NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF HEALTH SCIENCES

COURSE CODE: EHS 205

COURSE TITLE: CLIMATE CHANGE AND CONTEMPORARY ISSUES

COURSE GUIDE

EHS 205
CLIMATE CHANGE AND CONTEMPORARY ISSUES

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INTRODUCTION

EHS 205 Climate Change and Contemporary Issues is a two-unit course with three (3) Modules and nine (9) Units. Climate change in Inter-governmental Panel on Climate Change (IPCC) usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.

This definition differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines "climate change" as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods. The Earth's average temperature has been increasing since the Industrial Revolution. Between 1880 and 2015, average global surface temperatures rose by 0.9°C (1.5°F).

WHAT YOU WILL LEARN IN THIS COURSE

In this course, you have the course units and a course guide. The course guide will tell you what the course is all about. It is general overview of the course materials you will be using and how to use those materials. It also helps you to allocate the appropriate time to each unit so that you can successfully complete the course within the stipulated time limit.

The course guide also helps you to know how to go about your Tutor-Marked Assignment which will form part of your overall assessment at the end of the course. Also, there will be regular tutorial classes that are related to this course, where you can interact with your facilitator and other students. Please, I encourage you to attend these tutorial classes.

COURSE AIM

The course aims to give you a understanding of Ecology which is an important branch of Biology.

COURSE OBJECTIVES

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

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

- Define the term Climate change.
- Discuss on composition and Temperature of the Atmosphere
- What do you understand by the term Contemporary issues.
- Enumerate five contemporary issues and proffer a solution.
- Define the term greenhouse gases.
- Briefly enumerate the some greenhouse gases.
- What are the effects of greenhouse gases?
- Define extensively the term climate change.
- Enumerate the processes involved in global warming.
- Indicator to climate change.

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 Readings
- Assignments
- Presentation Schedule

STUDY UNIT

The study units in this course are given below:

MODULE 1	**INTRODUCTION TO CLIMATE CHANGE IN CONTEMPORARY ISSUES**
Unit 1	General Overview on climate change
Unit 2	Modern and contemporary issues
Unit 3	Green House Effect and global warming
MODULE 2	**CLIMATE CHANGE AND GLOBAL WARMING**
Unit 1	Introduction to climate change
Unit 2	Impact of climate change
Unit 3	Remedy to global warming
MODULE 3	**SOLAR RADIATION**
Unit 1	Effect of solar radiation
Unit 2	Introduction to ozone layer
Unit 3	Health risk associated with depletion

Module 1 deals with the definition and understanding of climate change as a term. The module also examines modern contemporary issues emanating from change in weather pattern as well as exposition on greenhouse effect, its causes and impact.

Module 2 critically deals with the relationship between climate change and global warming. In the various units, the causes of climate change, process of climate change were fully examined.

Module three is concerned with complete elaboration on the impact of global warming and climate change, and also proffers solution to the menace of global warming. It focuses on explaining the meaning of solar radiation and its interaction with the earth's atmosphere. Unit 2 highlights the various effects of intense solar radiation on human and other aquatic and terrestrial organism. It also describes the meaning of ozone layer, its role in protecting the earth, ozone layer depletion and interactions between the ozone layer. It elucidates the impact and concern of ozone layer depletion as well as mitigating measures.

There are activities related to the lecture in each unit which will help your progress and comprehension of the unit. You are required to work on these exercises which together with the TMAs will enable you to achieve the objectives of each unit.

PRESENTATION SCHEDULE

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

ASSESSMENT

There are three aspects to the assessment of this course. The first one is the self-assessment exercises. The second is the tutor marked 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 a three 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 should be returned to your facilitator.

You're expected to complete the assignments by using the information and material in your readings references and study units.

Reading and researching into you references will give you a wider via point and give you a deeper understanding of the subject.

1. Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you are not able to complete your assignment, make sure you contact your facilitator before the assignment is due to discuss the possibility of an extension. Request for extension will not be granted after the due date unless there in exceptional circumstances.

2. Make sure you revise the whole course content before sitting or the examination. The self-assessment activities and TMAs will be useful for this purposes and if you have any comment please do before the examination. The end of course examination covers information from all parts of the course.

COURSE MARKING SCHEME

Table 1. Course marking scheme

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

Table 2: Course Organisation

Unit	**Title of Work**	**Weeks Activity**	**Assessment (End of Unit)**
	Course Guide	**Week**	
1	General Overview on climate change	Week 1	Assignment 1
2	Modern and contemporary issues	Week 2	Assignment 2
3	Green House Effect and global warming	Week 3	Assignment 3
4	Introduction to climate change	Week 4	Assignment 4
5	Impact of climate change	Week 5	Assignment 5
6	Remedy to global warming	Week 6	Assignment 6
7	Effect of solar radiation	Week 7	Assignment 7
8	Introduction to ozone layer	Week 8	Assignment 8
9	Health risk associated with depletion	Week 9	Assignment 9

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.

The following are practical strategies for working through this 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 you 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 acted the tutorial classes because this is the only chance to have face to face content with your facilitator and to ask questions which will be answered instantly. It is also period where you can say any problem encountered in the course of your study.

FINAL EXAMINATION AND GRADING

The final examination for EHS 216: Introduction to Ecology and Environmental Science will be of 1½ hours duration. This accounts for 70 % of the total course grade. The examination will consist of questions which reflect the practice, exercises and the tutor-marked assignments you have already attempted in the past. Note that all areas of the course will be assessed. To revise the entire course, you must start from the first unit to the twelfth unit in order to get prepared for the examination. It may be useful to go over your TMAs and probably discuss with your course mates or group if need be. This will make you to be more prepared, since the examination covers information from all aspects of the course.

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.

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

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

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

SUMMARY

Climate change in Intergovernmental panel on climate change (IPCC) usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.

On completion of this course, you will have an understanding of basic knowledge of Climate change, the history of men and women who contributed to this field of study by their discoveries during their research works, the general characteristics. In addition you will be able to answer the following questions:

- Define the term Climate change.
- Discuss on composition and Temperature of the Atmosphere
- What do you understand by the term Contemporary issues.
- Enumerate five contemporary issues and proffer a solution.
- Define the term greenhouse gases.
- Briefly enumerate the some greenhouse gases.
- What are the effects of greenhouse gases?
- Define extensively the term climate change.
- Enumerate the processes involved in global warming.
- Indicator to climate change. Explain

The list of questions are expected to answer is not limited to the above list. Finally, you are expected to apply the knowledge you have acquired during this course to your practical life.

I wish you success in this course!

MAIN COURSE

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MODULE 1 INTRODUCTION TO CLIMATE CHANGE IN CONTEMPORARY ISSUES

Unit 1 General Overview on Climate Change
Unit 2 Modern and Contemporary Issues
Unit 3 Green House Effect and Global Warming

UNIT 1 GENERAL OVERVIEW ON CLIMATE CHANGE

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1.0 Introduction
2.0 Objectives
3.0 Main content
    3.1 Definition of Climate Change
    3.2 Composition and Temperature of the Atmosphere
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Reading

1.0 INTRODUCTION

Module one deals with the definition and understanding of climate change as a term. The module also examines modern contemporary issues emanating from change in weather pattern as well as exposition on greenhouse effect, its causes and impact.

2.0 OBJECTIVES

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

- define climate change
- describe problems arising from change of weather.

3.0 MAIN CONTENT

3.1 DEFINITION OF CLIMATE CHANGE

Climate change in Intergovernmental panel on climate change (IPCC) usage refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or as a result of human activity.

This definition differs from that in the United Nations Framework Convention on Climate Change (UNFCCC), which defines "climate change" as: "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.The Earth's average temperature has been increasing since the Industrial Revolution. Between 1880 and 2015, average global surface temperatures rose by 0.9°C (1.5°F).

3.2 Composition and Temperature of the Atmosphere

Dry airis mainly composed of nitrogen (78.08 % in volume), oxygen (20.95% in volume), argon (0.93% in volume) and to a lesser extent carbon dioxide1 (380 ppm or 0.038% in volume). The remaining fraction is made up of various trace constituents such as neon (18 ppm), helium (5 ppm), methane1 (1.75 ppm), and krypton (1 ppm). In addition, a highly variable amount of water vapour is present in the air. This ranges from approximately 0% in the coldest part of the atmosphere to as much as 5% in moist and hot regions. On average, water vapour accounts for 0.25% of the mass of the atmosphere.

4.0 CONCLUSION

The climate system is the highly complex system consisting of five majorcomponents: the atmosphere, the hydrosphere, the cry sphere, the lithosphere and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcing such as volcanic eruptions, solar variations and anthropogenic forcing such as the changing composition of the atmosphere and land use change.

Climate is traditionally defined as the description in terms of the mean and variability of relevant atmospheric variables such as temperature, precipitation and wind. Climate can thus be viewed as a synthesis or aggregate of weather. This implies that the portrayal of the climate in a particular region must contain an analysis of mean conditions, of the seasonal cycle and of the probability of extremes such as severe frost and storms.

5.0 SUMMARY

Climate change is referred to as any change in climate over time, whether due to natural variability or as a result of human activity.United Nations Framework Convention on Climate Change (UNFCC), attributed the alteration of the composition of the global atmosphere which is in addition to natural climate variability observed over comparable time periods. The impact of this alteration on the Earth's average temperature has been increasing since the Industrial Revolution. Between 1880 and 2015, average global surface temperatures rose by 0.9°C (1.5°F).

6.0 TUTOR-MARKED ASSIGNMENT

1. Define the term climate change.
2. Discuss on composition and temperature of the atmosphere.

7.0 REFERENCES/FURTHER READING

Ojo S. O. Ojo K. & Oni F. (2001). *Fundamentals of Physical and Dynamic Climatology*. Pub. in Nigeria by SEDEC Publishers, ISBN 978-35772-9-8

De Sherbinin, A. Schiller & A. Pulsipher, (2007). The vulnerability of global cities to climate hazards, *Environ Urban* **19** (2007),. pp. 39–64.View Record in Scopus | Cited By in Scopus (13)

McEvoy, P. Matczak, I. Banaszak and Chorynski A, (2010):Framing adaptation to climate-related extreme events [Internet], *Mitig Adapt Strateg Global Change* (2010). 10.1007/s11027-010r-r9233-2.

www. wikipedia.com

UNIT 2 MODERN AND CONTEMPORARY ISSUES

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  3.2 Review of contemporary issues
4.0 Conclusion
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7.0 References/Further Reading

1.0 INTRODUCTION

Contemporary issues can be seen as issues which has its implications, applicability, relevance, significance, effect and material presence in present time or at its given frame (period) of time.

2.0 OBJECTIVES

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

- discuss what is meant by the term contemporary issues
- explain some of the major contemporary issues.

3.0 MAIN CONTENT

3.1 WHAT ARE CONTEMPORARY ISSUES?

Contemporary issue can be defined as any event, idea, opinion or topic in a given subject that is relevant to the present day. Contemporary issues can be found in almost any matter of interest. In other word a Contemporary issues can be seen as issues which has its implications, applicability, relevance, significance, effect and material presence in present time or at its given frame (period) of time

3.1.1 Examples of contemporary issues

The following are the pressing contemporary issues of the world:

i. Climate Change

The global temperatures are rising, and are estimated to increase from 2.6 degrees Celsius to 4.8 degrees Celsius by 2100. This would cause more severe weather, crises with food and resources and the spread of diseases. The reduction of greenhouse emissions and the spreading of education on the importance of going green can help make a big difference. Lobbying governments and discussing policies to reduce carbon emissions and encouraging reforestation is an effective way of making progress with climate change.

ii. Pollution

Pollution is one of the most difficult global issues to combat, as the umbrella term refers to ocean litter, pesticides and fertilizers, air, light and noise pollution. Clean water is essential for humans and animals, but more than one billion people don’t have access to clean water due to pollution from toxic substances, sewage or industrial waste. It is of the utmost importance that people all over the world begin working to minimize the various types of pollution, in order to better the health of the planet and all those living on it.

iii. Violence

Violence can be found in the social, cultural and economic aspects of the world. Whether it is conflict that has broken out in a city, hatred targeted at a certain group of people or sexual harassment occurring on the street, violence is a preventable problem that has been an issue for longer than necessary. With continued work on behalf of the governments of all nations, as well as the individual citizens, the issue can be addressed and reduced.

iv. Security and Well Being

The U.N. is a perfect example of preventing the lack of security and well being that is a serious global issue. Through its efforts with regional organizations and representatives that are skilled in security, the U.N. is working toward increasing the well being of people throughout the world.

v. Lack of Education

More than 72 million children throughout the globe that are of the age to be in primary education are not enrolled in school. This can be attributed to inequality and marginalization as well as poverty. Fortunately, there are many organizations that work directly with the issue of education in providing the proper tools and resources to aid schools.

vi. Unemployment

Without the necessary education and skills for employment, many people, particularly 15- to 24-year olds, struggle to find jobs and create a proper living for themselves and their families. This leads to a lack of necessary resources, such as enough food, clothing, transportation and proper living conditions. Fortunately, there are organizations throughout the world teaching people in need the skills for jobs and interviewing, helping to lift people from the vicious cycle of poverty.

vii. Government Corruption

Corruption is a major cause of poverty considering how it affects the poor the most, eroding political and economic development, democracy and more. Corruption can be detrimental to the safety and wellbeing of citizens living within the corrupted vicinity, and can cause an increase in violence and physical threats without as much regulation in the government.

viii. Malnourishment and Hunger

Currently there are 795 million people who do not have enough to eat. Long-term success to ending world hunger starts with ending poverty. With fighting poverty through proper training for employment, education and the teaching of cooking and gardening skills, people who are suffering will be more likely to get jobs, earn enough money to buy food and even learn how to make their own food to save money.

ix. Substance Abuse

The United Nations reports that, by the beginning of the 21st century, an estimated 185 million people over the age of 15 were consuming drugs globally. The drugs most commonly used are marijuana, cocaine, alcohol, amphetamine stimulants, opiates and volatile solvents. Different classes of people, both poor and rich, partake in substance abuse, and it is a persistent issue throughout the world. Petitions and projects are in progress to end the global issue of substance abuse.

x. Terrorism

Terrorism is an issue throughout the world that causes fear and insecurity, violence and death. Across the globe, terrorists attack innocent people, often without warning. This makes civilians feel defenseless in their everyday lives. Making national security a higher priority is key in combating terrorism, as well as promoting justice in wrongdoings to illustrate the enforcement of the law and the serious punishments for terror crimes.

With so many current global issues that require immediate attention, it is easy to get discouraged. However, the amount of progress that organizations have made in combating these problems is admirable, and the world will continue to improve in the years to come. By staying active in current events, and standing up for the health and safety of all humans, everyone is able to make a difference in changing the fate of our world.

4.0 CONCLUSION

Currently there are 795 million people who do not have enough to eat. Long-termsuccess to ending world hunger starts with ending poverty. With fighting poverty through proper training for employment, education and the teaching of cooking and gardening skills, people who are suffering will be more likely to get jobs, earn enough money to buy food and even learn how to make their own food to save money.Contemporary issue can be defined as any event, idea, opinion or topic in a given subject that is relevant to the present day. Contemporary issues can be found in almost any matter of interest.

5.0 SUMMARY

Contemporary issue can be defined as any event, idea, opinion or topic in a given subject that is relevant to the present day. Contemporary issues have its implications, applicability, relevance, significance, effect and material presence in present time or at its given frame (period) of time. Our world and society is challenged by contemporary issues which include climate change, pollution, violence, security and wellbeing, lack of education, unemployment, government corruption, malnourishment and hunger, substance abuse and terrorism.

6.0 TUTOR-MARKED ASSIGNMENTs

1. What do you understand by the term Contemporary issues?

2. Enumerate five contemporary issues and proffer a solution.

7.0 REFERENCE/FURTHER READING

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UNIT 3 GREEN HOUSE EFFECT AND GLOBAL WARMING

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1.0 INTRODUCTION

A greenhouse is a structure with walls and roof made mainly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. A more scientific definition is "a covered structure that protects the plants from extensive external climate conditions and diseases, creates optimal growth microenvironment, and offers a flexible solution for sustainable and efficient year-round cultivation."

2.0 OBJECTIVES

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

- explain what a greenhouse is
- list the types of gases present in a greenhouse
- describe also its effect.

3.0 MAIN CONTENT

3.1 What Are Contemporary Issues? General Overview

A greenhouse is a structure with walls and roof made mainly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. A more scientific definition is "a covered structure that protects the plants from extensive external climate conditions and diseases, creates optimal growth microenvironment, and offers a flexible solution for sustainable and efficient year-round cultivation." A modern greenhouse operates as a system; therefore it is also referred to as controlled environment agriculture (CEA), controlled environment plant production system (CEPPS), or phytomation system. Many commercial glass greenhouses or hothouses are high tech production facilities for vegetables or flowers. The glass greenhouses are filled with equipment including screening installations, heating, cooling, lighting, and may be controlled by a computer to optimize conditions for plant growth.

3.1.1 Green House Gases

These are trace gases that partially absorbed the emitted long wave terrestrial radiation in the atmosphere.The major greenhouse gases emitted into the atmosphere are carbon dioxide, methane, nitrous oxide, and fluorinated gases. Some of these gases are produced almost entirely by human activities; others come from a combination of natural sources and human activities.

The World Meteorological Organization (WMO) describes the build-up of greenhouse gases in the atmosphere during the 20th century as resulting .from the growing use of energy and expansion of the global economy. According to the WMO, the build-up of greenhouse gases in the atmosphere alters the radiative balance of the atmosphere. The net effect is to warm the Earth's surface and the lower atmosphere because greenhouse gases absorb some of the Earth's outgoing heat radiation and reradiate it back towards the surface

Many of the major greenhouse gases can remain in the atmosphere for tens to thousands of years after being released. They become globally mixed in the lower part of the atmosphere, called the troposphere (the first several miles above the Earth's surface), reflecting the combined contributions of emissions sources worldwide from the past and present. Due to this global mixing, the impact of emissions of these gases does not depend on where in the world they are emitted. Also, concentrations of these gases are similar regardless of where they are measured, as long as the measurement is far from any large sources or sinks of that gas.

Several factors determine how strongly a particular greenhouse gas affects the Earth's climate. One factor is the length of time that the gas remains in the atmosphere. A second factor is each gas's unique ability to absorb energy. By considering both of these factors, scientists calculate a gas's global warming potential, which measures how much a given amount of the greenhouse gas is estimated to contribute to global warming over a specific period of time (for example, 100 years) after being emitted.

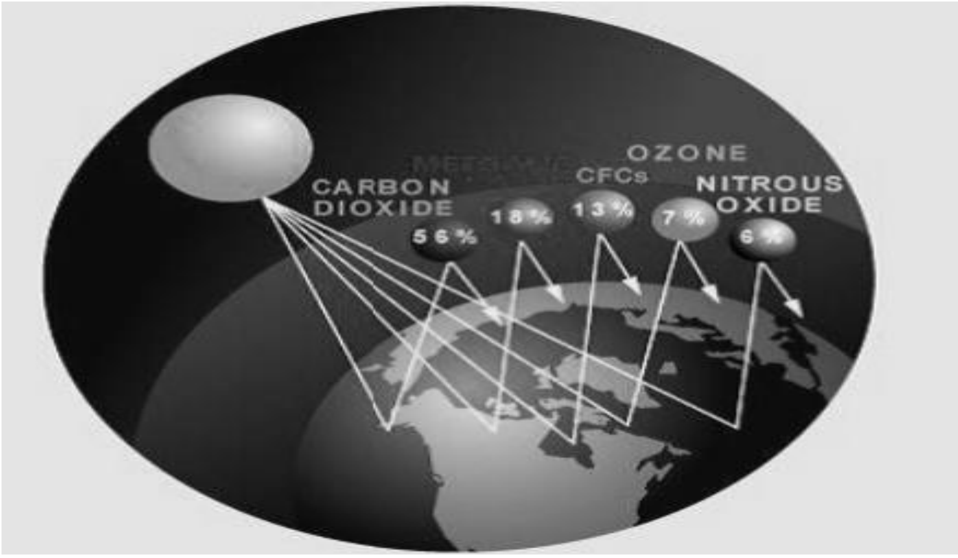

Fig. 1: Global anthropogenic GHG emissions

Source: education.psu.edu

3.2 Greenhouse Effect

Greenhouse effect can be defined as the exchange of incoming and outgoing radiation that warms the earth.The greenhouse effect occurs when solar energy making contact with the earth's surface is retransmitted to the atmosphere in the form of infrared thermal radiation. This radiation has a lower wave frequency than solar energy itself. GHG molecules absorb this thermal radiation at low frequencies, causing these molecules to vibrate. These greenhouse molecules then emit energy in the form of infrared photons, many of which return to the earth's surface. Non-GHGs such as oxygen and nitrogen do not absorb thermal radiation. The greenhouse effect is measured in terms of Radioactive Forcing (RF) in units of watts per square meter (W/m^2). Since the Industrial Revolution, the total RF is estimated to have increased by approximately 2.3 W/m^2 (1.1 W/m^2 – 3.3 W/m^2; 90% confidence interval) mainly due to the net effect of increased GHG and aerosol concentrations in the atmosphere.

Shortwave radiation passes through the atmosphere, whereas long wave terrestrial radiation emitted by the warm surface of the earth is being partially absorbed by a number of trace gases in the atmosphere.Thus the greenhouse effect arises because the atmosphere is largely transparent to incoming solar radiation, while being quite heavily absorbing to outgoing thermal radiation from the planetary surface and the atmosphere. Since the beginning of the earth origin, the effect exists as a natural process. But since the 20th century the effect is enhanced by man's activities that are liable to destabilizes the natural balance.

Greenhouse gases do not interfere to any great extent with the incoming solar energy. But once that energy reaches the Earth's surface, it is absorbed, warms the land and ocean surface of the planet, and then is re-emitted. The amount of heat re-emitted and eventually lost to space must equal the amount gained from the Sun if the temperature of the planet is to remain constant.

But the so-called terrestrial energy stream is different in character it is longer in wavelength than the incoming solar energy as the Earth is cooler than the Sun and the greenhouse gases interfere with it strongly before it can escape to space.

The greenhouse gases absorb the outgoing terrestrial energy, trapping it near the Earth's surface, and causing even more warming. This is the ‘greenhouse effect.’ Without it the planet would be too cold to support life as we know it.

Unfortunately, humanity, through energy generation, changing land use and other processes, has produced a substantial increase in the amount of greenhouse gases in the atmosphere, enhancing the natural greenhouse effect, and it is feared that this continuing change will lead to a major shift in global climate.

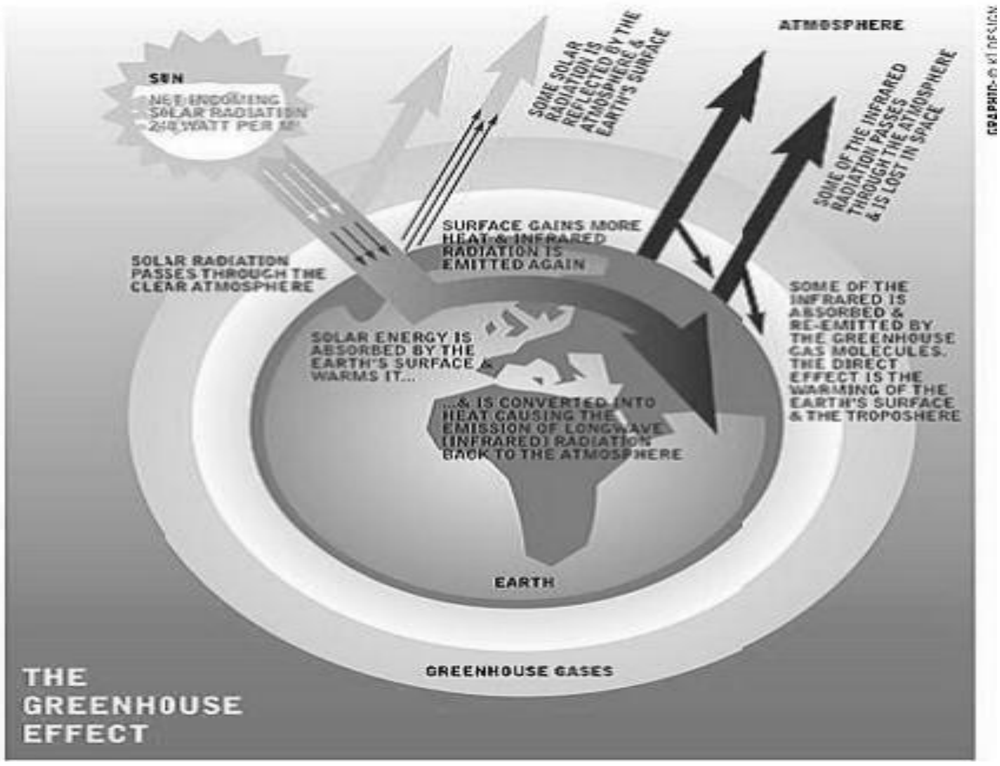

Fig. 2 Greenhouse Effect
Source: www.google.com

4.0 CONCLUSION

These are trace gases that partially absorbed the emitted long wave terrestrial radiation in the atmosphere.The major greenhouse gases emitted into the atmosphere are carbon dioxide, methane, nitrous oxide, and fluorinated gases. Some of these gases are produced almost entirely by human activities; others come from a combination of natural sources and human activities. A greenhouse is a structure with walls and roof made mainly of transparent material, such as glass, in which plants requiring regulated climatic conditions are grown. A more scientific definition is "a covered structure that protects the plants from extensive external climate conditions and diseases.

5.0 SUMMARY

Global warming as a contemporary issue has made the concept of greenhouse more relevant. Green house is more scientifically defined as "a covered structure that protects the plants from extensive external climate conditions and diseases, creates optimal growth microenvironment, and offers a flexible solution for sustainable and efficient year-round cultivation." A modern greenhouse operates as a system; therefore it is also referred to as controlled environment agriculture (CEA), controlled environment plant production system (CEPPS), or phytomation system. Many commercial glass greenhouses or hothouses are high tech production facilities for vegetables or flowers. Greenhouse effect can be defined as the exchange of incoming and outgoing radiation that warms the earth. The greenhouse gases absorb the outgoing terrestrial energy, trapping it near the Earth's surface, and causing even more warming. This is the 'greenhouse effect.' Without it the planet would be too cold to support life as we know it. Unfortunately, humanity, through energy generation, changing land use and other processes, has produced a substantial increase in the amount of greenhouse gases in the atmosphere, enhancing the natural greenhouse effect, and it is feared that this continuing change will lead to a major shift in global climate.

6.0 TUTOR-MARKED ASSIGNMENT

1. Define the term greenhouse gases.
2. Briefly enumerate the some greenhouse gases.
3. What are the effects of greenhouse gases?

7.0 REFERENCES/FURTHER READING

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MODULE 2 CLIMATE CHANGE AND GLOBAL WARMING

Unit 1 Introduction to Climate Change
Unit 2 Impact of Climate Change
Unit 3 Remedy to Global Warming

UNIT 1 INTRODUCTION TO CLIMATE CHANGE

CONTENTS

1.0 Introduction
2.0 Objectives
3.0 Main content
 3.1 Introduction to climate change
 3.2 Process of Global Warming
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Reading

1.0 INTRODUCTION

This unit critically deals with the relationship between climate change and global warming. In the various units, the causes of climate change, process of climate change were fully examined.

2.0 OBJECTIVES

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

- explain what is meant by the terms climate change and global warming
- explain the effects of climate change and global warming.

3.0 MAIN CONTENT

3.1 Introduction to Climate Change

Climate change is the subject of how weather patterns change over decades or longer. Climate change takes place due to natural and human influences. Since the Industrial Revolution (i.e., 1750), humans have contributed to climate change through the emissions of GHGs and aerosols, and through changes in land use, resulting in a rise in global temperatures.1 Increases in global temperatures may have different impacts, such as an increase in storms, floods, droughts, and sea levels, and the decline of ice sheets, sea ice, and glaciers.

3.2 Process of Global Warming

The earth receives energy through radiation from the sun. GHGs play an important role of trapping heat, maintaining the earth's temperature at a level that can sustain life. This phenomenon is called the greenhouse effect and is natural and necessary to support life on earth. Without the greenhouse effect, the earth would be approximately 33°C cooler than it is today. In recent centuries, humans have contributed to an increase in atmospheric GHGs as a result of increased fossil fuel burning and deforestation. The rise in GHGs is the primary cause of global warming over the last century.

4.0 CONCLUSION

The earth receives energy through radiation from the sun. GHGs play an important role of trapping heat, maintaining the earth's temperature at a level that can sustain life. This phenomenon is called the greenhouse effect and is natural and necessary to support life on earth. Without the greenhouse effect, the earth would be approximately 33°C cooler than it is today. Climate change is the subject of how weather patterns change over decades or longer. Climate change takes place due to natural and human influences.

5.0 SUMMARY

Climate change is the subject of how weather patterns change over decades or longer. GHGs play an important role of trapping heat, maintaining the earth's temperature at a level that can sustain life. This phenomenon is called the greenhouse effect and is natural and necessary to support life on earth. Industrial revolutions and humans have contributed to climate change through the emissions of GHGs and aerosols, and through changes in land use, resulting in a rise in global temperatures. Increases in globaltemperatures may have different impacts, such as an increase in storms, floods, droughts, and sea levels, and the decline of ice sheets, sea ice, and glaciers.

6.0 TUTOR-MARKED ASSIGNMENTS

1. Define extensively the term climate change.
2. Enumerate the processes involved in global warming.

7.0 REFERENCE/FURTHER READING

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UNIT 2 IMPACT OF CLIMATE CHANGE

CONTENTS

1.0 Introduction
2.0 Objectives
3.0 Main Content
 3.1 Sun's Output
 3.2 Milankovitch Cycles
 3.3 Volcanic Eruption
 3.4 Indicators of Climate Change
  3.4.1 Rises in Global Temperature
  3.4.2 Changes in snow temperature
4.0 Conclusion
5.0 Summary
6.0 Tutor-Marked Assignment
7.0 References/Further Reading

1.0 INTRODUCTION

Climate change is the subject of how weather patterns change over decades or longer. Climate change takes place due to natural and human influences. Since the Industrial Revolution (i.e., 1750), humans have contributed to climate change through the emissions of GHGs and aerosols, and through changes in land use, resulting in a rise in global temperatures.Evidence for a warming world comes from multiple independent climate indicators, from high up in the atmosphere to the depths of the oceans. They include changes in surface, atmospheric and oceanic temperatures; glaciers; snow cover; sea ice; sea level and atmospheric water vapour. Scientists from all over the world have independently verified this evidence many times. That the world has warmed since the 19th century is unequivocal.This unit also elaborates on the impact of global warming and climate change, and also proffers solution to the menace of global warming.

2.0 OBJECTIVES

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

- state the basic causes of climate change, suns output as well as volcanic eruption
- identify indicators of climate change
- discuss the change in weather pattern, impact of wildlife will be discussed in detail on this unit.

3.0 MAIN CONTENT

3.1 Sun's Output

Change in the amount of energy emitted by the Sun is a prime candidate as a cause of climate variability. And there is no doubt that on the longest timescales of Earth's geological history, trends in solar output have played a major role in shaping the Earth's climate and will continue to do so in the future.

Within our lifetime, though, of more concern are variations on the 10- to 100-year timescales. It has been known for many centuries that the face of the sun exhibits dark patches, 'sunspots', and that the number of sunspots varies with a fairly regular cycle of around 11 years.

Is this sunspot cycle an indicator of processes within the sun that might also affect the solar output and, hence, Earth's climate? Despite many studies, the evidence is still controversial. Sunspot cycles have been found in climate parameters, but the fluctuations are weak and tend to appear and disappear without reason. The 11-year sunspot cycle itself varies in strength on timescale of 80 years and longer, and these longer-term fluctuations have also been linked to climatic change. In the early 1600s, the sunspot cycle almost disappeared and this phenomenon, the so-called Maunder Minimum, has been associated with the height of the Little Ice Age. It has also been claimed that the warming of the 20th century was largely due to trends in sunspot activity, for example, in the length of the sunspot cycle.But, again, the evidence for these apparent correlations is not strong. Moreover, the fluctuations in solar output that likely accompanied these sunspot trends were not really sufficient to generate the observed climate changes, without some amplifying mechanism.

3.2 Milankovitch Cycles

On time scales of a thousand years and longer, changes in the character of the Earth's orbit around the Sun and in its rotation can significantly affect the way in which the energy from the Sun is distributed by season and by latitude. This is known as the 'Milankovitch Effect,' and it generates changes which are cyclic in nature. Comparison of the changes predicted by astronomical calculations with the observed climate record suggests that this mechanism has played a part in inducing the shift from ice age to interglacial conditions on time scales of 10,000 to 100,000 years. But in order to explain the scale of the observed variations, it is necessary to invoke other factors. One possibility is that the basic effect is magnified by the release and uptake of carbon dioxide as climate alters.

3.3 Volcanic Eruption

Explosive volcanic eruptions can inject large quantities of dust and the gas, sulphur dioxide, high into the atmosphere. Whereas volcanic debris in the lower atmosphere falls out or is rained out within days, the veil of pollution in the upper atmosphere is above the weather and may remain for several years, gradually spreading to cover much of the globe.
The volcanic pollution results in a substantial reduction in the stream of solar energy as it passes through the upper layers of the atmosphere, reflecting a significant amount back out to space.

Observational and modeling studies of the likely effect of recent volcanic eruptions suggest that an individual eruption may generate global cooling amounting to two or three tenths of a degree Celsius. The effect lasts for a year or two. Major eruptions have not been common this century, occurring once every ten to twenty years, so the long-term influence has been slight. The influence on climate has been on the year-to-year time scale.

Other forms of pollution can affect the passage of heat and light through the air – dust thrown up by windstorms or human activity, for example – but the most significant factor at this time is believed to be the rising amount of greenhouse gases, such as carbon dioxide and methane, in the atmosphere.

3.4 Indicators of Climate Change

3.4.1 Rise in Global Temperature

Evidence for a warming world comes from multiple independent climate indicators, from high up in the atmosphere to the depths of the oceans. They include changes in surface, atmospheric and oceanic temperatures; glaciers; snow cover; sea ice; sea level and atmospheric water vapour. Scientists from all over the world have independently verified this evidence many times. That the world has warmed since the 19th century is unequivocal.

Discussion about climate warming often centres on potential residual biases in temperature records from landbasedweather stations. These records are very important, but they only represent one indicator of changes in the climate system. Broader evidence for a warming world comes from a wide range of independent physically consistent measurements of many other, strongly interlinked, elements of the climate system.

A rise in global average surface temperatures is the best-known indicator of climate change. Although each year and even decade is not always warmer than the last, global surface temperatures have warmed substantially since 1900. Warming land temperatures correspond closely with the observed warming trend over the oceans. Warming oceanicair temperatures, measured from aboard ships, and temperatures of the sea surface itself also coincide, as borne out by many independent analyses.

The atmosphere and ocean are both fluid bodies, so warming at the surface should also be seen in the lower atmosphere, and deeper down into the upper oceans, and observations confirm that this is indeed the case. Analyses of measurements made by weather balloon radiosondes and satellites consistently show warming of the troposphere, the active weather layer of the atmosphere. More than 90% of the excess energy absorbed by the climate system since at least the 1970s has been stored in the oceans as can be seen from global records of ocean heat content going back to the 1950s.

As the oceans warm, the water itself expands. This expansion is one of the main drivers of the independently observed rise in sea levels over the past century. Melting of glaciers and ice sheets also contribute, as do changes in storage and usage of water on land. A warmer world is also a moister one, because warmer air can hold more water vapour. Global analyses show that specific humidity, which measures the amount of water vapour in the atmosphere, has increased over both the land and the oceans.The frozen parts of the planet known collectively as the cryosphere, affects, and are affected by, local changes in temperature. The amount of ice contained in glaciers globally has been declining every year for more than 20 years, and the lost mass contributes, in part, to the observed rise in sea level.

3.4.2 Changes in Snow Temperature

Snow cover is sensitive to changes in temperature, particularly during the spring, when snow starts to melt. Spring snow cover has shrunk across the NH since the 1950s. Substantial losses in Arctic sea ice have been observed since satellite records began, particularly at the time of the minimum extent, which occurs in September at the end of the annual melt season. By contrast, the increase in Antarctic sea ice has been smaller. Individually, any single analysis might be unconvincing, but analysis of these different indicators and independent data sets has led many independent research groups to all reach the same conclusion. From the deep oceans to the top of the troposphere, the evidence of warmer air and oceans, of melting ice and rising seas all points unequivocally to one thing: the world has warmed since the late 19th century.

- Effects on hydrological systems;
- Changes on terrestrial biological systems;
- Trend towards earlier greening of vegetation and longer thermal growing season;
- Changes in marine and freshwater biological systems associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation; Ocean acidification with an average decrease in pH of 0.1 units. The associated effects on the marine biosphere were not documented at the time of the assessment.

4.0 CONCLUSION

As the oceans warm, the water itself expands. This expansion is one of the main drivers of the independently observed rise in sea levels over the past century. Melting of glaciers and ice sheets also contribute, as do changes in storage and usage of water on land. A warmer world is also a moister one, because warmer air can hold more water vapour. Global analyses show that specific humidity, which measures the amount of water vapour in the atmosphere, has increased over both the land and the oceans.

Discussion about climate warming often centres on potential residual biases in temperature records from land based weather stations. These records are very important, but they only represent one indicator of changes in the climate system. Broader evidence for a warming world comes from a wide range of independent physically consistent measurements of many other, strongly interlinked, elements of the climate system.

Despite many studies, the evidence is still controversial. Sunspot cycles have been found in climate parameters, but the fluctuations are weak and tend to appear and disappear without reason. The 11-year sunspot cycle itself varies in strength on timescale of 80 years and longer, and these longer-term fluctuations have also been linked to climatic change. In the early 1600s, the sunspot cycle almost disappeared and this phenomenon, the so-called Maunder Minimum, has been associated with the height of the Little Ice Age. It has also been claimed that the warming of the 20th century was largely due to trends in sunspot activity.Change in the amount of energy emitted by the Sun is a prime candidate as a cause of climate variability. And there is no doubt that on the longest timescales of Earth's geological history, trends in solar output have played a major role in shaping the Earth's climate and will continue to do so in the future.

Evidence for a warming world comes from multiple independent climate indicators, from high up in the atmosphere to the depths of the oceans. They include changes in surface, atmospheric and oceanic temperatures; glaciers; snow cover; sea ice; sea level and atmospheric water vapour. Scientists from all over the world have independently verified this evidence many times. That the world has warmed since the 19th century is unequivocal. Discussion about climate warming often centres on potential residual biases in temperature records from land based weather stations.

A rise in global average surface temperatures is the best-known indicator of climate change. Although each year and even decade is not always warmer than the last, global surface temperatures have warmed substantially since 1900. Warming land temperatures correspond closely with the observed warming trend over the oceans.

5.0 SUMMARY

Change in the amount of energy emitted by the Sun, Milankovitch Effect, volcanic eruptions and other forms of pollutions which injects gases into the atmosphere have variable effects on climate change. Evidence for a warming world comes from multiple independent climate indicators, from high up in the atmosphere to the depths of the oceans. They include changes in surface, atmospheric and oceanic temperatures; glaciers; snow cover; sea ice; sea level and atmospheric water vapour.

6.0 TUTOR-MARKED ASSIGNMENT

1. Succinctly elaborate on the causes of climate change.
2. Explain the indicators of climate change.
3. Explain the impact of global warming.
4. What do you understand by the term Biodiversity?

7.0 REFERENCES/FURTHER READING

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UNIT 3 IMPACT AND REMEDY TO GLOBAL WARMING

CONTENTS

1.0 Introduction
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3.1 Impact of Global Warming
3.2 Improvement in Energy Efficiency
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3.2.3Changes in Agricultural practice
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1.0 INTRODUCTION

Reducing energy demand through conservation andinnovation appears to be a particularly promising means of reducing GHG emissions. For example, between the mid-1980s and 2015, energy efficiency standards and labeling for appliances and a broad range of products in the U.S., U.K., Australia, and other nations reduced the energy consumption of these products by 10% to 25%.98 In 2015, such measures saved consumers and businesses in the U.S. about $40 billion.99 A National Academies study concluded that while using LEED-Silver or equivalent standards in the construction of new buildings increased the costs of initial construction by up to 8%, energy costs would be reduced by between 5% and 30% over the life of the building. A report from the UN Foundation estimated that an investment of $3.2 trillion worldwide in energy conservation would avoid new supply investments of $3 trillion and would pay for itself within three to five years.

Since most energy use occurs in cities with rising populations, policies that encourage residential density, localized employment opportunities, diversified urban land use, and public transportation are particularly important.102 Behavioral changes can also have a tangible impact.

2.0 OBJECTIVES

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

- state the various ways in which you reduce the effect of global warming
- discuss the various alternative energy sources, as well as the need to change in our agricultural practice.

3.0 MAIN CONTENT

3.5. Impact of Global Warming

i. Biodiversity

The global biodiversity resource is under threat from a range of anthropogenic drivers, including pollution, land-use change and climate change (CBD 2003; Millennium Ecosystem Assessment 2005). Recent work has suggested that climate change may be as great a long-term threat to species survival as land-use change, although this work is not without its uncertainty. Irrespective, there is ‘very high confidence’ that climate change is already impacting on biodiversity at a global scale as determined by the IPCC criteria (i.e. an estimation that more than 95% of observed changes are principally caused by climate change). Information on the impact of climate change on biodiversity has two main sources: first, detected impacts (commonly from long-term monitoring of species or ecosystems), and second, modeled projections of future impacts. Although we have in general constrained our discussion to information from Europe, we also include information from some studies outside of Europe or at the global scale in order to illustrate some generic ecological processes. This information is not intended as a comprehensive review of climate change impacts on European biodiversity, but instead is meant to illustrate some of its major features.

ii. Rising sea level

As the world warms, sea levels rise, both because increasing temperatures cause ice fields to melt and because the oceans themselves are warming (and therefore expanding). Since around 1870, rates of global sea level rise (GSLR) have accelerated and are now about 3.5 mm (0.15 inches) per year. By 2100, sea levels are projected to rise by up to 2 meters (6.6 feet), depending on GHG emissions and the effects of warming air and ocean water on ice. Two thirds of the world’s largest cities are located in low-lying coastal areas, and increasing sea levels could submerge the land on which an estimated 470 million to 760 million people are living. A number of island nations—including 11 of the Solomon Islands are already submerged or at risk of total destruction. By 2050, between 665,000 and 1.7 million people in the Pacific are expected to be forced to migrate due to rising sea levels, including the entire populations of islands such as Fiji, the Marshall Islands, and Tuvalu. In larger countries, such as Bangladesh and the Netherlands, a very large proportion of the population will probably be forced to relocate (46% and over 70%, respectively). By 2100, in the U.S. alone, barring a concerted mitigation effort, $238 billion to $507 billion worth of coastal property will likely be below sea level.48 Some U.S. cities, including Miami, Florida and Norfolk, Virginia, are in particular danger of inundation and increased flooding.

iii. Change in weather pattern

Although it is difficult to link any single event directly to climate change, rising temperatures means that the atmosphere can hold more water vapor, allowing both for greater rates of rainfall and runoff when the air is saturated and for drier (more under-saturated) conditions otherwise.50,51 In other words, though overall rates of evaporation are not changing greatly, extremes in precipitation are becoming less frequent but more intense, and as a result rainfall patterns are shifting across the world. Since 2013, extreme drought has affected the Western U.S. In California, 2015 was the driest year on record, supplanting 2013; and 2014 had been the third-driest. Somalia, Kenya, and other East African countries have experienced below-average rainfall since the late 1990s, contributing to a 30% reduction in crop yields and famines in 2010, 2011, and 2016. There has also been an increase in the prevalence of hurricanes and other destructive weather events. For example, in 2013 the Philippines was hit by one of the worst typhoons in recorded history (Typhoon Haiyan), which led to over 6,000 deaths, displaced nearly 4 million people, and caused billions of dollars in damages.

iv. Political and security risk

Climate change has been linked to increased political instability worldwide. When food prices rose sharply in 2007-2008, dozens of so-called “food riots” caused casualties in Argentina, Cameroon, Haiti, and India. Both the Somalian civil war and the Syrian civil war have been linked to drought and famine exacerbated by climate change. The U.S. military has suggested that climate change is “a salient national security concern,” which could redraw maps and spheres of engagement while compounding conflicts and resource constraints in some of the world’s already vulnerable countries, leading to further instability and even war.

v. Health risk

Higher temperatures increase the possibility of heat-related injury and death. As many as 70,000 people died in the 2003 European heat wave, and more than 50,000 died in a 2010 heat wave in Russia Thousands more have perished in increasing and increasingly severe heat waves in India (2015), Europe (2006), and around the world. Water and vector borne diseases are also projected to increase as insects and other carriers move into higher latitudes. For example, between 2000 and 2013, instances of Lyme disease in the U.S. doubled. A warmer atmosphere also increases the concentrations of smog (a lung irritant), while continuing to burn fossil fuels particularly coal can lead to millions of premature deaths. The burning of coal has been linked to tens of thousands of premature deaths in the U.S. annually, and the World Health Organization found that, in 2012, 7 million people worldwide died due to air pollution. Studies conducted to quantify economically the health impacts of climate change have suggested that the costs are substantial. According to research conducted by the Harvard T.H. Chan School of Public Health, the extraction, transportation, processing, and combustion of coal in the U.S. cause 24,000 excess lives lost annually due to lung and heart disease (evaluated at $187.5 billion per year) and 11,000 excess lives lost annually due to high health burdens in coal-mining regions (evaluated at $74.6billion per year).Another study conducted by the EPA found that the health impacts of fossil fuel electricity in the U.S. totaled between $362 billion and $887 billion per year (representing 2.5% to 6.0% of GDP) due to premature mortality, workdays lost, and other direct healthcare costs.

vi. Impact of wildlife

Climate change also significantly affects many natural habitats and puts many species at higher risk of extinction in the coming century. Observing that current extinction rates are 100 times the normal rate, some scientists predict that the Earth is headed for the sixth mass extinction event in its history. By 2100, 30% to 50% of the world’s land and marine animal species may be extinct. Climate change is also having significant effects on the oceans. Over the last 100 years, it has raised near-surface ocean temperatures by about 0.74° C (1.3° F) and made the sea significantly more acidic, likely affecting marine animals’ reproduction and survival. In some places, live coral coverage is only half of what it was in the 1960s, and scientists predict that the world’s coral reefs could be entirely extinct by 2050. As many as 1 billion people rely on the fish that live in coral reefs as their primary protein source.

3.2 Improvement in Energy Efficiency

Reducing energy demand through conservation andinnovation appears to be a particularly promising means of reducing GHG emissions. For example, between the mid-1980s and 2015, energy efficiency standards and labeling for appliances and a broad range of products in the U.S., U.K., Australia, and other nations reduced the energy consumption of these products by 10% to 25%.98 In 2015, such measures saved consumers and businesses in the U.S. about $40 billion.99 A National Academies study concluded that while using LEED-Silver or equivalent standards in the construction of new buildings increased the costs of initial construction by up to 8%, energy costs would be reduced by between 5% and 30% over the life of the building. A report from the UN Foundation estimated that an investment of $3.2 trillion worldwide in energy conservation would avoid new supply investments of $3 trillion and would pay for itself within three to five years.

Since most energy use occurs in cities with rising populations, policies that encourage residential density, localized employment opportunities, diversified urban land use, and public transportation are particularly important.102 Behavioral changes can also have a tangible impact. For instance, McKinsey estimates that changes such as driving smaller cars could reduce fuel demand by about 10% in 2030.The International Energy Agency (IEA) estimates that around 40% of the reductions required by 2050could potentially come from increased energy efficiency.

3.2.1 Changes in Agricultural Practice

Changes in land use alsohave the potential to be an important factor in reducing carbon emissions. For example, from 2000 to 2005, the burning of tropical forests accounted for 7% to 14% of all anthropogenic CO_2 emissions.Because forests act as sinks that remove carbon from the atmosphere and place it in the ground, the destruction of those forests accelerates the pace of climate change. Biochar charcoal added to soil to enhance crop yields and nutrition—is one potential means of reducing GHG emissions while simultaneously improving soil health.120 Rather than burning agricultural and forestry waste, a source of enormous GHG emissions, waste biomass could be converted to biochar, which stores carbon in soil for thousands of years. Other changes in agricultural practices aim to reduce methane emissions from livestock, which account for 14.5% of global CO_2eq emissions. One possible solution is the use of feed additives, which could reduce these emissions by 25% to 30%. The U.N. Food and Agriculture Organization estimates that changes in practices “within existing [livestock agriculture] production systems could cut agricultural emission by about 30%.

3.2.3 Geo-engineering

Some scientists claim that geo-engineering, or intentionally interfering in the world's climate systems, is a possible solution to mitigating climate change.They suggest exploringpossibilities like injecting sulfates into the atmosphere, where their high reflectivity would stop up to1% of the sun's radiation from reaching the Earth's surface. One plan in the U.K. involves pumping "water nearly a kilometer up into the atmosphere, by way of a suspended hose" attached to a "stadiumsizehydrogen balloon" in the stratosphere, 20 km above the Earth.127 The plan, called Stratospheric Particle Injection for Climate Change (SPICE), is meant to test the feasibility of one day spraying sulfate particles in place of water. SPICE and other geo-engineering ideas were inspired by studying the atmosphere-cooling effects of volcanic eruptions, such as the Mount Pinatubo, Philippines eruption of 1991, which "spewed 20 million tons of sulfate particles into the atmosphere, cooling Earth by 0.5 degree Celsius for 18 months. Preliminary estimates suggest that geo-engineering could be relatively cheap, although it would have to be maintained continuously in order to control the Earth's temperature. However, this suggestion is hugely controversial. There are concerns that we have very little understanding of what the widespread distribution of sulfates might do and fear that they will damage the ozone layer, lead to drought, and possibly "disrupt the Asian and African summer monsoons, reducing precipitation to the food supply to billions."

4.0 CONCLUSION

Through the accelerated diffusion of so called "fourth generation" nuclear power: recent developments hold the promise of significantly reducing the capital costs associated with building nuclear power reactors while also making them safer and reducing their waste production. In addition, transportation is responsible for 26% of U.S.
CO_2 emissions, making it the second largest source behind electricity (30%).116 Efforts to reduce emissions from the sector include substantial investments in both biofuels and electric vehicles.

5.0 SUMMARY

Climate change has impacted negatively on humans, plants and wildlife. However the impact can be reduced and monitored by Reducing energy demand through conservation reducing as now practiced in some industrialized nations. Changes in land use alsohave the potential to be an important factor in reducing carbon emissions. For example, from 2000 to 2005, the burning of tropical forests accounted for 7% to 14% of all anthropogenic CO2 emissions.Because forests act as sinks that remove carbon from the atmosphere and place it in the ground, the destruction of those forests accelerates the pace of climate change.Some scientists claim that geo-engineering, or intentionally interfering in the world's climate systems, is also a possible solution to mitigating climate change.

7.0 TUTOR-MARKED ASSIGNMENT

1. Explain the impact of global warming.
2. What do you understand by the term Biodiversity?
3. Enumerate remedies to global warming.
4. List some alternative energy sources
5. List the health risk associated with global warming.

7.0 REFERENCE/FURTHER READING

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MODULE 3 SOLAR RADIATION

Unit 1 Effect of Solar Radiation
Unit 2 Introduction to Ozone Layer
Unit 3 Health Risk Associated with Depletion

UNIT 1 EFFECT OF SOLAR RADIATION

CONTENTS

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    3.2 Effect on Terrestrial Plant
    3.3 Effect on Air Quality
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5.0 Summary
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1.0 INTRODUCTION

Module 3 Unit 1 focuses on explaining the meaning of solar radiation and its interaction with the earth’s atmosphere.

2.0 OBJECTIVES

At the end of this unit, you will get to know that despite the small radiation amount in the UV spectral range; such fluxes are responsible for several important photo-biological and photochemical effects.

3.0 MAIN CONTENT

3.1 Definition of Terms

The term solar ultra violet radiation is define as the energy emitted by the sun in the in the form of electromagnetic waves. The UV-R, name given to the electromagnetic spectrum band between 100 and 400 nm wavelengths (1 nm = 1 nanometer = 10-9 m), corresponds to less than 10% of the total solar radiation incident on the top of atmosphere. This small spectral radiation band is subdivided, according to recommendation of the International Commission on Illumination (Commission Internationale de l'Éclairage - CIE), into: UVC, between 100 and 280 nm; UVB, between 280 and 315 nm; and UVA, between 315 and 400 nm. The remaining over 90% of solar radiation practically corresponds to the visible spectrum (400-780 nm) and near infrared spectrum (780-4000 nm).

UV-R undergoes intense attenuation when interacting with atmospheric components along the way to the Earth's surface. As we will see further on, this attenuation depends on the type of incident radiation, which is more intense for the shorter wavelengths. Despite the small radiation amount in the UV spectral range, such fluxes are responsible for several important photo-biological and photochemical effects.

3.1.1 Effect on human and Animal Health

Increased penetration of solar UV-B radiation is likely to have profound impact on human health with potential risks of eye diseases, skin cancer and infectious diseases. UV radiation is known to damage the cornea and lens of the eye.
Chronic exposure to UV-B could lead to cataract of the cortical and posterior sub capsular forms. UV-B radiation can adversely affect the immune system causing a number of infectious diseases. In light skinned human populations, it is likely to develop no melanoma skin cancer (NMSC). Experiments on animals show that UV exposure decreases the immune response to skin cancers, infectious agents and other antigens.

3.1.2 Effects on Aquatic organisms

While more than 30 percent of the world’s animal protein for human consumption comes from the sea alone, it is feared that increased levels of UV exposure can have adverse impacts on the productivity of aquatic systems. High levels of exposure in tropics and subtropics may affect the distribution of phytoplanktons which form the foundation of aquatic food webs. Reportedly a recent study has indicated 6-12 percent reduction in phytoplankton production in the marginal ice zone due to increases in UV-B. UV-B can also cause damage to early development stages of fish, shrimp, crab, amphibians and other animals, the most severe effects being decreased reproductive capacity and impaired larval development.

Increased solar UV radiation could affect terrestrial and aquatic bio-geo-chemical cycles thus altering both sources and sinks of greenhouse and important trace gases, e.g. carbon dioxide (CO2), carbon monoxide

(CO), carbonyl sulphide (COS), etc. These changes would contribute to biosphere-atmosphere feedbacks responsible for the atmosphere build-up of these gases. Other effects of increased UV-B radiation include: changes in the production and decomposition of plant matter; reduction of primary production changes in the uptake and release of important atmospheric gases; reduction of bacterioplankton growth in the upper ocean; increased degradation of aquatic dissolved organic matter (DOM), etc. Aquatic nitrogen cycling can be affected by enhanced UV-B through inhibition of nitrifying bacteria and photodecomposition of simple inorganic species such as nitrate. The marine sulphur cycle may also be affected resulting in possible changes in the sea-to-air emissions of COS and dimethylsulfied (DMS), two gases that are degraded to sulphate aerosols in the stratosphere and troposphere, respectively.

3.1.3 Effects on Terrestrial Plants

It is a known fact that the physiological and developmental processes of plants are affected by UV-B radiation. Scientists believe that an increase in UV-B levels would necessitate using more UV-B tolerant cultivar and breeding new tolerant ones in agriculture. In forests and grasslands increased UV-B radiation is likely to result in changes in species composition (mutation) thus altering the bio-diversity in different ecosystems. UV-B could also affect the plant community indirectly resulting in changes in plant form, secondary metabolism, etc. These changes can have important implications for plant competitive balance, plant pathogensand bio-geochemical cycles.

3.1.4 Effects on Air Quality

Reduction of stratospheric ozone and increased penetration of UV-B radiation result in higher photo dissociation rates of key trace gases that control the chemical reactivity of the troposphere. This can increase both production and destruction of ozone and related oxidants such as hydrogen peroxide which are known to have adverse effects on human health, terrestrial plants and outdoor materials. Changes in the atmospheric concentrations of the hydroxyl radical (OH) may change the atmospheric lifetimes of important gases such as methane and substitutes of chlorofluoro carbons (CFCs). Increased troposphere reactivity could also lead to increased production of particulates such as cloud condensation nuclei from the oxidation and subsequent nucleation of sulphur of both anthropogenic and natural origin (e.g. COS and DMS).

3.1.5 Effects on Materials and Structure

An increased level of solar UV radiation is known to have adverse effects on synthetic polymers, naturally occurring biopolymers and some other materials of commercial interest. UV-B radiation accelerates the photo degradation rates of these materials thus limiting their lifetimes. Typical damages range from discoloration to loss of mechanical integrity. Such a situation would eventually demand substitution of the affected materials by more photo stable plastics and other materials in future. In 1974, two United States (US) scientists Mario Molina and F. Sherwood Rowland at the University of California were struck by the observation of Lovelock that the CFCs were present in the atmosphere all over the world more or less evenly distributed by appreciable concentrations.

They suggested that these stable CFC molecules could drift slowly up to the stratosphere where they may breakdown into chlorine atoms by energetic UV-B and UB-C rays of the sun. The chlorine radicals thus produced can undergo complex chemical reaction producing chlorine monoxide which can attack an ozone molecule converting it into oxygen and in the process regenerating the chlorine atom again. Thus the ozone destroying effect is catalytic and a small amount of CFC would be destroying large number of ozone molecules. Their basic theory was then put to test by the National Aeronautic Space Authority (NASA) scientists and found to be valid, ringing alarm bells in many countries and laying the foundation for international action.

3.1.6 Effect on Photo-degradation

UV-B radiation is also responsible for photochemical degradation of compounds of dissolved organic material (DOM) of higher molecular weight into smaller, biologically-labile organic molecules [see review by that can stimulate bacterial activity.

4.0 CONCLUSION

This small spectral radiation band is subdivided, according to recommendation of the International Commission on Illumination (Commission Internationale de l'Éclairage - CIE), into: UVC, between 100 and 280 nm; UVB, between 280 and 315 nm; and UVA, between 315 and 400 nm. The remaining over 90% of solar radiation practically corresponds to the visible spectrum (400-780 nm) and near infrared spectrum (780-4000 nm).

This attenuation depends on the type of incident radiation, which is more intense for the shorter wavelengths. Despite the small radiation amount in in the UV spectral range, such fluxes are responsible for several important photo-biological and photochemical effects.

The remaining over 90% of solar radiation practically corresponds to the visible spectrum (400-780 nm) and near infrared spectrum (780-4000 nm).
Despite the small radiation amount in the UV spectral range, such fluxes are responsible for several important photo-biological and photochemical effects.

5.0 SUMMARY

The radiation of the sun gives rise to the UVR. This radiation is seen to be higher due to climate change. The impact can be seen to affect negatively human life; having adverse effects on aquatic creatures; impacting on terrestrial plants; impacting on quality of air by reducing the ozone layer; having effects on materials and structures and contributing to photo-degradation.

6.0 TUTOR-MARKED ASSIGNMENT

1. Succinctly define the term solar radiation.
2. What do you understand by the term Solar Radiation,
3. State the various effect of solar radiation as stated in this unit.

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UNIT 2 INTRODUCTION TO OZONE LAYER

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1.0 INTRODUCTION

This Unit, aptly describes the meaning of ozone layer and its role in protecting the earth. Unit 2 examines ozone layer depletion courtesy interaction between the ozone layer. Unit 3 elucidate on the impact and concern of ozone layer depletion as well as mitigating measures. The ozone layer is basically naturally occurring gas in the region of stratosphere where ozone particles are accumulated. Ozone layer is also naturally broken down but there is a balance between its formation and natural depletion. As a result the total amount of ozone remains constant. But ozone layer thickness varies with altitude and seasonal change. Ozone concentration is highest between 19-23 km. Most of ozone is formed at equator where there is maximum sunshine but with winds it travels at high altitude and get accumulated in stratosphere.
The ozone layer is a layer in Earth's atmosphere whichcontains relatively high concentrations of ozone (O3).

2.0 OBJECTIVES

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

- explain the ozone layer, and how it protects the earth
- state its impact and also the mitigating measures
- mention the various processes of depletion.

3.0 MAIN CONTENT

3.1 Introduction to Ozone Layer

Ozone (O_3) is a colourless gas just like oxygen (O_2) but it has very harsh odour. It is veryrare as compared to oxygen. It is estimated that out of 10 million air molecules about 2 millions are of O_2 andonly 3 are of ozone. The process of ozone formation is called as photolysis. When the UV radiations fromsun strike the O_2 molecules, it causes splitting of O_2. Oxygen molecules react with oxygen atoms in the upperatmosphere to form ozone. Stratospheric ozone is measured from the ground in units called “Dobson Unit” (D.U). Normal ozone concentration is between 300 - 350 D.U

The ozone layer is basically naturally occurring gas in the region of stratosphere where ozone particles are accumulated. Ozone layer is also naturally broken down but there is a balance between its formation and natural depletion. As a result the total amount of ozone remains constant. But ozone layer thickness varies with altitude and seasonal change. Ozone concentration is highest between 19-23 km. Most of ozone is formed at equator where there is maximum sunshine but with winds it travels at high altitude and get accumulated in stratosphere.

The ozone layer is a layer in Earth's atmosphere whichcontains relatively high concentrations of ozone (O_3). This layer absorbs 93-99% of the sun's high frequency ultraviolet light, which is potentially damaging to life on earth. Over91% of the ozone in Earth's atmosphere is present here. It is mainly located in the lower portion of the stratosphere from approximately 10 km to 50 km above Earth, though the thickness varies seasonally and geographically. The ozone layer was discovered in 1913 by the French physicists Charles Fabry and Henri Buisson. Its properties were explored in detail by the British meteorologist G. M. B. Dobson, who developed a simple spectrophotometer (the Dobson meter) that could be used to measure stratospheric ozone from the ground. Between 1928 and 1958 Dobson established a worldwide network of ozone monitoring stations which continues to operate today. The "Dobson unit", a convenient measure of the total amount of ozone in a column overhead, is named in his honor

3.1.1 Health Risk associate with ozone layer

Overexposure to UV radiation has a range of serioushealth effects, including skin cancers (contributing to an increase in melanoma), eye damage (including cataracts) and immune system suppression:

i. Eye Diseases

UV radiation also damages the eye's outer tissues causing "snow blindness", the ocular equivalent of sunburn. UVB's role in cataract formation is complex but some subtypes appear to be associated with UV exposure. As a result, uncontrolled ozone depletion was projected to cause significant increases in cataracts.

ii. Immune Suppression

UV exposure causes both local and whole-body immune suppression. Increased UV induced immune suppression due to uncontrolled ozone depletion could have influenced patternsof infectious disease, and the effectiveness ofvaccination, but might also have decreased the occurrence of various autoimmune diseases.

iii. Skin Cancer

UV radiation is a cause of skin cancer (melanoma and other types) in fair-skinned humans. Increases in UV radiation due to uncontrolled stratospheric ozone depletion would have led to more severe sunburn and large increases in skin cancer incidence (subject to changes in individual behaviour).

3.2 Ozone Layer Depletion

Ozone depletion describes two distinct, but related observations: a slow, steady decline of about 4 percent per decade in the total volume of ozone in Earth's stratosphere(ozone layer) since the late 1970s, and a much larger, but seasonal, decrease in stratospheric ozone over Earth's Polar Regions during the same period. The latter phenomenon is commonly referred to as the ozone hole. In addition to this well-known stratospheric ozone depletion, there are also tropospheric ozone depletion events, which occur near the surface in Polar Regions during spring.

The most pronounced decrease in ozone has been in the lower stratosphere. However, the ozone hole is most usually measured not in terms of ozone concentrations at these levels (which are typically of a few parts per million) but by reduction in the total column ozone, above a point on the Earth's surface, which is normally expressed in Dobson units, abbreviated as "DU". Marked decreases in column ozone in the Antarctic spring and early summer compared to the early 1970s and before have been observed using instruments such as the Total Ozone Mapping Spectrometer (TOMS).

Reductions of up to 70% in the ozone column observed in the austral (southern hemispheric) spring over Antarctica and first reported in 1985 (Farman et al 1985) are continuing. Through the 1990s, total column ozone inSeptember and October have continued to be 40–50% lowerthan pre-ozone-hole values. In the Arctic the amount lost is more variable year-to-year than in the Antarctic. The greatest declines, up to 30%, are in the winter and spring, when the stratosphere is colder.

3.2.1 Ozone Depletion Process

Ozone depletion process in the stratosphere leads to increase of UV-B on the ground with its harmful effects on health, ecosystems, aquatic system, materials etc. it is estimated that about 3 – 5.5% O_3 depleted in the northern hemisphere during 1969 – 1988.

In general there are three principal ways of O_3 depletion:

a. Hydrogen System (OH System)
b. Nitrogen System (N_2O)
c. Chlorine System ($CFCL_3$ or CF_2CL_2)

The OH system depletes only 10% of O_3. This reaction is seen above 40km over the earth's crust.

H2O + O (ID) $\rightarrow$ 2OH
$OH + O_3 \rightarrow H_2O + O_2$
$H_2O + O \rightarrow OH + 0_2$
Net $O + O_3 \rightarrow 2O_2$

OH can also be formed from oxidation of CH_4(CH_4+O(ID) – CH_3+OH). OH then reacts as above.

Sixty percent of ozone depletion occurs through N_2O system. N2O is produced by bacterial action of microorganisms in ocean and soil (denitrification) diffuse upwards from troposphere to stratosphere where it react with O in the presence of light to produce NO which then deplete O_3.

The detailed reaction is expressed as:

N_2O + O (ID) $\rightarrow$ 2NO
$N_2O + hv \rightarrow NO + O$
$NO + O_3 \rightarrow NO_2\ O_2$
$NO_2 + O \rightarrow NO\ O_2$
$O_3 + O \rightarrow$ 2O2

Neutral chlorine contributes only to very little to O3 destruction. But $CFCL_3$, $CFCL_2$ are the principal O_3 destroyers. They are inert in the troposphere but get dissociated into the stratosphere:

$CFCL_3, CF_2CL_2 \xrightarrow[180-220nm]{hV} Cl_2$
$Cl + O_3 \rightarrow NO2 + O_2$
$ClO + O \rightarrow Cl + O_2$
Net: $O + O_3 \quad 2O_2$

4.0 CONCLUSION

Most of ozone is formed at equator where there is maximum sunshine but with winds it travels at high altitude and get accumulated in stratosphere.

The ozone layer is a layer in Earth's atmosphere whichcontains relatively high concentrations of ozone (O3). This layer absorbs 93-99% of the sun's high frequency ultraviolet light, which is potentially damaging to life on earth

Between 1928 and 1958 Dobson established a worldwide network of ozone monitoring stations which continues to operate today. The "Dobson unit", a convenient measure of the total amount of ozone in a column overhead, is named in his honor

5.0 SUMMARY

The ozone layer is basically naturally occurring gas in the region of stratosphere where ozone particles are accumulated. Ozone layer is also naturally broken down but there is a balance between its formation and natural depletion. As a result the total amount of ozone remains constant. Depletion of the ozone layer has some negative impact on health of humans. Ozone depletion describes two distinct, but related observations: a slow, steady decline of about 4 percent per decade in the total volume of ozone in Earth's stratosphere(ozone layer) since the late 1970s, and a much larger, but seasonal, decrease in stratospheric ozone over Earth's Polar Regions during the same period. The latter phenomenon is commonly referred to as the ozone hole. In addition to this well-known stratospheric ozone depletion, there are also tropospheric ozone depletion events, which occur near the surface in Polar Regions during spring.

6.0 TUTOR-MARKED ASSIGNMENT

1. Extensively define the term layer depletion and enumerate the various processes involved.

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UNIT 3 HEALTH RISK ASSOCIATED WITH DEPLETION

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5.0 Summary
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1.0 INTRODUCTION

Unit three illuminates the impact of and concern of ozone layer depletion as well as mitigating measures.

2.0 OBJECTIVE

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

- discuss the different depletion processes.

3.0 MAIN CONTENT

3.1 Health Risk Associated With Depletion

3.1.1 Cataract

In the 1989 UNEP Environmental Effects Panel Report a static estimate was developed of the cataract risk of ozone depletion. In that effort it was estimated that the world's population, if subjected to a sustained 1% decrease in the ozone layer, would develop between 100,000 to 150,000 additional cases annually. More recently, the USEPA has updated the work developed for their earlier RIA (USEPA 1988), using a quantitative model that incorporates the ozone depletion scenarios developed by the Scientific Assessment Panel (UNEP 1998). Presented in Fig. 2.6 are the results of that effort (R. Rubenstein, personal communication). Although these estimates were developed on the basis of U S data, they should be applicable to similar populations, i.e., those that are adequately nourished, worldwide and under-nourished populations may be a greater risk.

3.1.2 Sun Burn

Exposure to sunlight may lead to a reddened and painful skin. This 'sunburn' is mainly caused by the UV-B radiation in sunlight. Exposures to more UV-B give more severe sunburns. An increase of sunburns by ozone depletion would be more than a nuisance; sunburn is also considered to be a risk factor for more serious effects, such as melanoma.

Analysis of available knowledge leads to the conclusion that sunburns will not appreciably increase under a decreasing ozone layer; this is due to a powerful adaptation of the skin. A gradual thinning of the ozone layer would, for instance, lead to 20 percent more UV-B in 10 years' time. The skin is equipped with an adaptation that can even cope with the changes in UV-B with the seasons. These are much more drastic; in mid-latitudes, the UV-B irradiance in summer is typically 10 times larger than in winter.

Experience with phototherapy of skin diseases shows that one UV-B exposure, sufficient to cause a slight reddening, decrease the sensitivity of the skin by about 20 percent. In a series of exposures, this can be repeated many times. That is how the skin adapts to the UV-B changes with the seasons. A calculation shows that adaptation from winter to summer irradiance requires such steps of 20 percent each. This will not change much under a UV-B irradiance increased by 20 percent due to ozone depletion. It will in fact become a bit easier, as the winter irradiance increases more than that in summer, so that the difference becomes a bit smaller.

It is certainly possible to think of situations where adaptation cannot work in this way. For instance, if a totally un-adapted skin is suddenly exposed to full sunlight, more UV-B in the sunlight will increase the likelihood of sunburn. Persons going on an expedition to the Antarctic ozone hole have reported experiences in this line. But such conditions are quite exceptional. By far the most sunburnarises from lack of care in going through the adaptation process. Such sunburns will not increase.

3.2 Other Opportunistic Infections

Although it is now adequately documented that UV radiation can modulate immune reactions in rodents as well as in humans, the impact of current levels of ambient solar UV radiation on infections in human populations is still unknown. Currently available epidemiological are unsuited to ascertain and quantify any such effect, and given the fact that scientists have been aware of this lack of data for decades, a well-designed epidemiological study that addresses this issue is long overdue. Consequently, we are still completely ignorant when it comes to quantifying possible effects on infections of ozone depletion.

In developing animal models for the effects of UV radiation on infections, investigators have been measuring changes in fundamental immune reactions that are associated with the course of the infection and that may also be measured in humans. Thus, the aim is to predict UV-induced effects on human resistance to infection by measuring the relevant changes in basic immune responses after UV exposure, a so-called 'parallelogram' approach. This approach is in its infancy and requires a thorough and detailed knowledge of the immunological responses that play a role in any particular infection under consideration, in order to identify the relevant measurements. This approach also has certain limitations in that the outcome of such analysis only evaluates host resistance and does not provide complete information on the spread and course of an infection in a population.

The first conjectural calculations demonstrate that physiologically relevant exposures to solar UV radiation (e.g. 90 minutes around noon in July at 40o N) may significant hamper cellular immunity against a bacterial infection (Listeria monocytogenes) in the 5 % most sensitive individuals in a population of white Caucasians. This result is in reasonable agreement with direct measurements of the UV-induced suppression immune reactions against simple chemicals where UVB exposures of the same order of magnitude as those calculated were found to affect a high percentage of people. In spite of these promising developments in indirect methods for assessing UV-related risks of infection, a more direct quantitative assessment of UV-induced enhanced infection remains desirable. A reliable assessment of the magnitude and breadth of effects of current ambient UV levels on infections and on success rates of vaccinations appears to be a long way off, and an expansion to include the effects of ozone depletion delves even deeper into realm of human ignorance.

3.2.1 Mitigation with replacement of chlorofluorocarbons

The need for reducing the CO2 equivalent emissions will affect many sectors of the economy: energy creation, transport, buildings, industry, agriculture, human settlements.

Availability of adequate energy supply is fundamental to modern living. Currently, a major portion of the energy is generated using fossil fuels—

coal, oil, and natural gas (in decreasing order of CO_2 emissions). These will need to be replaced by low- or zero-carbon fuels, such as wind, solar, and nuclear. It is true that nuclear power generation carries with it certain risks. But in order to increase the supply of low or zero-carbon energy, attention will have to be paid to increasing safeguards. Increased emphasis will have to be placed on developing technologies for generating energy through renewable sources. In these efforts, the technology for carbon capture and storage (CCS) will play an important role. The CCS technology captures the CO_2 produced by fossil fuels and stores it permanently underground. Another area for technological advancement will be storage of the electricity generated from renewable sources as the energy supply is intermittent.

4.0 CONCLUSION

Chronic exposure to UV-B could lead to cataract of the cortical and posterior sub-capsular forms. UV-B radiation can adversely affect the immune system causing a number of infectious diseases. In light skinned human populations, it is likely to develop nonmelanoma skin cancer (NMSC). Experiments on animals show that UV exposure decreases the immune response to skin cancers, infectious agents and other antigens.

The term solar ultra violet radiation is define as the energy emitted by the sun in the in the form of electromagnetic waves. The UV-R, name given to the electromagnetic spectrum band between 100 and 400 nm wavelengths (1 nm = 1 nanometer = 10-9 m), corresponds to less than 10% of the total solar radiation incident on the top of atmosphere. This small spectral radiation band is subdivided, according to recommendation of the International Commission on Illumination.

5.0 SUMMARY

There are health risks associated with the depletion of the ozone layer; namely cataract which Environmental Effects Panel Report a static estimate was developed of the cataract risk of ozone depletion. Other related health issues associated with the ozone layer depletion are sun burns, skin cancers and other opportunistic infections. The need for reducing the CO_2 equivalent emissions will affect many sectors of the economy: energy creation, transport, buildings, industry, agriculture, human settlements.Availability of adequate energy supply is fundamental to modern living. Currently, a major portion of the energy is generated using fossil fuels - coal, oil, and natural gas (in decreasing order of CO_2 emissions).

6.0 TUTOR-MARKED ASSIGNMENT

1. Extensively discuss the health risk associated with ozone layer depletion.

7.0 REFERENCES/FURTHER READING

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