocks under intense pressure. Earthquakes are caused by faults and the boiling of materials in the mantle. The resultant effects are: landslides, tsunamis, fire, sound and death of plants and animals. Earthquakes are common around the circumpacific belt especially the pacific ring of fire. This is where we have more of earthquakes. The secondary belt of earthquakes is around the Mediterranean area.

6.0 Tutor marked Assignment

A. What are earthquakes? Discuss the causes of earthquakes

B. List and explain the effects of earthquakes

——Self-–Assessment Exercise

——— How can we forecast or avert the occurrence of earthquakes in an area?

7.0 References

Chop, D. C. (2007). *A Synthesis of Physical Geography*. Joyce Publishers. Kaduna, Nigeria

Praveen, K. P., Subha, G. and Rajesh, W. (2017). Environmental Pollution and Safety Measures: International Issues and Its Global Impact in *Global Progress in Development of Sustainable Environment*. Discovery Publishing House PVT.Ltd. India.

Santosh, K.G. (2010). *Ecology and Environmental Studies*. Khanna Publishers, Indian.

Unit 2: Volcanic Eruption

1.0 Introduction

2.0 Objectives

3.0 Mmain Body

3.1 What is volcanicity?

3.2 Intrusive features of Volcanicity

3.3 Extrusive features of volcanicity

3.4 Impact of volcanicity on climate

4.0 Conclusion

5.0 Summary

6.0 Tutor Marked Assessment

7.0 References

1.0 Introduction

Volcanicity refers to the various process by which molten magma escapes with great force through areas of weaknesses such as joints, cracks and faults, either to be intruded or extruded before cooling to solidity. The major intrusive volcanic landforms are – Dykes, sills, laccoliths, lopoliths, phocoliths and Batholiths. The extrusive volcanic landforms are gaseous materials, solid materials and liquid materials. The impact of volcanic eruptions suggests that it can cause the cooling of the environment, which is only local and not global. Moreover, the changes in ecosystems and environment are reversible over a passage of time.

2.0 Objectives

———By the end of this unit, students should be able to know what volcanicity is all about, know the intrusive and extrusive landforms that can result from volcanic eruption and the impact it has on climate.

3.0 Main Body

3.1 What is volcanicity?

Volcanicity refers to the various processes by which molten magma escapes with great force through areas of weaknesses such as joints, cracks and faults, either to be intruded or extruded before cooling to solidify.

———The cooling and solidification of molten magma result in the formation of different volcanic landforms. The classification of volcanoes depends solely on the mode of formation. In that case, two categories of volcanic landforms appear, and they are (1) intrusive and (2) extrusive volcanoes.

3.2 **Intrusive Volcanic Landforms**

———These are the landforms that cannot be seen initially on the surface of the earth's crust because the molten magma, which formed it, was intruded beneath the surface. These landforms are also known as invisible volcanic landforms. The outstanding characteristics of volcanic landforms depend on whether the lava is mobile or viscous and also on the bedding plain into which lava is intruded. Mobile lava is watery and can spread out very quickly before solidifying to form low-lying sheets of lava. Viscous lava on the other hand, is thick and does not spread out to cover large areas before solidifying to form dome-shaped, mountains and hills.

Types of Intrusive Volcanic Landforms

———The major intrusive volcanic landforms are discussed below:

a. Dykes

———These are igneous rocks formed from the intrusion of molten magma in an area of weakness that cut across the country rocks vertically. They usually form swamps of small pillars of hills after the overlying sedimentary rocks have been removed by the agencies of denudation. On exposure, these walls of hills usually develop small depressions at the top in which water collects and flow down the steep slopes in the form of waterfalls. The rounded surface or head of rocks over which the water plunges downwards is known as the lip of the fall while the area at the bottom at which the water actually plunges is known as the plunging pool.

The most outstanding example of a dyke in the world is the Cleveland Dyke in North West England. In Wet Africa, examples include the Western dyke of Jos and the dykes of futa-jalon highlands in Guinea.

b. Sills

———These are similar magmatic. Intrusion but instead of the molten magma been intruded vertically, it is intruded along the bedding plains of the existing sedimentary rocks horizontally before cooling to solidify. Sills are of varying degree of thickness and they extend for several kilometers. Example is the Great Whim Sill of Great Britain, which consists of dolerites. There are also examples of sills which have been exposed by the agencies of denudation in the Jos Plateau of Nigeria.

c. Loccoliths

———These volcanic intrusive landforms that have blistered domed shaped surfaces with a flat base or bottom. It is formed as a result of massive accumulation of magma along horizontal bedding plains of rocks consequently arching up the overlying layers of rocks to attain a similar domed shape.

Sills are usually supplied with magma along a conduit pipe below. When smaller loccoliths are formed along the bedding plains of the rock strata

directly the mother laccolith, the landform then become a Cedar Tree laccolith.

———Example of lacolith and cedar tree laccoliths can be found in the Henry Mountains of Utah on the west of river Colorado where G.K. Gilbert identified five different categories of them after an intensive study of the area between 1975 and 7197 6. He produced a thesis on these landforms, which has been accepted as geomorphological essay.

d. Lopoliths

———In this, magma is intruded into a curved area of weakness near the surface of pre-existing country rocks before solidifying. When exposed by the agents of denudation, lopoliths attain the shape of a saucer to form a shallow basin, which, at times, contain water. The Bushveld lopolith of Tran svaal in South Africa is the world best example.

e. Phacoliths

———There are lens-shaped intrusive landforms which develop from the solidification of magma in area of weakness at the anticline or at the bottom of a syncline in a folded mountain structure. Example is in the Cordon Hills of shropshire, England.

f. Plutonic Plug or Bysmalith

———This is a very great type of lacolith, which has attained an imaginable vertical height. Similarly, the overlying rock has been arched up, but unlike the loccoliths, the size of a bysmalith is very steep and plunged downwards to an unknown depth. Example can be found in Mountain Homes, England.

g. Batholiths

———These are the largest intrusive volcanic landforms. They are domed shaped at the top, with very steep sides that extend downwards for several

miles. When exposed by the agents of denudation, they form massive residual mountains e.g. the coastal Batholiths of British Columbia and the Wicklow Mountains of Ireland.

———It is generally believed that large masses of magma arising upwards metamorphosised the country rocks with which they come into contact. These metamorphosed rocks together with the solidified magma give rise to extensive batholiths sometimes hundreds of kilometers is extent. They are the most spectacular of the intrusive landforms.

Theories of Batholiths formation

———Two theories exist for the formation or batholiths, tThe first is that of Cauldon Subsidence or Engulfment and the second is Thermal Granitization. The theory of cauldron subsidence states that very great tectonic earth movements have made massive areas of rocks to collapse into a reservoir of hot magma below which later solidified together with the rocks to form a batholith.

———The second stipulates that hot magma escaping through area of weakness have come in direct contact with the country rocks. The heat of the magma which is transferred into, rocks change both their structure and mineral composition thus transforming them into very hard igneous rocks by process of thermal granitization. With time, surrounding soft rocks are removed by the agencies of denudation, while the massive metamorphic rock remain standing to form a batholith.

———The small particles of metamorphic rocks directly above the batholith is called exnolith: Small batholith is known as stocks or bosses.

h. Volcanic Plug or Spine

This is a very hard large mass of rock. Which results from the solidification of magma that block the volcanic vent. When exposed to

agencies of denudation. It usually form residual volcanic mountains which attain great height. An example is the Tangeb Plug between Gombe and River Benue in Nigeria. The Devil Towers in the state of Wyoming. U.S.A the Guater Mellon plug or Santigo, and the Mamelks plug near Darker in Senegal are well known.

3.3 Extrusive features of volcanicity

As the name implies these are the volcanic landforms that could be seen with the naked eyes on the surface of the earth's crust right from the time they are formed. These landforms come into existence as a result of frequent volcanic eruption and accumulation of the materials that result from the eruption. Therefore, volcanic materials are three types:

Gaseous Materials

——These include carbon dioxide, hydrogen, sulphur, oxygen and other gasses. The interactions of these gasses result in volcanic explosions accompanied with fire, steams, hot water, ashes and dust.

Solid Materials

——These are solid fragmentary materials that are ejected from volcanic vent during an eruption. They are collectively known as pyroclast or volcanic bombs. They include solid lavas, ash, dust, mud and brecia

Liquid Materials

——These are magma in the form of lava that are either basic or acidic.

Types of Volcanoes

Volcanoes can either be active, dormant or extinct. Active volcanoes are those that are still erupting or which erupted within a few days, months or years ago. For example, Cameroun Mountain in West Africa is an active volcanic mountain.

———Dormant volcanoes are volcanoes that erupted long time ago and still show some sign of possible eruption in the future. In other words, these are 'sleeping' volcanoes and could 'wake-up' anytime. The Jos Plateau is an example of dormant volcano.

———Extinct volcanoes are volcanoes that that erupted long time ago and lost all signs of it being erupting again in the future. The kilimajaroo Mountain in East Africa is an example of an extinct volcano.

Extrusive Volcanic Landforms

———Landforms associated with extrusive volcanoes are carefully discussed below

i. Volcanic Cones, Ash and Cinder Cones

———These are made up of accumulation of fragments of solid materials such as lapills (small stones and pebbles), dust and ashes. Their slopes are not steep neither are they too gentle, but are converse at the top and slightly concave at the bottom. Examples of ash and cinder cone are the cinder cone near Naples Mountain, Paricutin, Mexico and one of the grasslands of Northern Tanzanian formed among dissected volcanic hills and which has developed residual patterns of drainage. The lava flow is so viscous that they solidified after a short distance.

ii. Basic Lava Shields or Cone

———These are formed from the solidification of basic lava, which contain low percentage of silica. Therefore, fluid spread vary fast to cover wide area before cooling down to solidify. These cones, which are flat, have many

gentle concave slopes and erupts without explosion. For example, the Hawaii type has the best-developed lava domes. In West Africa, volcanic cones are found in the Cameroun and Jos Plateau, Nigeria.

iii. Acidic Lava Dome

———These volcanic cones are formed from the accumulation and solidification of acidic lava which are viscous and contain high percentage of silica and therefore does not flow to cover an extensive area before cooling down to solidify to form lenticular dome-shaped mountains whose slopes are convex and very steep. The Central Maasif in Frances is an example.

iv. Composite Cones

———These are made up of ash and lava. They form the most imposing and the hardest volcanic mountains in the world, always fed with magma from a conduit below.

———These volcanoes usually have several major and minor vents through which magma and other materials are extruded. Mountain Sicily in Etna. Mountain Versuvis in Italy and Mountain Stromboli in the same location commonly referred to as the “Light House” of the Mediterranean are examples of composite cones. Composite volcanoes are also known as Strato volcanoes.

v. Multiple Volcanoes

———These are volcanoes that have several major vents. Prominent examples are found in New Zealand.

vi. Crater and Caldera

———When a volcano erupts the materials may collapse into the magma in the vent below. This gives rise to a wide opening or depression known as a crater, which may be several miles across. When rain falls, water collects in the depression to form a crater lake. For example, the great crater lake of Oregon, U.S.A, which is about 6 miles across with the Wizard Island at the middle and the Panyam Ccrater in Jos Plateau, ~~Northern~~ Nigeria near Panksh~~i~~ne. The crater lake of M~~m~~ountain ~~kilimajaroo~~Kilimanjaro in East African and L~~l~~ake Busumptusi in Ghana are other examples.

———A school of taught claims that the lake was formed as a result of water collection in a crater, while other school of taught claims that the lake was formed as a result of meteoritic depression. That is, meteoritic which falls from the sky and hit the surface of the land that results in the depression.

———A caldera is formed when a very destructive volcanic eruption or explosion occurs. Thus making materials at the sides to collapse into the depression below during each eruption. This result is a very wide, fairly shallow and gentle sided depression known as caldera which is much wider than a crater.

A crater is deeper and steeper inside than a caldera, while a caldera is wider, less shallow and gentle inside than crater. When rain falls and collects in a caldera, it forms a caldera lake. For example, lake Toba in Sumatra, the Katmair caldera lake in Alaska, U.S.A, which stretched over $2^{1}/_{2}$ miles across and the great crater lake of Oregon in U.S.A.

vii. Minor Volcanic Landforms

These include:

Solfatara

These are the volcanoes, which emit hot steams and sulphuric gases

Mud Volcanoes

These volcanoes emit hot steam, and mud and dust.

These above three examples of minor volcanic forms can be seen in Iceland, Greenland, Sicily and New Zealand

Fumaroles

These volcanoes emit hot steam and other types of gases apart from sulphur and carbon dioxide. For example, as in the valley of ten thousand slopes in Alaska, USA.

3.4 Impact of Volcanicity on Climate

The planet earth, on which we are living, is almost a circular body, having a radius of 6370km–. This entire 6370 km thickness of Earth can be divided into the following three major layers:

(i) The crust

(ii) The mantle

(iii) The core.

The interior of the Earth is extremely hot, as hot as about 1100^0C, which may be partly due to the amount of original heat left behind at the time of its formation, and partly due to the heat generated by radioactive elements present inside the Earth's crust. So much so, that in certain places, the interior crystal rocks exist in molten state. This molten material or liquid rock, heavily charged with gases and volatile substances existing below the Earth's surface, is called the magma. This magma differs from the molten rock in the same way as soda water differs from the ordinary water.

Due to the intense pressure inside the crust, the magma remains in a viscous state. But whenever, this pressure is released, because of the presence of fractures, fissures, and other weaker planes in the Earth's crust, the viscous hot matter melts, and injects up, along these weak

surfaces. When the cracks extend up to the surface, the magmatic matter also starts erupting over the ground; when after its extrusion, it is called the **lava.** The process of magma intrusion (i.e., movement of magma within the Earth's crust) and its eruption is known as the eruption of a volcano or a volcanism or volcanic activity.

———A frequently erupting volcano is known as an **active volcano;** one with rare eruptions is called a **dormant volcano;** while the volcanoes which have stopped their eruptions for a long geological time, are called the **extinct** or **dead volcanoes.**

———The volcanoes, thus, throw out molten material on the ground surface, which gets accumulated around the central opening or vent, forming a cone shaped mountain. Such mountains may largely vary in their height, ranging from a few hundred metres to thousands of metres. The eruption of volcanoes brings out large scale devastation of the nearby habitations as well as of the entire surrounding ecosystem. As a matter of fact, a volcano may throw out, with great force, the gaseous, liquid, as well as solid materials, causing large scale impact on environment and climate of the area.

———The **impacts of volcanic activity on climate** have been causing temporary cooling of the environment, but the impacts are only local or regional, but not global. Moreover, the changes in ecosystems and environment are reversible over a passage of time. Explosive eruptions emits huge quantities of gases and fine grained debris into the atmosphere which may remain there for months or years. This may filter out a portion of the incoming solar radiation which in turn will lower the temperature in the lower atmosphere.

4.0 Conclusion

In this unit, we examined volcanic eruption, intrusive and extrusive landforms as a result of volcanicity and its impact on climate.

5.0 Summary

A. Volcanicity refers to the processes by which molten magma escapes with great force through areas of weaknesses such as faults, joints and cracks.

B. Intrusive volcanic landforms include Dykes, sills, Locoliths, Lopoliths, Phacoliths, Batholiths and so on.

C. Extrusive volcanic landforms are gaseous, solid and liquid in nature.

D. The impact of volcanic eruption is mainly on the physical environment and other terrestrial bodies.

6.0 Tutor marked Assessment

1. List and discuss the intrusive volcanic landforms known to you.

2. Of what impact is volcanic activity on climate?

Self-exercise

What is volcanicity?

What are the external features of volcanicity?

7.0 References

Aziegbe, F. I. (2004). *The Basics of Geomorphology.* Nono Publishers. Benin City, Edo State

Chop, D. C. (2007). *A Synthesis of Physical Geography*. Joyce Publishers. Kaduna, Nigeria

Santosh, K.G. (2010). *Ecology and Environmental Studies*. Khanna Publishers, Indian.

Unit 3: Floods

1.0 Introduction

2.0 objectives

3.0 Main Body

3.1 Causes of Flooding

3.2 Types of Flooding

3.3 Effects of Flooding

3.4 Prevention and Control of floods

4.0 Conclusion

5.0 Summary

6.0 Tutor marked Assignment

1.0 Introduction:

Flood is a body of water that inundates normally dry lands. Most floods are harmful. They may destroy homes and properties and even wash away top soils, leaving the land barren for meaningful use.

2.0 Objective:

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

- Know the types of floods
- The causes of floods
- Effects of floods
- Means of prevention and control of floods

Main body

3.1 Causes of Flooding

From a geological perspective, floods are a natural consequences of stream flow in a continually changing environment. Floods have been occurring throughout earth history, and are expected so long as the water cycle continues to run. Floods are caused by the changing pattern of the water cycle.

A number of factors can contribute to flooding. Most of these factors are:

Heavy rainfall over a short period of time: When rain falls on the surface of the earth, some of the water is evaporated and returned to the atmosphere, some of it infiltrates the soil and moves downward into the ground water system, and some are intercepted by depressions and vegetation. What remains on the surface of the earth and eventually flows into streams is called runoff.

In general:

Runoff = precipitation – infiltration – interception - evaporation.

Evaporation tends to be the least of these quantities, particularly over short periods of time and thus precipitation, infiltration and interception are the most important variables that determine runoff and eventual discharge into streams. If rainfall is heavier than normal in a particular area and infiltration, interception and evaporation are low then runoff can be high.

Dam and levee failures: Dams occur as both natural and human constructed features. Natural dams are created by volcanic events, landslides, or blockage by ice. Human constructed dams are built for water storage, generation of electrical power and flood control. All types of dams may fail with the sudden release of water into the downstream drainage. Levee systems designed to prevent flooding can also fail. Both dams and levees failure can result to catastrophic flooding. For example, the St. Francis Dam near Saugus, California, failed in 1929 killing 450 people.

Natural factors: Areas around coastlines become subject to flooding as a result of tsunamis, hurricanes (cyclonic storms) and unusually high tides. In addition, long-term processes like subsidence and rising seas level as a result of global warming can lead to the encroachment of the sea on the land.

Drainage modification (urbanisation): Urban flooding occurs in towns located on flat or low lying terrain especially where little or no provision has been made for surface drainage or where existing drainage has been blocked with urban waste (refuse and eroded soil sediments). For example, the Ogunpa flood disaster that occurred in Ibadan, Nigeria in 1984 was caused by the blocking of waterways with refuse.

Destruction of wetlands: The destruction of wetlands may also contribute to moderate floods. The wetlands are the swampy lands along the edges of some rivers. When it rains, the wet soil and mud of a wetland acts like a sponge and stores the extra water. In the Niger Delta area of Nigeria for example, much of the wetland has been drained for oil and gas activities or for farmland. The only place floodwater can go is up and over its normal river banks and into areas where it can cause major damage.

Other causes of flooding are: Agricultural activities, topography of an area, lack of enough vegetal cover, soil type or geology of the area and adherence to land use pattern

3.2 Types of Flooding

River Flooding: Flooding along rivers is a natural and inevitable part of life. Some floods occur seasonally especially during the wet seasons. Torrential rains from decaying hurricanes or tropical systems can also produce river flooding.

Coastal Flooding: Winds generated from tropical storms and hurricanes or intense offshore low pressure systems can drive ocean water inland and cause significant flooding. Escape routes can be blocked off and blocked by high water. Coastal flooding can also be produced by earthquakes or volcanic activity.

Urban flooding: As land is converted from field or woodlands to roads or parking lots, it loses its ability to absorb rainfall. Urbanisz~~z~~ation increases runoff 2 to 6 times over what would occur on natural terrain. During periods of urban flooding, streets can become swift moving rivers, while basements can become death traps as they are filled with water.

Flash flooding: Flash floods occur within a few minutes or hours of excessive rainfall, a dam or levee failure, or a sudden release of water held by an ice jam. Flash floods can roll boulders, tear out trees, destroy buildings and bridges, and scour out new channels. Rapidly rising water can reach heights of 30 feet or more. Furthermore, flash flood-producing rains can also trigger catastrophic mud slides. There is not always a warming that these deadly and sudden floods are coming. Most flood deaths are due to flash flood. Several factors contribute to flash flooding. The two key elements are rainfall intensity and duration. Intensity is the rate of rainfall, and duration is how long the rain lasts. Topography, soil conditions, and ground cover also play important roles.

3.3 Effects of Flooding

Floods are among the most frequent and costly natural disasters in terms of human hardship and economic loss. As much as 90 percent of the damage related to all natural disasters (excluding drought) is caused by floods and associated debris flow.

Physical damage: Flood can roll boulders, tear out trees, destroy buildings and bridges. Economic losses occasioned by floods can be colossal. For

example, in the United States between 1992 and 2001; the economic loss of floods was put at 4.1 billion dollars annually. Also in Sokoto, Nigeria, the flood of 1987 was reported to have destroyed 85,–000 hectares of land estimated at 41 million naira.

Casualties: –People and livestock die due to drowning in floods. It also leads to epidemics and diseases. Between 1972 and 2001 an average of 127 people a year were reported killed by floods (mostly by flash floods) in the United States of America. In the Duguri flood in Borno State, Nigeria 200 people were reported killed.

Water supplies: –Floods may contaminate sources of drinking water and can also destroy sources of drinking water making clean drinking water scarce, especially if **sewerage** treatment plants are flooded.

Crops and food supply: –Flooding of farmland usually results in crop loss and reduction of food supply.

Disruption of electrical services: –Flooding may bring down electric poles, causing a major disruption in electricity supply.

Disruption in transportation systems: Roads may be blocked by flood water making vehicular movement difficult. Bridges and railways systems may be destroyed by flood water.

Erosion: Massive amounts of erosion can be accomplished by floodwater. The high velocity of flood waters allows the water to carry more sediment load. When the floodwater retreats, the sediments are left behind. Sediment deposited by flood waters could also help to increase agricultural productivity.

Job loss: Jobs may be lost due to the disruption of services, destruction of business (although jobs may be gained in the construction industry to help rebuild or repair flood damage).

Destruction of wildlife habitat: Floods may also destroy wildlife habitats.

3.4 Prevention and Control of floods

There are myriad of ways to prevent and control flood. The key action for effective control of flood lies in appropriate planning for regulating the use of flood-prone land.

Development of flood plains should be prohibited: Laws should be passed that restrict construction and habitation of flood plains. Existing developments that have enhanced flooding problems in an area should be demolished.

Channel modification: In order to construct roads, channel modification should involve increasing the channel cross sectional area so that higher discharge will not increase the stage of the river. In other words, by enlarging the cross-sectional area, higher discharge can be held within the channel.

Construction of dams: Dams can be used to hold water back so that discharge from downstream can be regulated at a desired rate. Constructed dams have spillways that can be opened to reduce the level of water reservoir behind the dam. Thus, the water level can be lowered prior to a heavy rain, and more water can be trapped in the reservoir and released later at a controlled discharge.

Construction of levees: Levees are embankments composed mainly of earthen materials that are used to prevent annual flooding.

Use of sandbags: Placing sandbags along the riverbeds and placing large rocks on banks to prevent erosion can also help in flood management. This process has a limit regarding the volume of water involve. Sandbags do not control or prevent flooding, when the volume and current of the water are unprecedented

Flood plain management: A non-structural approach to flood management will involve flood plain layout by government. Areas susceptible to flooding should be appropriately mapped out for government to buy the rights to the land.

Flood forecasting: Another non-structural approach will be the application of flood forecasting and installation of early warning systems that people can be informed well in advance of any impending floods.

Clearing drainage channels: Individuals should avoid clogging or blocking waterways and drainage channels with solid wastes.

4.0 Conclusion:

In this unit, we have learnt something about flood as a natural disaster. The types causes, effects, prevention and control of floods.

5.0 Summary:

Floods are defined as extremely high flows of river or any other water body, whereby water overflows its banks or confined water channels. The types of floods are river flooding, coastal flooding, urban flooding and flash flooding. The causes of flooding are heavy rainfall, dam and levee failure, urbanization, natural factor and the utilization of wetlands. The effects of flooding are loss of lives, destruction of transport systems, electrical services, farms lands, job losses, erosion and wildfire. Floods can be prevented and controlled by prohibition of flood main development, construction of dams, reservoirs, use of sand bags, floods for casting and the construction of retaining walls.

6.0 Tutor – Marked Assessment

1. (a) What is flood?

(b) List and discuss the possible causes of flood.

2. What are the steps we need to take in order to avert the negative impact of flooding?

7.0 References

Akpofure, Rim-Rukeh (2009). *Environmental Science: An Introduction*. Kraft Books Limited. Ibadan, Oyo State.

Cunningham, W.P. and (Cunningham, M. A. (2011) *Principles of Environmental Science. Inquiry and Applications*. Sixth Edition. McGraw Hill Publishers. United States.

Eseigbe, J.O. (2019). *Foundation Topics in Fluvial Geomorphology and Hydrology*. DD Concept Publishers, Ekpoma, Edo State.

Santosh Kumar Garg (2010). *Ecology and Environmental Studies*. Khanna Publishers. Indian

Unit 4: Droughts

1.0 Introduction

2.0 Objectives

3.0 Main Body

3.1 What is drought?

3.2 Economic Impact of drought

3.3 Social effects of droughts

3.4 Environmental losses of drought

3.5 Control of drought & desertification

4.0 Conclusion

5.0 Summary

6.0 Tutor Marked Assignment

7.0 References

1.0 Introduction

———The word drought is loosely used with that of desertification. Drought is the degradation of the land in arid, semi-–arid and sub humid dry areas caused by climatic change and human activities. Drought can turn productive land into non-productive one.

———The economic and environmental impact of drought include—–r Reduced crop yield, death of tree crops, fire, reduced pasture production, promotion of conflict between herders and farmers, increased solar radiation on the earth surface and physiological effects on plants.

———To combat drought, we need to have knowledge of the following facts: Land use planning system, terracing, mulching, control of livestock, use of good irrigation system and raising awareness among the citizenry.

2.0 Objectives

The objectives for this unit four is to enable the students to:

- know what is drought
- know the economic impact of drought
- know the social effects of drought
- the environmental losses because of drought
- understand the ways of controlling of drought

3.0 --- Main Body

3.1 What is drought?

A drought, usually, is not thought of as a natural disaster, like an earthquake, or a volcano, or a flood, or a fire, which are sudden and frightening events. This is because, a drought, unlike a tornado or an earthquake, usually does not have a sudden beginning or end. We can see a tornado and feel an earthquake, but we cannot see a drought. At the most, we can see the after-effects of a drought, because a drought occurs through a slow process of not getting sufficient water.

———A drought is said to be occurring at a place when the place does not get as much water as we expect or need, over a significant period of time. As it happens slowly, we only see its effects. A drought usually originates from a deficiency of precipitation (rainfall or snowfall) over an extended period of time, resulting in water shortage at some area. The shortfall in precipitation cannot be defined in terms of quantum, since a drought in Libya may occur when rainfall is much short of its average annual rainfall of 18cm for a continued number of years; while a drought in Mali may be said to be there, if rain does not fall after a period of only about 6 days.

———Since drought do not cause too many fatalities (deaths) as the people often migrate to other places, people do not realize that a drought is a very serious and costly natural hazard. As a matter of fact, the U.S. Federal Emergency Management Agency has estimated that droughts cost the United States an average loss of 6-8 billion dollars every year, making it the costliest natural disaster.

———As and when a drought occurs, it can have far-reaching impacts. That is because water is an important and essential requirement of all living beings. Even the abiotic world, like land and soil, need water to stay intact. All plants, animals and humans need water for their survival, besides its requirements for other human necessities and luxuries of life.

3.2 The Effects of drought

The effects of drought are multifaceted, affecting every area of human endeavor. Some of the effects of drought include: ~~such as political, economy and cultural as exemplified below:~~

Reduced crop yields: The most immediate consequence of drought is a reduction in crop production, due to inadequate and poorly distributed rainfall. Farmers are faced with harvesters that are too small to feed their families and fulfill their other commitment.

Death of tree roots: The effects of droughts are damage and death of trees. In the root system of a tree, feeder roots and roots hairs are responsible for the bulk of water supplies. As the soil dries, large portions of these roots will be at the risk of damage. When feeder roots and root hairs dry up and die, the plant eventually dies.

Heightened potential of wild land fires: Extended periods of dryness is a potential cause of wild land fires.

Physiological effects on plants: Drought triggers many changes in the metabolism, which can substantially alter the physiology of a plant. These changes include levels and types of hormones produced by the plant and alterations of basic processes such as photosynthesis. Drought also influences factors that determine the number of leaves that will emerge in every year, flower production and opening and closing of the stomata.

Heightened potential for pest attack on trees: For nearly all tree species, there are opportunistic insects and pathogens that take advantage of stressed trees. Wood boring insects such as bronze birch borer, two lined chestnut borer, and bark beetles noticeably increase during periods of drought. Spider mites, scales insects and lace bugs also increase. Pathogens that take advantage of weakened trees include canker diseases, vascular wilts, roots rots and wood rots. Stressed trees also show increased sensitivity to air pollutants, fungicides and pesticides.

Low rainfall causes poor pasture growth and may also lead to a decline in fodder supplies from crop residues. Insufficient levels of fodder around the village lead to weight loss and increased deaths among stock, especially where immigrant herds put further pressure on limited pastures.

Promotion of conflict between pastoralists and farmers: Drought affects food security of the people living in the affected areas. The most and frequent strategy of survival is for the people to move from the affected areas to an areas that are accessible in natural resources. This strategy often leads to conflict between different ethnic groups, families and individuals.

Increased reflection of solar radiation: Overgrazing and wood-cutting increase the surface albedo and disrupts the regional radiation balance. Surface heating declines as more solar radiation will be reflected and this in turn will cause some cooling of the atmosphere. This cooling encourages subsidence and helps to reduce the likelihood of precipitation by retarding convective activity.

The impacts of drought may be economic, environmental, and social:

The economic impacts of droughts include:

[(i)] Loss of crops and money to farmers, and reduction in ~~ed~~ business for all

(i)[(ii)] Loss of trees and timber, causing losses to the timber industry

(ii)[(iii)] Loss of business for those who manufacture and sell boats and fishing equipment, as they cannot see such items, because lakes will dry up.

(iii)[(iv)] Loss of business to those who deal on fisheries and related products.

(iv)[(v)] Loss of business to manufacturers, who manufacture goods required in agriculture like tractor manufacturers, or fertilizer manufacturers.

(v)[(vi)] Loss of business to those who deal on food processing activities.

(vi)[(vii)] Reduced navigability of rivers, leading or increased cost of transportation to be done by roads or railways.

(vii)[(viii)] Curtailed production of hydropower.

3.3 Social Effects of Drought

The social effects of droughts include:

(i) Large scale migration of people from drought-affected rural areas to urban areas
(ii) Loss of income, mental and physical stress
(iii) Health and nutritional problems
(iv) Famine, hunger, and all round chaos
(v) Loss of human life due to heat, hunger, depression, etc.

Usually, most of the environmental impacts of droughts remain temporary, as the damaged ecosystems recover and return to their original conditions, following the end of the drought. However, a few may linger on for somewhat longer time before returning to their original state. It would only be very rare, when some endangered species are completely lost.

3.4 Environmental losses of drought

The environmental losses of drought include:

(i) Losses or destruction of fish and wild life habitat
(ii) Lack of food, drinking water for humans, and animals
(iii) Increase in diseases in humans and wild animals, because of reduced food and water supplies.
(iv) Migration of wild animals in search of water to far off places, leading to loss of wild life in the drought-sticken areas, and presence of excess wild life in areas not affected by drought.
(v) Increased stress to endangered species, leading to their extinction and loss of biodiversity.
(vi) Loss of trees and other vegetation due to non-availability of water.
(vii) Loss of reservoirs, lakes and ponds

(viii) Reduced flow from streams and springs

(ix) Loss of wetlands

(x) Changes in salinity levels in estuaries

(xi) Increased ground water depletion, land subsidence, and reduced recharge

(xii) Reduced water quality in available nearby water sources, due to increased salt content, water temperature, pH, DO, and turbidity.

(xiii) Increased number of fires and loss of forests and human habitats

(xiv) Increased soil erosion due to winds and reduced soil air quality

(xv) Degraded landscape

3.5 Control of Drought

It is estimated that by 2025, 61 percent of the world's 3257 million hectares of productive dry land (i.e. lands where stock are grazed and crops grown without irrigation) will be severely desertified. The problem is clearly enormous. According to United Nations Conference for Combating Drought and Desertification, almost 25million tons of fertile soil disappears every year with one third of the planet's surface and over 2502 million people threatened by drought desertification. The following are some measures that can be employed to combat the effects of desertification and drought.

Good Land Use Planning: This should not only consider the best use of the land but also the carrying capacity of that land under a particular use. For example, placing restrictions on grazing and cultivation on a particular land based on the conditions in that particular area. Good land use planning would recognize that certain areas are best left as woodland and would prevent the clearing of that land for the expansion of cultivation or the provision of fuel wood.

Afforestation: This involves the planting of trees. Trees help to anchor the soil, act as wind breaks and absorb potentially damaging rainfall. However,

it should be started that drought-resistant plants such as D~~d~~**ogoyaro (Neem) and pines should be planted.**

Terracing: Erosion by surface runoff on steep slopes can be planted with grasses in rows along the contours of the hillside.

Alternative energy resource: The removal of trees for firewood and the subsequent damage to the land may be reduced if other types of fuel can be used. Another option is to use only the branches and not the whole tree, preserving the roots which help to bind the soil.

Control of livestock: Reducing numbers of livestock and the use of fencing to exclude grazing has been shown to be very effective in reducing the damage caused by overgrazing.

Weather forecasting: Through scientific and technological development, long-range drought forecasting can be carried out. This will help in preparing for any unforeseen harsh weather conditions.

Use of appropriate irrigation systems: Irrigation when appropriately managed will help to minimize sedimentation, salinization and water-logging.

Raising awareness: Raising awareness amongst the people will help in their response to government programmes. For example, June 17th of every year is a day observed annually throughout the world to combat drought.

4.0 Conclusion

———In this unit four, we examined what is drought, the economic and social impact of drought, the environmental losses as a result of drought, and the control mechanism of drought.

5.0 Summary

———A drought is said to be occurring at a place when the place does not get as much water as it is expected or needed, over a significant period of time.

———The economic impact of drought includes loss of valuable agricultural lands and crops, loss of business, reduced navigation of water amongst other. The environmental losses are: destruction of fish and wildlife, lack of food and water, loss of biodiversity, changes in salinity level and so on. On the other hand, the social effects of drought are loss of income, health and nutritional problems, farm, loss of human lives etc. And to combat drought, we need terracing, control livestock, weather forecast, creating awareness and good land use planning.

6.0 Tutor Marked Assessment

(1) List and discuss the methods we can adopt to ameliorate the impact of drought.

(2) What are the social and economic impact of drought?

7.0 References

Akpofure, Rim-Rukeh (2009). *Environmental Science: An Introduction*. Kraft Books Limited. Ibadan, Oyo State.

Santosh Kumar Garg (2010). *Ecology and Environmental Studies.* Khanna Publishers. Indian

Unit 5: Landslides and Avalanche

1.0 Introduction

2.0 Objective

3.0 Main Body

4.0 Conclusion

5.0 Summary

6.0 Tutor Marked Assessment

7.0 References

1.0 Introduction

A landslide is the movement of rock and soil down a slope. Landslides range in size from a single boulder in a rock fall to a debris avalanche, which may have huge volumes of rock and soil capable of covering many kilometers. The causes, prevention and the impact of landslides are discussed in this unit.

2.0 Objectives

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

- ~~Know~~ what landslides and Avalanches stand for
- The causes of slide hazards
- The p~~P~~revention and correction of landslides
- The impact of landslides.

3.0 Main Body

3.1 What is Landslide?

Slopes are the most common land forms, especially in hilly areas. Although most slopes appear stable and static, but they are actually dynamic systems, like rivers. Landslides are the natural phenomena that would occur with or without human activity. However, human use and interest has somewhere increased the chances of landslides, such as on hill side developments, because of over-steepening of slopes; and somewhere decreased the chances of landslides due to protective and stabilization measures adopted by man at fragile slopes.

———The word 'landslides', is actually used for rock-slides or rock-falls, caused by the movement of one solid rock mass over another. Other events, somewhat resembling the landslides, are earth flows (mud flows), and snow-slides called avalanches.

———A landslide or a rock slide, actually represents the movement of one solid mass over another. The weak or superficial mass fails along a definite failure plane, called the shear surface, or the slip surface.

———Rock slides, which represent the sliding of one rock mass over another, are very much susceptible to develop easily, if the planes of weakness (such as bedding or jointing) area parallel to the slope, and especially when the slope is undercut by a river.

3.2 The Causes of Landslides

Landslides have, in fact, been causing good enough loss of human life in the United States. Each year, about 25 people are killed by landslides; and this number increase to between 100 and 150 if we include collapse of trenches and other excavations also, which, in fact, are not strictly landslides, but earth-slides.

Water and vegetation are the two important factors that influence landslides. Chemical action of water gradually causes chemical weathering of rocks, making them prone to landslides. Vegetation, on the other hand,

consolidates the slope material, provides cohesion by its root system, and also retards the flow of water and its erosion capacity. Human activities such as mining and removal of trees have also been found to cause landslide.

The landslides can also be accelerated by earthquakes, vibrations or saturation of the unconsolidated sediments with water. The road or house building activities near the standing slopes may also cause land-slides. The steeper slopes are more susceptible to landslides. The major causes of landslides are: Internal property of the earth materials, the geomorphic setting of the environment and independent external factors.

3.3 Prevention and correction of landslides

It is usually difficult to prevent landslides. However, they can be controlled and minimized by stabilizing the hill slopes when we adopt the following measures:

i. By providing proper drainage of water through the rocks;

ii. By providing stone lining on fragile slopes of unconsolidated material;

iii. Mapping the area

iv. Evaluating man’s influence on land

v. Identifying and recognizing slide prone areas

vi. Adopting land use zoning method

In the correction of landslides, the following methods could be used:

i. The cut slope angle could be flattened to increase its stability

iiX. The use of retaining structure like concrete walls, pilings and so on. Could be constructed

iiiX. Unstable materials could be totally or partially removed from slopes

iv.X The use of rock bolts to hold unstable rocks to stable ones

v.X Ground water pressure can be decreased in an unstable area to increase stability.

3.4 The impact of landslides

While a smaller and moderate landslides, blocking traffic-way may offer some mild local environmental challenges, as it may result in destruction of some trees existing on the sliding rock mass, and killing of a few humans and animals trapped in the falling rocks and debris; but severe landslides may create lots of environmental problems, particularly if a landslide happens to block a flowing river, thereby creating an unplanned and unsafe dam type structure across the river, leading to collection of water upstream. Such collection of water may not only flood and submerge the upstream area, but may even destroy and damage the entire river's ecosystem, besides resulting into the huge loss of forest existing on the slidedslide rocks. Moreover, such a temporary obstruction is likely to breach at any time, leading to release of huge quantity of pounded up water, bringing floods and consequential destruction downstream.

Avalanche is a mass of snow that slides down a mountain slope. Most avalanches result from weather conditions that cause snow on a mountain slope to become unstable. Such disturbances, like heavy winds, earth tremors, and explosions can send the snow sliding down the mountain. Even humans, during their skying operation, have started many avalanches.

———Three kinds of avalanches have been recogniszed; i.e. (i) dry snow avalanche; (ii) wet snow avalanche and (iii) slab or solid avalanche.

———A dry snow avalanche consists of powdery snow and air that may move down faster than 150km/h or so. A wet snow avalanche is a mass of wet dense snow that typically moves slower than a dry snow avalanche. In a solid avalanche, a solid portion of snow breaks loose, as a slab, and splits into pieces as it slides.

———Experts can often recognisze the conditions that lead to avalanches by studying the terrain, snow weather in an area. To help control avalanches, they use explosives to reduce snow build ups. They also replant trees on slopes and erect barriers

4.0 Conclusion

Landslides are now common in our society today because of the need for man to explore natural resources. While some are man induced, most the landslides are also caused naturally.

5.0 Summary

Landslides are earth or rock materials flowing in a cliff. The causes of landslides range from weak geology of the area involve, external factors such as flooding, farming, mining etc. The preventive measures are the use of rock bolts, evaluation of man's influence on land, land use zoning system and so on.

6.0 Tutor Marked Assessment

1. (a) What do we mean by landslides?

(b) Discuss the causes and the impact of slide hazards

7.0 References

Akpofure, Rim-Rukeh (2009). *Environmental Science:, An Introduction*. Kraft Books Limited. Ibadan, Oyo State.

Cunningham, W.P. and (Cunningham, M. A. (2011) *Principles of Environmental Science. Inquiry and Applications*. Sixth Edition. McGraw Hill Publishers. United States.

Praveen, K. P., Subha, G. and Rajesh, W. (2017). Environmental Pollution and Safety Measures: International Issues and Its Global Impact in *Global Progress in Development of Sustainable Environment*. Discovery Publishing House PVT.Ltd. India.

Santosh Kumar Garg (2010). *Ecology and Environmental Studies.* Khanna Publishers. Indian

Suresh, K. Dhameja (2013). *Environmental Science.* S.K. Kataria and Sons Publishers. India.