



**NATIONAL OPEN UNIVERSITY OF NIGERIA**

**FACULTY OF HEALTH SCIENCES**

**DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCES**

**COURSE CODE: EHS 415**



**COURSE TITLE: PUBLIC UTILITIES AND ENVIRONMENTAL  
HEALTH ISSUES**



## **EHS 415: PUBLIC UTILITIES AND ENVIRONMENTAL HEALTH ISSUES**

### **Course Team**

Course Developer/Writer:

Assoc. Prof. A.O OLALUBI  
Kwara State University (Kwasu)

Course Editor:

Assoc. Prof. A. S. Dan-kishiya  
Department of Biological Sciences  
University of Abuja

Course Coordinator:

Professor Grace C. Okoli-Nnabuenyi  
HOD, Dept. of Environmental Health Science  
Faculty of Health Sciences  
National Open University of Nigeria

Programme Coordinator:

Professor Grace C. Okoli-Nnabuenyi  
Dean, Faculty of Health Sciences  
National Open University of Nigeria

National Open University of Nigeria

Headquarters

91 Cadastral Zone

Nnamdi Azikiwe Expressway,

Jabi Abuja

Nigeria

**Abuja Annex**

**245 Samuel Adesujo Ademulegun Street**

**Central Business**

**District Opposite**

**Arewa Suites Abuja**

**E-mail: [centralinfo@nou.edu.ng](mailto:centralinfo@nou.edu.ng)**

**URL: [www.nou.edu.ng](http://www.nou.edu.ng)**

**National Open University of Nigeria 2018**

**First Printed 2018**

**ISBN:**

**All Rights Reserved**

**Printed by.....**

**For**

**National Open University of Nigeria**

**Headquarters**

**91 Cadastral Zone**

**University Village**

**Nnamdi Azikiwe Express Way**

**Jabi, Abuja**

**e-mail:**

**[centrainfo@nou.edu.ng](mailto:centrainfo@nou.edu.ng)**ur/:

**[www.nou.edu.ng](http://www.nou.edu.ng)**



<b>CONTENTS</b>	<b>PAGE</b>
Course synopsis.....	
What you will Learn in this Course.....	
Course Objectives.....	
Working through this course.....	
The Course Material.....	
Study Unit.....	
Assignment file.....	
Presentation Schedule.....	
Assessment.....	
Tutor-Marked Assignment.....	
Course Marking Scheme.....	
Course Organization.....	
Facilitators / Tutors and Tutorials.....	
Summary.....	
Introduction.....	
Textbooks and References.....	

## **COURSE SYNOPSIS**

*EHS 415: Public Utilities and Environmental Health Issues* is a two (2) unit course with three (3) modules and eleven (11) units. The course comprises of introduction to public utilities and its components, what are public utilities? Public Vs. Private utilities in developed and developing world; Reforms and transformations in Public Utilities; Benefits of Public Utility in Nigeria; Core responsibilities and challenges confronting public utilities companies. The course also addresses concept of rural social determinants of health; topical environmental health issues among such includes water supply and distribution, drainage, sewage and treatment of sewage, sanitation, air pollution, power supply, fire services, environmental emergencies, disaster management, climate change and energy and biodiversity.

## **WHAT YOU WILL LEARN IN THIS COURSE**

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

## **COURSE OBJECTIVES**

The comprehensive objectives of the course are stated below. By the end of the course/after going through this course, you should be able to:

- i.** Define public utilities?
- ii.** Understand the concept of public utilities and its components,
- iii.** Explain reforms and transformations in Public Utilities
- iv.** Highlight benefits of Public Utility in Nigeria;
- v.** Discuss core responsibilities and challenges confronting Public Utilities
- vi.** Unravel the relationship between rural social determinants of health and health outcome.

- vii.** Discuss in details, some topical environmental health issues among such includes, water supply and distribution, drainage, sewage and treatment of sewage, sanitation, air pollution, power supply, fire services, environmental emergencies, climate change, biodiversity etc.,

## **WORKING THROUGH THIS COURSE**

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

## **THE COURSE MATERIALS**

The main components of the course are:

- The Study Guide
- Study Units
- Reference / Further Reading
- Assignments
- Presentation Schedule

## **STUDY UNITS**

The study units in this course are given below:

### **MODULE 1 CONCEPT OF PUBLIC UTILITIES**

- |        |                                                                |
|--------|----------------------------------------------------------------|
| Unit 1 | What are Public Utilities? Concept of Public Utilities         |
| Unit 2 | Public utilities and its encompassing components               |
| Unit 3 | Public Vs. Private utilities in developed and developing world |

## **MODULE 2 REFORMS, CORE RESPONSIBILITIES OF PUBLIC UTILITIES AND RURAL SOCIAL DETERMINANT OF HEALTH**

- Unit 1 Reforms, transformation and benefits of Public Utility in Nigeria
- Unit 2 Core responsibilities and challenges confronting public utility companies
- Unit 3 Rural social determinants of health

## **MODULE 3 CONCEPT OF ENVIRONMENTAL HEALTH AND OTHER TROPICAL CURRENT ENVIRONMENTAL HEALTH ISSUES**

- Unit 1 Water supply and distribution, drainage, sewage and treatment of sewage
- Unit 2 Sanitation, air pollution, power supply
- Unit 3 Fire services, climate change and energy
- Unit 4 Environmental emergencies and disaster management
- Unit 5 Biodiversity and environment

### **ASSIGNMENT FILE**

There are two types of assessments in this course. First are the Tutor-Marked Assessments (TMAs); second is the written examination. In solving the questions in the assignments, you are expected to apply the information, knowledge and experience acquired during the course. The assignments must be submitted to your facilitator for formal assessment in accordance with prescribed deadlines stated in the assignment file. The work you submit to your facilitator for assessment accounts for 30 percent of your total course mark. At the end of the course, you will be required to sit for a final examination of 1½ hours duration at your study centre. This final examination will account for 70 % of your total course mark.

### **PRESENTATION SCHEDULE**

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

### **ASSESSMENT**

There are three aspects to the assessment of this course. The first one is the self-assessment exercises. The second is the tutor marked assignments and the third is the written



examination or the examination to be taken at the end of the course. Do the exercises or activities in the unit by applying the information and knowledge you acquired during the course. The tutor-marked assignments must be submitted to your facilitator for formal assessment in accordance with the deadlines stated in the presentation schedule and the assignment file. The work submitted to your tutor for assessment will count for 30% of your total course work. At the end of this course, you have to sit for a final or end of course examination of about two hour duration which will count for 70% of your total course mark.

### **TUTOR-MARKED ASSIGNMENTS**

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

1. Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you are not able to complete your assignment, make sure you contact your facilitator before the assignment is due to discuss the possibility of an extension. Request for extension will not be granted after the due date unless there is an exceptional circumstance.
2. Make sure you revise the whole course content before sitting for the examination. The self-assessment activities and TMAs will be useful for this purposes and if you have any comment please respond before the examination. The end of course examination covers information from all parts of the course.

**Table 1: Course Marking Scheme**

<b>Assignments</b>	<b>Marks</b>
Assignments 1 – 4	Four assignments, best three marks of the four count at 10% each = 30% of Course marks.
End of course examination	70% of overall course marks
<b>Total</b>	<b>100% of course materials</b>

**Table 2: Course Organisation**

<b>Unit</b>	<b>Title of Work</b>	<b>Weeks Activity</b>	<b>Assessment (End of Unit)</b>
	<b>Course Guide</b>	<b>Week</b>	
<b>1</b>	What are Public Utilities? Concept of Public Utilities.	Week 1	Assignment 1
<b>2</b>	Public utilities and its encompassing components.	Week 2	Assignment 2
<b>3</b>	Public Vs Private utilities in developed and developing world.	Week 3	Assignment 3
<b>4</b>	Reforms and transformations in Public Utilities; Benefits of Privatization of Public Utilities Companies.	Week 4	Assignment 4
<b>5</b>	Core responsibilities and challenges confronting public utilities companies.	Week 5	Assignment 5
<b>6</b>	Rural social determinants of health	Week 6	Assignment 6
<b>7</b>	Concept of environmental health i.e., water supply and distribution, sewage and treatment of sewage, drainage	Week 7	Assignment 7
<b>8</b>	Other topical current environmental health issues i.e., sanitation, air pollution and power supply.	Week 8	Assignment 8
<b>9</b>	Fire services, climate change and energy	Week 9	Assignment 9
<b>10</b>	Environmental emergencies and Disaster Management	Week 10	Assignment 10
<b>11</b>	Environmental biodiversity	Week 11	Assignment 11

### **HOW TO GET THE MOST OUT OF THIS COURSE**

In distance learning, the study units replace the university lecturer. This is one of the huge advantages of distance learning mode; you can read and work through specially designed study materials at your own pace and at a time and place that suit you best. Think of it as reading from the teacher, the study guide tells you what to read, when to read and the relevant texts to consult. You are provided exercises at appropriate points, just as a lecturer might give you an in-class exercise. Each of the study units follows a common format. The first item is

an introduction to the subject matter of the unit and how a particular unit is integrated with the other units and the course as a whole. Next to this is a set of learning objectives. These learning objectives are meant to guide your studies. The moment a unit is finished, you must go back and check whether you have achieved the objectives. If this is made a habit, then you will significantly improve your chances of passing the course. The main body of the units also guides you through the required readings from other sources. This will usually be either from a set book or from other sources. Self-assessment exercises are provided throughout the unit, to aid personal studies and answers are provided at the end of the unit. Working through these self-tests will help you to achieve the objectives of the unit and also prepare you for tutor marked assignments and examinations. You should attempt each self-test as you encounter them in the units.

### **Practical Strategies for Working through the Course**

1. Read the Course Guide thoroughly.
2. Organize a study schedule. Refer to the course overview for more details. Note the time you are expected to spend on each unit and how the assignment relates to the units. Important details, e.g. details of your tutorials and the date of the first day of the semester are available. You need to gather together all these information in one place such as a diary, a wall chart calendar or an organizer. Whatever method you choose, you should decide on and write in your own dates for working on each unit.
3. Once you have created your own study schedule, do everything you can to stick to it. The major reason that students fail is that they get behind with their course works. If you get into difficulties with your schedule, please let your tutor know before it is too late for help.
4. Turn to Unit 1 and read the introduction and the objectives for the unit.
5. Assemble the study materials. Information about what you need for a unit is given in the table of contents at the beginning of each unit. You will almost always need both the study unit you are working on and one of the materials recommended for further readings, on your desk at the same time.
6. Work through the unit, the content of the unit itself has been arranged to provide a sequence for you to follow. As you work through the unit, you will be encouraged to read from your set books.

7. Keep in mind that you will learn a lot by doing all your assignments carefully. They have been designed to help you meet the objectives of the course and will help you pass the examination.
8. Review the objectives of each study unit to confirm that you have achieved them. If you are not certain about any of the objectives, review the study material and consult your tutor.
9. When you are confident that you have achieved a unit's objectives, you can start on the next unit. Proceed unit by unit through the course and try to pace your study so that you can keep yourself on schedule.
10. When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments, both on the tutor-marked assignment form and also that written on the assignment. Consult your tutor as soon as possible if you have any questions or problems.
11. After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in this course guide).

### **FACILITATORS / TUTORS AND TUTORIALS**

Sixteen (16) hours are provided for tutorials for this course. You will be notified of the dates, times and location for these tutorial classes. As soon as you are allocated a tutorial group, the name and phone number of your facilitator will be given to you.

These are the duties of your facilitator: He or she will mark and comment on your assignment. He will monitor your progress and provide any necessary assistance you need. He or she will mark your TMAs and return to you as soon as possible. You are expected to mail your tutored assignment to your facilitator at least two days before the schedule date. Do not delay to contact your facilitator by telephone or e-mail for necessary assistance if you do not understand any part of the study in the course material. You have difficulty with the self-assessment activities. You have a problem or question with an assignment or with the grading of the assignment. It is important and necessary you attend the tutorial classes because this is the only chance to have face to face contact with your facilitator and to ask questions which will be answered instantly. It is also a period where you can say any problem encountered in the course of your study.

## **SUMMARY**

The course *EHS 415: Public Utilities and Environmental Health Issues* is a two (2) unit course with three (3) modules and eleven (11) units. It comprises of introduction to public utilities and its encompassing components. It provides in-depth insight to what are public health utilities. Differentiate between Public and Private Utilities in developed and developing world. Effort was also devoted to explain reforms and transformations in Public Utilities. It is an application of utility measurement in public health, and in decision making. The course also discuss concept of rural social determinants of health, topical environmental health issues such as water supply and distribution, sewage and treatment of sewage, drainage, sanitation, air pollution, power supply, fire services, environmental emergencies, climate change and biodiversity. On completion of this course, you will have an understanding of basic knowledge of public utilities and topical environmental health issues in Nigeria. In addition you will be able to answer the following questions:

1. Define the term public utilities
2. List some components of public utilities
3. Differentiate between Public and Private Utilities in developed and developing world.
4. Discuss reforms and transformations in Public Utilities.
5. Highlight the benefits of Privatization in Nigeria
6. Explain the relationship between rural social determinants of health and environmental health.
7. Highlight and discuss topical environmental health issues such as water supply and distribution, sewage and treatment of sewage, drainage, sanitation, air pollution, power supply, fire services, environmental emergencies, climate change and biodiversity.

Finally, you are expected to apply the knowledge you have acquired during this course to improve your professional deliverables and entrepreneurship drive in pending future.

**I wish you success in this course.**

Course Code: EHS 415

Course Title: PUBLIC UTILITIES AND ENVIRONMENTAL HEALTH ISSUES

Course Developer/Writer: Assoc. Prof. A.O OLALUBI  
Kwara State University (KWASU)

## CONTENTS

## PAGE

### **MODULE 1 CONCEPT OF PUBLIC UTILITIES**

- Unit 1 What are Public Utilities? Concept of Public Utilities.....
- Unit 2 Public utilities and its encompassing components.....
- Unit 3 Public Vs. Private utilities in developed and developing world.....

### **MODULE 2 REFORMS, CORE RESPONSIBILITIES OF PUBLIC UTILITIES AND RURAL SOCIAL DETERMINANT OF HEALTH**

- Unit 1 Reforms, transformation and benefits of Public Utility in Nigeria.....
- Unit 2 Core responsibilities and challenges confronting public utility companies...
- Unit 3 Rural social determinants of health.....

### **MODULE 3 CONCEPT OF ENVIRONMENTAL HEALTH AND OTHER TROPICAL CURRENT ENVIRONMENTAL HEALTH ISSUES**

- Unit 1 Water supply and distribution, drainage, sewage and treatment of sewage....
- Unit 2 Sanitation, air pollution, power supply.....
- Unit 3 Fire services, climate change and energy.....
- Unit 4 Environmental emergencies and disaster management.....
- Unit 5 Biodiversity and environment.....

## **MODULE 1 CONCEPT OF PUBLIC UTILITIES**

- Unit 1 What are Public Utilities? Concept of Public Utilities
- Unit 2 Public utilities and its encompassing components
- Unit 3 Public Vs. Private utilities in developed and developing world

### **UNIT 1: CONCEPT OF PUBLIC UTILITIES**

#### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Public utilities; definition
  - 3.2 Services of public utilities
  - 3.3 Utility networks
  - 3.4 State of public utilities in Nigeria
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

#### **1.0 INTRODUCTION**

Utility is an infrastructure that refers to all basic inputs into and requirements for the proper functioning of the economy and those that enhance the standard of living of the populace. It has two generally accepted groups of utility, namely, economic and social. Economic utility is at a given point in time part of an economy's capital stock to ease economic production or serve as inputs to production (e.g. electricity, roads, and telecommunication). Social utility encompasses services such as health, education and recreation, water and sanitation which have direct and interactive impact on the quality of life. Together, both groups affect the level of productivity of the economy.

#### **2.0 OBJECTIVE:**

At the end of this unit, students should be able to highlight and discuss succinctly:

- (a) Concept of public utilities.

(b) Services provided by public and private utilities

### **3.0 MAIN CONTENT**

#### **3.1 Public utilities; definition**

The term *public utilities* refer to the collection of specific services provided by public and private organizations and institutions that make up the public services industry.

Succinctly, the term public utilities also refers to the large group of public service organizations that exist to locate, produce or collect, transmit, distribute and/or process and store, a variety of products and services that are vital to sustenance of modern life. These products and services are ubiquitous. They include the electric energy that lights our workspaces and powers computers, appliances, and motors in offices, stores, factories, and homes. These services also include the natural gas we use to heat our residences, cook our meals, and supply raw material for industrial processes. And, they include the water we drink and the treatment and disposal of our wastewater and household and commercial waste, including the organizations that collect, process, and store our solid and liquid waste, including toxic waste.

Also included are the many organizations that provide some aspects of public transportation and/or storage are also classified as public utilities. It was government regulation of this class of activity i.e., transportation of the public waterways and railroads that were among the first public utility industries to be brought under government regulation.

#### **3.2 Services of public utility**

At the broadest level, the services provided have been long been denominated according to the essential services they perform. These includes (1) public transportation, (2) communication services, (3) energy for light, heat and refrigeration services, (4) water, wastewater, drainage, flood protection, and irrigation, and (5) resource conservation through solid and hazardous waste collection and disposal. The products or services provided by the public utility industry include electrical energy, natural gas, water, sanitation, waste disposal and recycling, communications, public rail and bus transportation, and certain types of storage facilities, including public warehouses, and grain elevators, among others. In brief, these are the organizations and institutions that build and maintain the nation's critical infrastructure while providing the essential services necessary for modern civilization.



“The term ‘public utility’ encompasses a wide variety of industries including, among others, airlines, telecommunications (broadband internet services (both fixed-line and mobile) are increasingly being included within the definition, oil, natural gas, electricity, trucking, cable television (water and wastewater, solid waste collection and disposal, and public transit). These industries share a common ‘network’ structure, in that they have an extensive distribution system of lines, pipes, or routes requiring the use of public rights of way, often with strong physical linkages between component parts. In some cases, such as airlines, government owns a part of the infrastructure. Public utilities typically have substantial sunk costs because of their extensive infrastructure. Historically, utilities, where privately owned, have been rate-of-return regulated. Utilities are government-owned in some jurisdictions. In almost all cases, utilities have been granted legally enforced monopolies over their service territories.

### **3.3 Utility networks**

Utilities typically create a good or service at one location, and then distribute it over a ‘network’ where it is delivered to numerous customers for end use. The use of a network structure creates special issues for utilities. The network often exhibits economies of scale and involves substantial sunk costs, so the issue of natural monopoly has played an important role in utility literature. The network may require the use of public streets or other rights of way, so government involvement is of particular concern.

Since several firms often utilize the network, there are ‘network externalities’ or congestion if its use is not properly priced. The activities of utilities can be broken down into three components: production, transmission, and distribution. While the production component has, in the U.S., been almost exclusively privately owned, the transmission and distribution stages have been either private or government-owned.

### **3.4 State of public utilities in Nigeria**

Efficient provision of reliable electricity, telephone, water, and in the sector have reached crisis proportions as the electricity power system collapse became prominent and power supply has become increasingly erratic. Water taps also remain dry for most of the time, while the performance of telecommunication and postal services remain very unsatisfactory.

The protracted problem of the utility sector has imposed extremely high costs on the economy. Certainly, the unreliable but increasingly more expensive utility services since the advent of the Structural Adjustment Program (SAP) has contributed substantially to lowering

the quality of life and well-being of the average Nigerian who, over the past four decades, has become more and more impoverished. In response to these shortages, many businesses and households have resorted to self provision, often at high cost.

Relief from the failure of public providers often comes through the informal sector. The best-known examples are private water vendors who use trucks or smaller receptacles to haul water either for distribution at central locations or to individual dwellings. In some places, private vendors served 90 percent of households, and in several places purchases of water from private sources amounted to more than 30 percent of household income. It is important to note that a very large proportion of poor households cannot afford the cost of water from these private sources and has to resort to drawing water from streams and other unhygienic sources. It is against this background that agitation has mounted for private sector involvement in the provision of utility.

#### **4.0 CONCLUSION/SUMMARY**

Public utilities are the collection of specific services provided by public (government) and private organizations and institutions that make up the public services industry. Services include production, transmission, and distribution of products.

#### **5.0 Tutor-marked Assignment**

- a. Define Public utilities
- b. What are the various services provided by the public utilities?

#### **6.0 References/Further reading**

Public utility - Definition. Merriam-Webster Dictionary. Archived from the original on 2011-11-05. Retrieved 2011-10-11.

Public utility definition". Investorwords.com. Archived from the original on 2011-09-28. Retrieved 2011-10-11.

## **UNIT 2: PUBLIC UTILITIES AND ITS ENCOMPASSING COMPONENTS**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Classification of public utilities
  - 3.2 Rates/Charges of public utilities
  - 3.3 Components of public utilities
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

### **1.0 INTRODUCTION/DEFINITION**

A public utility is a business that furnishes an everyday necessity to the public at large. Public utilities provide water, electricity, natural gas, telephone service, and other essentials.

### **2.0 OBJECTIVE**

At the end of this unit, students should be able to understand and explain in details:

- (a) Public utilities and its components
- (b) Public utility services and national development

### **3.0 MAIN CONTENT**

#### **3.1 Classification of public utilities**

Utilities may be publicly or privately owned, but most are operated as private businesses. Typically a public utility has a monopoly on the service it provides. It is more economically efficient to have only one business provide the service because the infrastructure required to produce and deliver a product such as electricity or water is very expensive to build and maintain. A consequence of this monopoly is that federal, state, and local governments regulate public utilities to ensure that they provide a reasonable level of service at a fair price.

### 3.2 Rates/Charges of public utilities

A public utility is entitled to charge reasonable rates for its product or service. Rates are generally established according to statutes and regulations. The utility usually files a proposed rate schedule with the state public utility commission for approval. The commission holds public hearings to help decide whether the proposed schedule is fair. The commission may also require increased levels of service from the utility to meet public demand. Public utility industries are characterized by economies of scale in production.

Private utility companies would make decisions that are most profitable for them. Such decisions generally involve too high prices and relatively little service compared to competitive conditions. These decisions may or may not be in the best interests of the society. The government or the society would like to see these services being economically accessible to all or most of the population. Not all utility companies are in the private sector.

In many countries, utilities are owned by the government. Generally, in these cases, the government creates autonomous bodies for government utilities to prevent them from day-to-day political interference. In such instances, the government utilities' goals are better aligned with societal goals; however, they tend to be less efficient than their private sector counterparts.

### 3.3 Components of public utilities



#### **4.0 CONCLUSION/SUMMARY**

Utilities are publicly or privately owned, but most are operated as private businesses. A public utility is entitled to charge reasonable rates for its product or service and either federal, state, or local governments regulate public utilities to ensure that they provide a reasonable level of service at a fair price.

#### **5.0 TUTOR-MARKED ASSIGNMENT**

What are the components of public utility?

How are the components linked or connected?

#### **6.0 REFERENCES/FURTHER READING**

"investor-owned utility (IOU), private utility, private power company".

www.energyvortex.com. Archived from the original on 2 February 2017. Retrieved 8 May 2018.

"Electric Utilities". www.utilityconnection.com. Archived from the original on 27 October 2017. Retrieved 8 May 2018.

Pentland, William. "Investor-Owned Utilities: Asleep at the Switch or Above the Law?". forbes.com. Archived from the original on 29 July 2017. Retrieved 8 May 2018.

Mike I. Obadan· Privatization of public utilities in Nigeria CBN Economic & Financial Review, Vol. 42, NO. 4

## **UNIT 3: PUBLIC VS PRIVATE UTILITIES IN DEVELOPED AND DEVELOPING WORLD**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Background to differences in utilities in developing and developed world
  - 3.2 Natural monopoly of public utilities
  - 3.3 Factors determining differences between utilities
  - 3.4 Public and private utilities in developed countries
  - 3.5 Differences between utilities
  - 3.6 Reasons for the differences between utilities
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

### **1.0 INTRODUCTION/DEFINITION**

In the United States, public utilities are often natural monopolies because the infrastructure required to produce, and deliver product such as electricity or water is very expensive to build and maintain. As a result, they are often government monopolies, or if privately owned, the sectors are specially regulated by a public utilities commission.

### **2.0 OBJECTIVE**

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

- a. Analyse the differences between public and private utilities.
- b. Discuss the merits and demerits of public and private utilities.

### **3.0 MAIN CONTENT**

#### **3.1 Background to differences in utilities in developing and developed world**

The first public utility in the United States was a grist mill erected on Mother Brook in Dedham, Massachusetts in 1640. Developments in technology have eroded some of the

natural monopoly aspects of traditional public utilities. For instance, electricity generation, [electricity retailing](#), [telecommunication](#), some types of public transit and postal services have become competitive in some countries and the trend towards [liberalization](#), [deregulation](#) and [privatization](#) of public utilities is growing. However, the infrastructure used to distribute most utility products and services has remained largely monopolistic. Public utilities can be [privately owned](#) or [publicly owned](#). Publicly owned utilities include cooperative and municipal utilities. [Municipal](#) utilities may actually include territories outside of city limits or may not even serve the entire city. [Cooperative utilities](#) are owned by the customers they serve. They are usually found in [rural](#) areas. Publicly owned utilities are non-profit. Private utilities, also called investor-owned utilities, are owned by [investors](#), and operate for profit, often referred to as a rate of return.

### **3.2 Natural monopoly of public utilities**

A fundamental economic principle that differentiates utilities from all other forms of economic organizations is that of the natural monopoly. Natural monopolies occur when a single firm is able to supply a market at a cost and price far lower than would be possible if several firms served the market. The concept of utilities being a natural monopoly came into general use during the Progressive Era reform movement, when the federal government began its first experiments with ways to control the perceived excesses of the very large and growing businesses, cartels, trusts, and early utilities.

### **3.3 Factors determining differences between utilities**

Two key factors which distinguish the majority of the utility industry from other economic endeavors are:

1. Elements of the utility industry operate under socially-sanctioned conditions of monopoly competition and
2. One or more element of the organizations' operations or supply chain are regulated by one or more levels of government.

### **3.4 Public and private utilities in developed countries**

- ❖ U.S. laws require that regulated businesses be managed in ways different in many respects from that of the non-regulated businesses. For example, management decisions

in regulated businesses are often subject to public oversight at public utility commission hearings. Public policy and public opinion expect different conduct in many managerial matters, including the setting of prices, the mandate to meet all service-area demand, and restrictions on allowed operating profits, among others.

- ❖ Because public utilities provide essential public services that are considered to be endowed with a public interest, utilities management requires both public and private sector management knowledge.
- ❖ Market economies must often balance conflicting social and private interests. This is paramount in the utility industry, where there exists a variety of conditions under which economic activities take place.
- ❖ At one end of the range of conditions are the privately owned, non-regulated businesses that range in size from General Electric and General Motors to the independent corner grocery store. At the opposite end of this continuum are the government-owned organizations such as the U.S. Post Office, TVA, and Bonneville Power; extreme examples at this pole include the nationalized industries that were often found in many Third World countries, the Soviet Bloc of nations, and socialist economies such as were found in Great Britain, Sweden, New Zealand, and others. Municipally owned and operated utilities are near to this tradition of public ownership.
- ❖ Somewhere between the opposite poles of this economic continuum are free-enterprise businesses such as banks, investment brokers, and insurance companies that are subject to varying degrees of special economic regulation.
- ❖ Also in this group are the privately owned public utilities; these have been on the receiving end of the most complete government regulation of any industry in the group. These regulated industries are a diverse group of public service organizations ranging in size and scope from multinational, vertically integrated energy corporations to local water and power cooperatives. These utilities have been subject to government regulation at either the federal, state, or local, or all three levels at once.
- ❖ Most energy utilities and waste collection operations are privately owned businesses—commonly referred to as investor-owned utilities (IOUs).
- ❖ On the other hand, local governments own most of the nation's water, wastewater, and solid waste disposal site utilities.
- ❖ These governments may operate the utility themselves, or they may contract with private operators for day-to-day operations; in either case, government utility may also contract



with private firms to perform their billing and customer service functions, among others.

### **3.5 Differences between utilities and other business organizations**

Public utilities differ from other business organizations in many other ways.

1. Utilities are legally required to serve all customers in their market area without discrimination;
2. They are generally neither exclusively profit or non-profit; a mix of both types of organizations exist, often side-by-side;
3. Utility income often includes a mix of earnings from rates charged customers, stocks and bonds, and/or taxes;
4. Utilities are economic organizations because there is a cost to produce and a price for supply of the products, regardless of what form of ownership or governance that characterizes the organization involved in the industry;
5. Utilities often practice legally sanctioned price discrimination; and
6. Prices for the utility's product or service often do not reflect supply and demand market forces.

### **3.6 Reasons for the differences between utilities**

These differences from other industries occur for a number of reasons.

1. First, unlike other types of businesses, utilities are legally required to serve all customers in their market area without discrimination; they are limited in this requirement only by their capacity, and may be required to construct additional capacity if demand warrants (A Mix of Governance Models)
2. Second, they are generally neither exclusively profit or non-profit; a mix of both types of organizations exist, often side-by-side, functioning in the same chain of production or collection and distribution or processing.
3. Third, utilities' income often includes a mix of earnings from rates charged customers, stocks and bonds, and/or taxes. Taxes may be applied in a variety of different ways. For example, the allocations to the utility may come from a general fund, as in the case of large, publicly owned hydroelectric projects, or in the form of special assessments (one-time, single purpose tax levies) placed upon property owners who benefit from the utility, as in the case of sewer installation charges to property owners who may be served by the line.
4. Fourth, utilities are economic rather than social organizations. This is because there is an

economic cost to produce and a price for supply of the products, regardless of what form of ownership or governance that characterizes the organization involved in the industry.

5. Fifth, utilities often practice legally sanctioned price discrimination. Utilities are supposed to provide a common benefit to each class of users, but users do not always enjoy equal benefit from the products of the utility. Moreover, homeowners are often charged a higher rate for the service than are industrial users, for example. This is often seen as an unfair subsidy from some ratepayers and/or general taxpayers to organizations such as businesses. This discrepancy has long been a source of bitter debate and controversy. Despite this legally sanctioned price discrimination, prices charged by utilities to all their customers must be seen as “reasonable” by regulators and the general public.
6. Sixth, prices for the product or service often do not reflect supply and demand market forces. Rather, prices for many public utilities are set as more or less arbitrary mandates by governmental regulatory bodies after a series of public hearings and supplier justification. In the case of publicly owned utilities, prices are often kept artificially low for political purposes and do not take into consideration the true cost of the service. True costs would give greater consideration to depreciation and the cost to maintain emergency reserves which are mandated by regulatory agencies. With investor-owned utilities, commissions weigh all the cost data provided by the firm to justify their rates. In addition, regulated utilities are allowed to add a legislatively established minimum rate of return to the accepted cost of their operations.

#### **4.0 CONCLUSION/SUMMARY**

The term public utility is used to describe a variety of publicly and investor-owned organizations that provide certain specific essential services to residential consumers, industrial and commercial customers, and government organizations. Utilities are supposed to provide a common benefit to each class of users, but users do not always enjoy equal benefit from the products of the utility. Despite this legally sanctioned price discrimination, prices charged by utilities to all their customers must be seen as “reasonable” by regulators and the general public. In the case of publicly owned utilities, prices are often kept artificially low for political purposes and do not take into consideration the true cost of the service. With investor-owned utilities, commissions weigh all the cost data provided by the firm to justify their rates. Regulated utilities are allowed to add a legislatively established minimum rate of return to the accepted cost of their operations.

## **5.0 TUTOR-MARKED ASSIGNMENT**

Enumerate the differences between public and private owned utilities

## **6.0 REFERENCES/FURTHER READING**

Ariyo A, and Jerome A. (2004), Utility privatization and the poor: Nigeria in focus. *Global Issue Papers Vol.12, No., pp 1-7.*

"Public Utilities Commission of Texas". Public Utilities Commission of Texas. Archived from the original on 14 August 2012. Retrieved 17 February 2017.

## **MODULE 2 REFORMS, CORE RESPONSIBILITIES OF PUBLIC UTILITIES AND RURAL SOCIAL DETERMINANT OF HEALTH**

- Unit 1 Reforms, transformation and benefits of Public Utility in Nigeria
- Unit 2 Core responsibilities and challenges confronting public utility companies
- Unit 3 Rural social determinants of health

### **UNIT 1 REFORMS, TRANSFORMATION AND BENEFITS OF PUBLIC UTILITY IN NIGERIA**

#### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Current reforms and transformations in public utilities
  - 3.2 Utility privatization in Nigeria
  - 3.3 Privatization of public utilities and poverty
    - 3.3.1 Macroeconomic Linkages
    - 3.3.2 Microeconomic Linkages
    - 3.3.3 Affordability and privatization of public utilities
  - 3.4 Reasons debarring privatization of public utilities
  - 3.5 Benefits of privatization of public utility companies
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

#### **1.0 INTRODUCTION/DEFINITION**

Transformation in public utilities focussed on ways public utilities were managed, regulated, and governed. That managerial transformation had been largely accomplished by the middle of the second decade of the new century. Traditional bureaucratic administration had been or was being replaced by market-driven managerial and entrepreneurial leadership. The historical method of government regulation of utilities as natural monopolies best kept under tight government control was still extant, although it was being replaced by deregulation and privatization, just as it had happened in many other industries.

## **2.0 OBJECTIVE**

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

- (a) To discuss in details the current reforms and transformations in public utilities
- (b) Determine reasons debarring privatization of public utilities
- (c) Outline benefits of public utilities

## **3.0 MAIN CONTENT**

### **3.1 Current reforms and transformations in public utilities**

By the late 1990s many publicly owned utilities had to either give way to investor-owned governance or find and implement the economic efficiencies that were expected to accrue from free market competition. However, not all of the changes to the regulatory system were as successful as had been hoped. The collapse of a number of deregulated and privatized utilities, a growing number of blackouts in the electricity sector, and natural gas and water shortages that followed were attributed to the difficulties associated with utility restructuring. For public utilities in general, many, but not all, of the problems they faced in the last several decades of the twentieth century have been solved. However, new challenges to maintaining sustainability have arisen to replace those that have been resolved. For example, shortages in energy supplies have been replaced by relatively secure supply of oil and natural gas resources. Regulation of the electric and natural gas utility distribution segments of the industry appear to be little changed, but with federal regulators concerned with the need to ensure the security of the nation's electric energy grid and extensive gas and fuel pipeline system.

Water and wastewater utilities, nearly exclusively publicly owned enterprises, remain under the often heavy-handed oversight of federal, state and local governments. Like the entire sector, water utilities are faced with the need to acquire the funds necessary for repair and replace aging infrastructure while encouraging consumers to use less of what is becoming an increasingly scarce resource. Solid waste utilities are running out of sites for ecologically sound landfills while also having to dispose of larger amounts of waste products. While some hesitancy in the willingness to apply greater regulatory restrictions on utility operations is apparent, the regulatory movement has not disappeared, nor has it eased. Rather, the regulatory focus appears to be more focused on rules and regulations to enhance the sustainability of the public utility system than on rate equability. Regardless of the intent, regulatory changes require investments. The external challenges to the industry brought on by

population growth and changing climate conditions have resulted in water shortages and stresses on wastewater and solid waste treatment and disposal facilities. Regulatory developments in these sectors are also leaning toward maintaining and monitoring compliance with public health standards in the face of the climate and environmental stresses that now affect the sustainability of the sector. The telecommunications and cable television sectors, while not discussed in this text, remain overwhelmingly competitive private-sector businesses that remain under federal oversight.

In the context of economic reforms, specifically structural adjustment programme, in the mid-1980s, the Nigerian government introduced the privatization and commercialization programme and implemented it up to 1993. Even though the major public utilities were known to be poor performers, some of them were slated to be commercialized under the programme. After about five years of suspension, the privatization programme resumed in 1999 with the scheduling of major enterprises, including utilities in the monopoly sector of the economy for privatization in Phase III of the programme.

### **3.2 Utility privatization in Nigeria**

Nigeria's public enterprise sector is perhaps the largest in Sub-Saharan Africa both in terms of absolute numbers of enterprises and the contribution to the gross domestic product. Since the colonial era, public enterprises have assumed increasingly diverse and strategic developmental roles in the Nigerian economy. This was accentuated during the oil boom era of the 1970s and 1980s, when the military regimes decided to take control of the commanding heights of the economy. The sectors covered include manufacturing, agriculture, banking and finance, services, and public utilities such as telecommunications, power and water.

The privatization of the utility sector deserves special focus because of its socioeconomic implications for the welfare of the poor in Nigeria. In fact, utilities are often considered as "too crucial" to the national welfare to be totally sold to the private sector. Furthermore, a complete sale to foreigners of what is seen as the "national patrimony" by the population is highly unpopular as it questions both the identity and the sovereignty of the country. Nevertheless, the current privatization is anchored on the concept of private sector participation in which private operators act as core investors.

### **3.3 Privatization of public utilities and poverty**

There are various ways in which utility privatization can affect the poor. These are normally assessed in terms of its macroeconomic and microeconomic linkages

#### **3.3.1 Macroeconomic Linkages**

Issues relating to growth, employment and public expenditure or macroeconomic in focus, and their impacts are indirect.

For example, privatization can lead to a significant improvement in public finances through the elimination of unproductive subsidies and avoidable transfers to unprofitable SOEs, as well as the generation of privatization revenues. If these public funds are reallocated to programs whose incidence is more progressive, this change can benefit the poor. The situation will be greatly improved if revenue generated from privatization could be used to effectively expand national production possibility frontiers.

#### **3.3.2 Microeconomic linkages**

The second aspect focuses on microeconomic linkages which are felt directly by the poor. The first relates to impact of privatization on access to utility by the poor. There is a general feeling that private sector-led privatization will aggravate the problem of non-access of the poor to utility services because private providers would focus on high income areas in which they can maximize the profit on their investment.

#### **3.3.3 Affordability and privatization of public utilities**

Affordability is another issue that may arise from privatization. In particular, improved quality standards may lead to increase in cost of production. This may warrant increase in tariffs and blockade of sources and types of leakages, such as illegal connection. These may effectively reduce the ability of the poor to afford the price charged for utility services if there is no coordinating initiative by the government.

### **3.4 Reasons debarring privatization of public utilities**

For a long time in Nigeria, some enterprises, particularly those providing utilities, have been seen as being too 'big' or 'strategic' to be left in the hands of the private sector. They have also been seen as having monopoly status, providing public service. Other reasons have also been advanced for not privatizing utilities, among which are that competition may not be effective,

they should not be owned by foreigners, the employees / unions would be against it, unemployment will result, the private sector would not provide non-economic services, the need not to lose control of the board or that no one would buy them. These are some of the reasons for the expressed opposition to the privatization of enterprises, in Nigeria, mainly utilities, such as: National Electric Power Authority (NEPA); Nigerian Ports Authority (NPA); Federal Airports Authority of Nigeria (FAAN); Nigerian National Petroleum Corporation (NNPC); Nigerian Airways Nigerian Railways Nigerian Telecommunications Limited (NITEL); Nigerian Postal Service (NIPOST); Water Corporations.

While water supply has a natural monopoly status, electricity distribution and railways have partial monopoly status. All the others have no monopoly status. All of them are expected to provide services for direct consumption to enhance welfare or as vital inputs into the production process. But then, the failings of public enterprises (PEs) or state-owned enterprises (SOEs) in most parts of the developing world, Nigeria included, have elicited so much attention and concern.

Concerns have been expressed that most public utilities do not work or becoming redundant, hence, new investment is needed and the government does not have the money for it, the government can no longer afford subsidies for them, political interference in utilities is stifling, no tax revenue is received, and that most PEs are unable to introduce new technology and techniques and enhance efficiency.

Indeed, those who have been dissatisfied with the services of public enterprises have argued that in country after country, unbridled state expansion has led to the following:

- a. Economic inefficiency in the production of goods and services by the public sector, with higher costs of production, inability to innovate, and costly delays in delivery of the goods produced;
- b. Ineffectiveness in the provision of goods and services, such as failure to meet intended objectives, diversion of benefits to elite groups, etc.,
- c. Rapid expansion of the bureaucracy, severely straining the public budget with huge deficits of public enterprises becoming massive drain on government resources, inefficiency in government, etc;
- d. Poor financial performance of PEs, reflecting a history of huge financial losses, overstaffing, and burden of excessive debts.



Therefore, it is further stressed, under the circumstances, of PEs being economically inefficient and wasteful of resources, making significant demands on government resources as well as on domestic and foreign credit, and low profitability, the issue of privatizing PEs should be viewed with less emotion. And that the benefits of privatization should more than compensate for the loss of public sector ownership and control inherent in the narrow conception of privatization.

### **3.5 Benefits of Privatization of Public Utilities Companies**

The benefits that can be associated with privatization include the following:

- a. Reduction of financial and administrative burden of government as a result of SOEs' inefficiencies;
- b. Increasing the availability of services; raising the quality of services provided and reducing the high cost of utilities, domestic manufacturing and services;
- c. Reducing the spill-over effects of perennial inefficiencies of parastatals providing utilities;
- d. Improving economic efficiency and performance in terms of productive and allocative efficiency;
- e. Improvements in public finance through fiscal deficit reduction, and increase in taxes paid by profit-making enterprises;
- f. Possible increased inflow of foreign direct investment with the attendant benefits of transfer of technology, management skills and technical assistance;
- g. Ensuring the enthronement of popular capitalism;
- h. Increasing the size and dynamism of the private sector;
- i. Broadening and deepening the domestic capital market;
- j. Introduction of new technology and techniques, and expansion of service more quickly to badly served areas; and developing a competitive industry which serves consumers well.

### **4.0 CONCLUSION/SUMMARY**

The collapse of a number of deregulated and privatized utilities, a growing number of blackouts in the electricity sector, and natural gas and water shortages that followed were attributed to the difficulties associated with utility restructuring. Reasons for not privatizing

public utility have been stated and various benefits of privatization of public utility have been enumerated as well.

## **5.0 TUTOR-MARKED ASSIGNMENT**

State the benefits of privatization of public utilities

What are the reasons for not privatizing public utilities?

## **6.0 REFERENCES/FURTHER READING**

Berg, Sanford V., and John Tschirhart. (1998). *Natural Monopoly Regulation*. Cambridge, U.K.: [Cambridge University](#) Press.

Galbraith, John K. 1973. Power and the Useful Economist. *American Economic Review* 63: 1–11.

Kahn, Alfred E. 1971. *The Economics of Regulation: Principles and Institutions*. 2 vols. [New York](#): Wiley.

Ariyo A, and Jerome A. 2004, Utility privatization and the poor: Nigeria in focus. *Global Issue Papers Vol.12, No., pp 1-7*

"Public Utilities Commission of Texas". Public Utilities Commission of Texas. Archived from the original on 14 August 2012. Retrieved 17 February 2017.

Ali I, Ali JF, and Raza DSH. 2011, Determinants of Public Sector Employees' Performance in Pakistan. *Far East Journal of Psychology and Business Vol.5, No.3, pp.23-29*.

## **UNIT 2: CORE RESPONSIBILITIES AND CHALLENGES OF PUBLIC UTILITIES COMPANIES**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Roles of public utilities in national development
  - 3.2 Forces against public utilities
    - 3.2.1 Megatrends impacting public utilities
    - 3.2.2 New trends of challenges and opportunities of public utilities
  - 3.3 Challenges confronting public utility companies in Nigeria
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

### **1.0 INTRODUCTION/DEFINITION**

Public utilities provide services at the consumer level, be it residential, commercial, or industrial consumer e.g., IBEDC, NNPC, Water corporation, Federal Environmental Protection Agency (FEPA), Nigeria Telecommunication (NITEL), MTN, AIRTEL, GLO to mention just a few. In turn, utilities and very large consumers buy and sell electricity at the wholesale level through a network of [regional transmission organizations](#) (RTO) and independent system operators (ISO) within one of three grids, the [Eastern Interconnection](#), the [Texas Interconnection](#), which is a single ISO, and the [Western Interconnection](#). Public utilities generally supply goods or services that are essential, like water, electricity, telephone, and [natural gas](#). For example, the transmission lines for the transportation of electricity or [natural gas](#) pipelines have natural monopoly characteristics in that once these lines are laid by one utility the duplication of such effort by other firms is wasteful. In other words, these industries are characterized by economies of scale in production.

### **2.0 OBJECTIVE**

At the end of this unit, students should be able to understand and explain in details:

- (a) Core role of public utilities in national development.

- (b) Impact of public utilities in the life and activities of people and industries in both developed and developing countries.

### **3.0 MAIN CONTENT**

#### **3.1 Role of public utilities in national development**

Utilities play crucial role in the life and activities of people and industries in both developed and developing countries. Utility services involve a broad range of activities including water, electricity, transportation and telecommunication. It could be referred as “all basic inputs into and requirements for the proper functioning of the economy and those that enhance the standard of living of the people”.

Utilities impact greatly on a country’s living standards, and overall economic growth.

Specifically, water, electricity and telecommunications are fundamental to human sustenance, health, economic and social progress. Specifically, they affect capacities of the local industries to produce quality and affordable products that can compete favourably in the global marketplace. It has been reported that the public utility sectors account for 7.1% to 11% of the GDP (World-Bank, 1994), and the impacts of such services on human development and enhanced quality of life are just apparently enormous. In view of this crucial role of utilities, governments, all over the world, are charged with the responsibility of managing the public resources to ensure social welfare and generation of maximum public good through government monopoly or regulated private establishments.

#### **3.2 Forces against public utilities**

##### **3.2.1 Megatrends impacting public utilities**

Today there are at **least four** megatrends that impact all utilities, regardless of size, location, or sector, and which function as major barriers to their continued sustainability.

- i. The **first trend** includes the changes occurring in the source and type of product and service supplied. On one hand, the once abundant water supplies are declining rapidly, droughts are longer and occurring more often, wastewater and solid waste disposal methods and sites are becoming more restricted, while on the other, the availability and use of once-scarce domestic supplies of energy supplies have increased dramatically, resulting in deep declines in prices.

- ii. The **second trend** involves the supply and delivery changes made necessary by changing climate conditions and for replacement and repair of aging and obsolete infrastructure.
- iii. A **third** is the growing difficulty of coming up with funds needed to pay for the improvements needed to meet the needs of demographic changes to society; federal financial support continues to decline while the ability to impose increases in rates is more problematic.
- iv. A **fourth trend** is the operational changes imposed upon all public service organizations because of the security threat imposed by domestic terrorist activity.

### **3.2.2 New trend of challenges and opportunities of public utilities**

For many public utilities, the financial challenges are exacerbated by the significant drop in service income brought about by successful conservation developments. Financial needs are growing faster than income for nearly all utilities. The ability to implement changes in rates or to use a different rate structure for different classes of users is becoming problematic due to court-instituted changes and restrictions.

This new edition of the challenges and opportunities facing public utilities was planned as a way to help bring to public awareness the challenges facing public and private utilities. In the long run, rate payers are responsible for providing utility managers with the wherewithal to overcome these and other challenges. However, the book does not address technical issues; rather it focuses on the administrative legal, political and economic issues that commissioners and administrators of large and small public utilities must deal with every day. It is also intended for the leaders of communities, and for the students of utility operations that will be the managers and commissioners of the future.

Investor-owned utilities and those owned by community groups, municipalities, counties, and regional organizations in the United States and elsewhere in the world continue to go far in surmounting many of the challenges they faced in the first decade of the new century. However, they know their work is not done; the many new challenges they face a decade later may be even more difficult to overcome. Many of these issues appear to be attributable to what many scientists believe to be the warming of the climate. A warmer climate in some regions has resulted in severe drought and overstressed water resources, while in others the changes have resulted in more severe rainstorms, hurricanes and cyclones. Arid areas such as the western U.S. and Asia have become more arid while population growth is beginning to

over-tax limited water supplies in many of these regions. There is just so much freshwater available and many supplies are already under strain. Parts of the U.S. and elsewhere are undergoing a long-term drought, one for which no early end is in sight. At the opposite end of the scale, other areas are forced to deal with the effects of weather trends that are increasingly severe and damaging to existing infrastructure. Added to the supply problem is that much of the country's water and wastewater infrastructure is one to several hundred years old and buried under metropolitan streets. In the U.S., for example, many of the major mains serving cities were constructed in the nineteenth century. In Europe and Asia, many are even older. Much of that infrastructure is beginning to fail at the same time that supplies are reaching or beyond their sustainability.

### **3.3 Challenges confronting public utilities companies in Nigeria**

Two main issues facing public utilities are coverage of service area and pricing. Alternately stated, the regulators try to balance the competing aims of economic efficiency and social equity. Economic efficiency generally requires that markets be left to work by themselves with little intervention. Such instances are usually not equitable or fair (some consumers might be priced out of the market). Equity issues demand that everyone gets the service at a "just" or "fair" price. However, these instances can turn out to be inefficient. For example, consider the cost of electric utility of having to run cables a number of miles especially to serve one or two remote fishing cabins that are used sparingly.

In general, the pricing of the services of public utilities may be problematic. As mentioned above most public utilities are structural monopolies, implying that there is no room for competition in the market for services they provide e.g., Ibadan Electricity Distribution Company Plc. (IBEDC) is a customer focused institution. IBEDC is committed to distributing power and changing lives. Its franchise area includes Kwara, Ogun, Osun and Oyo states respectively.

It covers some parts of Ekiti, Kogi and Niger states with 22 Business Hubs in Nigeria.

However, if they are left alone to price like monopolies, the resulting price is too high and a large part of the market area may not be served. While the utility companies have no complaints about such arrangements, given the essential nature of the services they provide, the society would like to provide such services to all or most of the population. Think, for instance, about the undesirability of denying heat to someone in the winter. Hence, their pricing actions are regulated. However, these decisions are somewhat problematic. If these

utilities are mandated to set prices at the low competitive levels, they may generally end up making losses. So there continues to be an on-going tussle between regulators and the utility companies regarding a “fair” price between the monopoly and competitive levels.

Common alternate pricing actions include

- i. Setting prices equal to average production costs and serving the maximum area possible;
- ii. Rate of return regulation; and
- iii. Price cap regulation.

Under average cost pricing, the utility is assured of breaking even, since the prices equal average costs. The equity aspects are somewhat met since most of the market is being served. However, the regulated firm lacks incentives to minimize costs. Under rate of return regulation, the regulators let the firms charge any price, provided the rate of return on invested capital does not exceed a specified rate. Whereas such regulation is flexible in allowing pricing freedom and frees the regulators from monitoring prices, a key drawback is that such regulation can lead to over-capitalization. In other words, when the rate of return is fixed at 5 percent, then the firm can charge higher prices by investing more in capital than it would otherwise (i.e., 5% of \$10 million is greater than 5% of \$6 million).

Price cap regulation directly sets a limit on the maximum price charged by regulated firms. This type of regulation can result in a loss of service area. Sometimes, point of price cap regulation may induce firms to seek cost-manipulating technologies so as to influence utility profits margin. With technological changes over time, the nature of regulation changes in that some functions of the utility companies are “unbundled” and thrown open to free competition. New technologies might make it possible to break up the different stages of the electric generation process or natural gas transmission such that competition might be allowed to function in some stages. For example, in twenty-first-century United States, Nigeria and elsewhere the electricity generation market is relatively competitive and consumers are able to purchase electricity from competing vendors (generators). However, the transportation of electricity still remains a natural monopoly and continues to be regulated. Further, often times the deregulation of some or all functions of public utilities might occur over time due to political-economic compulsions.

However, Nigerian public utility organizations have been performing abysmally largely due to employee performance related problems. The problem of poor performance among agencies of public utility sector has been a subject of considerable discussion.

#### **4.0 CONCLUSION/SUMMARY**

Despite heavy investment in capital infrastructures, and high recurrent expenditures, efficient and effective provision of electricity, telephone, water, and transport services has remained a heinous task to achieve. Nigerian public utilities have started to experience decreasing performance since the Nigeria's oil boom years of the 1970s.

#### **5.0 TUTOR-MARKED ASSIGNMENT**

Identify and outline issues confronting public utilities companies in Nigeria

#### **6.0 REFERENCES/FURTHER READING**

World-Bank. (1994), Infrastructure for development, world development report 1994. New York: Oxford University Press.

Prasad V. S. N. Tallapragada, B. S. Adebuseyi Nigeria's Power Sector: Opportunities and Challenges [Economic Policy Options for a Prosperous Nigeria](#) pp 301-327

[Titus Olugbenga Koledoye](#): The current and future challenges of electricity market in Nigeria in the face of deregulation process March 2013 International Journal of Engineering Research Vol. 1(3):pp. 33-39



## **UNIT 3: RURAL SOCIAL DETERMINANTS OF HEALTH**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Health indicators; Life expectancy as a determinant of health
  - 3.2 Life expectancy in Nigeria
  - 3.3 Health and major determinants of health status of people
  - 3.4 Major determinants of health status
  - 3.5 Review of empirical studies on social determinants of health status developed and developing countries
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

### **1.0 INTRODUCTION/DEFINITION**

Health is important so much so that it has been declared a fundamental human right in most of the UN member states. Hence, the introduction of the concept of *Universal Health Coverage* (UHC) that everyone should have an equal access to sustainable, affordable and quality health services. A cursory look of the global health indicators reveals that the health of the world population, on average, had been improving over the last five decades.

### **2.0 OBJECTIVE**

To understand and be able to state major determinants of health status of people

### **3.0 MAIN CONTENT**

#### **3.1 Health indicators; Life expectancy as a determinant of health**

According to HDRs (1990) and (2013), the world's life expectancy at birth rose from 53 years in 1960 to 65 and 70.1 years in 1987 and 2012 respectively. The reports also showed that the Under-5 and Maternal mortality rates fell to 55 and 145 per 1000 per 1000 and 100,000 live births in 2010 from 108 and 250 in 1980s respectively. Contrarily, the reports indicated that sub-Saharan Africa (SSA) recorded little or no progress and had been having the poorest

health indicators up till now than any other region. This is so because the above reports displayed that the SSA's life expectancy at birth crawled to only 54.9 years in 2012 from 40 and 46 years in 1960 and 1975 respectively. Whilst, the Under-5 and Maternal mortality rates of the region dropped marginally from 183 and 530 in 1980s to 120 and 475 in 2010 respectively.

### **3.2 Life expectancy in Nigeria**

The same ugly picture as that of the region has been painted for Nigeria by the reports. According to the reports, the nation's life expectancy increased slightly to 52.3 years in 2012 from 40 and 46 years in 1960 and 1975 respectively. The Under-5 and Maternal mortality rates of the country are indicated to have also oozed to 143 and 630 in 2010 from 174 and 800 in 1980s respectively. These make the country to have one of the least life expectancy and the highest Under-5 and maternal mortality rates in the world.

In other words, Despite, Nigeria being the giant of Africa and also one of the leading oil producing nations in the world, the health status of her citizens is still nothing to write up about. Thus, in view of the extent and depth of poverty in the land, it should not be surprising that the health status of the country is poor. In connection to the above, a concerted effort has been made by health practitioners and Development economists to map out the major determinants of health so as to inform the investment decisions in health human capital by the policymakers. To this end, they come to term that it is the interaction and inter-relationship among health services, biological, individual behaviour, social factors and physical environment that determine health status of an individual (Centers for Disease Control and Prevention (CDC), 2014 and World Health Organization (WHO), 2014).

### **3.3 Health and major determinants of health status of people**

WHO, (2003) defined health as "a state of complete physical, mental and social wellbeing and not merely the absence of diseases or infirmity". From this definition, it is obvious that the determinants of health are three-fold: physical, psychological and social factors. Thus, determinants of health go beyond biological and genetic factors.

### **3.4 Major determinants of health status**

CDC, (2014) and WHO, (2014) highlighted the following as the major determinants of health status of the people:

1. **Health Services:** this implies that people with access to better quality-health care services tend to be healthier than those without. This is self-evident in view of the divergence in health status of people in developed world and those in the developing one.
2. **Biology and Genetics:** this suggests that genetic makeup, family history and fragility of immune system, affect one's health strongly. For instance, sickle cell is a hereditary disease while old people are vulnerable to disease than young ones. Thus, ages, sex, HIV status, family history of cardiovascular diseases etc., are some of the biological and genetic variables.
3. **Physical Environment:** this deals with the how safe, qualitative and sustainable the environment is; as it is through which basic needs of life are met. If the environment is safe, sustainable and qualitative, then the drinking, water, air, land and food will be safe and qualitative. Consequently, people living in such an environment will be healthy.
4. **Individual Behaviour or Lifestyle:** such personal behaviour as eating habit, exercise, smoking, alcohol use, promiscuity and handling stress, affect one's health greatly.
5. **Social Factors:** This has to do with education level, income level, family and friends, ethnicity, religion, occupational status and others; which significantly affect people's health status.



### **3.5 Review of empirical studies on social determinants of health status developed and developing countries**

With reference to Canadian Centre on Substance Abuse (CCSA), (2014), and Keon, (2009), it was observed that good health is brought about 15% by genetics, 25% by health care service, and 60% by the remaining socioeconomic determinants and physical environment. It is

apparent that the primary factor that determines the health of the people is not the medical treatment or choice of lifestyle but the conditions the people are experiencing. Certain health behaviors, such as smoking, drinking, poor nutrition, or lack of exercise, can have significant effects on a person's health. Similarly, a person's income, wealth, educational achievement, race and ethnicity, workplace, and community can also have profound health effects.

This conform with a study conducted in Ilorin Metropolis, North western, Nigeria to empirically investigate the determinants of health status using cross-sectional data. The decision of the study was informed by lack of adequate comprehensive studies on determinants of health status in Nigeria. Primary data was obtained from 630 paper-based interviewed administered questionnaires distributed across Ilorin metropolis, Kwara State. The Grossman's health production model was applied as theoretical model. Both logistic and probit regression models have been estimated. The health measure was self-rated health status. The estimated work suggests that age, sources of drinking water, residence-type, marriage-type and household size are statistically significant.

There had been a lot of empirical studies on the determinants of health status in the world both at micro and macro levels, country-specific and cross-countries studies. The studies in Nigeria are not broad-scoped because they seemed to be narrow on either maternal or children health. But this study takes the tasks of examining the general determinants of health status in Nigeria. A panel study using system GMM for 141 developing countries in Asia was carried out by Kamiya, (2011). The results uncovered that GDP per capita and access to improved sanitation were the strong determinants of children health status. Education and health resources have positive impact on life expectancy while risky lifestyle (tobacco and alcohol uses) were harmful to health. These results were obtained in a panel study with endogenous regression for Organisation for Economic Cooperation and Development (OECD) countries by Pokas and Soukiazis, (2010). In addition, Casanova and Bori, (2013) examined the links between unemployment, economic growth, inequality, and health using random effect panel technique and for 32 countries for the 1980-2010 period with five years interval. Their results indicated high economic growth and high levels of inequalities explained the observed health inequality.

Moreover, Imam and Koch, (2004) and Ogunleye, (2012) using Arellano-Bond GMM studied 38 and 40 sub-Saharan African (SSA) countries respectively. Imam et al (2004) found out that increase in GDP per capita and education intervention affect mortalities in the SSA. Ogunleye, (2012) revealed that alcohol consumption, urbanization, and carbon emission

determined child mortality while all these variables and food availability determined life expectancy in the SSA.

In the same vein, A study of the Measurement and Determinants of Health, Poverty and Richness in Portugal, using an ordered probit econometric approach, undertaken by Simóe, Crespo, Moreira, and Varum, (2012). Their results disclosed that gender, age, education, region of residence, and eating habits were the critical determinants of health status. Also, Lordan, Soto, Brown and Coreavalez, (2011) conducted a survey of the link between socioeconomic status and health outcomes in Fiji using a binary probit econometric method. They arrived at the findings that income has positive effect on health outcome. Individual characteristic, socioeconomic, and institutional variables were the strong determinants of health status in Colombia. These results were found in a study of the determinants of health status in a developing country of Colombia using an ordered probit model by Ramirez, Gallego, and Sepúlveda, (2004). Zhao, Xue, and Gilkinson, (2010) discovered that immigration category (family class, skilled worker-principal applicants), sex, world region of birth, education level, age group, family income, and employment type determined significantly the health status of immigrants in Canada. These were obtained in their longitudinal survey of health status and social capital of recent immigration in Canada. Saroj, (2004) using a multivariate regression analysis of determinants of health status in Thailand; brought to light that education, living conditions and health resources have positive and significant effect on health while the net effect of income on health was inconclusive.

Similarly, Alam, (2008) explored that ageing, socioeconomic disparities and health outcomes in India using multinomial logit and found that lower caste, old age, illiteracy, economically dependent household with lower per capita consumption expenditure, and poor drainage facilities caused poor health outcome. Income per capita, female literacy, public health expenditure, immunization coverage and HIV/AIDS prevalence influenced health status significantly in Kenya.

Lawson, (2004) examined the determinants of health seeking behavior in Uganda and using multinomial logit regression found out that income, education and user fee all have significant effects on the health status of Ugandans. The significant differences in health seeking behaviour to be related to age and gender, and that increased levels of education are consistently associated with a transfer away from government provided health care, possibly indicating that people regard its quality as inferior.

Muriithi, (2013), used multinomial logit model to determine the health seeking behavior Nairobi and found out that distance, gender, acreage all have negative significant effect on the health status of the people in Nairobi. Perhaps, quality of the health care, trust, waiting time, service information size of household education, age, occupation and user fee all have positive significant impact on the health status of the people in Nairobi.

Also, Abor, and Nkrumah (2013) studied the socio-economic determinants of maternal health care utilization in Ghana using the probit regression. From her results, she found out that age, place of delivery, education, household wealth, ethnicity and religion has important impacts on the maternal health care utilization in Ghana.

Adewara, and Visser, (2011) employed anthropometric measures and regression analysis to examine the environment determinant of children's health in Nigeria using the 2008 DHS data set.

Their results showed that sources of drinking water and sanitation facilities were the strong determinants of children's health in the country. Adewara, and Oloni, (2013), and Ichoku, and Nwosu, (2011) examined the health inequalities among regions and income groups respectively and using the DHS in Nigeria and the anthropometric measures. Adewara, *et al* (2013) uncovered the existences regional health inequality with North worst hit by the problem. However, Ichoku, *et al* (2011) exposed that differences in wealth accounted for 58.0% and caused 33% of differences in child nutritional and underweight status between the poor and non-poor in the country.

Imoghele, Ighata, and Obasanmi, (2014) realized that income, consumer price index and female literacy affected infant mortality in Nigeria. This was deduced from their study of a quantitative analysis of determinants of health outcome in Nigeria for 1995-2010 period using co-integration testing. Immunization, age of the children, gender, mother's employment and educational status, household size and sector, were found by Adeoti, and Awoniyi, (2010) to be the major determinants of children's health in Nigeria. This was arrived at using Two Stage Least Squares and Control unctioin estimation procedures on DHS data set. Ogunjuyigbe, and Liasu, (2006) discerned that education, wealth status, and access to health care services determined the maternal health in Nigeria. This was in their study using the 2008 DHS data set. Lastly, Akangbe, Asiyanbi, Nantami, Adesiji, and Oladipo, (2012) ascertained that level of education, space of family members and safety environment were the major factors responsible for farmers' health in Kwara state of Nigeria.

#### **4.0 CONCLUSION/SUMMARY**

Sources of drinking water and residence have positive impacts on households' health status, while age, household size and marriage-type have negative effect on their health status. Therefore, the following measures to improve the households' health have been suggested:

- a) Social security scheme should be introduced to protect the aging households;
- b) Population with access to improved water sources should also increase particularly at the rural areas;
- c) Housing acquisition programmes should also be initiated; and
- d) There should be awareness creation on the importance of family planning in terms of household size and socioeconomic pre-requisites to be polygamous.

#### **5.0 TUTOR-MARKED ASSIGNMENT**

State the various determinant of health status

Discuss the influence of environment on ability and disability adjusted life year of individual

#### **6.0 REFERENCES/FURTHER READING**

- Akangbe, Asiyambi, Nantami, Adesiji, and Oladipo, (2012) "Effects of Physical Environmental Factors On Health Status of Small Scale Farmers in Kwara State, Nigeria", *Nigerian Journal of Agriculture, Food and Environment*, 8(1): 22-26.
- Adeoti, A. I. and Awoniyi, B. (2010) "Determinants Of Child And Maternal Health Status And Demand For Health Care Services In Nigeria", *African Economic Research Consortium*.
- Imoghele, L. E., Ighata, J. A. and Obasanmi, J. O. (2014) "A Quantitative Analysis of Determinants of Health Outcomes in Nigeria", *Research Journal of Clinical Pharmacy, Medicine, and Medical Sciences*, 2(23):17-24
- Ichocku, H. E. and Nwosu, E. O. (2011) "Social Determinants and Dynamics of Health Inequality in Nigeria", *Central Bank of Nigeria Economic and Financial Review*, 49(3): 47-69.
- Adewara, S. and Oloni, E. (2013), "An analysis of regional inequality in underweight in Nigeria", *International Journal of Development and Sustainability*, 4(2): 2402-2413.
- Adewara, S. O., and Visser, M., (2011) "Use of Anthropometric Measures to Analyze How Sources of Water and Sanitation Affect Children's Health in Nigeria", *Environment for Development Discussion Paper Series*.

- Abor, P. A., and Nkrumah, G. A., (2013) “The Socio-economic Determinants of Maternal Health Care Utilisation in Ghana”, Department of Public Administration and Health Services Management *University of Ghana Business School Legon*. Revised WIP submitted to *AERC*
- Muriithi, M.K., (2013) “The Determinants Of Health-Seeking Behavior In A Nairobi Slum, Kenya”, *European Scientific Journal March*, 8(9).
- Lawson, D., (2004) “Determinants of Health Seeking Behaviour in Uganda – Is it Just Income and User Fees That Are Important?” *Institute for Development Policy and Management University of Manchester*. Harold Hankins Building, Precinct Centre, Oxford Road, Manchester M13 9QH, UK.



## **MODULE 3            CONCEPT OF ENVIRONMENTAL HEALTH AND OTHER TROPICAL CURRENT ENVIRONMENTAL HEALTH ISSUES**

- Unit 1            Water supply and distribution, drainage, sewage and treatment of sewage
- Unit 2            Sanitation, air pollution, power supply
- Unit 3            Fire services, climate change and energy
- Unit 4            Environmental emergencies and disaster management
- Unit 5            Biodiversity and environment

### **UNIT 1:            WATER SUPPLY, DISTRIBUTION, SEWAGE TREATMENT AND DRAINAGE**

#### **CONTENTS**

- 1.0    Introduction
- 2.0    Objectives
- 3.0    Main contents
  - 3.1    Water supply, distribution and sanitation
    - 3.1.1    Highlight of National Demographic Profile of Nigeria
    - 3.1.2    Brief Historical Perspective of Water Supply, Sanitation Development
    - 3.1.3    Management of Public Water Supply
    - 3.1.4    Importance of public water supply systems
    - 3.1.5    Problems Associated with Water Supply and Distribution
    - 3.1.6    Water scarcity
  - 3.2    Methods of handling sewage (Sewage and treatment of sewage)
    - 3.2.1    Sewerage.
    - 3.2.2    Types of sewage
    - 3.2.3    Physical Composition of sewage
    - 3.2.4    Chemical Composition of sewage
    - 3.2.5    Microbial content of sewage
    - 3.2.6    Health and environmental implication of sewage
    - 3.2.7    Sewage collection and disposal
    - 3.2.8    Sewage treatment
    - 3.2.9    Reuse of treated or untreated sewage

- 3.2.10 Sewage and Algal Biomass Production
- 3.3 Drainage
  - 3.3.1 The Need for drainage
  - 3.3.2 Types of drainage
  - 3.3.3 There are two types of artificial drainage
  - 3.3.4 Surface drainage
  - 3.3.5 Sub-surface drainage
  - 3.3.6 Current Drainage practices
  - 3.3.7 Construction of Drainage system
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

## **1.0 INTRODUCTION/DEFINITION**

Water is one of the world's most valuable resources. It is a basic necessity of life for both plants and animals. Mankind cannot, in fact, survive without water as even the human body is made up of about 70% water. Water resources are becoming increasingly scarce in many parts of the world due to development, increased demand, climate change and resulting drought and explosive population growth.

## **2.0 AIM AND OBJECTIVE**

To understand water supply and its management

To be able to know different methods of handling sewage

## **3.0 MAIN CONTENT**

### **3.1 Water supply, distribution and sanitation**

The availability of a reliable and clean supply of water is one of the most important determinants of our health. According to WHO, diseases related to drinking-water contamination represent a major burden on human health and the interventions to improve the quality of drinking water provide significant benefits to health. The water crises of the world are not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people and the environment suffer badly. Water is derived from various sources such as the ocean water constituting 97% of the earth's water, ice 2%, and 1% fresh

water obtained from the rivers, lakes, underground water, the atmospheric and soil moisture. The state of water supply and sanitation access worldwide is alarming: in 2000, 1.1 billion people lacked access to improved water supply, and 2.4 billion to adequate sanitation, more located in rural than urban areas.

Considering the population growth, these figures are going to increase unless appropriate and sound measures are taken to reverse this trend. Africa, where 28% of the total un-served population for water supply live, has a great challenge ahead. As the most populated country of the continent, Nigeria will be central as to whether or not Africa reaches the MDG. Nigeria, the “giant” of Africa in terms of population and oil economy, has lots to achieve in order to reach these targets meanwhile it has a rapid population growth. The relatively recent democratic government has to cope with extreme poverty, low human development, a history of corruption and decentralisation of responsibility for water and sanitation from central to local government. These constraints partially explain why the Government has not been successful in fulfilling its responsibility to provide safe water supply to his citizens up to now.

The Federal Ministry of Water Resources Roadmap for Nigeria Water Sector estimates water resources potential of the country as 267 and 92 billion m<sup>3</sup> of surface and ground water respectively. It also estimates the water supply and sanitation service coverage as 58% (87 million) and 32% (54 million) respectively. UNICEF estimates are slightly lower at 47% water supply service coverage. It has also been estimated that about 60% of all the diseases in the developing countries are related to unsafe water supply and inadequate sanitation.

About 51% of Nigeria’s 165 million population resides in rural or remote areas and only 47% of this rural populace have access to improved water sources. Of the 49% that live in urban and peri-urban areas, only 72% of have access to improved water sources. Water supply is a basic requirement of life. The availability of a reliable and clean supply of water is one of the most important determinants of our health. Water scarcity poses risks and stress for human society. The World Health Organisation (WHO) identifies improvement in access to safe drinking-water as a contributing factor to tangible benefits to health.

The provision of water supply systems in the region is thus, important and urgent, requiring the use of existing, emerging and innovative technologies that are also sustainable.

### **3.1.1 Highlight of National Demographic Profile of Nigeria**

Population: over 130 million

Population growth: 2.38%

Living in absolute poverty: 75 million (58% of total population)

Life expectancy: 43 years

Infant mortality: 198/1000

Water supply coverage: 60%

Sanitation Coverage: 38%

Human development index: 158

Adult literacy: 67%

International development assistance: \$2 per capital (average \$21 per capita in Sub-Saharan Africa)

### **3.1.2 Brief Historical Perspective of Water Supply and Sanitation Development**

The history of water supply development dates back to the colonial era when the first ten year plan (1944 - 1956) included in its overall budget about 5.7% of total expenditure for the sector. Then, concrete open wells were constructed under the supervision of Public Works Department (PWD), of the Regional Governments who were responsible for providing safe water to the rural communities. Since independence, several National Rural Water Supply Programmes (NRWSP) have been undertaken notably by FGN, notably among such includes NBP, DFRRI, PTF and INAWSSP. State Governments, LGAs, World Bank, UNDP and UNICEF among others have also contributed in one way or the other to the development of rural water supply.

In the mid 1970s the World Bank financed Agricultural Development Programme (ADP) pilot projects in 6 States namely Bauchi, Benue, Kano, Plateau, Oyo and Sokoto Rural Water Supply component assumed a major part of these pilot projects that have now extended to other states of the Federation. In 1981, UNICEF included rural water supply and sanitation in Nigeria country programme in Imo, Gongola (now Taraba and Adamawa), Kwara, Cross River, Niger and Anambra States. Today, 22 states are benefiting from the programme. From 1989 - 1992, the UNDP operated the Rusafiya Project focusing on the local government with perceived advantages of being closer to the communities. Through this programme, the rural water and sanitation sector strategy and action plan was developed. State and Local Governments were also involved in other rural water supply projects. Other Non-Governmental Organizations in addition to other religious bodies, private individuals and corporate multinationals like Shell, Mobil, Chevron have contributed in no small way to rural water supply both in their areas of operation and some other accessible parts of the

country. Programmes initiated by the Government of the Federation include the National Borehole Programme in 1981. This programme was planned and implemented by the then Federal Department of Water Resources, to supply water through a motorized system of boreholes to rural areas or communities. In 1986 the Federal Government established the Directorate of Foods, Roads and Rural Infrastructure (DFRRI), with a policy of intensive development of rural areas. DFRRI project, in contrast to the national borehole programme had the community participation and involvement as a strategy.

Intervention in the water supply sector include the effective rehabilitation of all existing boreholes and massive drilling of new ones in rural and semi-urban areas and the installation of hand pumps or similar devices such as windmills, to provide potable water for both human and animal consumption.

### **3.1.3 Management of Public Water Supply**

Public water supply started in Nigeria early in the twentieth century in a few towns managed at the lowest administrative level. Amongst the early beneficiaries were Lagos, Calabar, Kano, Ibadan, Abeokuta, Ijebu Ode (Ogun State) and Enugu. The schemes were maintained with revenue from water sales with virtually no operational subvention from government. With the creation of regional governments in the early 1950s the financial and technical responsibilities for developing new water schemes were taken over by the regional governments who also assigned supervisory high level manpower to oversee operations and maintenance. The regions were slow to set up independent bodies to develop, operate and manage the water supply. The first water corporation was formed in the western region in 1966 which took over all the assets and liabilities, including the existing staff. The staff of the Water Division of the Ministry of Works was also transferred to the new corporation. The next corporations were formed in the 1970s. Today, all 36 states and the Federal Capital Territory have water boards/corporations or public utilities boards managing their public water supply. Their efforts are supplemented, in many cases, by local governments who supply water to small villages in their areas of jurisdiction. The Federal Government got involved in the management of water resources in 1976 when the Federal Ministry of Water Resources and the 11 River Basin Development Authorities (RBDAs) were created. The purpose of the RBDAs was to provide bulk water, primarily for irrigation.

### **3.1.4 Importance of public water supply systems**

Strategic management and provision of sustainable public water supply is essential and crucial for the future of the world's economy, economic and industrial development.

It is also important for protection and improvement of public health, improving the quality and standard of living, ecosystem preservation as well as poverty alleviation and eradication especially in developing countries. Though these challenges are enormous, with pragmatic steps, they are surmountable. Public water supply accounts for 90% of water supply in middle and low-income countries and serves domestic, institutional, industrial and commercial functions while domestic water supply represents between 50–70% of public water supply. Improvement in water supply contributes to health equity by reducing the link between poverty and disease. It prevents approximately 2.4 million deaths annually and averts approximately 7% of global burden of diseases and 19% of child mortality worldwide.

In the same vein, provision of public water supply leads to 3.6% increase in per capita GDP growth along with improved sanitation, contributes to socio-economic development and well-being, increases school attendance as a result of reduction of water-borne diseases.

Public water supply is one of the indices of human development. In terms of cost, public water sources are 4–10 times cheaper compared to private sources. Private water sources cost twice the amount to operate and maintain costs of a piped distribution system. Despite its cheapness, approximately 1.2 billion people still lack access to safe drinking water in developing countries owing to lack of effective large scale water-supply infrastructures.

### **3.1.5 Problems Associated with Water Supply and Distribution in Developing Countries**

Successful management of any resources requires accurate knowledge of the resource available, the uses to which it may be put, the competing demands for the resource, measures and processes to evaluate the significance and worth of competing demands and mechanisms to translate policy decisions into actions on the ground.

Identified problems of water supply and distribution are:

- (a) Lack of adequate information on water resources couple with lack of the technology and its applications hinder the process of water supply and distribution in most developing countries of the world.
- (b) Poor management is one of the major reasons for poor performance and/or efficiencies of water utilities and the management remuneration rates are determined by the government salaries in most urban areas because the utilities are in public sector and thus follow

public service rules. In the past, most government in developing countries responded to water stress by seeking to augment supply. It was reported that large scale river diversion programs in China and India underline the continuing appeal of this approach.

- (c) Population growth without corresponding expansion of water supply facilities causes shortfall in terms of supply. Providing adequate water supply to the rapidly growing urban population is a challenging task for governments throughout the world. The urban poor, who lives in poor condition and often constitute the labour source that generates the wealth of the cities, often have limited access to adequate water and face increased health problems.
- (d) Gross reduction in duration of water supply: “More recently, in South Asian countries, above 90% of the population with piped water supply still receive water less than 12 hours. Conditions are similar in most African countries for example only 11% of water consumers in Zaria, Nigeria receive water for less than 12 hours a day through piped connection and the mean service hours are 2.9 per day in Mombassa, Kenya. Access to piped water into the households averages about 85% for the wealthiest 20% of the population, compared with 25% for the poorest 20%. Consumers residing faraway from supply point.
- (e) Pressure dependant flow condition: People living at higher altitude are at disadvantaged position because of intermittently generated inequitable water distribution due to pressure dependant flow condition.
- (f) Factors such as source limitation inequalities in service provision between the rich and the poor and access to standard pipe networks contributed to the water stress condition and poor water distribution in Nigeria.
- (g) High risk of contamination through broken pipes or joints and health hazards: Health hazards are prominent with intermittent supply which entails a high risk of contamination through broken pipes or joints, and low pressure or even a vacuum condition in pipelines that last for a significant period of time is usually created by interruption of supply.

Other challenges of public water utilities and public water supply systems have to do with technical, social, economic, legal, institutional and environmental dimensions. Some of concomitant challenges include increasing urbanization rate, inadequate investment funds, inadequate management capacities and poor governance, inappropriate institutional frameworks, inadequate legal and regulatory framework. Other challenges faced by public water supply systems include data collection, availability and accuracy, inadequate financial

resources for effective operations, lack of skilled technical personnels, urbanization and unsustainable water consumption practices, lack of monitoring and evaluation of water quality assurance, health outcomes and economic returns, bacteriological contamination during distribution and storage, poor water quality, poor governance and stakeholder engagement and migration, technical inefficiencies and unreliability, over-dependence on government for finance.

Nevertheless, these challenges are solvable using scientific and engineering expertise with good management of available resources.

### **3.1.6 Water scarcity**

Most developed and developing countries are at risk of severe water shortages in the 21st century if urgent steps are not taken. This is because water supply poses a huge challenge to most urban, peri-urban and rural areas in developing countries because new sophisticated sources which are cost effective for major urban areas of these countries are usually not available. Human development is being driven by clean water, dignity is enhanced, opportunities extended health improved and wealth rose with clean water. The crisis in water and sanitation is no doubt, a crisis for the poor, justifying the claim; it was reported that “Almost two in three people lacking access to clean water, survive on less than \$2 a day, with one in three living on less than \$1 a day” . Fitness of drinking water to be distributed is paramount; it should therefore be taken into consideration in water supply and distribution system.

### **3.2 Sewage and treatment of sewage**

Sewage (or domestic wastewater or municipal wastewater) is a type of [wastewater](#) that is produced by a [community](#) of people. It is characterized by [volume](#) or [rate of flow](#), physical condition, chemical and toxic constituents, and its [bacteriologic](#) status (which organisms it contains and in what quantities). It consists mostly of [grey water](#) (from sinks, tubs, showers, dishwashers, and clothes washers), [black water](#) (the water used to flush [toilets](#), combined with the [human waste](#) that it flushes away); soaps and detergents; and [toilet paper](#) (less so in regions where [bidets](#) are widely used instead of paper). Sewage usually travels from a building's [plumbing](#) either into a [sewer](#), which will carry it elsewhere, or into an [onsite sewage facility](#) (of which there are many kinds). Whether it is combined with surface runoff in the sewer depends on the sewer design ([sanitary sewer](#) or [combined sewer](#)).



The reality is that most wastewater produced globally remains untreated causing widespread [water pollution](#), especially in low-income countries: A global estimate by [UNDP](#) and [UN-Habitat](#) is that 90% of all wastewater generated is released into the environment untreated. In many developing countries the bulk of domestic and industrial wastewater is discharged without any treatment or after primary treatment only.

The term sewage is nowadays regarded as an older term and is being more and more replaced by "wastewater".

### **3.2.1 Sewerage:**

In general [American English](#) term "sewage" and "[sewerage](#)" mean the same thing. In common British usage, and in American technical and professional English usage, "sewerage" refers to the [infrastructure](#) that conveys sewage. Before the 20th century, sewers usually discharged into a [body of water](#) such as a stream, river, lake, bay, or ocean. There was no treatment, so the breakdown of the [human waste](#) was left to the [ecosystem](#). Today, the goal is that sewers route their contents to a [wastewater treatment plant](#) rather than directly to a body of water. In many countries, this is the norm; in many [developing countries](#), it may be a yet-unrealized goal. Current approaches to sewage management may include handling surface runoff separately from sewage, handling grey water separately from black water ([flush toilets](#)), and coping better with abnormal events (such as peaks storm water volumes from extreme weather). Proper collection and safe, nuisance-free disposal of the liquid wastes of a community are legally recognized as a necessity in an urbanized, industrialized society.

### **3.2.2 Types of sewage**

- (1) The wastewater from residences and institutions, carrying bodily wastes (primarily faeces and urine), washing water, food preparation wastes, laundry wastes, and other waste products of normal living, are classed as domestic or sanitary sewage.
- (2) Liquid-carried wastes from stores and service establishments serving the immediate community, termed commercial wastes, are included in the sanitary or domestic sewage category if their characteristics are similar to household flows. Wastes that result from industrial processes such as the production or manufacture of goods are classed as industrial wastewater, not as sewage.
- (3) Surface runoff, also known as storm flow or overland flow, is that portion of precipitation that runs rapidly over the ground surface to a defined channel.

Precipitation absorbs gases and particulates from the atmosphere, dissolves and leaches materials from vegetation and soil, suspends matter from the land, washes spills and debris from urban streets and highways, and carries all these pollutants as wastes in its flow to a collection point.

### **3.2.3 Physical Composition of sewage**

The major component of untreated or treated sewage is water. The influent of a sewage treatment plant (STP) is typically 95%+ water by volume. The other major physical components include grit and sediment; the concentration of these varies in response to nature of the sewage infrastructure. [Sewerage systems](#) may be exclusively foul water drains from domestic and industrial premises. However, there are many systems that include surface water drains as well as foul sewers. In some extreme cases, entire streams may also form part of the system. In the latter two cases, rainfall is a major influence on the volume flow. It is possible to determine the Dry Weather Flow (DWF, the amount of liquid flow produced daily by the total population and industry in the wastewater receiving area) for a system by quantifying the number of premises and people in the catchment.

In the United Kingdom, each person produces ~200 litres / day to the sewer while this value is nearly 300 litres / day in the United States of America. In other less developed parts of the world, the DWF may be substantially less.

Other physical components of sewage are sanitary products including plastics and rags. The nature and quantity of these materials is also dependent on the culture of the people in the catchment and may vary from location to location. It is also possible to find objects such as branches, leaves, and even animals in the influent sewer.

### **3.2.4 Chemical composition of sewage**

Sewage is a complex mixture of chemicals, with many distinctive chemical characteristics. These include high concentrations of ammonium, nitrate, [nitrogen](#), [phosphorus](#), high conductivity (due to high dissolved solids), high alkalinity, with pH typically ranging between 7 and 8. The organic matter of sewage is measured by determining its [biological oxygen demand](#) (BOD) or the [chemical oxygen demand](#) (COD). The chemical nature of sewage varies widely according to the catchment. In regions with sparse industrial activity, domestic wastes comprise the majority of the matter. These materials are rich in proteins, carbohydrate, lipids, and non-digestible matter.

### 3.2.5 Microbial content of sewage

The heterogeneous nature of sewage provides an excellent growth medium for a multitude of [microorganisms](#). Many of these microbes are necessary for the degradation and stabilization of organic matter and thus are beneficial. The diversity of participating microorganisms ensures a complex ecosystem will exist during sewage treatment. Bacteria represent the most abundant form of microorganisms in sewage, with in excess of  $10^{12}$  cells per litre. Sewage contains human feces, and therefore often contains pathogens of one of the four types:

- (a) Bacteria (for example *Salmonella*, *Shigella*, *Campylobacter*, *Vibrio cholerae*),
- (b) Viruses (for example *Hepatitis A*, *rotavirus*, *enteroviruses*),
- (c) Protozoa (for example *Entamoeba histolytica*, *Giardia lamblia*, *Cryptosporidium parvum*)
- (d) Parasites such as helminths and their eggs (e.g. *ascaris* (roundworm), *ancylostoma* (hookworm), *trichuris* (whipworm)).

Sewage can be monitored for both disease-causing and benign organisms with a variety of techniques. Traditional techniques involve filtering, staining, and examining samples under a microscope. Much more sensitive and specific testing can be accomplished with DNA sequencing, such as when looking for rare organisms, attempting eradication, testing specifically for drug-resistant strains, or discovering new species. Sequencing DNA from an environmental sample is known as metagenomics.

Sewage contains pathogenic or potentially pathogenic microorganisms which pose a threat to public health. By definition, a pathogen is an organism capable of inflicting damage on its host. [Waterborne diseases](#) whose pathogens are spread by the faecal-oral route (with water as the intermediate medium) can be caused by bacteria, viruses, and [parasites](#) (including protozoa, worms, and rotifers).

### 3.2.6 Health and environmental implication of sewage

All categories of sewage are likely to carry [pathogenic organisms](#) that can transmit disease to humans and animals. Sewage also contains organic matter that can cause odour and attract flies. Sewage contains nutrients that may cause [eutrophication](#) of receiving water bodies; and can lead to [eco-toxicity](#).

### 3.2.7 Sewage collection and disposal

A system of [sewer](#) pipes (sewers) collects sewage and takes it for treatment or disposal. The system of sewers is called [sewerage](#) or *sewerage system* in British English and *sewage system* in American English.

In a situation where main sewerage system has not been provided, sewage may be collected from homes by pipes into [septic tanks](#) or [cesspits](#), where it may be treated or collected in [vehicles](#) and taken for treatment or disposal. Properly functioning septic tanks require emptying every 2–5 years depending on the load of the system.

### 3.2.8 Sewage treatment

Sewage treatment is the process of removing [contaminants](#) from municipal [wastewater](#), containing mainly household [sewage](#) plus some [industrial wastewater](#). Physical, chemical, and biological processes are used to remove contaminants and produce treated wastewater (or treated [effluent](#)) that is safe enough for release into the environment. It is a form of [waste management](#). A septic tank or other [on-site wastewater treatment](#) system such as [bio-filters](#) or [constructed wetlands](#) can be used to treat sewage close to where it is created. Sewage treatment results in [sewage sludge](#) which requires [sewage sludge treatment](#) before safe disposal or reuse. Under certain circumstances, the treated sewage sludge might be termed "[bio-solids](#)" and can be used as a [fertilizer](#). In [developed countries](#) sewage collection and treatment is typically subject to local and national [regulations and standards](#). A by-product of sewage treatment is a semi-solid waste or slurry, called [sewage sludge](#). The sludge has to undergo further [treatment](#) before being suitable for disposal or application to land. Sewage treatment may also be referred to as [wastewater treatment](#). However, the latter is a broader term which can also refer to industrial wastewater. For most cities, the [sewer system](#) will also carry a proportion of industrial effluent to the sewage treatment plant which has usually received pre-treatment at the factories themselves to reduce the pollutant load. If the sewer system is a [combined sewer](#) then it will also carry [urban runoff](#) to the sewage treatment plant. Sewage water can travel towards treatment plants via [piping](#) and in a flow aided by [gravity](#) and [pumps](#).

The first part of filtration of sewage typically includes a [bar screen](#) to filter solids and large objects which are then collected in [dumpsters](#) and disposed of in landfills. [Fat](#) and [grease](#) is also removed before the primary treatment of sewage.

**Primary treatment of sewage:** Primary treatment involves holding the sewage temporarily in a quiescent basin where heavy solids can settle at the bottom while oil, grease and lighter

solids float on the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.

**Sedimentation Aids:** Sewage includes colloidal particles, which may remain suspended indefinitely. However, these very finely divided particles tend to flocculate with the aid of mechanical agitation, aeration, or chemical [coagulation](#). The quality of the final [effluent](#) can thus be significantly increased. Mechanical [flocculation](#) is normally achieved in double-zone tanks incorporating an inner mixing zone (paddles rotating at  $\leq 450$  mm/s) and another conventional settlement zone (e.g., the Dorr Clariflocculator, which gives 20% better effluent than that obtained by plain sedimentation at very little extra cost).

Chemical coagulants in common use are as follows:

- (a) Hydrated lime:  $\text{Ca}(\text{OH})_2$
- (b) Aluminum [sulfate](#):  $\text{Al}_2(\text{SO}_4)_3$
- (c) Iron (II) sulphate:  $\text{FeSO}_4$

However, the misuse of chemicals can sterilize sewage or at least slow down the biological degradation rate. Sedimentation aids are usually unnecessary for most wetland system due to the presence of plants that slow down the flow velocity of the storm [runoff](#).

### 3.2.9 Reuse of treated or untreated sewage

Sewage can be converted to [biogas](#) using [anaerobic digestion](#). Increasingly, [agriculture](#) is using untreated wastewater for irrigation. Cities provide lucrative markets for fresh produce, so are attractive to farmers. Because agriculture has to compete for increasingly scarce water resources with industry and municipal users, there is often no alternative for farmers but to use water polluted with urban waste, including sewage, directly to water their crops. There can be significant health hazards related to using water loaded with pathogens in this way, especially if people eat raw vegetables that have been irrigated with the polluted water.

The [International Water Management Institute](#) has worked in India, Pakistan, Vietnam, Ghana, Ethiopia, Mexico and other countries on various projects aimed at assessing and reducing risks of wastewater irrigation. They advocate a ‘multiple-barrier’ approach to wastewater use, where farmers are encouraged to adopt various risk-reducing behaviours. These include ceasing irrigation a few days before harvesting to allow pathogens to die off in the sunlight, applying water carefully so it does not contaminate leaves likely to be eaten raw, cleaning vegetables with disinfectant or allowing faecal sludge used in farming to dry before

being used as a human manure. The [World Health Organization](#) has developed guidelines for safe water use.

### **3.2.10 Sewage and Algal Biomass Production**

Sewage is the most favourable medium for algae production. It provides all the necessary nutrients needed for algal growth. New Zealand's Aqua-flow Bionomic Corporation has become the World's first producer of [biofuel](#) from sewage-pond-grown algae. One particular advantage of the human-sewage approach is that algae from sewage tends to have a lot of oil according to Cary Bullock, CEO of Greenfuel Technologies, a company cultivating algae to convert emissions into biofuel.

Bacteria digestion of organics is the known method to reduce [BOD](#), COD, TSS, TDS, etc. in Sewage. Anaerobic bacteria proliferate in untreated sewage giving rise to H<sub>2</sub>S gas that produces the obnoxious smell. Aerobic bacteria require plenty of dissolved oxygen to do the organic digestion. Untreated sewage is let out into the nearest water bodies where anaerobic bacteria slowly consume the organics and produce H<sub>2</sub>S that gives rise to bad smell. Further the waters become infested with water weeds and plants like hyacinth. These then become the breeding place of mosquitoes and disease producing organisms. Utilization of domestic sewage for algal [biomass](#) production has been studied extensively by employing a variety of micro algal species.

## **3.3 Drainage**

Drainage is the natural or artificial removal of a surface's water and [sub-surface water](#) from an area with excess of water. The internal drainage of most [agricultural soils](#) is good enough to prevent severe [waterlogging](#) (anaerobic conditions that harm root growth), but many soils need artificial drainage to improve production or to manage water supplies.

### **3.3.1 The Need for drainage**

During rain or irrigation, the fields become wet. Water then infiltrates into the soil and is stored in its pores. When all the pores are filled with water, the soil is said to be saturated and no more water can be absorbed; when rain or irrigation continues, pools may form on the soil surface. Part of the water present in the saturated upper soil layers flows downward into deeper layers and is replaced by water infiltrating from the surface pools. When there is no more water left on the soil surface, the downward flow continues for a while and air re-enters

in the pores of the soil. This soil is not saturated anymore. However, saturation may have lasted too long for the plants' health. Plant roots require air as well as water and most plants cannot withstand saturated soil for long periods (rice is an exception).

Besides damage to the crop, a very wet soil makes the use of machinery difficult, if not impossible. The water flows from the saturated soil downward to deeper layers and feeds the groundwater reservoir. As a result, the groundwater level (often called groundwater table or simply water table) rises. Following heavy rainfall or continuous over-irrigation, the groundwater table may even reach and saturate part of the root zone. Again, if this situation lasts too long, the plants may suffer. Measures to control the rise of the water table are thus necessary. The removal of excess water either from the ground surface or from the root zone, is called drainage. Excess water may be caused by rainfall or by using too much irrigation water, but may also have other origins such as canal seepage or floods. In very dry areas there is often accumulation of salts in the soil. Most crops do not grow well on salty soil. Salts can be washed out by percolating irrigation water through the root zone of the crops. To achieve sufficient percolation, farmers will apply more water to the field than the crops need. But the salty percolation water will cause the water table to rise. Drainage to control the water table, therefore, also serves to control the salinity of the soil.

### **3.3.2 Types of drainage**

1. Natural
2. Artificial

Many areas have some natural drainage; this means that excess water flows from the farmers' fields to swamps or to lakes and rivers. Natural drainage, however, is often inadequate and artificial or man-made drainage is required.

### **3.3.3 There are two types of artificial drainage:**

Surface drainage and Sub-surface drainage

### **3.3.4 Surface drainage**

Surface drainage is the removal of excess water from the surface of the land.

This is normally accomplished by shallow ditches, also called open drains.

The shallow ditches discharge into larger and deeper collector drains. In order to facilitate the flow of excess water toward the drains, the field is given an artificial slope by means of land grading.

### 3.3.5 Sub-surface drainage

Subsurface drainage is the removal of water from the root zone. It is accomplished by deep open drains or buried pipe drains.

- i. Deep open drains: The excess water from the root zone flows into the open drains. The disadvantage of this type of subsurface drainage is that it makes the use of machinery difficult.
- ii. Pipe drains: Pipe drains are buried pipes with openings through which the soil water can enter. The pipes convey the water to a collector drain. Drain pipes are made of clay, concrete or plastic. They are usually placed in trenches by machines. In clay and concrete pipes (usually 30 cm long and 5 - 10 cm in diameter) drainage water enters the pipes through the joints. Flexible plastic drains are much longer (up to 200 m) and the water enters through perforations distributed over the entire length of the pipe.
- iii. Deep open drains versus pipe drains: Open drains use land that otherwise could be used for crops. They restrict the use of machines. They also require a large number of bridges and culverts for road crossings and access to the fields. Open drains require frequent maintenance (weed control, repairs, etc.).

In contrast to open drains, buried pipes cause no loss of cultivable land and maintenance requirements are very limited. The installation costs, however, of pipe drains may be higher due to the materials, the equipment and the skilled manpower involved.

### 3.3.6 Current Drainage practices

New drainage systems incorporate [geotextile](#) filters that retain and prevent fine [grains](#) of [soil](#) from passing into and clogging the drain. Geotextiles are synthetic textile fabrics specially manufactured for [civil](#) and [environmental engineering](#) applications. Geotextiles are designed to retain fine soil particles while allowing water to pass through. In a typical drainage system, they would be laid along a trench which would then be filled with coarse [granular material](#): [gravel](#), [sea shells](#), stone or [rock](#). The geotextile is then folded over the top of the stone and the trench is then covered by soil. [Groundwater](#) seeps through the geotextile and flows through



the stone to an outfall. In high [groundwater](#) conditions a perforated plastic ([PVC](#) or [PE](#)) pipe is laid along the base of the drain to increase the volume of water transported in the drain.

### **3.3.7 Construction of Drainage system**

Drainage systems are constructed to ensure that waste water and sewage is transported neatly to disposal points, thereby keeping the environment well drained and free of waste. The following examples make up a good drainage system; drainage pipes, closed ditches having pipe drains, channels and conduits. Nigerian coastal cities are daily overwhelmed with flood waters, and millions of properties have been destroyed and lives lost. Poor drainage systems are often associated with street flooding, and this has become critical environmental problems in coastal cities of Nigeria such as Lagos, Port Harcourt, Ondo, Warri, Uyo, and Calabar.

These towns which are quite close to the Atlantic Ocean experience heavy flooding especially during the rainy season. However, it is not waters from the Ocean that usually floods these cities but the heavy rains, and the low nature of the topography and the poor drainage networks.

Major causes of street flooding in Nigerian cities includes land use problems, increased paved surfaces, river channel encroachments, poor waste disposal techniques, physical development control problems, gaps in basic hydrological data and cultural problems.

## **4.0 CONCLUSION/SUMMARY**

Water is derived from various sources such as the ocean water constituting 97% of the earth's water, ice 2%, and 1% fresh water obtained from the rivers, lakes, underground water, the atmospheric and soil moisture. It is a basic necessity of life for both plants and animals. Mankind cannot survive without water. It is therefore imperative that water and sewage is properly managed for optimal benefit.

## **5.0 TUTOR-MARKED ASSIGNMENT**

Discuss water supply and its management

What are the different methods of handling sewage?

## 7.0 REFERENCES/FURTHER READING

Ajibade, F. O., Adewumi, J. R., Ojo, O. M., Babatola, J. O. and Oguntuase, A. M. (2015) Issues, Challenges and Management of Water Supply and Sanitation in Nigeria: An Overview; Conference Proceedings: National Development Strategies Toward Sustainable Civil Infrastructure.

D. M. Akali, O. T. Iorhemen, Otun J. A., Alfa M. I (2014) Provision of Sustainable Water Supply System in Nigeria: A Case Study of Wannune-Benue State *World Journal of Environmental Engineering*, 2014, Vol. 2, No. 1, 1-5

Abdullahi B. Mohammed and Abdulrahman A. Sahabo (2015) Water Supply and Distribution Problems in Developing Countries: A Case Study of Jimeta-Yola, Nigeria *International Journal of Scientific Engineering and Applied Science (IJSEAS)* - Volume-1, Issue-4, June 2015 ISSN: 2395-3470 [www.ijseas.com](http://www.ijseas.com)

Isaac Idowu Balogun, Adebayo Olatunbosun Sojobi and Emmanuel Galkaye (2017) Public water supply in Lagos State, Nigeria: Review of importance and challenges, status and concerns and pragmatic solution *Cogent Engineering* (2017), 4: 1329776 <https://doi.org/10.1080/23311916.2017.1329776>

Yusuf, M. J., Sanni, J. E., Alabi, J. O., Onyowoicho, C. O., & Amanda, U. E. Evaluation of Drainage System in Part of Lokoja Town in Kogi State, Nigeria *International Journal of Engineering and Modern Technology* ISSN 2504-8856 Vol. 3 No. 5 2017 [www.iiardpub.org](http://www.iiardpub.org)

Corcoran, E., C. Nellemann, E. Baker, R. Bos, D. Osborn, H. Savelli, eds. (2010). Sick water? The central role of wastewater management in sustainable development. A rapid response assessment (PDF). Arendal, Norway: UNEP/GRID-Arendal. ISBN 978-82-7701-075-5. Archived from the original (PDF) on 2015-12-18.

Wastewater engineering: treatment and reuse (4th ed.). Metcalf & Eddy, Inc., McGraw Hill, USA. 2003. p. 1807. ISBN 0-07-112250-8.

## **UNIT 2: SANITATION, AIR POLLUTION AND POWER SUPPLY**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Sanitation
  - 3.2 Benefits of improving sanitation
  - 3.3 Types of sanitation
    - 3.3.1 Basic sanitation
    - 3.3.2 Container-based sanitation
    - 3.3.3 Community-led total sanitation
    - 3.3.4 Dry sanitation
    - 3.3.5 Ecological sanitation
    - 3.3.6 Emergency sanitation
    - 3.3.7 Environmental sanitation
  - 3.4 Air pollution
  - 3.5 Causes of air pollution
    - 3.5.1 Anthropogenic air pollution sources
    - 3.5.2 Sources from processes other than combustion
    - 3.5.3 Natural sources of air pollution
  - 3.6 Power supply
    - 3.6.1 Power sector reforms in Nigeria
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

### **1.0 INTRODUCTION/DEFINITION**

Sanitation is the effective use of tools and actions that keep our environment healthy, according to WHO Sanitation generally refers to the provision of facilities and services for the safe disposal of human urine and faeces. Air pollution is the release of pollutants or contaminants into the air that are detrimental to human health and the planet as a whole.

## 2.0 AIMS AND OBJECTIVE

To be able to describe different methods of sanitation

To state different types and causes of pollution

To determine problems of power supply

## 3.0 MAIN CONTENT

### 3.1 SANITATION

The word “sanitation” refers to the maintenance of hygienic conditions, through services such as garbage collection and wastewater disposal. Sanitation refers to a generalised conditions associated to clean drinking water and adequate treatment and disposal of human excreta and waste water. These include latrines or toilets to manage waste, food preparation, washing stations, effective drainage and other such mechanisms.

In many health care establishments in developing countries patients have no access to sanitation facilities. Excreta are usually disposed of in the environment, creating a high direct or indirect risk of infection to other people. Human excreta are the principal vehicle for the transmission and spread of a wide range of communicable diseases, and excreta from hospital patients may be expected to contain far higher concentrations of pathogens, and therefore to be far more infectious than excreta from households. The challenge in sanitation include poor access to improved water and sanitation in Nigeria which remains a major contributing factor to high morbidity and mortality rates among children under five.

The use of contaminated drinking water and poor sanitary conditions result in increased vulnerability to water-borne diseases, including diarrhoea which leads to deaths of more than 70,000 children under five annually. Seventy-three per cent of the diarrhoeal and enteric disease burden is associated with poor access to adequate water, sanitation and hygiene (WASH). Diseases which are easily transmitted in communities that have low levels of sanitation are ascariasis (intestinal worm), typhoid, cholera, hepatitis, polio, schistosomiasis, and trachoma.

The following sanitation approaches exists and they includes community-led total sanitation, container-based sanitation, ecological sanitation, emergency sanitation, environmental sanitation, onsite sanitation and sustainable sanitation. A sanitation system includes the capture, storage, transport, treatment and disposal of wastewater. The purposes of sanitation are to provide a healthy living environment for everyone, to protect the natural resources and to provide safety, security and dignity for people when they defecate or urinate.

### **3.2 Benefits of improving sanitation**

These include:

1. It prevent the spread of intestinal worms, schistosomiasis and trachoma, which are neglected tropical diseases that cause suffering for millions;
2. It reduce the severity and impact of malnutrition;
3. The promotion of dignity and boosting safety, particularly among women and girls;
4. The promotion of school attendance: girls' school attendance is particularly boosted by the provision of separate sanitary facilities; and
5. The potential recovery of water, renewable energy and nutrients from faecal waste.

### **3.3 TYPES OF SANITATION**

#### **3.3.1 Basic sanitation**

This is defined as the use of effective and improved sanitation facilities that are not shared with other households in a particular community. This tend to minimise the transmission of disease among individuals from different housholds, also it aids in diagnostic approaches to certain ailments which could result due to unsanitary conditions.

#### **3.3.2 Container-based sanitation**

CBS refers to a system where human excreta is collected in sealable, removable containers (that are transported to treatment facilities. Container-based sanitation is usually provided as a service involving provision of certain types of portable toilets, and collection of excreta at a cost borne by the users. With suitable development, support and functioning partnerships, CBS can be used to provide low-income urban populations with safe collection, transport and treatment of excrement at a lower cost than installing and maintaining sewers. In most cases, CBS is based on the use of urine diverting dry toilet.

#### **3.3.3 Community-led total sanitation**

Community-Led Total Sanitation (CLTS) is an intervention approach to rural inhabitants which achieve behaviour change by a process of "triggering", leading to spontaneous and long-term abandonment of open defecation practices. CLTS takes an approach to rural sanitation that works without hardware subsidies and that facilitates communities to recognize the problem of open defecation and take collective action to clean up and become "open defecation free".

### **3.3.4 Dry sanitation**

The term "dry sanitation" is not in widespread use and is not very well defined. It usually refers to a system that uses a type of dry toilet and no sewers to transport excreta. Often when people speak of "dry sanitation" they mean a sanitation system that uses urine-diverting dry toilet.

### **3.3.5 Ecological sanitation**

Ecological sanitation, which is commonly abbreviated to ecosan, is an approach, rather than a technology or a device which is characterized by a desire to "close the loop" (mainly for the nutrients and organic matter) between sanitation and agriculture in a safe manner. Put in other words: "Ecosan systems safely recycle excreta resources (plant nutrients and organic matter) to crop production in such a way that the use of non-renewable resources is minimised". When properly designed and operated, ecosan systems provide a hygienically safe, economical, and closed-loop system to convert human excreta into nutrients to be returned to the soil, and water to be returned to the land. Ecosan is also called resource-oriented sanitation

### **3.3.6 Emergency sanitation**

Emergency sanitation is required in situations including natural disasters and relief for refugees and Internally Displaced Persons. There are three phases: Immediate, short term and long term. In the immediate phase, the focus is on managing open defecation, and toilet technologies might include very basic latrines, pit latrines, bucket toilets, container-based toilets, chemical toilets. The short term phase might also involve technologies such as urine-diverting dry toilets, septic tanks, decentralized wastewater systems. Providing handwashing facilities and management of fecal sludge are also part of emergency sanitation. The Sphere Project handbook provides protection principles and core standards for sanitation to put in place after a disaster or conflict.

### **3.3.7 Environmental sanitation**

Environmental sanitation encompasses the control of environmental factors that are connected to disease transmission. Subsets of this category are solid waste management, water and wastewater treatment, industrial waste treatment and noise pollution control.

### **3.4 AIR POLLUTION**

Air pollution is the release of pollutants or contaminants into the air that are detrimental to human health and the planet as a whole. It occurs when harmful or excessive quantities of substances including gases (such as carbon dioxide, carbon monoxide, sulfur dioxide, nitrous oxides, methane and chlorofluorocarbons), particulates (both organic and inorganic), and biological molecules are introduced into atmosphere. More so, car emissions, chemicals from factories, dust, pollen and mold spores may be suspended as particles. Ozone, a gas, is a major part of air pollution in cities.

### **3.5 CAUSES OF AIR POLLUTION**

Air pollution is caused by the presence in the atmosphere of toxic substances, mainly produced by human activities, even though sometimes it can result from natural phenomena such as volcanic eruptions, dust storms and wildfires, also depleting the air quality.

#### **3.5.1 Anthropogenic air pollution sources**

1. Combustion of fossil fuels, like coal and oil for electricity and road transport, producing air pollutants like nitrogen and sulfur dioxide
2. Emissions from industries and factories, releasing large amount of carbon monoxide, hydrocarbon, chemicals and organic compounds into the air
3. Agricultural activities, due to the use of pesticides, insecticides, and fertilizers that emit harmful chemicals

#### **3.5.2 Sources from processes other than combustion**

1. Fumes from paint, hair spray, varnish, aerosol sprays and other solvents. These can be substantial; emissions from these sources was estimated to account for almost half of pollution from volatile organic compounds
2. Waste deposition in landfills, which generate methane. Methane is highly flammable and may form explosive mixtures with air. Methane is also an asphyxiant and may displace oxygen in an enclosed space. Asphyxia or suffocation may result if the oxygen concentration is reduced to below 19.5% by displacement.
3. Military resources, such as nuclear weapons, toxic gases, germ warfare and rocketry.
4. Fertilized farmland may be a major source of nitrogen oxides.

### 3.5.3 Natural sources of air pollution

1. Dust from natural sources, usually large areas of land with little vegetation or no vegetation
2. Methane, emitted by the digestion of food by animals, for example cattle
3. Radon gas from radioactive decay within the Earth's crust. Radon is a colorless, odorless, naturally occurring, radioactive noble gas that is formed from the decay of radium. It is considered to be a health hazard. Radon gas from natural sources can accumulate in buildings, especially in confined areas such as the basement and it is the second most frequent cause of lung cancer, after cigarette smoking.
4. Smoke and carbon monoxide from wildfires.
5. Vegetation, in some regions, emits environmentally significant amounts of Volatile organic compounds (VOCs) on warmer days. These VOCs react with primary anthropogenic pollutants—specifically, NO<sub>2</sub>, SO<sub>2</sub>, and anthropogenic organic carbon.
6. Volcanic activity, which produces sulfur, chlorine, and ash particulates

### 3.6 POWER SUPPLY

A power supply is a component that supplies power to at least one electric load. Typically, it converts one type of electrical power to another, but it may also convert a different form of energy – such as solar, mechanical, or chemical - into electrical energy.

A power supply provides components with electric power. The term usually pertains to devices integrated within the component being powered. For example, computer power supplies convert AC current to DC current and are generally located at the rear of the computer case, along with at least one fan.

A power supply is also known as a power supply unit, power brick or power adapter. All power supplies have a *power input* connection, which receives energy in the form of electric current from a source, and one or more *power output* connections that deliver current to the load. The source power may come from the electric power grid, such as an electrical outlet, energy storage devices such as batteries or fuel cells, generators or alternators, solar power converters, or another power supply. The input and output are usually hardwired circuit connections, though some power supplies employ wireless energy transfer to power their loads without wired connections.

#### 3.6.1 Power sector reforms in Nigeria



The sectors - power, telecoms, ports, and oil and gas - are at various stages of reforms. The reform actions taken so far in power sector in Nigeria are highlighted as follows:

1. Objectives defined for the power sector reform;
2. A power policy was approved by the Federal Executive Council on March 28, 2001;
3. A draft Electric Power Sector Reform Bill was approved by the Federal Executive Council and submitted to the National Assembly for enactment in September 2001. The passage of the Bill (not passed as at September, 2004) is said to be paramount to the establishment of a transparent power sector in Nigeria. The Bill creates a sector regulator, Nigerian Electricity Regulatory Commission responsible for tariff regulation, and economic and technical regulation of the electricity supply industry; and
4. Approval on August 26th, 2002 by the National Council on Privatization, of the implementation of the blueprint for the restructuring of NEPA.

The restructuring entailing unbundling of NEPA, will involve the creation of six Generation Companies (Gencos); an independent Transmission Company; and eleven Distribution/Marketing Companies (Discos) matching NEPA's existing zonal structure, with the exception that the high demand and revenue - yielding Lagos zone will be restructured into two separate companies. The establishment of these companies will be followed later by divestiture of the Federal Government's interests in the Discos followed by the Gencos. The BPE is currently considering a post-restructuring strategy of putting management contracts in place in some of the new companies. Also, it is said to be working hand in hand with both the Ministry of Power and Steel and NEPA towards the implementation of the restructuring blueprint.

As it were, the outstanding activities are still many, including the passage of the Power Bill; restructuring of NEPA; establishment of the National Electricity Regulatory Commission and a Special Purpose Entity (to hold and pay off NEPA's major financial and trading liabilities); development of the Rural Energy Policy; finalization of the Transition Market Rules; and privatization of the individual power companies.

#### **4.0 CONCLUSION/SUMMARY**

Environmental sanitation encompasses the control of environmental factors that are connected to disease transmission. The purposes of sanitation are to provide a healthy living

environment for everyone, to protect the natural resources and to provide safety, security and dignity for people when they defecate or urinate.

## **5.0 TUTOR-MARKED ASSIGNMENT**

Discuss different methods of sanitation

Outline sources of air pollution

## **6.0 REFERENCES/FURTHER READING**

Community Led Total Sanitation (CLTS) An Evaluation of the WaterAid's CLTS Programme in Nigeria: 2007

Godson Rowland Ana Air Pollution in the Niger Delta Area: Scope, Challenges and Remedies: October 15th 2010 Reviewed: April 22nd 2011Published: September 26th 2011 DOI: 10.5772/16817

## **UNIT 3: FIRE SERVICE, CLIMATE CHANGE AND ENERGY**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Fire safety needs
  - 3.2 Prevention of fire
  - 3.3 Preventive measures
  - 3.4 Fire safety strategies
    - 3.4.1 Fire protection equipment
    - 3.4.2 Automatic fire detection system
    - 3.4.3 Automatic sprinkler system
    - 3.4.4 Automatic release mechanism
    - 3.4.5 Automatic self-closing device
    - 3.4.6 Basement
    - 3.4.7 Boundary
    - 3.4.8 Cavity
    - 3.4.9 Ceiling
    - 3.4.10 Circulation space
  - 3.5 Common fire hazards
  - 3.6 Climate Change and energy
    - 3.6.1 Climate change and adaptation
    - 3.6.2 Assessing impacts, vulnerability and adaptation to climate change
    - 3.6.3 Information gathering – data, systematic observation and monitoring
    - 3.6.4 Information analysis – reporting of impacts, vulnerability, adaptation
    - 3.6.5 Regional impacts of and vulnerabilities to climate change
  - 3.7 Adaptation to climate change
    - 3.7.1 Adaptation strategies, plans and programmes
    - 3.7.2 Adaptation measures in key vulnerable sectors
    - 3.7.3 Impacts of Climate Change on the Millennium Development Goals
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment

## 6.0 References/Further reading

### 1.0 INTRODUCTION/DEFINITION

Fire is one of mankind's greatest discoveries but can also be a great source of risk in accidents. An imperative aspect of fire prevention is concerned with the human duty in ensuring that accidental fires are not allowed to start. Training and education at all levels plays a vital part in this and the management responsible for a building has a role to ensure that people in the building understand the danger attached to various activities they assume.

### 2.0 OBJECTIVE

- a) To ensure adequate knowledge of fire safety measures and their viability in buildings
- b) To provide an adequate level of fire safety in buildings and other structures consideration needs to be given to a whole range of connected design and use aspects
- c) To reduce the probability of fire outbreak in a building or premises
- d) To highlight the concerns and needs of developing countries in adapting to the impact of climate change
- e) To outline the effects of climate change in the developing countries
- f) To assess the vulnerability to future climate change; current adaptation plans, strategies and actions; and future adaptation options and needs.

### 3.0 MAIN CONTENT

#### 3.1 FIRE SAFETY NEEDS

If a fire does take place, it is essential that occupants become aware of it as soon as possible and have awareness of the actions they need to take to move to a place of safety. This requires knowledge of the safety provisions which have been made and an easy identification of the route to follow to reach safety outside the building. In large and complex buildings this may be a progressive progress through areas of increasing safety. It is not normally expected that the occupants will use on-site amenities to control a fire but where these are available it is possible that use can be made of them to deal with a small fire and quench it.

#### 3.2 PREVENTION OF FIRE

Studies of fires have shown that most accidental fires start from three main causes namely;

1. Malfunctioning of equipment
2. Misuse of heat sources

### 3. Human error

By paying attention to simple safety measures it is possible to reduce the chance of a fire starting and thereby increase fire safety. The Code is not intended to provide full details of these precautions as they are properly dealt with in other standards and specifications. It however draws attention to these in general terms to offer a basis for more positive actions.

As far as the prevention of human error is concerned, it is primarily a question of education and management. It is in the interests of the owners and managers of premises to ensure that the building occupants have knowledge of fire hazards and are encouraged to be careful in the handling of heat sources and equipment to prevent a fire starting.

### **3.3 PREVENTIVE MEASURES AND REQUIREMENTS**

1. Enforce good housekeeping practices; this includes implementing routines for the regular taking away and disposal of waste
2. Establish and maintain out-of-hours inspection and security procedures, including means of preventing arson
3. Carry out routine checks, inspections, and tests, including monitoring the maintenance of heat generating equipment that could cause fires, chafing of cables, self-heating of cables due to electrical resistance and checks on fuel supplies and storage.
4. Issue and control work permits and associated procedures
5. Instruct and supervise contractors and sub-contractors carrying out construction and maintenance operations within the building
6. Avoid conditions leading to gas and dust explosion hazards
7. Maintain integration with other systems (e.g. ventilation, communications).
8. All fixed equipment which generates heat or utilizes energy, such as heaters, cookers, refrigeration units etc., shall be installed according to the provisions contained in the standards dealing with their use in buildings.
9. The equipment shall be maintained in good working order and no repairs or modifications shall be carried out by unqualified people.
10. All operations which can be potentially hazardous shall be carried out in a safe manner by staff trained to undertake such operations
11. Operations which require the use of flammable materials shall be controlled so that only a small quantity of material necessary for the operation is present and the rest is kept in a

safe place from which it can be withdrawn as needed. Such materials shall be stored in a detached protected place with limited access to specified personnel.

12. There shall be a ban on smoking in those areas where flammable materials are present e.g. in stores, factories using or producing such materials. In such cases special facilities shall be made available for the staff who need to smoke.
13. Smoking and the use of naked flames should also be prohibited from premises where a fire can cause special problems for the escape of people, such as cinema, theatres, hospital wards, public transport etc. Notices shall be displayed to draw attention to the sanction on smoking and where the ambient light conditions are poor the notices shall be illuminated.
14. Cooking appliances using bottled gas should be well installed with connections made to a good standard if possible the cylinder shall be located in a protected place at a safe distance from the appliance.
15. Spare gas cylinders shall be kept in a safe place away from the appliance.
16. In organizations where more than 20 people work the management shall draw attention of the staff to the risk of a fire and hold regular drills and instruction courses to advise them of the safe measures to use. Large organizations shall have specially appointed people with responsibility for safety.

### **3.4 FIRE SAFETY STRATEGIES**

#### **3.4.1 Fire protection equipment**

Fire extinguishers, fire hose reels, fire hydrants, hydrant valves, fire blankets and fire protection systems such as automatic fire detection and alarm systems, automatic fire sprinkler systems and emergency warning and inter-communication systems

#### **3.4.2 Automatic fire detection system**

A system of fire detectors installed in a building or other space which are connected to a control panel competent of providing an automatic warning when a detector responds to a fire.

#### **3.4.3 Automatic sprinkler system**

A sprinkler installation provided with a fusible link or other sensing device which responds to a fire and sprays water on the contents. The system requires sprinkler heads, water supply and appropriate control valves.

#### **3.4.4 Automatic release mechanism**

A device which allows a door held open to close automatically on receiving a signal from a fire alarm system, or a detection system or a manually operated switch.

#### **3.4.5 Automatic self-closing device**

A mechanical device to close a door after it has been opened and released.

#### **3.4.6 Basement**

Part of a building below surrounding ground level which is intended to be used for accommodation, car parking or other intentions

#### **3.4.7 Boundary**

Demarcation between buildings adjacent to each other or between a building and the centre of a road, street or stream

#### **3.4.8 Cavity**

Concealed space within building elements or between building elements, such as in a hollow wall or between a ceiling and a roof

#### **3.4.9 Ceiling**

Underneath side of a floor, or a separate construction provided below a floor or a roof with a gap above.

#### **3.4.10 Circulation space**

Common space used by occupants of a building to gain right of entry from a room to an exit or a stairway or a lobby. It may be a corridor or a foyer or an entrance hall.

### **3.5 COMMON FIRE HAZARDS**

Some common fire hazards are:

1. Kitchen fire from unattended cooking, such as frying, boiling and simmering.
2. Electrical systems overloaded, resulting in hot wiring or connections, or failed components.
3. Combustible storage areas with insufficient protection.
4. Combustibles near equipment that generates heat, flame, or sparks.
5. Candles and other open flames
6. Smoking (cigarettes, cigars, pipes, lighters, etc.).
7. Equipment that generates heat and utilizes combustible materials.
8. Flammable liquids and aerosols.
9. Flammable solvent (and rags soaked with solvent) placed in enclosed trash cans.
10. Fireplace chimneys not properly or regularly cleaned.
11. Cooking appliances-stoves, ovens.
12. Heating appliances-fireplaces, wood burning stoves, furnaces, boilers, portable heaters.
13. Household appliances-clothes dryers, curling irons, hair dryers, refrigerators, freezers.
14. Chimneys that concentrate creosote.
15. Electrical wiring in poor condition.
16. Leaking Batteries.
17. Personal ignition sources-matches, lighters
18. Electronic and electrical equipment
19. Exterior cooking equipment-barbecue.

### **3.6 CLIMATE CHANGE AND ENERGY**

Over the next decades, it is projected that billions of people, particularly those in developing countries, face shortages of water and food and greater danger to health and life as a result of climate change. There is need for combined global action is needed to enable developing countries to adapt to the effects of climate change that are taking place now and will worsen in the future. Under a business as usual scenario, greenhouse gas emissions could rise by 25–90 per cent by 2030 relative to 2000 and the Earth could warm by 3°C this century. Even with a temperature rise of 1–2.5°C the IPCC predict serious effects including reduced crop yields in tropical areas leading to increased risk of hunger, spread of climate sensitive diseases such as malaria, and an increased risk of extinction of 20–30 per cent of all plant and animal species. By 2020, up to 250 million people in Africa could be exposed to greater risk of water stress. Over the course of this century, millions of people living in the catchment



areas of the Himalayas and Andes face increased risk of floods as glaciers retreat followed by drought and water scarcity as the once extensive glaciers on these mountain ranges disappear. Sea level rise will lead to inundation of coasts worldwide with some small island States possibly facing complete inundation and people living with the constant threat of tropical cyclones now face increased severity and possibly increased occurrence of these events with all associated risk to life and livelihoods. Developing countries are the most vulnerable to climate change effects because they have fewer resources to adapt: socially, technologically and financially. Climate change is expected to have far reaching effects on the sustainable development of developing countries including their ability to attain the United Nations Sustainable Development Goals. Many developing countries' governments have given adaptation action a high, even urgent, precedence.

### **3.6.1 Climate change and adaptation**

Rising fossil fuel burning and land use changes have released, and are continuing to release, increasing quantities of greenhouse gases into the Earth's atmosphere. These greenhouse gases include carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>) and nitrogen dioxide (N<sub>2</sub>O), and a rise in these gases has caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere, heat that would normally be radiated back into space. This increase in heat has resulted to the greenhouse effect, resulting in climate change. The main characteristics of climate change are rise in average global temperature (global warming); changes in cloud cover and precipitation particularly over land; melting of ice caps and glaciers and reduced snow cover; and increases in ocean temperatures and ocean acidity – due to seawater absorbing heat and carbon dioxide from the atmosphere.

It is now obvious that global warming is mostly due to man-made productions of greenhouse gases (mostly CO<sub>2</sub>). Over the last century, atmospheric concentrations of carbon dioxide increased from a pre-industrial value of 278 parts per million to 379 parts per million in 2005, and the average global temperature rose by 0.74°C. According to scientists, this is the largest and fastest warming trend that they have been able to discern in the history of the Earth. An increasing rate of warming has particularly taken place over the last 25 years, and 11 of the 12 warmest years on record have occurred in the past 12 years. The IPCC Report gives detailed projections for the 21st century and these show that global warming will continue and accelerate. The best estimates indicate that the Earth could warm by 3°C by 2100. Even if countries reduce their greenhouse gas emissions, the Earth will continue to warm.

Projections by 2100 range from a minimum of 1.8°C to as much as 4°C rise in global average temperature. Human beings have been adapting to the variable climate around them for centuries.

Global local climate variability can influence peoples' decisions with consequences for their social, economic, political and personal conditions, and effects on their lives and livelihoods. The impacts of climate change imply that the local climate variability that people have previously experienced and have adapted to is changing and changing at relatively great speed.

### **3.6.2 Assessing the impacts of and vulnerability and adaptation to climate change**

Assessing the impacts of and vulnerability to climate change and subsequently working out adaptation needs requires good quality information. This information includes climate data, such as temperature, rainfall and the frequency of extreme events, and non-climatic data, such as the current situation on the ground for different sectors including water resources, agriculture and food security, human health, terrestrial ecosystems and biodiversity, and coastal zones.

### **3.6.3 Information gathering – data, systematic observation and monitoring**

For countries to understand their local climate better and thus be able to predict local climate change, they must have sufficient operational national systematic observing networks, and access to the data available from other universal and regional networks. Systematic observations of the climate system are usually done by meteorological centres and other specialised centres. They take observations at standard predetermined times and places, and monitor atmosphere, ocean and terrestrial systems. The main climate variables measured include temperature, rainfall, sea surface temperature, sea level rise, wind speeds, tropical cyclones (including hurricanes and typhoons), snow and ice cover.

There is need for the international body and community to support and further develop climate research and systematic observation systems, taking into account the concerns and needs of developing countries.

There is need for trainings and meeting that will underscore need to take stock of available climate information in developing countries so that it can be clear where the systematic observation needs are most pressing. Follow-up actions should include improving and sustaining operational observing networks.

Collaboration between national and international providers of climate information and the users, in all sectors, of such information for adaptation to climate change is vital as well as generating awareness among different user communities of the usefulness of climate information and services and enhancing national and regional coordination.

Data needs to be carefully packaged so that it can be used effectively. Rescuing historical meteorological data is important. Education and training and improved national planning and reporting would also help build capacity.

#### **3.6.4 Information analysis – reporting of impacts, vulnerability and adaptation**

Reliable, systematic climate data helps countries determine their current climate variability, and model future changes. Countries use a number of assessment models, tools and methodologies as well as various scenarios to help provide an assessment of the future impacts of climate change. Climate change impacts, vulnerability and adaptation assessments need to generate outputs that are policy relevant. To do this, climate change data as well as future impacts and vulnerabilities needs to be incorporated with socioeconomic data and analyses across a range of sectors, and the outcome must be adapted for policymakers and stakeholders.

#### **3.6.5 Regional impacts of and vulnerabilities to climate change**

It should however be noted that Africa is a continent already under pressure from climate change/stresses and is highly susceptible to the impacts of climate change. Many areas in Africa are recognized as having climates that are among the most variable in the world on seasonal and decadal time scales. Floods and droughts can occur in the same area within months of each other. These events can lead to famine and widespread disruption of socio-economic well-being. For example, estimates reported that one third of African people already live in drought-prone areas and 220 million are exposed to drought each year.

Many factors contribute and compound the impacts of current climate variability in Africa and will have harmful effects on the continent's ability to cope with climate change. These include poverty, illiteracy and lack of skills, weak institutions, limited infrastructure, lack of technology and information, low levels of primary education and health care, poor access to resources, low management capabilities and armed conflicts. The over-exploitation of land resources, including forests, rise in population, desertification and land degradation pose

additional pressure. In the Sahara and Sahel, dust and sand storms have negative effects on agriculture, infrastructure and health.

Africa is vulnerable to a number of climate sensitive diseases including malaria, tuberculosis and diarrhoea. Under climate change, rising temperatures are changing the geographical distribution of disease vectors which are migrating to new areas and higher altitudes, for example, migration of the malaria mosquito to higher altitudes will expose large numbers of previously unexposed people to infection in the densely populated east African highlands.

Future climate variability will also intermingle with other stresses and vulnerabilities such as HIV/AIDS (which is already reducing life expectancy in many African countries) and conflict and war, resulting in increased susceptibility and risk to infectious diseases (e.g. cholera and diarrhoea) and malnutrition for adults and children.

### **3.7 ADAPTATION TO CLIMATE CHANGE**

Adaptation to climate change in developing countries is vital and has been painted by them as having a high or urgent priority. Although uncertainty remains about the extent of climate change impacts, in many developing countries there is sufficient information and knowledge available on strategies and plans to implement adaptation activities now. However, developing countries have limitations in capacity making adaptation difficult.

Limitations include both human capacity and financial resources. Strategies and programmes that are more likely to succeed need to link with coordinated efforts aimed at poverty alleviation, improving food security and water availability, combating land degradation and reducing loss of biological diversity and ecosystem services, as well as improving adaptive capacity. Sustainable development and the Millennium Development Goals are necessary backdrop to integrating adaptation into development policy. Reduction policies are also important elements of adaptation.

#### **3.7.1 Adaptation strategies, plans and programmes**

Adapting to climate change will entail adjustments and changes at every level – from community to national and international. Communities must build their resilience, including adopting suitable technologies while making the most of traditional knowledge, and diversifying their livelihoods to cope with present and future climate stress. Local coping strategies and traditional knowledge need to be used in synergy with government and local interventions. The choice of adaptation interventions depends on national situations. To

enable workable and effective adaptation measures, ministries and governments, as well as institutions and non-government organizations, must consider incorporating climate change in their planning and budgeting in all levels of decision making.

### 3.7.2 Adaptation measures in key vulnerable sectors

Vulnerable sectors	Reactive adaptation	Anticipatory adaptation
Water Resources	<ul style="list-style-type: none"> <li>– Protection of groundwater resources</li> <li>– Improved management and maintenance of existing water supply systems</li> <li>– Protection of water catchment areas</li> <li>– Improved water supply</li> <li>– Groundwater and rainwater harvesting and desalination</li> </ul>	<ul style="list-style-type: none"> <li>Better use of recycled water</li> <li>– Conservation of water catchment areas</li> <li>– Improved system of water management</li> <li>– Water policy reform including pricing and irrigation policies</li> <li>– Development of flood controls and drought monitoring</li> </ul>
Agriculture and food security	<ul style="list-style-type: none"> <li>– Erosion control</li> <li>– Dam construction for irrigation</li> <li>– Changes in fertilizer use and application</li> <li>– Introduction of new crops</li> <li>– Soil fertility maintenance</li> <li>– Changes in planting and harvesting times</li> <li>– Switch to different cultivars</li> <li>– Educational and outreach programmes on conservation and management of soil and water</li> </ul>	<ul style="list-style-type: none"> <li>– Development of tolerant/resistant crops (to drought, salt, insect/pests)</li> <li>– Research and development</li> <li>– Soil-water management</li> <li>– Diversification and intensification of food and plantation crops</li> <li>– Policy measures, tax incentives / subsidies, free market</li> <li>– Development of early warning systems</li> </ul>
Human health	<ul style="list-style-type: none"> <li>– Public health management reform</li> <li>– Improved housing and living conditions</li> <li>– Improved emergency response</li> </ul>	<ul style="list-style-type: none"> <li>-Development of early warning system</li> <li>– Better and/or improved disease/vector surveillance and monitoring</li> <li>– Improvement of environmental quality</li> <li>– Changes in urban and housing design</li> </ul>

Terrestrial ecosystems	<ul style="list-style-type: none"> <li>-Improvement of management systems including control of deforestation, reforestation and afforestation</li> <li>– Promoting agroforestry to improve forest goods and services</li> <li>– Development/improvement of national forest fire management plans</li> <li>– Improvement of carbon storage in forests</li> </ul>	<ul style="list-style-type: none"> <li>- Creation of parks/reserves, protected areas and biodiversity corridors</li> <li>– Identification/development of species resistant to climate change</li> <li>– Better assessment of the vulnerability of ecosystems</li> <li>– Monitoring of species</li> <li>– Development and maintenance of seed banks</li> <li>– Including socioeconomic factors in management policy</li> </ul>
Coastal zones and marine ecosystems	<ul style="list-style-type: none"> <li>-Protection of economic infrastructure</li> <li>– Public awareness to enhance protection of coastal and marine ecosystems</li> <li>– Building sea walls and beach reinforcement</li> <li>– Protection and conservation of coral reefs, mangroves, sea grass and littoral vegetation</li> </ul>	<ul style="list-style-type: none"> <li>– Integrated coastal zone management</li> <li>– Better coastal planning and zoning</li> <li>– Development of legislation for coastal protection</li> <li>– Research and monitoring of coasts and coastal ecosystems</li> </ul>

### 3.7.3 Impacts of Climate Change on the Millennium Development Goals

Millennium Development Goal	Potential impacts of climate change
Goal 1: Eradicate extreme poverty and Hunger	<ul style="list-style-type: none"> <li>– Damage to livelihood assets, including homes, water supply, health, and infrastructure, can undermine peoples’ ability to earn a living;</li> <li>– Reduction of crop yields affects food security;</li> <li>– Changes in natural systems and resources, infrastructure and labour productivity may reduce income opportunities and affect economic growth;</li> <li>– Social tensions over resource use can lead to conflict, destabilising lives and livelihoods and forcing communities to migrate</li> </ul>
Goal 2: Achieve	– Loss of livelihood assets and natural disasters reduce opportunities for full

universal primary Education	<p>time education, more children (especially girls) are likely to be taken out of school to help fetch water, earn an income or care for ill family members;</p> <ul style="list-style-type: none"> <li>– Malnourishment and illness reduces school attendance and the ability of children to learn when they are in class;</li> <li>– Displacement and migration can reduce access to education</li> </ul>
Goal 3: Promote gender equality and empower women	<ul style="list-style-type: none"> <li>– Exacerbation of gender inequality as women depend more on the natural environment for their livelihoods, including agricultural production. This may lead to increasingly poor health and less time to engage in decision making and earning additional income;</li> <li>– Women and girls are typically the ones to care for the home and fetch water, fodder, firewood, and often food. During times of climate stress, they must cope with fewer resources and a greater workload;</li> <li>– Female headed households with few assets are particularly affected by climate related disasters.</li> </ul>
Goal 4: Reduce child mortality	<ul style="list-style-type: none"> <li>– Deaths and illness due to heat-waves, floods, droughts and hurricanes;</li> <li>– Children and pregnant women are particularly susceptible to vector-borne diseases (e.g. malaria and dengue fever) and water-borne diseases (e.g. cholera and dysentery) which may increase and/or spread to new areas – e.g. anaemia resulting from malaria is currently responsible for one quarter of maternal mortality;</li> </ul>
Goal 5: Improve Maternal Health	<ul style="list-style-type: none"> <li>– Reduction in the quality and quantity of drinking water exacerbates malnutrition especially among children;</li> <li>– Natural disasters affect food security leading to increased malnutrition and famine, particularly in sub-Saharan Africa.</li> </ul>
Goal 6: Combat HIV/AIDS, malaria and other diseases	<ul style="list-style-type: none"> <li>– Water stress and warmer conditions encourage disease;</li> <li>– Households affected by AIDS have lower livelihood assets, and malnutrition accelerates the negative effects of the disease</li> </ul>
Goal 7: Ensure environmental sustainability	<ul style="list-style-type: none"> <li>– Alterations and possible irreversible damage in the quality and productivity of ecosystems and natural resources;</li> <li>– Decrease in biodiversity and worsening of existing environmental degradation;</li> <li>– Alterations in ecosystem-human interfaces and interactions lead to loss of</li> </ul>

	biodiversity and loss of basic support systems for the livelihood of many people, particularly in Africa.
Goal 8: Develop global partnership for Development	– Climate change is a global issue and a global challenge: responses require global cooperation, especially to help developing countries adapt to the adverse effects of climate change; – International relations may be strained by climate impacts.

#### **4.0 CONCLUSION/SUMMARY**

An imperative aspect of fire prevention is concerned with the human duty in ensuring that accidental fires are not allowed to start and appropriate fire safety strategies must be used in preventing fire accident. There is need for combined global action is needed to enable developing countries to adapt to the effects of climate change that are taking place now and will worsen in the future. Training and education at all levels will plays a vital role management of accidental fire and as well as impact of climate change.

#### **5.0 TUTOR-MARKED ASSIGNMENT**

- a. Discuss fire safety strategies for preventing fire accidents
- b. Outline the effect of climate change in Nigeria

#### **6.0 REFERENCES/FURTHER READING**

- Ogbonna Chioma I and Nwaogazie Ify L (2015). Fire safety preparedness in workplaces in Port Harcourt, Nigeria International Research Journal of Public and Environmental Health Vol.2 (8): 112-121.
- Akinyemi, O. O. and Adeyemi A.(2014). Energy Supply and Climate Change in Nigeria Journal of Environment and Earth Science [www.iiste.org](http://www.iiste.org) ISSN 2224-3216 (Paper) ISSN 2225-0948 (Online) Vol.4 (14).



## **UNIT 4: ENVIRONMENTAL EMERGENCIES, DISASTER MANAGEMENT**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Emergency response
    - 3.1.1 Benefits of Training
  - 3.2 Disaster
  - 3.3 Types of disaster
    - 3.3.1 Natural Disasters
    - 3.3.2 Man-Made Disasters
    - 3.3.3 Complex Emergencies
    - 3.3.4 Pandemic Emergencies
  - 3.4 Management of disaster
    - 3.4.1 Disaster Prevention
    - 3.4.2 Disaster Preparedness
    - 3.4.3 Disaster Response/Relief
    - 3.4.4 Disaster Recovery
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

### **1.0 INTRODUCTION/DEFINITION**

Given that environmental emergency situations not only cause casualties and agricultural destruction, but also cause outbreaks of multiple diseases, one needs to build a more integrated response system and combine multiple response approaches to cope with the intensifying environmental emergencies. Environmental Emergency Preparedness and Response provides a framework that will enable you to effectively respond to emergency situations that may have adverse environmental effects. The application of this practical framework facilitates a quick and sustainable recovery in case of both natural and man-made disasters. The development of response procedures ensures that employees have access to the

essential resources and are aware of techniques/methods to be used when responding to complex emergencies.

Disaster, as defined by the United Nations, is a serious disruption of the functioning of a community or society, which involves extensive human, material, economic or environmental impacts that surpass the ability of the affected community or society to cope using its own resources.

## **2.0 OBJECTIVE**

- (a) To assess emergency management plans and programs
- (b) To examines the advances in the humanitarian response to public health over the past years and the challenges currently faced in managing natural disasters and armed conflict.

## **3.0 MAIN CONTENT**

### **3.1 EMERGENCY RESPONSE**

Considering that the nature of an emergency is unpredictable and can change in scope and impact, it is vital to take action and be prepared before an unforeseen situation occurs. Environmental Emergency Preparedness and Response training will offer the important skills needed to develop a response plan and coordinate the required resources for properly responding to environmental emergencies. Moreover, it will improve knowledge and confidence to preserve organization and employees during life-threatening emergencies.

#### **3.1.1 Benefits of Training for environmental emergency preparedness and response**

This shall assist to:

1. Develop and maintain emergency management plans and programs
2. React effectively to a wide range of emergencies
3. Develop contingency plans that describe the roles, decision-making and communication processes
4. Develop high standards of health and safety at work
5. Develop protective measures for people and property in case of emergency situations
6. Establish an emergency communications plan
7. Eliminate, reduce or mitigate environmental impact in the event of a release of hazardous material

## 3.2 DISASTER

Disaster, as defined by the United Nations, is a serious disruption of the functioning of a community or society, which involves extensive human, material, economic or environmental impacts that surpass the ability of the affected community or society to cope using its own resources. Disaster management is how we deal with the human, material, economic or environmental impacts of said disaster, it is the process of how we “prepare for, respond to and learn from the impacts of major failures”. According to the International Federation of Red Cross and Red Crescent Societies a disaster occurs when a hazard impacts on vulnerable people. The combination of hazards, vulnerability and inability to reduce the potential harmful consequences of risk results in disaster.

Natural disasters and armed conflict have marked human existence throughout history and have always caused peaks in mortality and morbidity.

$$DISASTER = (VULNERABILITY + HAZARD) / CAPACITY$$

## 3.3 TYPES OF DISASTER

### 3.3.1 Natural Disasters

According to the International Federation of Red Cross & Red Crescent Societies Natural Disasters are naturally occurring physical phenomena caused either by rapid or slow onset events that have primary impacts on human health and secondary impacts causing further death and suffering. **Examples:**

Geophysical (e.g. Earthquakes, Landslides, Tsunamis and Volcanic Activity)

Hydrological (e.g. Avalanches and Floods)

Climatological (e.g. Extreme Temperatures, Drought and Wildfires)

Meteorological (e.g. Cyclones and Storms/Wave Surges)

Biological (e.g. Disease Epidemics and Insect/Animal Plagues)

### 3.3.2 Man-Made Disasters

Man-Made Disasters as viewed by the International Federation of Red Cross & Red Crescent Societies are events that are caused by humans which occur in or close to human settlements often precipitated as a result of Environmental or Technological Emergencies.

**Examples:** Environmental Degradation, Pollution, Accidents such as Industrial, Technological and Transport usually involving the production, use and or transport of hazardous materials

### **3.3.3 Complex Emergencies**

Some disasters can result from multiple hazards, or, more often, to a complex combination of both Natural and Man-made causes which involve a break-down of authority, looting and attacks on strategic installations, including conflict situations and war.

They are typically characterized by the following:

1. Extensive Violence
2. Displacements of Populations
3. Loss of Life
4. Widespread Damage to both Societies and Economies
5. Need for Large-scale, Humanitarian Assistance across Multiple Agencies
6. Political and Military Constraints which impact or prevent Humanitarian Assistance
7. Increased Security Risks for Humanitarian Relief Workers

**Examples:** Food Insecurity, Epidemics, Armed Conflicts, Displaced Populations

### **3.3.4 Pandemic Emergencies**

Pandemic is an epidemic of infectious disease that has spread across a wide region, which can occur to the human population or animal population and may affect health, disrupts services leading to economic and social costs. It may be an strange or unpredicted increase in the number of cases of an infectious disease which already exists in a certain region or population or can also refer to the appearance of a significant number of cases of an infectious disease in a region or population that is usually free from that disease. Pandemic Emergencies may occur as a consequence of Natural or Man-Made Disasters.

**Examples:** Ebola, Zika, Avian Flu, Cholera, Dengue Fever, Malaria, Yellow Fever

## **3.4 Management of disaster**

### **3.4.1 Disaster Prevention**

Disaster prevention is the outright evading of adverse impacts of hazards and related disasters. It is the concept of engaging in activities which intend to prevent or avoid potential adverse impacts through action taken in advance, activities designed to provide protection

from the occurrence of disasters. While not all disasters can be prevented, good risk management, evacuation plans, environmental planning and design standards can decrease risk of loss of life and injury alleviation.

The HYOGO Framework was one such Global Plan for natural Disaster Risk Reduction, which was adopted in 2005 as a 10 year Global Plan, signed by agreement with 168 Governments which provided guiding principles, priorities for action, and practical means for achieving disaster resilience for vulnerable communities.

### **3.4.2 Disaster Preparedness**

"The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, current hazard events".

According to ICRC, Disaster Preparedness refers to measures taken to get ready for and reduce the effects of disasters, be they Natural or Man-made. This is achieved through research and planning in order to try to predict areas or regions that may be at risk of disaster and where possible prevent these from occurring and/or reduce the impact those disasters on the vulnerable populations that may be affected so they can effectively cope. Disaster preparedness activities entrenched with risk reduction measures can prevent disaster situations and also result in saving highest lives and livelihoods during any disaster situation, enabling the affected population to get back to normalcy within a short time period.

Minimisation of loss of life and damage to property through facilitation of effective disaster response and rehabilitation services when required. Preparedness is the main way of reducing the impact of disasters. Community-based preparedness and management should be a high priority in physical therapy practice management.

### **3.4.3 Disaster Response/Relief**

Disaster response is the provision of emergency services and public assistance during or immediately after a disaster in order to save lives reduce health impacts, ensure public safety and meet the basic subsistence needs of the people that are affected.

It focused principally on immediate and short-term needs the division between this response/relief stage and the subsequent recovery stage is not clear-cut. Some response actions, such as the supply of temporary housing and water supplies, may extend well into the recovery stage.

Rescue from immediate danger and stabilization of the physical and emotional condition of survivors is the primary aims of disaster response/relief, which goes hand in hand with the recovery of the dead and the restoration of essential services such as water and power.

Coordinated multi-agency response is vital to this stage of Disaster Management in order to reduce the impact of a disaster and its long-term results with relief activities including:

Rescue, Relocation, Provision Food and Water, Provision Emergency Health Care, Prevention of Disease and Disability, Repairing Vital Services e.g. Telecommunications, Transport, Provision Temporary Shelter

### **3.4.4 Disaster Recovery**

Vulnerability of communities often goes on for long after the initial crisis is over. Disaster Recovery refers to those programmes which surpass the provision of immediate relief to assist those who victim of the full impact of a disaster and include the following activities:

1. Rebuilding Infrastructure e.g. Homes, Schools, Hospitals, Roads
2. Health Care and Rehabilitation
3. Development Activities e.g. building human resources for health
4. Development Policies and Practices to avoid or mitigate similar situations in future

## **4.0 CONCLUSION/SUMMARY**

Disaster, an environmental emergency is a serious disruption of the functioning of a community or society, which involves extensive human, material, economic or environmental impacts that surpass the ability of the affected community or society to cope using its own resources. It could be natural or manmade. Training is important for environmental emergency preparedness and response. Management include preparedness, response/relief and recovery.

## **5.0 TUTOR-MARKED ASSIGNMENT**

- a. What is disaster, add a note on environmental emergency preparedness and response
- b. Mention benefits of environmental emergency preparedness and response training
- c. Discuss management of disaster

## 6.0 REFERENCES/FURTHER READING

- United Nations Office for Disaster Risk Reduction. Terminology. <http://www.unisdr.org/we/inform/terminology#letter-p> [Accessed 29 Nov 2016]
- Elliott D. Disaster and Crisis Management. In *The Handbook of Security 2014* (pp. 813-836). Palgrave Macmillan UK.
- International Federation of Red Cross and Red Crescent Societies. What is a Disaster. <http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/what-is-a-disaster/>. [Accessed: 9 Jan 2017]
- Leaning J, Guha-Sapir D. Natural Disasters, Armed Conflict, and Public Health. *New England Journal of Medicine*. 2013 Nov 7;369(19):1836-42
- International Federation of Red Cross and Red Crescent Societies. Types of Disasters. <http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/definition-of-hazard/>. [Accessed: 02 Jan 2017]
- International Federation of Red Cross and Red Crescent Societies. Complex/Manmade Hazards: Complex Emergencies. <http://www.ifrc.org/en/what-we-do/disaster-management/about-disasters/definition-of-hazard/complex-emergencies/>. [Accessed 18 Dec 2016]
- International Federation of Red Cross and Red Crescent Societies. About Disaster Management. <http://www.ifrc.org/en/what-we-do/disaster-management/about-disaster-management/> [Accessed: 03 Jan 2017]

## **UNIT 5: BIODIVERSITY AND ENVIRONMENT**

### **CONTENTS**

- 1.0 Introduction
- 2.0 Objectives
- 3.0 Main contents
  - 3.1 Classification of biodiversity
    - 3.1.1 Genetic diversity
    - 3.1.2 Species diversity
    - 3.1.3 Ecosystem diversity
  - 3.2 Biodiversity: meaning and measurement
    - 3.2.1 Taxonomy diversity
    - 3.2.2 Community diversity
  - 3.3 Biodiversity: changes in time and space
    - 3.3.1 Changes over Time
    - 3.3.2 Changes in space
  - 3.4 Loss of biodiversity and causes
    - 3.4.1 In-Situ Conservation
    - 3.4.2 Ex-Situ Conservation
- 4.0 Conclusion/Summary
- 5.0 Tutor-marked Assignment
- 6.0 References/Further reading

### **1.0 INTRODUCTION/DEFINITION**

The term ‘‘biodiversity’’ was first used in its long version (biological diversity) by Lovejoy and is most commonly used to explain the number of species. Identifying that conventional methods of determining, and separating, species were insufficient, others expanded the definition, by including the variety and variability of living organisms.

### **2.0 OBJECTIVE**

To define biodiversity, assess various forms of diversity, changes over time and its conservation



### **3.0 MAIN CONTENT**

Biodiversity is an attribute of an area and specifically refers to the variety within and among living organisms, assemblages of living organisms, biotic communities, and biotic processes, whether naturally taking place or modified by humans. Biodiversity can be measured in terms of genetic diversity and the identity and number of different types of species, assemblages of species, biotic communities, and biotic processes, and the amount (e.g., abundance, biomass, cover and rate) and structure of each. It can be observed and measured at any spatial scale ranging from microsites and habitat patches to the entire biosphere.

### **3.1 CLASSIFICATION BIODIVERSITY**

The classification of biodiversity can be classified into those authors who consider biodiversity to be a state and those who believe that it is a measure of the state. Most authors have defined biodiversity as a state or attribute, for example, “biodiversity is the variety of...” or “variety and variability of...”

Standard dictionaries have classified diversity as a state, condition, or quality. Other definitions of biodiversity restricted the scope of the attribute to explicit, quantifiable dimensions or measures, for example, “biodiversity is the number of...” or “the number and relative abundance of...” This emphasis on quantitative, operational definitions of biodiversity and criticisms of non-quantitative definitions

#### **3.1.1 Genetic diversity**

Genetic diversity is dependent on the heritable variation within and between populace of organisms. New genetic variation arises in entities by gene and chromosome mutations, and in organisms with sexual reproduction it can be spread through the population by recombination. It has been estimated that in humans and fruit flies alike, the number of possible combinations of different forms of each gene sequence surpass the number of atoms in the world.

Each of the approximated  $10^9$  different genes distributed across the world's biota does not make an identical contribution to overall genetic diversity. In particular, those genes that control fundamental biochemical processes are robustly conserved across different taxa and generally show little variation, although such variation that does exist may wield a powerful effect on the viability of the organism; the converse is true of other genes. A large amount of

molecular variation in the mammalian immune system, for example, is possible on the basis of a small number of inherited genes.

### **3.1.2 Species diversity**

Historically, species are the fundamental descriptive units of the living world and this is why biodiversity is very frequently, and incorrectly, used as a synonym of species diversity, in particular of “species richness,” which is the number of species in a site or habitat.

Discussion of worldwide biodiversity is typically presented in terms of global numbers of species in different taxonomic groups. An approximate 1.7 million species have been described to date; estimates for the total number of species existing on earth at present vary from 5 million to nearly 100 million. A conservative working estimate suggests there might be around 12.5 million.

### **3.1.3 Ecosystem diversity**

While it is possible to define what is in principle meant by genetic and species diversity, it is difficult to make a quantitative assessment of diversity at the ecosystem, habitat, or community level. There is no unique definition or classification of ecosystems at the global level, and it is difficult in practice to measure ecosystem diversity other than on a local or regional basis, and then only largely in terms of vegetation. Ecosystems are further divorced from genes and species in that they explicitly include abiotic parts, being partly determined by soil/parent material and climate.

## **3.2 BIODIVERSITY: MEANING AND MEASUREMENT**

### **3.2.1 Taxonomy diversity**

Biodiversity measurements that quantify genetic difference directly, or indirectly through use of the taxonomic hierarchy (Williams et al., 1991), are currently being used. The indirect taxonomic approach is more practical because we already have a “rule of thumb” taxonomic hierarchy, whereas reliable approximate of overall genetic differences between taxa are nearly non-existent

### **3.2.2 Community diversity**

Early ecologists did not restrict themselves to measuring species diversity. They also tried to understand the relationship of diversity with other features of the community. The

dependence of species diversity on the structural complexity of the environment was demonstrated, as was the role of predation and periodical disturbance in determining a given level of diversity. The relationship between the species diversity and standing crop of a community was also shown.

### **3.3 BIODIVERSITY: CHANGES IN TIME AND SPACE**

#### **3.3.1 Changes over Time**

Two pertinent points appear to be well substantiated. First, taxonomic diversity, as measured by the number of identified phyla of organisms, was greater in Cambrian times than in any later period. Second, it appears that species diversity and the number of families has undergone a net increase between the Cambrian and Pleistocene epochs, although interrupted by isolated phases of mass extinction.

#### **3.3.2 Changes in space**

Species diversity in natural habitats is high in warm areas and decreases with increasing latitude and altitude; additionally, terrestrial diversity is usually higher in areas of high rainfall and lower in drier areas. The richest areas are tropical moist forest and, if current estimates of the number of microfaunal species of tropical moist forests are convincing, then these areas, which cover perhaps 7% of the world's surface area, may well contain over 90% of all species. If the diversity of larger organisms only is considered, then coral reefs such as Bunaken and, for plants at least, areas with a Mediterranean climate in South Africa and Western Australia may be as diverse. Gross genetic diversity and ecosystem diversity will tend to be positively correlated with species diversity.

### **3.4 LOSS OF BIODIVERSITY AND CAUSES**

Species extinction is a natural process that occurs without the intervention of humans since, over geological time, all species have a limited period of existence. Extinctions caused directly or indirectly by humans are occurring at a rate that far exceeds any reasonable approximate of background extinction rates, and to the extent that these extinctions are correlated with habitat perturbation, they must be increasing.

### **3.4.1 In-Situ Conservation**

The maintenance of biological diversity is the sustainable management of viable populations of species or populations in situ or ex situ. The maintenance of a noteworthy proportion of the world's biological diversity only appears feasible by maintaining organisms in their wild state and within their existing range. This allows for continuing adaptation of wild populations by natural evolutionary processes and, in principle, for current utilization practices to continue. For such maintenance to succeed, it almost invariably requires enhanced management through the integrated, community-based conservation of protected areas.

### **3.4.2 Ex-Situ Conservation**

Viable populations of many organisms can be maintained in cultivation or in captivity. Plants may also be preserved in seed banks and germplasm collections; similar techniques are under development for animals (storage of embryos, eggs, and sperm, i.e., "frozen zoos") but are more problematic. Ex situ conservation is extremely costly in the case of most animals, and while it would in principle be possible to conserve a very large proportion of higher plants ex situ, this would be feasible for only a small percentage of the world's organisms. Furthermore, it often involves a loss of genetic diversity through founder effects and the high probability of inbreeding.

## **4.0 CONCLUSION/SUMMARY**

Biodiversity is an attribute of an area and specifically refers to the variety within and among living organisms, assemblages of living organisms, biotic communities, and biotic processes, whether naturally taking place or modified by humans. It can be genetic, species or ecosystem diversity and changes in time and space can occur. Species extinction is a natural process that occurs without the intervention of humans since, over geological time, all species have a limited period of existence.

## **5.0 TUTOR-MARKED ASSIGNMENT**

- a. Classify biodiversity with example
- b. What are the different causes of biodiversity?

## **7.0 REFERENCES/FURTHER READING**

[Blessing, J. O.](#)(2016). Impact of Human Activities on Biodiversity in Nigerian Aquatic Ecosystems Science International Volume 4 (1): 12-20.

Nigeria Fifth National Biodiversity Report, 2015.