GRADE 10

SOCIAL SCIENCE

UNIT 1

RESOURCE DEVELOPOMENT AND MANAGEMENT

TOPIC 1: RENEWABLE RESOURCES

TOPIC 2: NON-RENEWABLE RESOURCES

TOPIC 3: PEOPLE AND THE EARTH

TOPIC 4: GOVERNMENT RESOURCE DEVELOPMENT AND MANAGEMENT

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The Principal
DEMAS TONGOGO

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CONTENT

SECRETARY'S MESSAGE

Achieving a better future by individual students and their families, communities or the nation as a whole, depends on the kind of curriculum and the way it is delivered.

This course is a part of the new Flexible, Open and Distance Education curriculum. The learning outcomes are student-centred and allows for them to be demonstrated and assessed.

It maintains the rationale, goals, aims and principles of the national curriculum and identifies the knowledge, skills, attitudes and values that students should achieve.

This is a provision by Flexible, Open and Distance Education as an alternative pathway of formal education.

The course promotes Papua New Guinea values and beliefs which are found in our Constitution, Government Policies and Reports. It is developed in line with the National Education Plan (2005 -2014) and addresses an increase in the number of school leavers affected by the lack of access into secondary and higher educational institutions.

Flexible, Open and Distance Education curriculum is guided by the Department of Education's Mission which is fivefold:

- to facilitate and promote the integral development of every individual
- to develop and encourage an education system satisfies the requirements of Papua New Guinea and its people
- to establish, preserve and improve standards of education throughout Papua New Guinea
- to make the benefits of such education available as widely as possible to all of the people
- to make the education accessible to the poor and physically, mentally and socially handicapped as well as to those who are educationally disadvantaged.

The college is enhanced to provide alternative and comparable pathways for students and adults to complete their education through a one system, many pathways and same outcomes.

It is our vision that Papua New Guineans' harness all appropriate and affordable technologies to pursue this program.

I commend all those teachers, curriculum writers, university lecturers and many others who have contributed in developing this course.

UKE KOMBRA, PhD

Secretary for Education

COURSE INTRODUCTION

Dear Student,

Welcome to the Grade 10 Social Science Course. This course is based on the National department of Education Department (NDOE) Lower Secondary Social Science Syllabus. However, you will be doing this course through correspondence or at your convenient time at home. It has been written to enable you to do it at the comfort of your home.

Social Science is about how people relate to other people and their environments and how they organize themselves and use their resources.

There are three units in this course.

Unit 1: **Resource Development and Management,** identifies the types of resources and elaborates on how these resources are used and managed in Papua New Guinea.

Unit 2: **Environmental Change, Pollution and Solution,** looks at how people's activities have changed and polluted the environment. It also discusses solutions to the environmental issues we face today in our environment.

Unit 3: **Papua Guinea and the Global Community,** explores aspects of Papua New Guinea's relationship with the global community.

The unit books have a corresponding project each that elaborates more on certain topics in the respective unit.

Each unit is divided into topics and each consists of Lessons, Summaries, Practice Exercises and Answers. At the end of each lesson, you are expected to do the practice exercises. The answers to each practice exercise are found at the end of each topic. You must correct your own answers. A test is given for each topic in the Assignment Booklet.

There are three Assignments and three Projects Assignments giving a total of six assignments. You will find each assignment after each unit you study. You must do these assignments. Before working on them, you must revise all the lessons. Remember to check all your assignments before you send them in for marking. The Assignment marks will be added together with your final external examination mark. This will give you a final mark and grade.

There will be an examination after you have completed this course. You will do the examination only after all your Assignments have been marked.

We hope you will find this course interesting and informative.

All the best in your studies!
Your Teacher

UNIT 1 INTRODUCTION

Dear Student,

Welcome to Unit 1 of Grade 10 Social Science course. This unit is titled **Resource Development and Management**. At the end of this unit you should be able to:

- Identify the different types of resources
- Discuss how these resources are developed
- State how these resources are managed in Papua New Guinea.

This unit is made up of four topics.

In Topic 1 – **Renewable Resources**, you will define resources, identify the different renewable resources we have and state how these resources are managed in Papua New Guinea.

In Topic 2 – **Non-Renewable Resources,** you will define non-renewable resources, identify the different non-renewable resources and state how these resources are managed in Papua New Guinea.

In Topic 3 – **People and the Earth,** you will learn about changes that have occurred in land use in the past and present.

In Topic 4 – **Government Resource Development and Management in Papua New Guinea,** you will learn about resource development and management in Papua New Guinea.

Each topic comprises of **lessons** followed by **Practice Exercises** and finally **Answers** to the exercises. You must read and understand the content of the lessons well in order for you to do the exercises efficiently. You are required to **do your own corrections** after the completion of all the questions in each exercise. Answers to the **Practice Exercises** are provided at the end of each topic. All lessons in each topic must be covered thoroughly. You will then do the **topic test** in the **Assignment Booklet** and then you proceed to the next topic.

The lessons in each topic are written in simple language. If you have any problems understanding the lessons, please talk to your FODE Provincial Coordinator, ring or write to us.

We hope that you will enjoy studying this **Topic**.

We wish you all the best in your study!

STUDY GUIDE

Follow the steps given below and work through the lessons.

Step 1 Start with Topic 1, Lesson 1 and work through it in order.

Step 2 When you complete Lesson 1, you must do Practice Exercise 1.

Step 3 After you have completed the exercise, you must correct your work. The answers are given at the end of each Topic

Step 4 Then, revise well and correct your mistakes, if any.

Step 5 When you have completed all these steps, tick the check-box for Lesson 1, on the content page, like this:

☑ Lesson 1: What is a Resource?

Then go on to the next lesson. You are to repeat the same procedure until you complete all the lessons in a Topic.

As you complete each lesson, tick the box for that lesson on the content page, like this √ This will help you check your progress.

Assignment: Topic Tests

When you have completed all the lessons in a Topic, do the Topic Test for that Topic, in your Assignment Booklet. The Unit book tells you when to do this.

Marking:

The Topic Tests in each **Assignment** will be marked by your **Distance Teacher**. The marks you score in each Assignment will count towards the final result. If you score less than 50%, you will have to repeat that Assignment.

Remember, if you score less than 50% in three (3) consecutive Assignments, your enrolment will be cancelled. So, you are encouraged to do your work carefully and make sure that you pass all Assignments.

ALL THE BEST IN YOUR STUDIES!

TOPIC 1

RENEWABLE RESOURCES

In This Topic You will Learn About:

- **What a Resource is**
- **Forest Resource**
- **Forest Management and Conservation**
- **Forest Resource of Papua New Guinea**
- **Water Resource**
- **Water Pollution**
- **Water Management and Conservation**
- **Air as a Resource**
- **Renewable Energy Resources**

TOPIC INTRODUCTION

In this topic you will study Populatopn Density and Distribution. The topic is made up of nine lessons. They are;

Lesson 1	What is a Resource?
Lesson 2	Forest Resources
Lesson 3	Forest Management and Conservation
Lesson 4	Forest Resources of Papua New Guinea
Lesson 5	Water Resources
Lesson 6	Water Pollution
Lesson 7	Water Management and Conservation
Lesson 8	Air as a Resource
Lesson 9	Renewable Energy Resources

At the end of this topic, you should be able to;

- define and identify renewable resources and
- state ways of managing and conserving our renewable resources

We hope you will enjoy this topic.

Your teacher

Lesson 1: What is a Resource?

Welcome to Lesson 1. In this lesson, you will learn about resources which are renewable and non – renewable.

Your Aims

- define resource, renewable and non- renewable resources and ecosystem
- identify values attached to resources and the characteristics of resources
- list the factors that the value of a resource depends on
- distinguish the main classifications of resources and their examples
- analyse the factors that will have negative impacts on our natural resources.

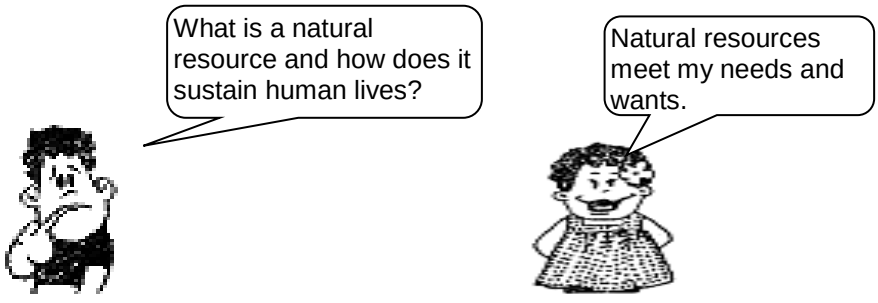
First of all, let us take a look at the term **resource.**

What is a Resource?

A resource is something that can be used.

It is a source or supply from which an organisation gains profit. Typically, resources are materials or other assets that are changed to produce goods and services to satisfy people's needs and wants. Resources are classified as either natural resources or man-made resources.

Natural Resources



A natural resource is anything obtained from the natural environment to satisfy human needs and wants.

When we say natural, we refer to things that were not made by man. These resources were there, ever since the universe was created. Natural resources may exist as a separate body such as fresh water and air, as well as a living organism such as animals.

Now, talking about natural resources, they all come from the environment. The land is the good mother of everything. From the land we obtain resources such as metal ores, gold, copper, oil and other important forms of underground mineral resources as well as those on the land such as rainforests, animals of all kinds and food crops. We also have natural resources from underneath the sea and up in the air. Natural resources occur naturally within environments that exist undisturbed by mankind, in a natural form. It is characterised by its eco systems that make up the entire vegetation.

Eco-system is everything that is found within the environment both living and non-living things.

The pictures below show examples of natural resources in our environment.

A Huli man of Hela Province is admiring the natural beauty of his environment. Water fall and the forest at the background are natural resources.

An atoll south of Daru and North West of Cairns in Australia. The atoll and the sea and its inhabitants are marine resources.

However, it is very sad to see these resources become scarce (less) or become extinct (die out). They are slowly dying out as a result of human activities such as logging, mining, bushfires, and agricultural activities and over use of a particular resource.

Therefore, it is important to use these resources in a sustainable way so that the future generations continue to use these resources again. In many developing countries these resources are being abused or exploited such as open cut mining in Pogera and OK Tedi in Papua New Guinea. A lot of tree spices and natural eco systems which inhabit this unique setting has been disturbed by human activities that might cause permanent scarcity.

Sustainable means using the resources in a way that does not harm the environment so that it can last.

Man-made Resources

A man-made resource is one which is made by man and machines. For example, buildings, bridges, dams, roads, manufactured foods and more.

Man-made products are made from natural resources which are found in the natural environment. All natural and man-made resources that are around us make our survival easier.

Let us now look at renewable and non-renewable resources.

Renewable and non-renewable resources

Natural resources are grouped into two categories, **renewable** and **non-renewable**.

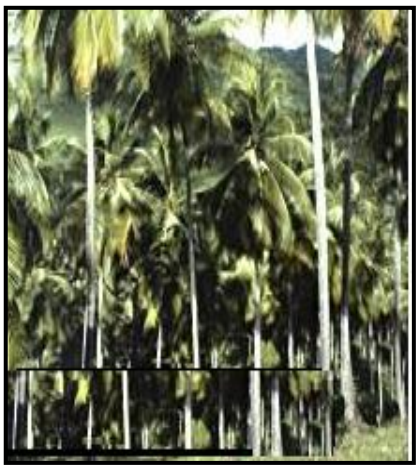
Renewable Resources

A renewable resource is one that may be replaced over time by natural processes.

Renewable resources include plants, animals, water, air, sunlight and land. Some of these natural resources are becoming scarce because of human activities. Non-living resources such as air, water and land are fast becoming polluted because of human activities and are unsafe for use by other living things including human beings.

Here are examples of renewable resources which can be used for its values but can be replaced by natural processes and conservation.

- Fish has become a commodity for commercial purposes and has generated huge amounts of income for Papua New Guinea. However, over fishing can reduce the supply of fish for future generations.
- Rainforests have been cleared for logging and mining but can be replaced by planting new trees.
- Cash crops such as coconut and oil palm can be replanted.



Coconut trees

Forest Vegetation

Fish Species

Bird Species/plumes

Oil Palm trees

A huge area of the richest forests in the world has been cleared for wood fuel, timber products, agriculture, and development purposes. These forests are disappearing at a faster rate. The tropical rainforests of the Brazilian Amazon River basin were cut down at an estimated rate of 14 million hectares each year. The countries with the most tropical forests tend to be developing and are mostly overpopulated nations in the southern hemisphere. Due to poor economic conditions, people resort to clearing the forest and planting crops as a means of survival.

Natural vegetation and trees

Logging in Oregon produce paper products.

Forest cleared by a native family in the Amazon to make garden.

Non-renewable Resources

Non-renewable resources are those in limited supply. These resources cannot be replaced or can be replaced only over long periods of time.

Non-Renewable resources are formed over very long geological periods. They include earth minerals and metal ores (gold, copper, nickel) fossil fuels (coal, petroleum, and natural gas) and groundwater in certain aquifers.

Since their rate of formation is extremely slow, they cannot be recycled immediately like forestry once exhausted. Out of these, the metallic minerals can be re-used by recycling them but coil and petroleum cannot be recycled and once it runs out that is the end of it because it takes millions of years to form.

In Papua New Guinea we have the multi-million kina projects like the PNG LNG, Pogera, and Kutubu, Ok Tedi and Lihir which provide employment and generate income. On the other hand it will have negative impacts on the environment and the life span of these natural resources. Therefore, developers and other stakeholders should have strategies that will have sustainable development taking place in the country.

Below are pictures of sites in Papua New Guinea where some of the non-renewable resources are abstracted.

.

Ramu Nickel Mine in Madang

Lihir Gold Mine in New Ireland Province

A liquid natural gas facility in Port Moresby

Napa Napa Oil Refinery

Energy is used for transportation, heating, cooling, cooking, lighting, and industrial production. Fossil fuels account for more than 90 percent of global energy production

but are considered problematic resources. They are non-renewable, which means they cannot be replaced quickly. In particular, coal plants have been one of the worst industrial pollution. Moreover, mining or drilling for fossil fuels has caused extensive environmental damage. The world energy supply depends on many different resources including traditional fuels such as firewood and animal waste, which are significant energy sources in many developing countries.

Values of Resources

Both renewable and non-renewable resources have its values attached to it which meet the needs of the people. Natural resources are conserved for their biological, economic, and recreational values, as well as their natural beauty and importance to local cultures. For example, tropical rainforests are protected for their important role in both global ecology and the economic livelihood of the local culture. Coral reefs may be protected for its recreational value for scuba divers or for fishing; and a scenic river may be protected for its natural beauty.

A good example in Papua New Guinea is the *Kokoda Track* which has a historical value attached to it. Therefore; the track is protected for visitors to see and walk through. The proposed nickel mining along Kokoda was stopped due to this historical value of the track.

Fuzzy Wazzy Angels and an injured Australian soldier crossing a river along the Kokoda Track during World War II

An Australia Trekker at Kokoda Track

Soil is also a non-renewable resource that we need to use it wisely. When soil is not protected, it erodes, or washes away. In severe soil erosion, gullies form, a natural geological process that is greatly developed through poor agricultural practices, as well as other human activities. Loss of productive topsoil to soil erosion is one of the most pressing problems confronting modern agriculture.

Clear Fell logging causes soil erosion

Over use of forests affects soil layers

Therefore, soil is also one of the most important non-renewable resource that we must protect at all cost. Most mining and logging companies working in Papua New Guinea do not seem to take extra care about our land due to money culture creeping into our society. We should be critical and firm in our decision making because it will have long term effects on our resource consumption and future generation and also contribute to global warming. A tough decision made to protect the Kokoda Track is a good example for us to learn from.

Summary

You have now come to the end of lesson 1. In this lesson you have learned that:

- natural resources are all the things on earth that support life. plants, animals, air, and water are natural resources.
- renewable resources can be replaced. plants are renewable resources because they can be cut or cleared but they grow again. animals like fish are renewable resources because they can reproduce.
- non-renewable resources cannot be replaced easily. fossil fuels are non-renewable resources. coal, oil, and natural gas are fossil fuels.
- fossil fuels come from plants and animals which died millions of years ago. we are using up fossil fuels much faster than the natural processes can replace.
- land is one of the most important resources that provide everything that we need for human survival and it is a non-renewable resource.
- consumption of natural resources rise every year as the human population increases and standards of living rise.
- it is the obligation of all groups of people, individuals, industries, and the government to prohibit or limit the use of pesticides and other toxic chemicals.
- to save our forest we must have in place workable policies in place for limiting clear fell logging.
- failure to do so results in contaminated air, soil, rivers, plants, and animals.

NOW DO PRACTICE EXERCISE 1 ON THE NEXT PAGE

Practice Exercise 1

1. What are resources?

   _____

   _____

2. Name three (3) Renewable Resources found in Papua New Guinea.

   A. _____
   B. _____
   C. _____

3. Name three (3) Non-Renewable Resources found in Papua New Guinea.

   A. _____
   B. _____
   C. _____

4. Give five (5) values that natural resources can provide to the people.

   A. _____
   B. _____
   C. _____
   D. _____
   E. _____

5. Explain why some natural resources are non-renewable.

   _____

   _____

6. Write two (2) effects of development on natural resources.

   A. _____
   B. _____

NOW CHECK YOUR ANSWERS AT THE END OF THE TOPIC

Lesson 2: Forest Resources

Welcome to Lesson 2. In lesson 1, we discussed the importance of natural resources in the environment and the consequences of destroying these resources. This lesson will be centred on forest resources.

Your Aims

- define forest resources, forestry, deforestation and reforestation
- identity different types of forests, their characteristics and their global locations
- discuss poor practices on forests and its consequences
- explain the benefits of forest and its values

First of all, let us define these very important terms, **forests, forest resources, forestry, deforestation** and **reforestation.**

Forest refers to trees and undergrowth covering a large area or is a place where there are lots of trees, plants, animals, insect species and the entire eco system.

Below is an example of a forest floor.

A typical rainforest in Papua New Guinea

Forest resources are anything useful that is found within a forest area which satisfies people's needs and wants.

Forest resources are mostly made up of plant community, especially trees or other woody vegetation and animal species, occupying a large area of land. Climate, soil, and the rainfall of the region determine the characteristic of trees in a forest. In local environments, dominant species of trees are characteristically associated with certain shrubs and herbs. The type of vegetation on the forest floor is influenced by the larger and taller plants. Sometimes low vegetation affects the organic composition of the soil. Disturbances such as a forest fire or timber harvest may result in a shift to another forest type or eventually developed into a different vegetation type. A good example in Papua New Guinea is the Markham Valley grassland.

Forestry is the science or practice of planting, managing, and caring for forests.

That is, planting forest and looking after them. New areas are ploughed and planted while cut-over forests may be replanted. The trees are given fertilizers and are protected from pests, diseases and major fires. They are felled when the trees are mature, when there is overcrowding or when the trees die.

Although forestry originally concerned mainly timber production, it now also involves the management of grazing areas for domestic livestock, the preservation of wildlife habitats, fresh water protection, and the development of recreational areas like towns and cities. The management of forestlands therefore helps to ensure that wooded areas are used for maximum benefit according to their nature.

Deforestation is the complete clearance of forests by cutting or burning.

Deforestation occurs as a result of the activities below.

- Cutting or over harvesting of trees for its products such as timber, ply wood, and other paper making purposes.
- Clearing for agricultural purposes, road constructions, mining and settlements such as towns and cities.

Clearing of tropical rainforest south of Lake Kutubu

Deforestation and Erosion in Bulolo

Deforestation in Costa Rica, as in Papua New Guinea, is a result of clearing land for agriculture and harvesting tropical timber for export. Costa Rica, while still heavily forested, has one of the highest rates of deforestation in Central America.

A logger in Costa Rica

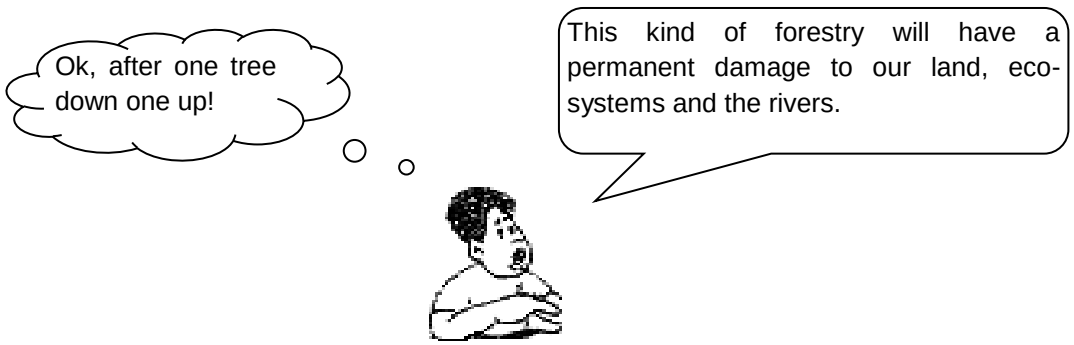
After the large vegetation of a rainforest is removed, an area rarely recovers. As such a lot of deforested stream valley is eroding away because there is no longer a good root system to anchor the topsoil or decaying plant. If the cycle continues, the area may eventually resemble a desert.

Deforestation for farming Papua New Guinea

Deforestation causes draught Philippines

Clear-cutting forestry in Malaysia

Clear-cutting is a forestry harvesting technique in which all of the trees in a given area are removed. The advantages of this technique include the eventual production of trees of approximately the same age and height, which are easy to harvest using mechanized equipment. The disadvantages include the elimination of old growth forest and animal habitat, excessive erosion, and changing the face of the original landscape such as creating savannah grassland.



Reforestation means the replanting of young trees after old trees have been harvested. In large forestry plantations, mature trees are harvested and young seedlings are replanted. This process is important if Papua New Guinea is to maintain a sustainable timber industry. Reforestation helps to prevent soil erosion and allows the local animals and plant life to survive. Reforestation can be found in Transgogol Valley in Madang Province.

When the company harvests the mature timber, the area is cleared and new young timber trees are planted. These young trees take seven years to mature before they are harvested. This reforestation cycle is one of the Forestry Acts which the company must follow to satisfy the Forestry law of Papua New Guinea.

Types of Forest

There are different types of forests across the world, and most of these forests are determined by their climatic settings. Forest vegetation found in the tropics would be different from those further away from the tropics. In the tropics most of the forest resources are comprised of tropical rainforest while further away from the tropics the forest type changes.

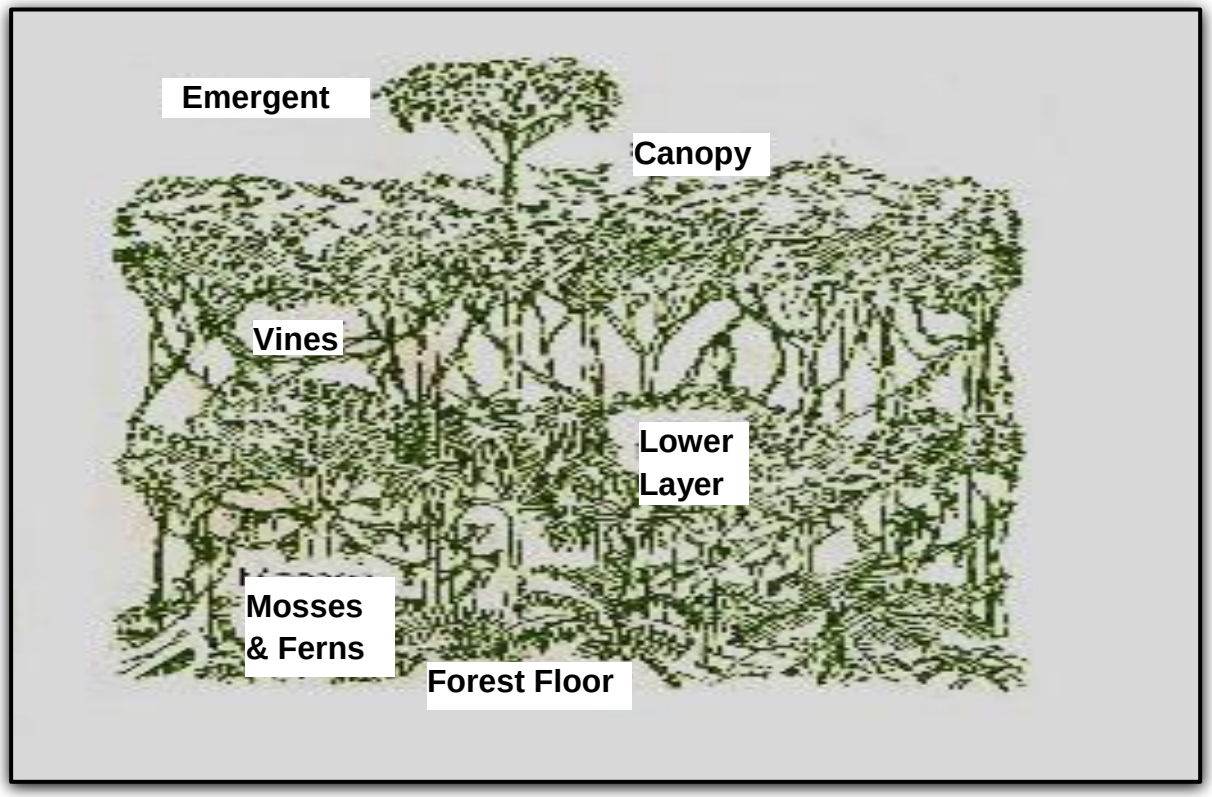
1. **Tropical Rainforest**

Rainforest is an area of rich forest which has developed where rainfall exceeds 1000mm per annum. However, most of the world's rainforests are found within the tropics. These forests are known as tropical rainforests.

Tropical rain forests are very thick and unpassable because the climate is hot and very wet all year round. The forest is made up of several layers. A few trees grow very tall and stand out over the rest of the forest. Beneath them smaller trees grow so close together that their leaves form a dense canopy which almost completely shades the forest floor below.

Plants need light to live, so very few trees grow under the **canopy** of a rainforest. Because the air is very humid, many other plants are able to grow on the larger trees, so many rainforest trees are covered in **mosses or lianas**. When a tree dies and falls to the forest floor it quickly rots through the action of fungi and bacteria which live in the soil.

LAYERS OF TROPICAL RAINFORESTS



Rain forests are a home to many different plant and animal species. The Amazon rain forest is the world's largest tropical rain forest. Papua New Guinea as a tropical country has diversity of these tropical rainforest and is the home of the unique **Bird of Paradise** which is not found anywhere around the world.

Koalas live in Rainforest

Birds of Paradise only found in New Guinea

In the western Pacific region, rainforests grow throughout the tropics from the northeast coast of Australia, through Papua New Guinea, Indonesia to India and Philippines.

Tropical rain forests grow in warm places near Earth's equator. The equator is an imaginary line that goes around the middle of the planet. There are tropical rain

forests in Central and South America, Africa, and Asia. It is always hot and wet in a tropical rain forest.

Tropical rain forest Pacific

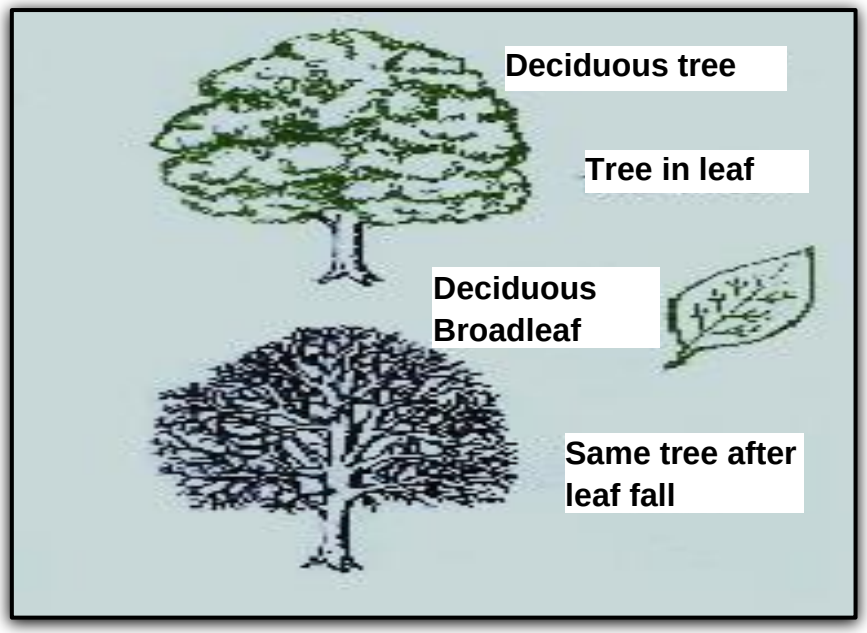
Temperate rainforest – California

Tropical rainforest Amazon

2. Deciduous Broadleaf Forests

The deciduous broadleaf forests grow mainly in the warmer temperate regions between 25° and 55° of latitude further away from the equator. Here the trees have to cope with differences in temperature between summer and winter. Cold weather, especially frost can kill the delicate growing tips of plants. In order to protect themselves, deciduous trees stop growing and lose their leaves when it becomes too cold in winter. Deciduous means to loose leaves in one season. When the temperature begins to get warmer, the trees start growing again producing new leaves for summer. The leaves that fall off the trees in winter rot slowly in temperate climates. They form a rich dark layer of humus in the soil. Humus is like compost and is very fertile.

DECIDUOUS BROADLEAF TREE



Deciduous Broadleaf forest –Belgium Deciduous

Broadleaf forest - France

3. Evergreen Coniferous Forest

Evergreen coniferous forests grows in colder temperate regions between 55° to 65° which is quite cold where these types of forests withstand the coolest winter periods and survive. The trees have tall, straight trunks and the leaves are long and thin like needles. The trees are called evergreen because they have leaves all year round. Whenever an old leaf falls off, a new one grows immediately. These needle – like leaves are very tough and can withstand the cold winters. They do not rot very easily, so nothing is able to grow on the forest floor.

Coniferous forests grow right across northern Europe, Asia and North America. Hokkaido, in Japan has coniferous forest, whereas the rest of Japan has mainly deciduous broadleaf forest.

Evergreen coniferous forest

Coniferous forest

Importance and Values of Forest Resources

Economical Values

In Papua New Guinea a lot of forest has been cleared for commercial agriculture such as the oil palm project in the New Britain and Coffee projects in the Highlands.

Today, due to boom in mining industry and the Multi-million kina LNG Project a lot of our forest resources will be destroyed for the sake of generating income. It is also done to meet the time boom changes in technology that we have to cope with.

On the other hand we need such organisations like the Greenpeace who will educate us to use our resources in a sustainable way. All logging companies should be encouraged to carry out reforestation exercise to maintain continuity.

Cultural Values

Forest resources are important for cultural reasons. Many people use materials from forests to make weapons for use in tribal customs and ceremonial rituals. Hunters sometimes capture animals alive for ritual purposes as well as nutrition**.** As the forests are cleared and products are developed for exports, traditional materials are becoming scarce.

Throughout the world rainforests are being rapidly destroyed, threatening the traditional cultures. The government must regulate export quotas of specific materials, including plants and animals to ensure the survival of Papua New Guinean culture.

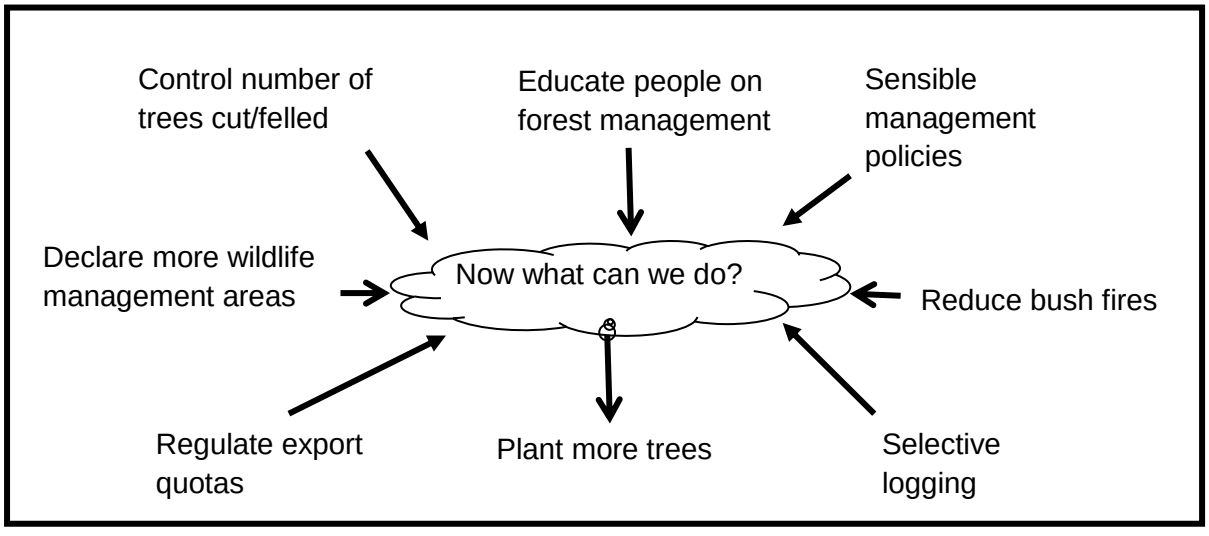
Ecological Values

Forests are important because, they support and protect the soil. They are a home to many plants and animals that are part of the forest ecosystem. Forests conserve water and provide river catchments. They are a place for leisure activities and the source of many products used by people. Forests are important because all living things in the forest interact with each other in order to survive known as the ecosystem. Plants and animals depend on each other.

Effects of Deforestation

Good virgin forests take many thousand years to develop, but they can be easily wiped out in a year. What are the consequences of clearing forest?

Firstly, it will affect the wildlife i.e., extinction of plants and animal species. Moreover, cultural practices based on the forest will eventually die out. The future generation will have no idea on the important values of a forest and there will be no cultural practices to be passed on to our children.



A variety of living things found in the rainforest can be protected by selecting certain areas for protection from logging, gardening, and manage forest in a most sustainable way.

In Papua New Guinea such an approach can be achieved by declaring some areas national parks and work with people for in-depth consultation to create Wildlife Management Areas.

Sustainable use of the rainforests can help reduce the global warming caused by air pollution due to industrialization. Uncontrolled burning of forests and grasslands adds to this pollution of the air

As such remember, most forests hold their nutrients in the soil. However, tropical rainforests hold their nutrients in the plants themselves, so their destruction means that the forests cannot recover and grow again.

Summary

You have come to the end of lesson 2. In this lesson you have learned that:

- forest resources include all living organisms and non-living things that make up the entire eco-system.
- most tropical rainforests are cleared for commercial purposes such as logging, large scale agricultural and subsistence farming.
- Papua New Guinea's rainforests is the home to some of the unique animal and plant species that are not found anywhere around the world like bird of paradise and orchids.
- forest types and trees are often influenced by the climatic conditions where tropics is dominated by tropical rainforests and further temperate areas is deciduous broadleaf and coniferous evergreen forests.
- most logging companies in Papua New Guinea are careless and the government need to come up with a policy to monitor as a checklist.
- deforestation will be endangering animal life and plant species that might cause permanent extinction.
- conservationists' campaign for preservation of our natural rainforests which directly contributes to global warming when over used and wastes exposed to the air.
- the economic value attest to forest and its inhabitants is causing more disturbances to our forests.

NOW DO PRACTICE EXERCISE 2 ON THE NEXT PAGE

Practice Exercise 2

1. Explain why forests found in the tropics are comprised of mostly tropical rainforest?

   _____

   _____

2. Name the tress that loose leaves during winter in the temperate regions.

   _____

3. What is deforestation?

   _____

   _____

4. What is the name of one of the biggest rainforest in South America?

   _____

5. List 3 effects caused by deforestation to the natural forest?

   A. _____

   B. _____

   C. _____

6. Name 3 economic values that forests can provide to humans.

   A. _____

   B. _____

   C. _____

NOW CHECK YOUR ANSWERS AT THE END OF THE TOPIC.

Lesson 3: Forest Management and Conservation

Welcome to Lesson 3. In this lesson, you will learn about Forest Management and Conservation. Now that you know why forests are important and their values, you are now in a better position to suggest ways to manage and conserve our forests in your small ways or even bigger ways.

Your Aims

- define forest management and conservation.
- identify the methods used in conservation.
- enumerate the benefits of forest conservation.

What is Forest Management?

Forest management is a practice of regulating forest resources to meet the needs of the people and at the same time preserve to meet the needs of the future generations.

In the past, forest management was only concerned with timber production but today it also involves the management of:

- grazing areas for domestic livestock
- preservation of wildlife habitats
- watershed protection and
- development of recreational opportunities

Forest management includes activities such as

- Biological diversity,
- Soil conservation,
- Watershed protection
- Setting up national Parks
- Reforestations
- Monitoring of forest use especially logging and
- Doing assessments and evaluations of forest quality

It is generally the policies and practices used that protect forest eco-system from extinction or dying out. A proper management skill in place helps support a long term use of these resources such as re-planting in the case of logging.

Definition of Conservation

Suppose you have a whole chicken in the refrigerator. You could eat the whole chicken now, or you could divide it into quarters to keep some to eat later. Saving some of the chicken to eat later would be a kind of conservation. You would be saving or conserving, your chicken so that it would last longer. Conservationists are people who want to save the earth's natural resources so they will last longer. Conservation is the protection and wise use of natural resources. If we decide to use everything at once, we might run out of supply in the future.

Conservation is the protection of natural or man-made resources and landscapes for later use.

Conservation talks about protecting resources for future use by stopping unwise use or exploitation. It promotes an end to wasteful use of non-renewable resources, more efficient extraction methods and recycling.

Conservationists campaign to protect our natural resources such as forests. These unique plant species survive in forest vegetation and they are endangered species.

Conservation of resources means using them wisely. Conservation has always been important in the traditional life of Papua New Guinea. This includes:

- keeping the soil fertile
- controlling hunting and fishing to allow wildlife to breed and multiply
- protecting forest areas and water resources to allow people to live off the land

These practices have protected the natural resources of Papua New Guinea for thousands of years. By conserving these resources, people can produce goods to satisfy their needs and improve their standard of living. Resources must be managed so that they are protected for the future. Some of these conservation practices include;

- using the same garden land without cutting down more forest
- growing trees for fire wood on grassland instead of cutting down forests
- avoid making bushfires and grow trees.
- growing trees and plants that will attract wildlife such as birds and other animal species

The Methods of Conservation

1. Animal Conservation

In some countries around the world there are laws and policies set up for protecting natural environment and its habitants or living things that feed on it. In Africa and most parts of Europe, governments have develop laws that stops people from over-hunting certain animal species which are in danger of dying out when they are over used.

This is a step towards conservation which means saving some of it for the future generation.

Male mountain gorilla and son

Even though every country with a wild gorilla population has laws banning their capture and hunting, the gorilla trade continues. The animals are also under threat from habitat loss. Today, countries such as Rwanda are implementing educational, conservation and tourism programmes in an effort to demonstrate to the local population the value of the native wildlife. This mountain gorilla and his son are in Parc des Volcans, Rwanda. The government law of Rwanda states clearly that anyone caught hunting or keeping these animals for illegal trade will be dealt with according to the laws. These laws are stated clearly for conservation purposes.

2. Landscaping

The purposes of landscape conservation and public recreation of many parks have been established to protect endangered species of animals or plants and to promote scientific research. They may therefore be seen as nature reserves, a term which refers to a variety of areas in which rare animals, plants, or whole environments are protected and studied. Hunting and other disruptive activities are not allowed and public access is often strictly controlled or even forbidden. The creation of Adventure Park in Port Moresby is a good example of landscape conservation.

Adventure Park, Port Moresby

Yorkshire Dales Conservation- England

Reserves are areas selected by governments or private organizations for special protection against damage or degradation. They are chosen for their outstanding natural beauty, as areas of scientific interest, or as forming part of a country's cultural heritage, and often also to provide facilities for public recreation such as Yorkshire found in England.

Savannah grassland in Serengeti National Park, East Africa

Herds of large grazing animals, such as the zebra and wild beast grazing here in Serengeti National Park in East Africa, are an important element of the ecology of savannah grasslands. Grazing animals and fire keep vegetation to a minimum in savannah areas with high rainfall. Occasional fires burn back old grass and stimulate growth of new grass. This is one of the protected areas where different animal species call this savannah grassland their home.

Earth Day is celebrated on April 22 every year.

Protected Animal species – Kenya

Replanting trees and protecting endangered animals is a step towards management and conservation. It means saving our animal and plant species such as forests. Conservationist campaign about maintaining continued supply instead of running out through unwise use of particular natural resources.

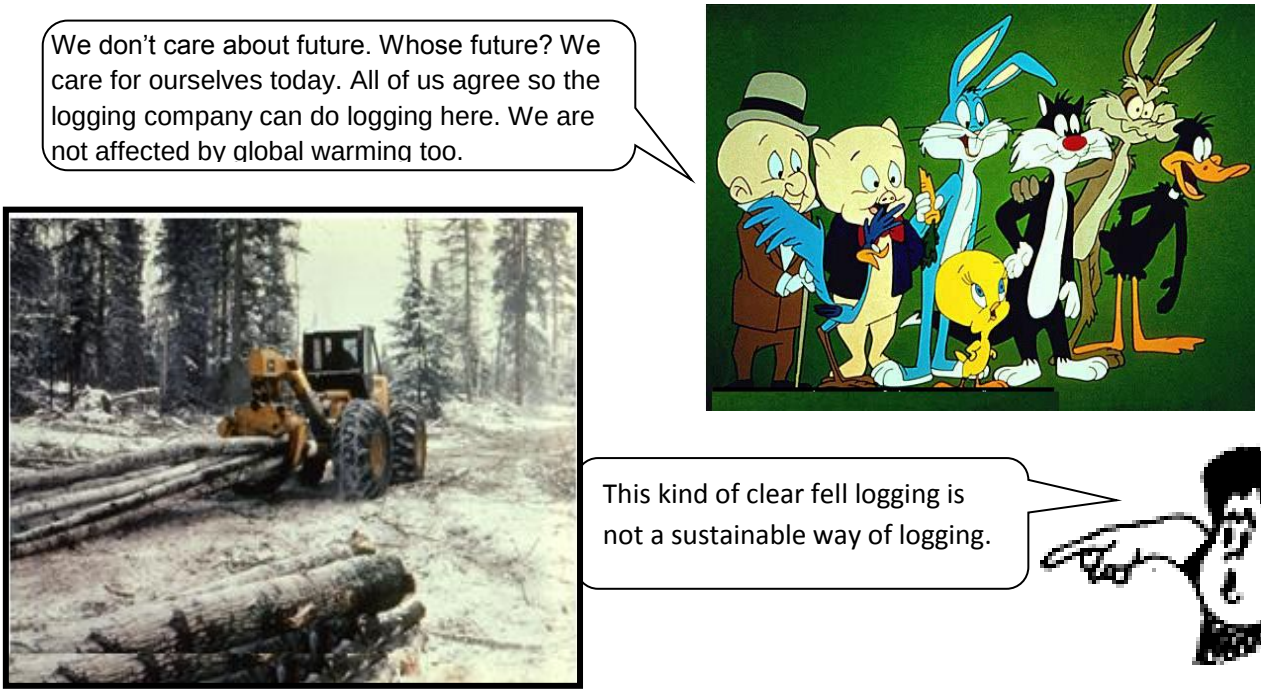
3. Conservation awareness

Another way of conservation and management would to educate people through awareness and campaigns so that they are informed about the dangers of over using our natural resources such as forests and other mineral resources. Most people in the rural areas are not informed about the effects of global warming which is directly contributed by human activity such as bushfires that destroy our environment. Carrying out awareness of the importance of conservation is important so that people are well prepared to make wise decisions when it comes to resources development like mining or logging companies.

Many conservation organizations are working hard to save forested areas. Most countries now have national parks and nature reserves. Such areas have to be looked after to help the remaining wildlife and to protect the area from illegal hunting of animals and logging of trees.

For example; in Papua New Guinea and the Pacific region natural forests were cleared especially for subsistence farming but today a lot of forests are being cleared for commercial purposes. Much of our forests are under pressure from human activity, such as the spread of subsistence agriculture due to increase in rural population, logging and clearance for large-scale agriculture such as oil palm plantations in the New Britain. Logging, mining, hunting, and other activities that use up natural resources are usually not allowed in national parks. A good example in Papua New Guinea is the 'Kokoda Track' where no mining or logging companies are allowed to carry out their activities there.

A variety of organizations and community groups have taken the lead in implementing sustainable development programs in the United States during the 1990s, some of them national in scope and others local. The money funded programs to develop long-range economic planning, promote jobs with minimum impact on the environment, and protect the wildlife and ecosystems of the region's barrier islands and coastal islands is now an important argument given the threats by the global warming.



Wellington – New Zealand

Logging that involves clear-felling like the one shown in the photograph on the previous page, demonstrates an unwise type of harvesting technique. Plant and animal species that are inhabitants of the forest will lose their home and to certain extend may go extinct.

Forest resources are becoming more connected to economic value due to changes in technology and living standards. Most people are now being influenced by the money culture therefore; the idea of conservation and sustainable use of our environment will be less considered. Especially in the case where a logging company shows interest in an area now everyone will agree to let the company harvest their forest with less consideration about the environmental effects. Even though it can be a sacred place most people will not hesitate to prevent such development. Conservation and prevention of environment degradation should always be our concern.

Bad use of forest – Yellowstone National Park – USA

Conserved forest/river- West Virginia - USA

Greenpeace is an international environmental organization dedicated to preserving the earth's natural resources and its diverse plant and animal life. The organization campaigns against nuclear weapons testing, environmental pollution, and destructive practices in fishing, logging, and other industries. The organization is well known for scaling corporate skyscrapers and factory smokestacks to hang protest banners.

One way to save fossil fuels is to use less of them. Engineers are building cars that use less gasoline. New furnaces burn less oil or natural gas to heat buildings. Energy-efficient refrigerators and air conditioners use less electric power. Scientists are looking for ways to replace fossil fuels. They are experimenting with hydrogen and other fuels to replace gasoline. They are looking for ways to use solar power and the energy in the blowing wind. They are looking for safe ways to use the power that comes from tiny bits of matter called atoms. Recycling is a popular way to conserve natural resources.

Recycling means collecting things to be reused rather than thrown away. You can recycle paper, cans, metals, plastics, and bottles etc. You can recycle glass and plastic bottles and everyone can do something to conserve natural resources.

Papua New Guinea needs to protect its abundant wildlife for future generations. A lot of our beautiful birds, butterflies and animals if not protected, will be in danger of extinction. This requires sound management so that wild life can flourish in their

natural environment. Destructive methods of hunting must be discouraged. Legislate or make laws that can protect and conserve wild life for sustainability.

Summary

You have now come to the end of lesson 3. In this lesson you have learned that:

- conservation is the practice of protecting wild plant and animal species and their habitats. The goal of wildlife conservation is to ensure that nature is sustained for future generations to enjoy.
- national parks play a very important role in safekeeping some of the world's endangered animal species and plants from completely dying out.
- when more forests are cleared for commercial logging, agriculture and subsistence farming it also contributes to the global warming which is everyone's responsibility.
- as the population increases due to improvement in technology our natural resources will be in great danger through overuse.
- there should be some management policies in place to conserve our natural resources from disappearing. The governments should come up with workable policies to protect our resources.

NOW DO PRACTICE EXERCISE 3 ON THE NEXT PAGE.

Practice Exercise 3

1. Define Conservation?

_____

_____

2. What is an earth day, and what will be your contribution during the earth day?

_____

_____

_____

3. What is recycling?

_____

_____

_____

4. What is the purpose of conservation?

_____

_____

_____

5. List 3 ways that can have Socio-Economic value to forest/animal conservation.

A. _____

B. _____

C. _____

NOW CHECK YOUR ANSWERS AT THE END OF THIS TOPIC

Lesson 4: Forest Resources of Papua New Guinea

Welcome to Lesson 4. In this lesson, you will learn about Forest Resources of Papua New Guinea.

Your Aims

- Define forest.
- identify forest categories of Papua New Guinea.
- discuss the forest resources ownership in Papua New Guinea.
- explain the sustainable forest management practices in Papua New Guinea.

What makes up forests?

Forests are areas of vegetation where the main plants are trees.

There are different kinds of forest in different parts of the world. The type of forest a place has depends on the type of climate it has. Forests once covered most of the land across the world, but huge areas have been cleared to make way for farmland, factories, mines and quarries, roads, villages, towns and cities.

Papua New Guinea forest is mainly tropical rainforest and it is one of the most valued resources due to its economic, social and cultural values. They are used as the sources of many materials for sustaining life and for continuing cultural practices. The destruction of large lowland rainforest areas results in the destruction of plants and animals that live there and have been part of the life of the people of Papua New Guinea. In some parts of the country, the local people are beginning to understand the importance of forests and are taking actions to protect the environment and preserve their forest for future generations.

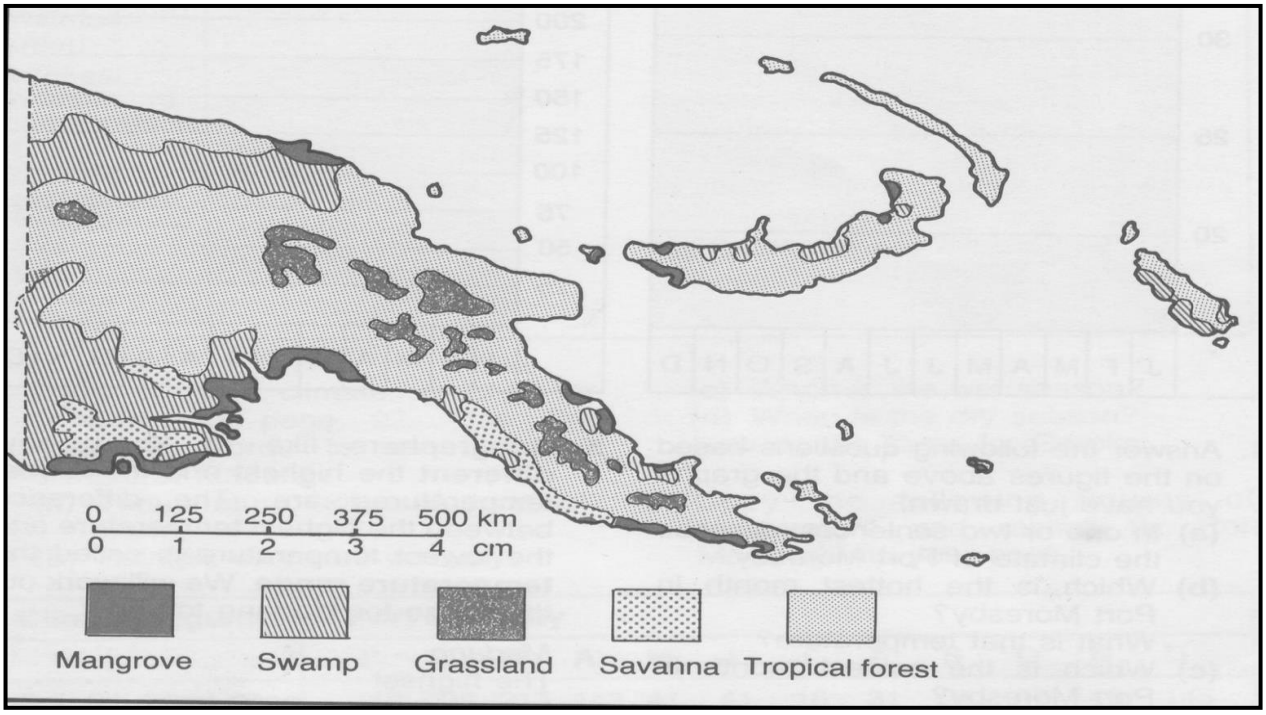
The uses of forest in Papua New Guinea

Many of Papua New Guinea forests are tropical rainforest. These forests are very important to the local people because it benefits them in many ways. Below are some uses of forest in Papua New Guinea.

- The main source of food supply for people
- Provide materials for buildings and other infrastructures
- Source of fresh water
- Provides traditional and modern medicine
- Forest products are also used by people for personal needs and to generate an income
- Many other manufactured goods are made from forests products such as drugs, chemicals, clothes, papers, cosmetics, oils, rubber and many more.

When rainforests such as trees are wiped out, traditional cultures and potentially valuable plants can be lost.

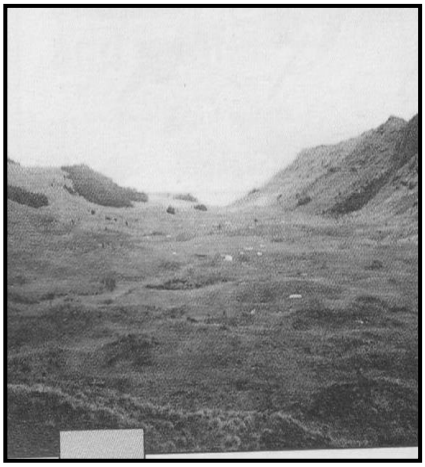
VEGETATION IN PAPUA NEW GUINEA



Now take a closer look at this Vegetation Map. It shows the five main vegetation types in Papua New Guinea. It also shows that rain forest is the dominant vegetation in both lowlands and the highlands of Papua New Guinea. Rain forests are common in tropical countries which have hot and wet climate all year round.

Different Forest Categories of Papua New Guinea

Lower Montane forest



Savannah grassland

Alpine vegetation

Mangrove Swamps

Lowland forest, Morobe.

Topical Highlands Forest Vegetation

Plants just above the rainforest floor

Not only in Papua New Guinea but throughout the world, forests are being destroyed, threatening traditional cultures and reducing a range of plant and animal species that are dependent on it. In Papua New Guinea, forests are threatened by;

- population growth,
- the growth of cash economy,
- urbanisation,
- mining industry boom
- and poor logging practices.

Tropical forest grow where the climate is hot and wet most of the year. This climate is ideal for plant growth and results in a dense forest with high biodiversity and a number of layers. Tropical rainforest is dominant in Papua New Guinea because we have a tropical climate. However, when forests are over used, the landscape and the biomass are affected. This may result in the changes in vegetation and the eventual extinction of plant and animal species.

Deforestation to make way for new palm oil in West New Britain

Destroying the Forests

Burning and cutting down forests, like this area of the Amazon rain forest, contributes to global warming. Burning trees produces a gas called carbon dioxide that traps heat within Earth's atmosphere. Cutting down trees leaves fewer trees to absorb carbon dioxide from the air.

Values and Uses of Forest in Papua New Guinea

Nowadays, many foreign logging companies cut down large areas of forest for timber. Timber is sold overseas (exported) for money but the rural landowners receive very little money. People have always cleared forests but the speed at which trees are cut down today is more than it can replace itself by natural processes.

A Newly Cut Road for transporting timber

When the natural vegetation is cleared, it will grow back again quickly as long as people do not use the land too soon. In many drier parts, it takes very long time for this to happen. In many parts of Papua New Guinea, people do not give enough time for the vegetation to grow back before clearing the land again. As a result new type of vegetation like grasslands replaces the original forest. These grasslands are not natural but *human-induced.*

You just learnt about natural vegetation in Papua New Guinea. However, in many cases the vegetation has been changed or *modified* by people. Rainforests is used in many ways by our rural people. They collect fruits and nuts, medicinal plants, timber for making canoes and houses and firewood.

People have a lot of influence over the forest vegetation which can change or negatively impacts the natural vegetation. In fact much of the original primary and old growth forest has gone. The remaining forest is under pressure from human activity, such as the spread of subsistence agriculture due to increasing rural population.

Large forest cleared for subsistence farming- SHP

Commercial Logging of Tropical Rainforests

The table below shows an analysis of advantages and disadvantages of private ownership and engagement of logging companies in harvesting our forest resources.

Comparison of ways of using forests

Community based forestry	**Commercial logging**
There is still access to food, food, medicine, building materials and cultural needs	Loss of food medicines, building materials and cultural needs
There is still sustainable income to pay for school fees and other commitments	One off – payment , often not wisely used; short-term employment but lose of future income
Sawn timber can be used locally for building own house	Sown timber is exported and it is no longer available here
Sawn timber can be carried manually from the forests to where it is to be used	Logs are pulled by machines and disturbs surrounding environment
Allows traditional customs and social structures to continue	Traditional customs and social structures are damaged by outsiders
Cares for forest and water ways from contamination	Damages forests plants/animals and waterways with use of big machines
Communities are able to keep control of their land and make their own decisions	Decision making power is generally taken away from communities
Communities remain self-sufficient	Communities are forced to rely on outside sources for goods and services

Sustainable Forest Management Practices in Papua New Guinea

SUSTAINABLE USE of rainforests means using rainforest resources without destroying the natural processes that keep the balance of that area.

Case study of Hunstein people of Sepik plain

The people of Hunstein Range have had their area proclaimed as a Wildlife Management Area. In doing so they have decided for a new type of development which;

- puts culture as key part of any plan
- includes all the people in decision-making
- protects their environment and gives them long term economic prosperity
- excludes destructive commercial logging

Hunstein Range is largely covered with tropical rainforest. It rises to about 1500 metres above the Sepik plains and contains an extremely wide range of Eco-Systems that have hardly been disturbed by human activities. Biodiversity is extremely high. These people have their culture and economy based on the rainforest.

They are village based subsistence farmers, sago farmers and hunter-gathers. Loss of rainforest would mean loss of their way of life. These people have worked with the government and non-governmental organisations to assess the opinions open to them. They could have commercial logging and cash-in-hand or maintain their environment and way of life by having their area proclaimed a Wildlife Management Area. To help them decide the future of their area the people were assisted to

- map their area and gave a value to all the activities that took place
- make a fauna and flora inventory
- record story and culture
- consider activities that could provide cash but would maintain the environment and their way of life like portable sawmilling, fragrant bark collection, butterfly and orchid farming, and curving and billum making.

After considering their options, the people of the Hunstein Ranges chose to maintain their environment and culture and have their area proclaimed a Wildlife Management Area.

Tropical rain forests are home to an amazing number of plants and animals. A patch of tropical rain forest, no bigger than a school parking lot can have almost as many different *species* (kinds) of trees as there are in all the forests. Where would you go to find more kinds of plants and animals than anywhere else on Earth? You would go to a tropical rain forest. If this is the case we have to use these scare resources in such a sustainable way so that there is continuity. Conservationists are looking for ways to protect our rainforests. In other places people need the rainforest for food and wood. In order to use our resources in a sustainable way people can use the forest without destroying them. People are learning how to grow nuts, seeds and other crops in the rainforest. They are learning how to make butterfly farms and other places people can visit for vacations.

Forest Resources Ownership in Papua New Guinea

Forests are valuable resources in our country. Most forests are owned and managed by the local customary land owners unlike some other places around the world. Our local customs and cultures of depending and living on food and shelter provided by our forests is slowly fading away. The modern technology and modernization is creeping into our society where money is becoming a medium of survival.

Many of our land and forests are being given away cheaply to foreign companies for logging development and other mining industry boom. A lot of our sacred natural forests will disappear due to money culture and population explosion. Most of the logging companies coming into our country do not have a proper logging practice which is one factor that makes our forests to disappear. As such we have a duty to protect our forest resources so that there is a balance on the supply of our natural and its habitants like animal species and plants. It is not only the government but every citizen needs to be informed and the advantages and disadvantages of overuse of our natural forests. A practical example of Hunstein plain people of East Sepik is a very good example about making informed decisions about our resources.

Summary

You have now come to the end of lesson 4. In this lesson you have learned that:

- tropical rainforests are found in both low and highland areas of Papua New Guinea.
- sustainable use of forest resources is about wise use instead of exploiting the entire resources at once which might leave the land unusable.
- Papua New Guinea has different forest species from coastal lowland to the highlands of Papua New Guinea.
- most forest is being used for subsistence farming and commercial logging.
- some major logging companies in Papua New Guinea have bad logging practices and the Government has pressured them to be more responsible.
- in Papua New Guinea most of the landownership is with the traditional landowners therefore, they play a pivotal role in forest development and extraction of other resources from the land.
- some natural forests should be declared Wildlife Management Area to conserve the forest resources and the entire eco-system.
- development of forest resources brings economic prosperity together with the exploitation of the resources.
- often customary landowners are not careful with issuing of licence to the logging companies.
- the loss of a tree can have significant impact on animals, plants and other plants that feed on it.

NOW DO PRACTICE EXERCISE 4 ON THE NEXT PAGE.

Practice Exercise 4

1. Where do we find most mangrove forests in Papua New Guinea?

   _____

2. Name two provinces in Papua New Guinea where large logging companies are operating.

   A. _____

   B. _____

3. Do the logging companies provide life time employment work? Yes/No Explain.

   _____

   _____

4. Research and locate a photograph of a tropical rainforest in one of the provinces of Papua New Guinea.

   _____

NOW CHECK YOUR ANSWERS AT THE END OF THE TOPIC.

Lesson 5: Water Resources

Welcome to Lesson 5. In this lesson, you will learn about Water Resources.

Your Aims

- define Water Resources.
- identify the sources of fresh water.
- state different uses of fresh water.
- describe the World Water Supply and Distribution.

What are Water Resources?

Water resources are sources of water that are useful.

.About three-quarters of Earth's surface is covered with water. Living things are mostly made up of water. Without water, there would be no life on Earth.

Sources of Fresh Water

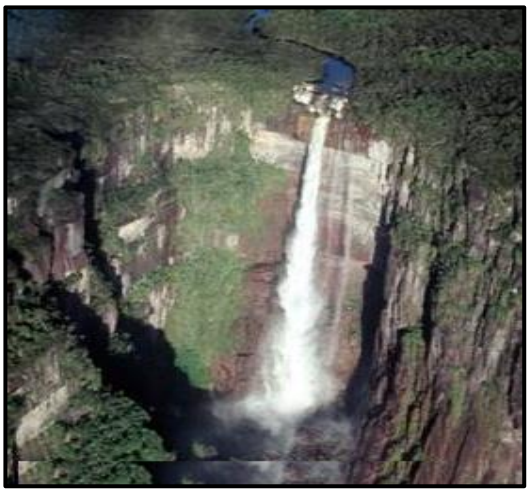
The sources of fresh water supply.

- In oceans
- As ice (mainly in ice caps)
- Ground water (underground)
- Surface water (in rivers, lakes, ponds, creeks etc.)
- In the atmosphere
- In the biosphere (in bodies of living things)

Here below are photographs of some of the sources of fresh water.

Ocean and lakes are stored water

Glaciers are stored water



Water fall formed by streams that runs into oceans

River

The ocean holds about 97 percent of the world's water. The remaining 3 percent of the total water content on earth is fresh water. This is found in ground water, rivers lakes, and ponds and in the atmosphere.

Not all water is safe to drink. Water in lakes and rivers can be polluted or it can be tasteless. It can have harmful chemicals or germs that cause disease.

In Papua New Guinea there often seems to be plenty of water, both as rainfall and in the rivers. However, some areas have heavier rainfall than others and some parts of a year are drier than others. Many people live near rivers, lakes or the sea because water is very important in their lives.

Scientists have learned how to clean, or purify, drinking water. They learned that boiling water could kill germs. They learned that adding certain chemicals could kill germs. Engineers learned how to keep dirty water in sewers, away from drinking water. Governments passed laws to keep factories from polluting water.

However, most of the water is salt water while the people need fresh water for drinking and cooking or irrigation. Some places have more fresh water than the other places, in other words those who live next to big rivers have more fresh water than those who live in the deserts. Fresh waters are very essential for living things especially human beings because most of our bodies are made up of water. There are so many sources of fresh water that is suitable for use; drinking, farming, washing and cooking.

As we learnt it is possible to recycle cans, glass, and paper. Did you know that nature recycles water, too? Water goes from the ocean, lakes, and rivers into the air. Water falls from the air as rain or snow. Rain or snows eventually find their way back to the ocean. Nature's recycling program for water is called the water cycle.

Ocean covers nearly three-quarters of the surface of the Earth. It is home to many living creatures. In the ocean there is a natural life cycle; animals eat other animals to get their food. Oceans lose water through evaporation but most of the water lost returns as rain. Oceans around Papua New Guinea are important as it allows big ships to carry people and cargo between Papua New Guinea and other countries. countries. In addition Papua New Guineans use the ocean to sail their canoes to trade yams, sago and clay pots to neighbouring islands and atolls.

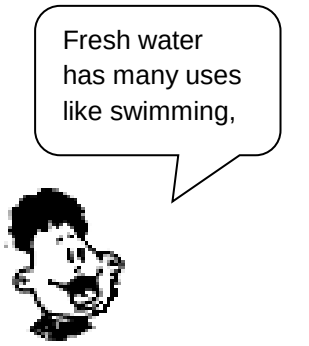
Runoff Water (moving around on land)

Rain water that falls on land always flows from high places to lower areas. This flow is called runoff. The water cuts channels as it flows. Some water seeps into the ground. It fills cracks between rocks. Underground water also flows from places that are full to places that have less water. Water from land flows into streams. Streams flow down mountains. Streams join together to make rivers and eventually the water flows into storage in the ocean. Then the water cycle starts all over again.

Different uses of Water

Clean water is essential for life and good health. Think about the different ways you use water. You drink water when you are thirsty. You take a bath and wash your clothes with water. You water the grass or other plants. You swim in water or use boats. Water pouring over huge dams may even make the electricity which light up your home

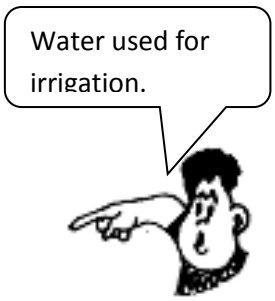
Water is used in agriculture, industrial, household, recreational and environment purposes. All living things and the non-living part of the environment need water to exist on earth.



Swimming pool

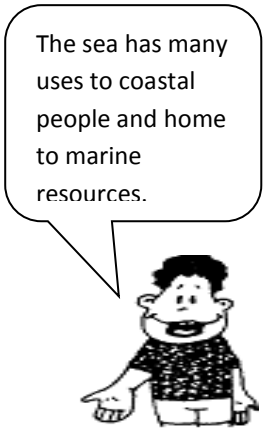
Fire fighters using water

Farming/Irrigation



Large-Scale Irrigation

Diving/leisure



Seas for fishing

Sirinumu Dam in Sogeri supplies water to the entire city of Port Moresby.

Water is needed for food preparation, drinking, washing, and irrigation. In addition, massive quantities are used daily in industrial processes. Yet, it is a limited resource that must be collected and distributed with increasing care. The most important source of water is rain, which may be collected directly and stored in tanks for later use. A watershed is the network of streams, and rivers by which entire areas are watered. Ground water is rain that passes through rock layers, forming pools after many years. If it is under pressure, groundwater may bubble to the surface as a spring. Irrigation canals, reservoirs, wells, and water towers are man-made devices for changing and collecting water from these natural sources. Water from reservoirs, wells, and rivers is usually processed in a treatment plant before distribution. PNG Water Board is a state agency that is responsible for the treatment and distribution of water supply throughout the country.

Horseshoe Falls, also called the Canadian Falls, is the Canadian part of the famous Niagara Falls Located in south-eastern Ontario, it is a major tourist attraction.

Sydney harbor Bridge

Sydney Opera House and its Harbour Bridge provided for Australia one of the most tourist attraction destination in the world. Many tourists have enjoyed a night glimpse of this fantastic harbour.

This photograph shows typical Outback scenery at Longreach in Queensland, where the major ways of earning a living are by raising beef cattle and sheep. The land is dry and needs to be watered. Windmills are used there to pump water from underground sources. This is the significance of water resources and people make use of water to suit their lives in their environment.

Windmills at Longreach, Queensland

In the Sahara desert, there is no permanent streams flow across the surface. Dried riverbeds are fill with water only when it rains. But water does rise to the surface in places, mostly from springs and wells. These areas are called oases. There are hundreds of oases scattered across the Sahara, mostly along its edges and in mountainous areas. Oases can support abundant plant and animal life.

Oasis in Sahara Desert

Desserts are areas that receive very little rainfall. The Sahara, in northern Africa, is the largest desert in the world. However, these people know how to survive in such areas with little water resources. In such situation; the fresh water resources that we have should be used wisely for the purpose of sustainable use and conservation. Without fresh water people and animals will not survive, in other words no water means no life on earth.

Summary

You have now come to the end of lesson 5. In this lesson you have learned that:

- water is an important resource because without water there is no life on earth.
- nature itself recycles water to maintain stability of the water level. .
- scientists believe that boiled water preserved for drinking is clean and safe for consumption.
- water is a multi-purpose resource which can be used for generating electricity, irrigation, leisure recreational, and sewage system in industrialized cities.
- oases are important source of water supply in the deserts like Sahara where it gives live to all its inhabitants.

- some of the biggest waterfalls in the world are also becoming tourist attraction which can be used for commercialization or bring economic benefits.
- man-made structures such dams and wells are constructed to collect water for use in many places in the world today.

NOW DO PRACTICE EXERCISE 5 ON THE NEXT PAGE.

Practice Exercise 5

1. What is the name of the well where the desert people get their water?

   _____

2. Name one example of the following sources of water.

   A. Stored-water: _____

   B. Runoff-water: _____

   C. Underground-water: _____

3. Give three (3) important values of seas to people.

   A. _____

   B. _____

   C. _____

4. Name two types of man-made water sources.

   A. _____

   B. _____

5. A mountain of ice melting down the valley causing erosion is called,

   _____

6. Why do we say ‘if there is no water, there is no life on earth?

   _____

   _____

   _____

NOW CHECK YOUR ANSWERS AT THE END OF THIS TOPIC

Lesson 6: Water Pollution

Welcome to Lesson 5. In this lesson, you will learn about Water Pollution, the sources of pollution and how water can be treated for use.

Your Aims

- define water pollution.
- identify the main categories of water pollutants.
- name the methods of analysing water pollution and ways to water treatment.

What is water pollution?

Water pollution is the contamination of water bodies (e.g. lakes, rivers, oceans, aquifers and groundwater).

This form of environmental degradation occurs when **pollutants** are directly or indirectly discharged into water bodies without adequate treatment to remove harmful compounds.

Water Pollutants

A pollutant is anything that can make water harmful for consumption.

Pollutants include **industrial wastes** (harmful chemical substances from factories, farms, mining sites and nuclear plants) and **sewage from homes**. Water pollution is usually caused by human activities. There are two sorts of sources, point and nonpoint sources. **Point sources** discharge pollutants at specific locations through pipelines or sewers into the surface water. **Nonpoint sources** are sources that cannot be traced to a single site of discharge. Examples of point sources are: factories, sewage treatment plants, underground mines, oil wells, oil tankers and agriculture. Examples of nonpoint sources are: acid deposition from the air, traffic, pollutants that are spread through rivers and pollutants that enter the water through groundwater. Nonpoint pollution is hard to control because the perpetrators cannot be traced.

A good example of non –point sources of pollution would be the issues raised by the people living along the Markham River who claimed that their river has been destroyed by the Wafi Gold Mining. They argued that their river resources like fish were found dead in big numbers floating on the surface of the river which is really unusual. However the mine continues to claim their innocence because they claimed to have a best waste treatment plant. The government has engaged scientist to carry out investigation and further test and present a report to find out the root cause of these issues.

River pollution – Mining Oil Spill – from Tankers Sewage from homes

In most developed world, water and air pollution comes from factories and power plants that burn coal and oil. Smoke from factories and power plants can mix with water in the air to make acid rain. Air pollution also comes from cars and other vehicles that burn gasoline. Soil pollution can come from chemicals used on farms to kill insects and other pests. Pollutants can also seep from garbage dumps into the soil and nearby water.

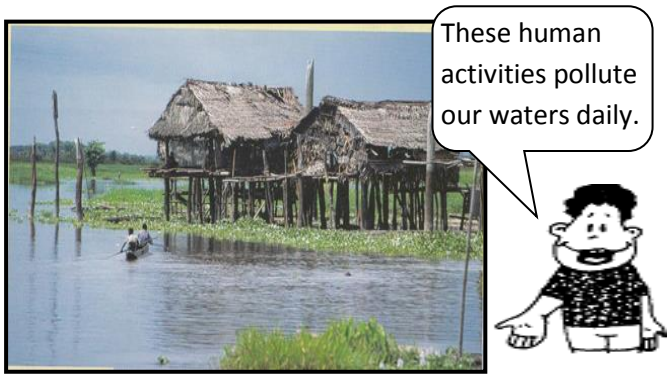
Air Pollution - Los Angeles Pesticides (farmers use in agriculture)

Air pollution is sometimes visible as a brown haze in the sky over Los Angeles. Acid rain forms when air pollution mixes with water in the atmosphere.

Water pollution comes from factories that dump poisonous chemicals into lakes and rivers. Water pollution can also come from farms. Farmers put chemicals on the ground to help crops grow and to kill insects. Rain can wash these chemicals into lakes and rivers. Big ships called oil tankers can pollute the ocean if the oil leaks out of the tankers. There can be a huge oil spill if a tanker has an accident and sinks into the sea bed. A special kind of pollution comes from nuclear power plants. Nuclear power plants produce radioactive waste. This waste lasts for thousands of years and can cause cancer and other deadly illnesses if it is not properly stored.

- Wastes from human body can be a disaster to clean water if it is not treated well. Once it is disposed openly, it can be harmful to our health when we use it, such as drinking water. Therefore in towns and cities, waste management policies have been put in place to manage both household and industrial waste.
- Wastes from other animals can also be harmful to clean water. Most fresh water next to cow paddock and piggery are normally polluted with animal wastes and are not safe for drinking. Similarly dead animals that are dumped into water system can contaminate the river, making it unsafe for use.

Nuclear Testing (USA –Marianas Island)



Sepik River (human wastes pollute rivers)

Mining wastes disposal is (point sources)

Air pollution by cars and industry (non-point sources)

Plants and animals require water that is moderately pure, and they cannot survive if their water is loaded with poisonous chemicals or harmful microorganisms. If severe, water pollution can kill large numbers of fish, birds, and other animals, in some cases killing all members of a species in an affected area. Pollution makes streams, lakes, and coastal waters unpleasant to look at, to smell, and to swim

Effects of water pollution

Anything harmful that is discharged into water will certainly pollute the water and have serious effects on the environment. Fish and shellfish harvested from polluted waters may be unsafe to eat. People who use polluted water can contract various diseases such as;

- dysentery
- diarrhea
- hepatitis A
- lead poisoning and
- various skin diseases

Prolonged exposure to these pollutants may develop cancer or may result in babies born with birth defects. Pollution can also get into the air and cause respiratory and lung diseases including:

- asthma attacks.
- chronic obstructive pulmonary disease.
- reduced lung function.
- pulmonary cancer – caused by a series of harmful chemicals that inhaled from the air.

Plants and animals that use the water can also be affected and eventually die out as the poisonous substances can destroy them directly or destroy their habitat.

Polluted air can mix with rain to make acid rain. Acid rain kills trees and harms fish in lakes. Pollution can also get into soil and water. From there, pollutants can get into food chain where plants take in the pollution from the ground. Consequently animals that eat the plants can be harmed too, in these food chain bigger animals and even people might eat contaminated meat.

How can we detect and stop water pollution?

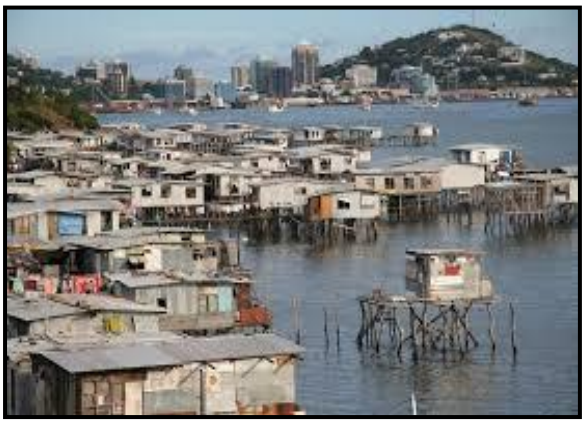
Chemicals that cause pollution are not easy to get rid of. They stay in the air and ground and water for a long time. The best way to fight pollution is to stop producing it in the first place. Governments can pass laws that forbid or limit the use of chemicals that cause pollution. Laws can stop factories from dumping poisonous chemicals in lakes, rivers, and the ocean. Factories and power plants can clean up the smoke that they give off. Engineers can build cars that burn less gasoline. They can find ways for cars to give off cleaner exhaust gases. Scientists are looking for fuels to replace coal and oil. They are looking for ways to use the power in wind and in rays from the Sun. They are also looking for safe ways to get rid of nuclear waste. You can help cut down on the amount of garbage you make. You can recycle paper, plastic, glass bottles, and metal cans. Recycled material gets used over again. It helps cut down on pollution.

These people cannot fish in their river; it is polluted with large forestry waste/chemicals

Water pollution is detected in laboratories, where small samples of water are analysed for different contaminants. Living organisms such as fish can also be used for the detection of water pollution. Changes in their behaviour or growth show us, that the water they live in is polluted. Specific properties of these organisms can give information on the sort of pollution in their environment. Laboratories also use computer models to determine what dangers there can be in certain waters. They import the data they have on the water into the computer, and the computer then determines if the water has any impurities.

One practical example of water pollution in Papua New Guinea is human waste disposal by many of our coastal people living over the sea. A good example is the Motuan village of Hanuabada, they live, wash, cook, excrete (human waste) into the

sea. Therefore; naturally people are informed that it is unhealthy to fish in waters next to the village due to human settlement. The fishermen need to travel several distances to catch fresh fish from the deep sea for consumption.



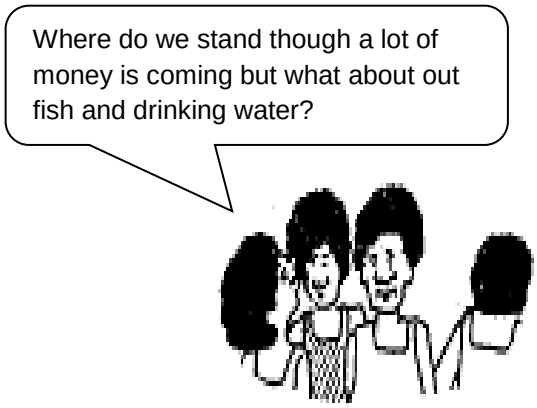
Port Moresby – Hanuabada Village

Kerema –Yokea village (river used for wastes)

Pollution is harmful to the environment as well as people because we rely heavily on the river resources and environment.

Practically most pollution to water and environment is caused by humans. It occurs due to certain factors that sometimes becomes beyond human control. For example; some of our major rivers and seas become polluted due to human settlement and the demand for cash economy. We are living in the cross road where times and technology is changing at a rapid pace. As living standards are improved there is a population increase and more resources such as water systems and environment will be used to meet the demand. For instance; the land owners living along the Kikori River protested to shut the LNG project because their river was polluted with mine wastes and chemicals. However; majority of the landowners oppose the idea and favoured the company due to the huge amount of cash economy that is coming into the area.

Similarly, the famous Waghi River that runs through the Western Highlands and the Jiwaka Province is polluted with chemical wastes from various agricultural projects such as tea and coffee plantations along the river banks. It will be a challenging decision for the people to allow these projects to develop or stop the operation. In other words they go for money and infrastructure development promised or to protect our natural water systems and the surrounding environment. It is better to analyse and establish facts on the damages that it may pose on the environment, especially on the water and then make a decision on whether to proceed on keeping in mind the long term effects it may have on the environment.



Natural water and environment (Purari)

River systems destroyed by projects.(Fly River)

Why is water an essential element for survival of all living things?

Rivers have always been important to people. People built houses near rivers because it provided water for drinking, cooking, washing, growing crops, fish for food, and transportation routes.

Today people still use rivers for water and transportation. They also learned how to control rivers. They build walls along rivers to keep them from overflowing. They build dams to harness the power of water for making electricity and a good example is the Yonki Dam in Eastern Highlands of Papua New Guinea. They build reservoirs to collect water for drinking and for industries to use. They have even straightened out bends in rivers called meanders.

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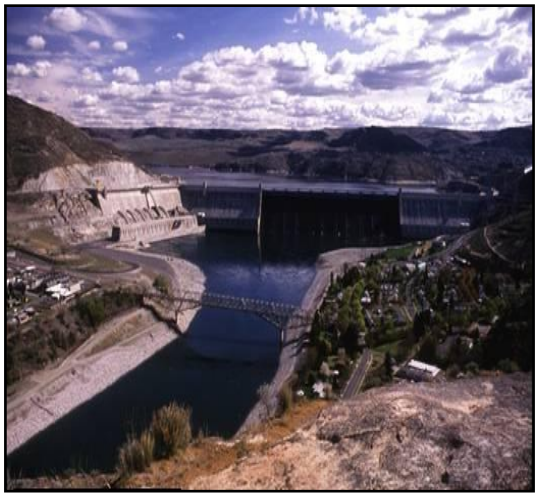
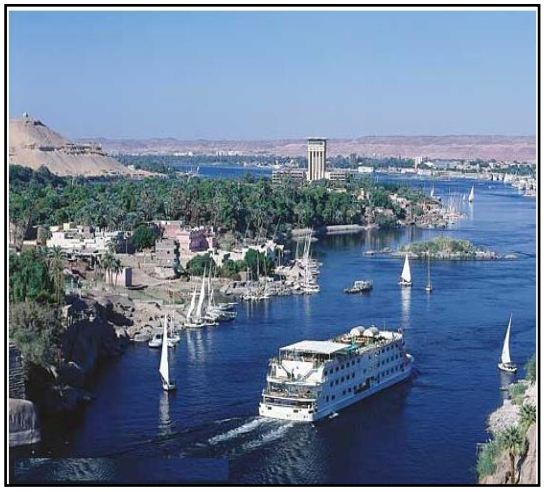


Grand Coulee Dam- Washington, USA provides electricity



Natural harbour for ships and boats

Some things that people do and use have harmed rivers and all forms of water system. Factories built along rivers polluted river water. Dams prevent rivers from carrying sediment to the sea and changed the way animals live in the rivers.

In some places people have taken steps to protect rivers and natural harbor. They passed laws to prevent factories from polluting rivers. Some dams are being taken

down to let the water flow freely. People now know that rivers are important and must be used wisely.

Therefore, without water living things cannot survive on earth. It is very important that we all work together to safe guard our water systems to keep it clean all the time and free from all forms of pollution. If we fail to act now, we will regret in the future that our river systems can no longer support the living things that depend on them.

Summary

You have now come to the end of lesson 6. In this lesson you have learned that:

- not all water is safe to drink. water in lakes and rivers can be polluted.
- rivers can have harmful chemicals or germs that cause disease. Scientists have learned how to clean, or purify, drinking water.
- boiling water could kill germs.
- engineers know how to keep dirty water in sewers, away from drinking water.
- people get sick from drinking polluted water. many poor people still do not have pure drinking water.
- people need fresh water for drinking and for growing food on farms. ocean water is too salty to drink.
- most water pollution is caused by human activities such as mining, farming and manufacturing.
- polluted water is dangerous for human health which can cause life time disability and death.
- cash economy is the major cause of most water pollution.
- some places have more fresh water than others, e.g. compare the Sahara desert of african continent and the amount of fresh water we have in Papua New Guinea.
- water is a scarce resource that has to be used wisely and should be protected from all forms of pollution.

NOW DO PRACTICE EXERCISE 6 ON THE NEXT PAGE.

Practice Exercise 6

1. Name at least two rivers that are most polluted in Papua New Guinea.

   A. _____

   B. _____

2. Name two activities that have caused these rivers to be unsafe for use as drinking water.

   A. _____

   B. _____

3. Most water pollution is caused by human activities. Give (5) human activities that cause water pollution.

   A. _____

   B. _____

   C. _____

   D. _____

   E. _____

4. How can cash economy cause water pollution?

   _____

   _____

   _____

5. Who is responsible to fight against water pollution?

   _____

   _____

NOW CHECK YOUR ANSWERS AT THE END OF THETOPIC.

Lesson 7: Water Management and Water Conservation

Welcome to lesson 7 of Unit 1. In this lesson you will learn about Water Management and Water Conservation.

Your Aims

- Define water management and water conservation
- Identify the goals of water conservation efforts
- Explain the water conservation program used around the world

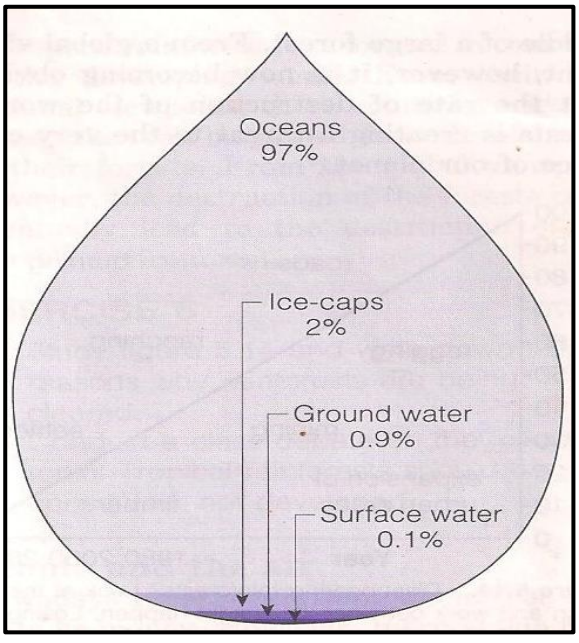
Water Management and Water Conservation

Water is a very important resource and it is essential for life. People can survive for up to two months without food but can die very quickly without water. Three quarters of the earth's surface is water. However, **water is a scarce resource** because only 0.1% world's water can be used to satisfy people's needs. Also not everyone has equal access to this water. In Papua New Guinea, we are lucky because water is not a scarce resource. However, many areas of the world suffer water shortages because of arid (dry) climates. In other areas, people have polluted so much of the water. Both the quality and the quantity of water are important because they affect people's health, their ability to stay clean and to grow crops.

What is water? Water refers to the liquid which forms the seas, lakes, rivers, rain and is the basis of the fluids of all living things.

Water management refers to the controlling of the usage of water. Water conservation refers to the preservation (looking after) or restoration of water.

This diagram shows the sources of water on earth. Remember in lesson five we discovered that only a small percentage of water is fresh and is suitable for human consumption. This small amount of fresh water must be managed well to prevent pollution and to conserve.



Goals of Water Conservation Effort

Goals of conservation effort refer to the aims of looking after water by the people for their benefit in the future. Turn to the next page to see the goals.

1. Protection from harm

Rules and laws are in place to stop people from polluting the water. This is to make sure that those who pollute or damage the water systems are fined or charged accordingly.

2. Value for the use of water as a resource

This means those who have access to this resource must pay for its consumption. Companies looking after the operation and distribution of water must pay tax, royalties and other fees. Thus the country can generate income for itself.

3. Sustainability

Sustainability is to manage and keep something going. For instance, royalties can be put into a sovereign wealth fund where it can build up wealth. Also this money must be invested in education and research and for development of physical infrastructures like roads, bridges and wharves.

Water Conservation Programs

The following are the water conservation programs used around the world for the following purposes.

1. Household application

This refers to the usage of water in homes. The following are water-saving technology for the home.

a) Use low-flow shower heads sometimes called energy-efficient shower heads as they also use less energy.

b) Use Low-flush toilets and composting toilets. These have a dramatic impact in the developed world, as conventional Western toilets use large volumes of water.

c) Use Dual (two) flush toilets created by Caroma includes two buttons or handles to flush different levels of water. Dual flush toilets use up to 67% less water than conventional toilets.

d) Use Saline water (sea water) or rain water for flushing toilets.

e) Use Faucet aerators (water tap), which break water flow into fine droplets to maintain "wetting effectiveness" while using less water. An additional benefit is that they reduce splashing while washing hands and dishes.

f) Wastewater reuse or recycling systems. This allows the reuse of gray water for flushing toilets or watering gardens and recycling of wastewater through purification at a water treatment plant.

g) Rainwater harvesting refers to using tanks to trap rain water for later use.

h) Use Garden hose nozzles that shut off water when it is not being used, instead of letting a hose run.

i) Use low flow taps in wash basins.

j) Use swimming pool covers that reduce evaporation and can warm pool water to reduce water, energy and chemical costs.

k) Use automatic faucet (water tap). A water conservation faucet eliminates water waste at the faucet. It automates the use of faucets without the use of hands.

Water can also be conserved by landscaping with native plants and by changing behavior, such as shortening showers and not running the faucet while brushing teeth**.**

2. Commercial Application

Many water-saving devices (such as low-flush toilets) that are useful in homes can also be useful for business water saving. The following are the water saving technology for businesses.

WATERLESS URINAL

a) Waterless urinals. Water is not needed to flush urines.

b) Waterless car washes.

c) Infrared or foot-operated taps, which can save water by using short bursts of water for rinsing in a kitchen or bathroom.

d) Pressurized water brooms, which can be used instead of a hose to clean sidewalks

e) Water-saving steam sterilizers, for use in hospitals and health care facilities. With this there is no need to wash individual equipment which is time consuming wasting water.

f) Rain water harvesting.

g) Water to Water heat exchangers.

3. Agricultural Application

The following are water saving measures for agriculture especially crop irrigation.

a) An evaporation pan is used to determine how much water is needed to satisfy plant needs.

b) Overhead irrigation is using center-pivot or lateral-moving sprinklers. It has the potential for a much more equal and controlled distribution pattern.

c.) Drip irrigation.
Though expensive it brings water right to the root of the plant.

1. OVER HEAD IRRIGATION

2. DRIP IRRIGATION

Methods of Reducing Water Loss

The following are some ways of reducing water loss.

1) Mulching: That is the application of organic or inorganic material such as plant Debris or compost slows down the surface run-off, improves the soil moisture, reduces evaporation losses and improves soil fertility.

2) Soil Cover: Soil covered by crops, slows down run-off and minimizes evaporation losses. Hence, fields should not be left bare for long periods of time.

3) Ploughing: This helps to move the soil around. By doing this it holds more water thereby reducing evaporation.

4) Shelter belts: Shelter belts of trees and bushes along the edge of agricultural fields slow down the wind speed and reduce evaporation and erosion.

5) Planting: Planting of trees, grass, and bushes breaks the force of rain and helps rainwater penetrate the soil.

6) Net Surface traps: Fog and dew contain substantial amounts of water that can be used directly by adapted plant species. This will trap water for plants to use.

7) Contour Farming: This is adopted in hilly areas and in lowland areas for paddy fields. Farmers recognize the efficiency of contour-based systems for conserving soil and water.

8) Salt Resistance crops: Salt-resistant varieties of crops have also been developed

recently. Because these grow in saline areas, overall agricultural productivity is increased without making additional demands on freshwater sources. Thus, this is a good water conservation strategy.

9) Canal: Transfer of water from surplus areas to deficit areas by inter-linking water systems through canals saves water.

10) Water System: Use of efficient watering systems such as drip irrigation and sprinklers will reduce the water consumption by plants.

Summary

You have now come to the end of lesson 7. In this lesson you have learned that:

- water is a scarce resource because only 0.1% world's water can be used to satisfy people's needs.
- water refers to the liquid which forms the seas, lakes, rivers, rain and is the basis of the fluids of all living things.
- water management refers to the controlling of the usage of water.
- water conservation refers to the preservation (looking after) or restoration of water.
- there are three goals of water conservation effort; protection from harm, value for money, sustainability.
- water conservation program applies mainly to the following; household application, commercial application, agricultural application.

NOW DO PRACTICE EXERCISE 7 ON THE NEXT PAGE.

Practice Exercise 7

1. Write the meaning to the following words.

   a) Water

   _____
   _____

   b) Water management

   _____
   _____

   c) Water Conservation

   _____

   _____

2. Explain why water is a scarce resource.

   _____

   _____

3. Why is water conservation important?

   _____

   _____

4. List the three goals of water conservation effort.

   a)_____

   b) _____

   c) _____

5. List the 3 applications that the water conservation program covers.

   a) _____

   b) _____

   c) _____

6. Name the 10 ways to reduce water loss.

   a) _____ f) _____

   b) _____ g) _____

   c) _____ h) _____

   d) _____ i) _____

   e) _____ j) _____

CHECK YOUR ANSWERS AT THE END OF THE TOPIC.

Lesson 8: Air as a Resource

Welcome to lesson 8 of Unit 1. In the last lesson you learned about Water Management and Water Conservation. In this lesson you will learn about Air as a Resource.

Your Aims

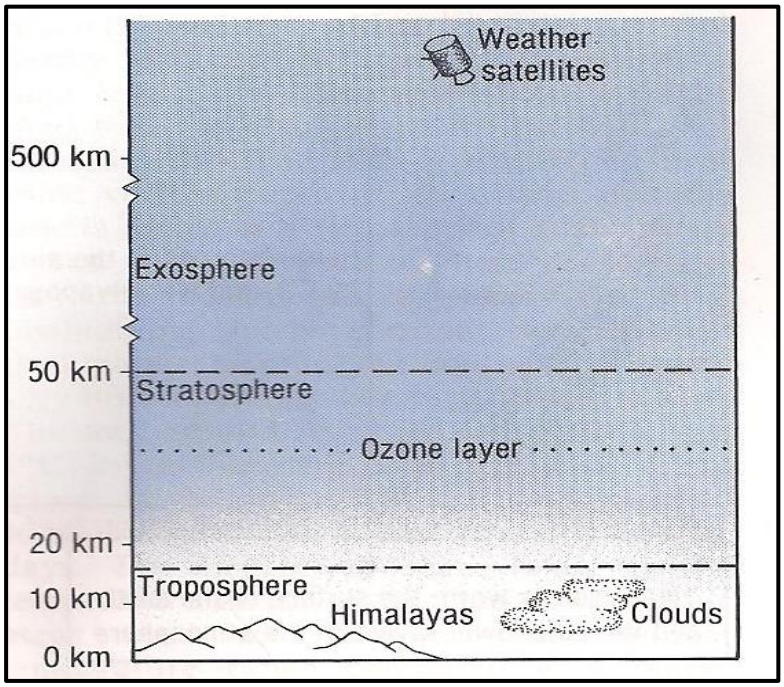
- Define Air
- State the importance of clean air
- Explain the cause and the effects of air pollution
- Identify ways of looking after the air around us
- Mention one by one international examples of good practices of minimizing pollution of air

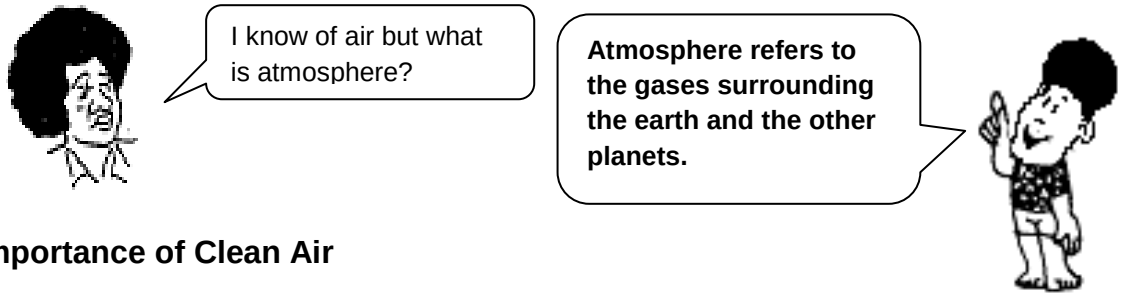
What is Air?

Air refers to the invisible (unseen) mixtures of gases surrounding the earth.

The air is made up of several gases. The two main ones are nitrogen (78%) and oxygen 21%. A third gas, the carbon dioxide is present in small quantity however it has great importance for maintaining life on earth and also because of its effect on the weather. The diagram below shows the layers of the **atmosphere** in which the air we breathe is found.

THE LAYERS OF THE ATMOSPHERE





Importance of Clean Air

Clean air is very important for good health. Dust, gas, smoke and any other small particles in large quantities can pollute clean air. The simplest example is smoking tobacco. This is illegal in many public places in different countries. This is because it can cause lung cancer. There are many other sources of harmful smoke that pollute the air and harm human health.

Causes and Effects of Air Pollution

What is **air pollution**? Air pollution is the contamination (poisoning) of air by harmful substances that can cause health problems. Below are the seven main **causes** of air pollution. Air pollution can result in acid rain if the chemicals sulphur dioxide and nitrogen oxide are present in the clouds. This becomes very dangerous for humans and their environment.

1. Power Plants

This is where **fossil fuels** (fuels made from remains of dead plants and animals millions of years ago that turn into coal, oil or gas) are burnt to produce energy like electricity. Fossil fuel **emissions** (waste given off) contain major greenhouse gases, including carbon dioxide, methane, nitrous oxide.

This diagram above shows a power plant where fossil fuels such as coal are burnt to produce energy like electricity.

2. Vehicle Emissions

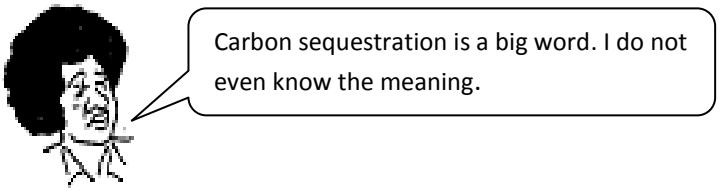
The use of vehicles contributes about 10% to the air pollution.

3. Industry

The major contributor of pollution comes from the industries. Industries such as mining, manufacturing, agriculture and nuclear plants burn fossil fuels such as coal, petrol and gas to produce energy. These fuels when burnt give of greenhouse gases that is responsible for the general increase of the earth's temperature known as the global warming.

4. Deforestation

Forests act as sinks for carbon dioxide through a process called **carbon sequestration**. Trees store carbon dioxide in their plant tissue as they take in this gas to undergo the process of food-making. In effect, this action removes carbon dioxide from the air. When forests are burned and destroyed, this storage area for carbon dioxide is removed, increasing the concentrations (level) of atmospheric carbon dioxide.



Carbon sequestration is the removal and storage of carbon from the atmosphere in carbon sinks (such as oceans, forests or soils) through physical or biological processes, such as photosynthesis.

5. Wood fire

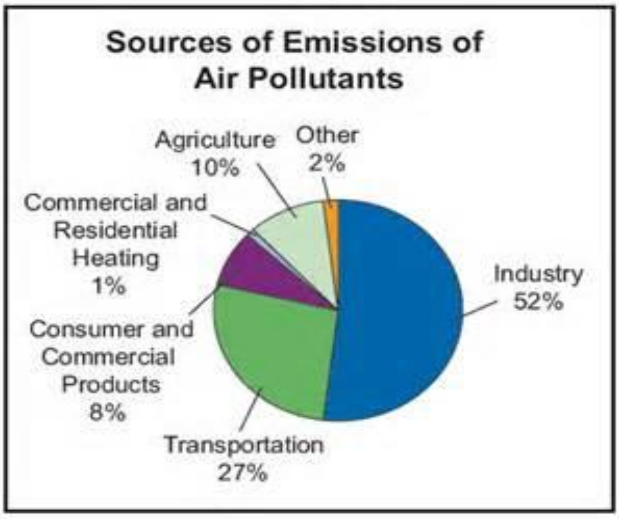
The smoke from the wood fire contains particular matter called **soot** when burnt are given off into the air. They can also remain in your respiratory system which will eventually cause lung cancer and other illness like asthma.

6. Smoking

Smoking as in smoking tobacco can also contribute to air pollution. Tobacco smoke contains 40% of a chemical called carcinogen. This makes it a deadly form of air pollution.

7. Natural Process

Natural processes can contribute to the effects of air pollution. Natural events such as volcanoes and tornadoes can stir up debris and cause widespread air pollution. Natural erosion of rock and soils also releases toxins such as **radon** into the air. Radon is the second leading cause of lung cancer in the United States, according to the National Cancer of Institute of United States of America. The diagram on the right shows sources of air pollution.



Effects of Air Pollution

The following are the effects of Air Pollution.

1. Global warming
The increasing level of greenhouse gases especially carbon dioxide, is believed to be the cause of global warming. This increase in the earth's average temperature has resulted in the melting of ice at the two poles, causing the sea level to rise. People affected the most are those who live on small islands of the Pacific. Their food gardens are destroyed by salt water and are their respective governments are now looking at relocating them.

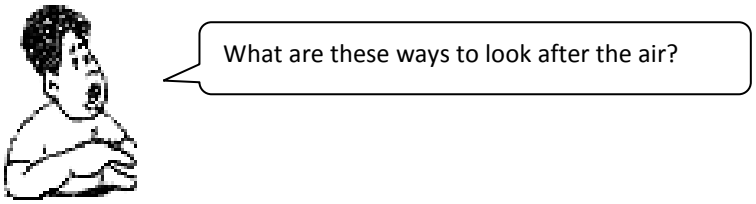
2. Ozone depletion
Ozone depletion refers to the layer of the atmosphere called the ozone reducing in size due to the dangerous chemical burning it. When this happens direct sunlight from the sun will cause skin cancer since the ozone prevents direct sunlight to reach us.

3. Smog
Smog is the fog or haze made worse by other pollutants in the atmosphere such as smoke. It causes visibility and breathing problem.

4. Poor air quality
With poor air quality people will have health problems like respiratory condition of asthma, lung cancer and minors like sneezing, coughing or irritated throat.

Ways of looking after the air around us

The air around us needs to be taken care of with great care.



The following can be some ways to help look after the air around us. People must reduce their personal energy consumption in the home by turning off unused lights and electronics, reducing their home's heating on cold days and limiting their use of air conditioning to very hot days to save energy. In countries that use fossilized fuels like coal they can install solar electrical systems and geothermal or solar heating systems to further reduce their consumption of coal-generated power. This will help to reduce the level of carbon dioxide and other harmful chemicals and gases released into the air. Also reduce the use of vehicles and stop burning of grass which can cause wood fires leading to more carbon given off into the air. Stop smoking and report vehicles without exhaust emissions.

Good Practices to Minimising Air Pollution

These are practices that are used by countries over the world to help reduce air pollution.

1. The Air Pollution Act

This was created in 1984. It has greatly helped to reduce pollution in especially the industrialized world. The industries are to minimize their carbon emissions by up to 80%.

2. The Clean Air Act

This was created in 1970. It has helped to reduce pollution as well.

3. Air Quality Act

This was created in 1967. It was to control the quality of the air that is whether it is fresh or pollute**d.**

4. Recycling

Recycle paper, plastic, glass bottles, cardboard, and aluminum cans. This conserves energy and reduces production emissions.

5. Renewable energy

Quit coal and move away from fossil fuels, replacing them with clean, renewable energy.

Summary

You have now come to the end of lesson 7. In this lesson you have learned that:

- air refers to the invisible (unseen) mixture of gases surrounding the earth.
- the two main gases that make up air are nitrogen (78%) and oxygen (21%).
- the third gas, carbon dioxide, though not big plays a very important part in controlling life on earth and also the weather.
- atmosphere refers to the gases surrounding the earth and other planets.
- the importance of clean air is for good health.
- air pollution is the contamination (poisoning) of air by harmful substances that can cause health problems.
- fossilized fuels are fuels made from remains of dead plants and animals millions of years ago that turn into coal, oil or gas. They are burnt to produce energy like electricity.
- the seven main cause of pollution; power plants, vehicle emissions, industry, deforestation, wood fire, smoking and natural process.
- the good practices of minimizing air pollution; Air Pollution Act, Clean Air Act, Quality Air Act, Recycling and renewable energy.

NOW DO PRACTICE EXERCISE 8 ON THE NEXT PAGE

Practice Exercise 8

1. Write the meaning to the following words.
   a) Air

   _____

   _____

   b) Atmosphere

   _____

   _____

   c) Air pollution

   _____

   _____

2. Explain fossilized fuel

   _____

   _____

3. What is the importance of clean air?

   _____

4. Explain Carbon Sequestration?

   _____

   _____

1. List the 7 main causes and 4 effects of air pollution.

Causes	Effects
a) E.g Power Plant	a) E.g Global Warming
b)	

6. List the 5 good practices to minimize pollution.

a)_____ b)_____ c)_____

d)_____ e)_____

CHECK YOUR ANSWERS AT THE END OF THE TOPIC.

Lesson 9: Renewable Energy Resources

Welcome to lesson 9 of Unit 1. In the last lesson you learned about Air as a resource. In this lesson you will learn about Renewable Energy Resource.

Your Aims

- Define Renewable Energy
- Identify examples of Renewable Energy
- Describe international examples of how these Renewable Energy Resources are tapped

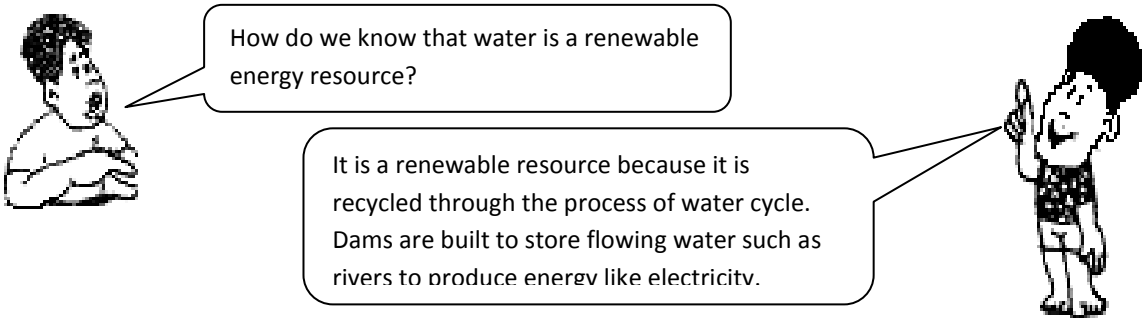
What is Renewable Energy?

There are various kinds of renewable energy resources used. What then is energy? Energy refers to the power derived (taken out) from physical or chemical resources to provide light and heat or to make machines work.

,

Renewable energy is energy generated from natural resources such as sunlight, wind, rain, tides and geothermal heat which are naturally replenished.

Therefore renewable energy resources include naturals resources such as wind, rain, waves, tides, sunlight and geothermal heat (hot spring).



Types of Renewable Energy

There are six main types of renewable energy that the world is currently using.

1. Solar energy

This is energy produced from the light and heat of the sun.

2. Wind energy

This is energy that is produced from the speed of the wind.

3. Tidal energy and wave energy

This energy type is produced from the strength of the tides and waves of the sea.

4. Biomass energy

This energy is produced from plants and animal materials. For instance, trees or manure.

3. Hydro-electric energy

This energy is produced from flowing water like rivers and waterfalls.

6. Geothermal energy

This energy is produced from hot springs called **geysers**. This is where water boils from time to time under the earth sending up a column of water and steam into the air.

How Renewable Energy Resources are tapped

The idea of **tapping** these renewable energy resources mentioned above are similar on an international level. That is, worldwide, countries use that idea to tap these renewable resources.

Tapping means to take some off from supply. Thus tapping refers to taking energy supply from renewable resources.

Now, let us look at the international examples of how these renewable resources are tapped.

1. Solar energy

Devices such as solar cells convert (change) sunlight into electrical energy. Also thermal collectors convert sunlight into heat energy. Solar technologies are used in watches, calculators, water pumps, space satellites, for heating and supplying clean electricity to the power grid. There is enough solar radiation striking the surface of the earth to provide all of our energy needs.

This pictures shows the solar cells used to trap heat and light from the sun to produce solar energy.

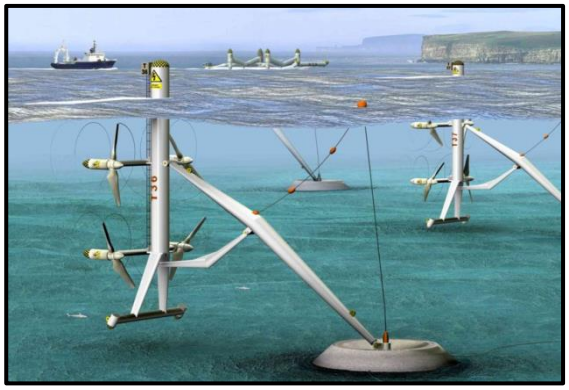
2. Wind energy

Moving air turns the blades of large wind mills or generator to make electricity, or to pump water out of the ground. A high wind speed is needed to power wind generators effectively. While wind generators do not produce any greenhouse gas emission they may cause vibrations, noise and visual pollution. .

A wind vane producing energy using wind

3. Tidal energy and wave energy

Tidal power, also called tidal energy, is a form of hydropower that converts the energy obtained from tides into useful forms of power, mainly electricity. Although not yet widely used, tidal power has potential for future electricity generation. Tides are more predictable than wind energy and solar power. The movement of wave can also drive air turbines to make electricity. Although tidal wave energy does not produce pollution they can cause other environmental problems.



The device above is called a tidal turbine. It can generate electrical energy from the tides or wave from the sea.

4. Biomass energy

Biomass is plant and animal material that can be used for energy. This includes using wood from trees, waste from other plants (for example, bagasse from sugar cane) and manure from livestock. Biomass can be used to generate electricity, light, heat, motion and fuel. Converting biomass energy into usable energy has many environmental benefits. It uses materials that are usually dumped, and uses up methane (a greenhouse gas). Fuels such as ethanol can be made from biomass and used as an alternative to power motor cars.

A biomass energy station

5. Hydro-electric energy

A dam

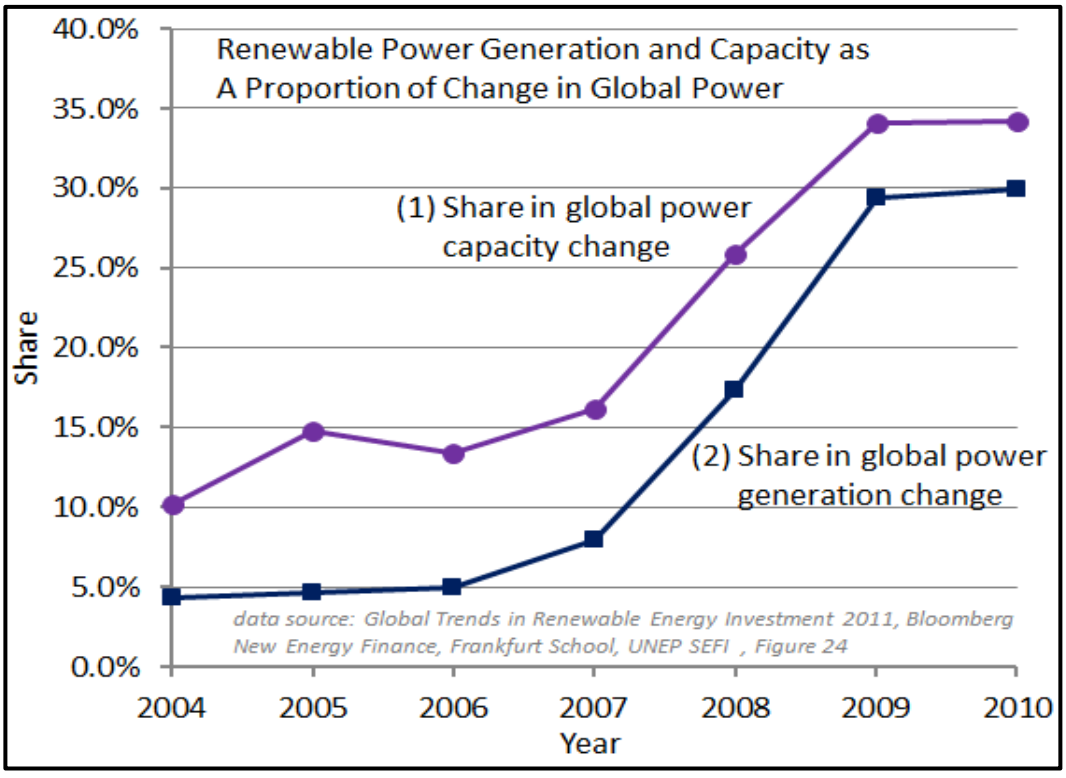
Fast flowing water released from dams in mountainous areas can turn water turbines to produce electricity. It does not cause pollution but there are other environmental effects must be considered. Ecosystems may be destroyed, cultural sites may be flooded and sometimes people need to be resettled. There are also impact of fish breeding, loss of habitat and changes in flow of water.

6. Geothermal energy

A geothermal factory

Geothermal energy uses heat energy from beneath the surface of the earth. Some of this heat finds its way to the surface in the form of hot springs or geysers. Other schemes tap the energy by pumping water through hot dry rocks several kilometers beneath the earth's surface. Geothermal energy is used for the generation of electricity and for space and water heating in small number of countries.

Therefore, the use of these renewable energy resources must be sustainable. The worlds demand for it is rapidly increasing. Now, you turn to the next page to see the diagram for the consumption of these energy resources.



This diagram shows the global consumption of renewable energy resources.

Summary

You have now come to the end of lesson 10. In this lesson you have learned that:

- energy is the power derived (taken out from) from physical or chemical resources to provide light and heat or to make machines work.
- renewable energy resources refer to those resources that replenishes or are renewed giving power for things that require it to work.
- there are six main types of renewable energies; solar energy, wing energy, tidal and wave energy, hydro- electric energy, biomass energy and geothermal energy.
- tapping means to take some off from a supply. Thus we say tapping is taking energy supply from renewable resources.

NOW DO PRACTICE EXERCISE ON THE NEXT PAGE.

Practice Exercise 9

1. Explain the following words.
   a) Energy

   _____

   _____

   b) Renewable energy resources

   _____

   _____

2. List the six main types of renewable energy resources and state where it is tapped from and how it is tapped.

Type of renewable energy	Where it is tapped from.	How it is tapped
a) E.g. Solar Energy	Sun	Using solar cells and thermal collectors
b)		
c)		
d)		
e)		
f)		

CHECK YOUR ANSWERS AT THE END OF THE TOPIC.

ANSWERS TO PRACTICE EXERCISE 1-9

EXERCISE 1

1. A resource is anything that can be used to satisfy needs and wants. These are mostly natural resources such as land, animals, plants and minerals, which support life on earth.

2. A. Trees
   B. Animals eg. Fish
   C. Rivers/Sea

3. A. Gold/ Iron
   B. Copper
   C. Oil/Gas

4. A. Economy/Money
   B. Building Materials
   C. Fresh Drinking Water
   D. Subsistence gardening or large scale agricultural project
   E. Energy/Fuel

5. Non-renewable resources take millions of years to form unlike renewable resources.

6. A. Pollution (river systems and water sources like sea can be polluted by chemicals).
   B. Plants and animals species can be destroyed permanently.

EXERCISE 2

1. The tropical region has wet and dry seasons all year round unlike the areas away from the tropics.

2. Deciduous Broadleaf forests

3. Deforestation is an act of over harvesting forest in an area – that can be through logging, commercial agriculture, subsistence farming, or any form of destroying natural forest resources.

4. Amazon Rainforest

5. A. Mass Erosion (of rich nutrients)
   B. Disappearance of wildlife
   C. Forest changes landscape – to savannah grassland.

6. A. Logging
   B. National Park/Zoo
   C. Wild Life Conservation Sites etc.

EXERCISE 3

1. Conservation is the protection of natural or man-made resources and landscapes for later use.
.
2. It is the time we remember our earth and its living things. The earth day falls on the 22 April every year. Our duty now is to plant trees or other plants for preservation.

3. Recycling means re-using a product instead of abandoning them. For example, after drinking a can coke the empty can has to be reused for conservation purposes.

4. The main purpose of conservation is to save natural resources for future use or to maintain the supply for the future generation.

5. A. Promote Tourism Industry
   B. Protection of endangered species
   C. Recreation and leisure centres for families.

EXERCISE 4

1. Lowland coastal areas of Papua New Guinea

2. A. Madang Province B. West Sepik Province/Western Province.

3. No. as soon as the timber runs out they will leave. They provide only a short-term employment which cannot last.

4. Students research

EXERCISE 5

1. Oases

2. A. Seas/lakes
   B. River
   C. Oases

3. A. Home to marine Resources e.g. Fish
   B. Sea transports/ships
   C. Food supply (fish and sea food for people)

4. A. Water Supply
   B. Electric Power Hydro

5. Glaciations

6. Everything survives on water including humans, animals and plants.

EXERCISE 6

1. A. Fly River B. Waghi River

2. A. OK Tedi Mining B. Tea & Coffee Plantations

3. A. Mining B. Agriculture
   C. Human wastes D. Hydro-Electricity
   E. Transportation (ships & boats)

4. Most people today are so much interested in making money and they do not worry or care about the dangers that economic activities impose on the natural environment including water. Disposing of industrial wastes into the water systems pollute or contaminate the water.

5. Everyone, including individuals, community, family, churches, government and non-government organisations.

EXERCISE 7

1. a) Water refers to the liquid which forms the seas, lakes, rivers, rain and is the basis of the fluids of all living things.

   b) Water management refers to the controlling of the usage of water.

   c) Water conservation refers to the preservation (looking after) or restoration of water.

2. Because there is only 0.1% fresh water

3. So that there is enough water and it does not run out.

4. a) protection from harm
   b) Value for money
   c) Sustainability

5. a) Household application
   b) Commercial application
   c) Agricultural application

6. a) Mulching
   b) Soil Cover
   c) Ploughing
   f) Net Surface Traps
   g) Contour Farming
   h) Salt Resistance Crops

d) Shelter belts
e) Planting
i) Canals
j) Water System

EXERCISE 8

1. a) Air refers to the invisible (unseen) mixture of gases surrounding the earth.

   b) Atmosphere refers to the gases surrounding the earth and other planets.

   c) Air pollution is the contamination (poisoning) of air by harmful substances that can cause health problems.

2. Fuels made from remains of dead plants and animals millions of years ago that turn into coal, oil or gas and are burnt to produce energy like electricity.

3. For good health

4. Carbon sequestration means forests exchanging oxygen for carbon dioxide in the air through the process of carbon and oxygen cycle.

5.

Causes	Effects
a) power plants	a) global warming
b) vehicle emissions	b) Ozone depletion
c) industry	c) smog
d) wood fire	d) poor air quality
e) deforestation	
f) smoking	
g) natural process	

6. a) Air Pollution Act b) Clean Air Act c) Air Quality Act
   d) Recycle e) Renewable energy

EXERCISE 9

1. a) Energy refers to the power derived (taken out) from physical or chemical resources to provide light and heat or to make machines work.

   c) Renewable energy refers to those resources that can be replenished or renewed giving power for things that require it to work.

2.

Type of renewable energy	Where it is tapped from.	How it is tapped
a) E.g. Solar Energy	Sun	By using solar panel/solar cells or thermal collectors converting heat and light into energy.
b) Wind	Wind	By using wind vanes.
c) Tidal and wave energy	Sea	By building dams or barricade along the section of the coast where wind blows all the time and the sea is always rough.
d) Hydro- electric energy	River	By building dams along mountainous area where flowing river water is trapped and turbines help convert water into energy.
e) Biomass energy	Plants and animals	By using machines that will convert wood and wastes of animals (manure) and plants (bagasse from sugar) and decomposed food scraps into energy.
f) Geothermal energy	Hot springs	By pumping water through hot dry rocks several kilometers beneath the earth's surface to produce energy required.

YOU HAVE COME TO THE END OF TOPIC 1. NOW TURN TO YOUR ASSIGNMENT BOOK 1 AND COMPLETE TOPIC TEST 1 BEFORE YOU PROCEED TO THE NEXT TOPIC.

TOPIC 2

NON-RENEWABLE RESOURCES

In This Topic You will Learn About:

- **What a Non-Renewable resource is**
- **Mineral Resources**
- **Non-renewable Energy Resources**

TOPIC: INTRODUCTION

In this topic you will study Non-Renewable Resources. The topic is made up of three lessons. They are;

Lesson 1 : What is a Non-Renewable Resource?

Lesson 2: Mineral Resources

Lesson 3: Non-Renewable Energy

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

- define and give examples of non-renewable resources and discuss their characteristics
- List the different types of mineral resources and explain their advantages and disadvantages
- Identify and give examples of non-renewable energies and discuss their uses and effects.
- Discuss energy conservation practices and policies in Papua New Guinea and other parts of the world.

We hope you will enjoy this topic.

Your teacher

Lesson 10: What is a Non-Renewable Resource?

Welcome to lesson 10 of Unit 1. In the last lesson you learned about Renewable Energy Resources. In this lesson you will learn about Non-Renewable Resources.

Your Aims

- define non-renewable resources
- discuss the features of non-renewable resources
- identify examples of non-renewable resources

What is non-renewable resource?

Non-renewable resources are those that cannot be replaced or can be replaced over a very long time.

These resources are limited and once used may not be replaced or it may take a very long time to be replaced. The non-renewable resources are mainly earth minerals, fossil fuels (petroleum and gas). Below are some of the non-renewable resources.

- gold
- copper
- silver
- nickel
- cobalt
- coal
- gas
- oil

Features of non-renewable resources

The following are some features of the non-renewable resources.

1. They are found in the lithosphere and are extracted through mining.
2. They are limited
3. Extracting minerals, petroleum and gas costs a lot of money
4. Non-renewable mineral resources are mainly located along the edges of the continental plates.
5. They are also located where the plates uplifted in the past

Non-renewable resources are limited and so we must be careful when extracting them. Over exploitation of the resources may lead to the depletion of the resources and eventual destruction of the environment.

Papua New Guinea is fortunate to have a number of these resources in the country. The list on the next page consists of existing and future mining projects in Papua New Guinea.

.

Existing Mining Projects in PNG

• OK Tedi	Copper & Gold	Western province
• Porgera	Gold and Silver	Enga
• Lihir	Gold and Silver	New Ireland
• Ramu	Nickel and Copper	Madang
• Hidden Valley	Gold and Silver	Morobe
• Tolukuma	Gold	Central
• Simberi	Gold	New Ireland
• Sinivit	Gold	East New Britain

Mining Projects in the pipeline (Future Projects)

• Solware 1	Sulphate	New Ireland
• Woodluck	Gold	Milne Bay
• Frieda River	Gold	East sepik
• Yandeara	Copper	Madang
• Wafi -Golpu	Gold and Copper	Morobe
• Mt Kare	Gold	Southern Highlands
• Imwauna	Gold	Milne Bay

Fossil fuels such as oil and liquefied natural gas (LNG) have also been developed in Papua New Guinea.

More on minerals and non-renewable energy will be discussed in the next two lessons. Now read the main points of this lesson below.

Summary

You have come to the end of the lesson 10. In this lesson you have learned that:

- Non-renewable resources are those that cannot be replaced or can be replaced over a very long time.

- The non-renewable resources are mainly earth minerals and fossil fuels (petroleum and gas).

- The following are some features of the non-renewable resources.
    a) They are found in the lithosphere and are extracted through mining.
    b) They are limited
    c) Extracting minerals, petroleum and gas costs a lot of money
    d) Non-renewable mineral resources are mainly located along the edges of the continental plates.
    e) They are also located where the plates uplifted in the past

- Over exploitation of the resources may lead to the depletion of the resources and eventual destruction of the environment.

NOW DO PRACTICE EXERCISE 11 ON NEXT PAGE.

Practice Exercise 11

1. What is a non-renewable resource?

   _____

2. Name two features of non-renewable resources.

   (i) _____

   (ii) _____

3. How many mining sites are found in New Ireland in total?

   _____

4. Which minerals are mined in Pogera?

   _____

NOW CHECK YOUR ANSWERS AT THE END OF THE TOPIC

Lesson 11: Mineral Resources

Welcome to lesson 11 of Grade 10 Social Science Course. In Lesson 11, you will learn about mineral resources and its uses.

Your Aims

- define mineral and mineral resources.
- identify different type of minerals and their uses.
- explain the advantages and disadvantages of mining minerals.
- Identify measures that governments can take to minimise over exploit of mineral resources.

What is a Mineral?

A mineral is a naturally occurring substance that is formed through natural processes in the earth's crust or on the surface of the earth.

Minerals are part of the 92 elements that make up the rocks of the earth. Mineral are non-renewable resources that cannot be replaced once they run out. Most of the mineral resources are found at the edge of the continental plates. They are also located where the plates are uplifted in the past. Minerals are found in **ore deposits.** Ore is a material that has enough of the mineral in it to make mining worth the money. Iron ore and aluminium ore have a lot of the mineral in the ore. Gold and silver have much less mineral in the ore. They are more valuable and the miner can spend more money to get the gold or silver out of the ore.

Minerals

Mining is a large extractive (taking out) industry in Papua New Guinea. Some of the important mineral resources are:

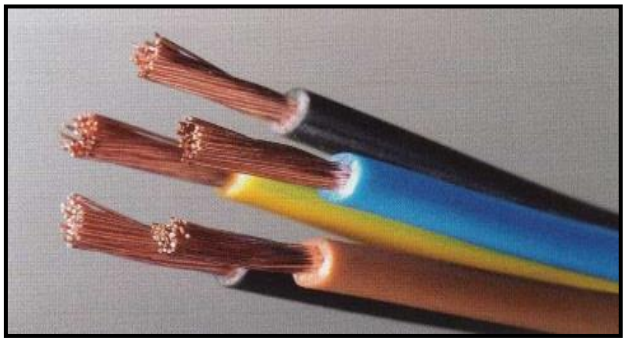
- Gold
- Copper
- Nickel
- Silver and
- Cobalt etc.

Minerals as a resource have its importance and usage where necessary. The following shows features, characteristics and the usage of these minerals.

Gold is more useful than any mineral mined from the earth. The different properties it contained allows it to be used for many different purposes. The photograph on the right show a stack of gold bars.

Gold conducts electricity, does not tarnish, is very easy to work, can be drawn into wire, can be hammered into thin sheets, alloys with many other metals, can be melted and cast into highly detailed shapes, has a wonderful color and a brilliant luster. Gold is a precious metal that is sought after by many people.

Copper is a reddish brown corrosion resistant metal. It is an excellent conductor of heat and electricity. It is used for wire, plumbing, coins, electrical and electronics equipment, and alloys (particularly brass). The image on the right shows samples of copper wires



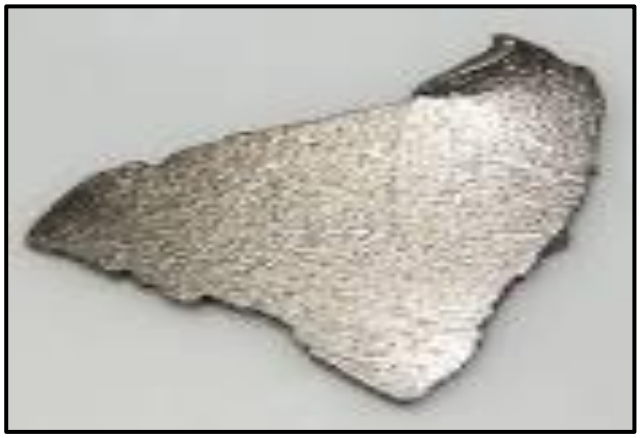
Silver is a heavy white precious metal that is capable of a high polish and is the best metal conductor of heat and electricity. It is used in jewellery, coins, medals, alloys, photography, silver ware, and electrical and electronics industries

.

Nickel is a silvery-white metal that is fairly hard, but can be hit and pressed into different shapes easily without breaking or cracking. It is one of the few elements that is magnetic at room temperature, can be polished to a shine and resists corrosion. It is also a conductor of electricity and heat. The majority of nickel that is mined today is used to make nickel steels and alloys. Nickel steels, such as stainless steel, are strong and corrosion resistant. Nickel is often combined with iron and other metals to make strong magnets.

One kina (K1) coin is made from copper and nickel.

Cobalt is a hard, steel grey metal used in preparation of magnetic, wear-resistant, and high-strength alloys and in compounds used in the production of inks, paints and varnishes. It is one of the few elements that is naturally magnetic It can be easily magnetised and maintains its magnetism at high temperatures.



Mineral resources are very important source of income for our country, however, there are also disadvantages of using these resources. Below are some of the advantages and disadvantages of minerals as a resource.

Advantages:

- It brings about tax money for national, provincial and local level governments.
- Compensation and royalty for land owners.
- It provides jobs and the chance for workers to gain technical and professional skills.
- Provides contracts for small companies owned by people of the resource areas.
- It brings about improvement in education and health care <u>services</u> for the mine communities.

Disadvantages:

- It causes environmental damages and increases social problems.
- The environmental damages can be :
  - i) Downstream sedimentation of waterway caused by waste rocks dumped into water way.
  - ii) Chemicals in milling processes can find its way into the rivers and make it very poisonous for living things and people.
  - iii) Increase flooding, destruction of river bank gardens, plant life and decrease fish populations etc….
- The social problems that can be caused are:
  - i) Unwanted immigrants moving into a resource area
  - ii) Gambling and prostitution
  - iii) Disruption of traditional ways
  - iv) Younger people are not able to learn subsistence skills to prepare themselves when mine shuts down.

Today many countries who own mineral resources do not consider the effects of overuse and abuse on the environment. They do not care as much about future generations. Therefore governments must have measures put in place to control the overuse and abuse of the mineral resources.

Summary

You have come to the end of the lesson 11. In this lesson you have learned that:

- minerals are one example of non-renewable resource
- minerals have important and special uses as required by people.
- mining minerals have both advantages and disadvantages.
- in PNG today minerals of different types are mined everywhere.
- all governments must have strategies in place to minimise over exploitation of mineral resources.

NOW DO PRACTICE EXERCISE 11 ON NEXT PAGE.

Practice Exercise 11

1 What is a mineral resource?

_____

2. List the four examples of mineral resources.

(iii) _____

(iv) _____

(v) _____

(vi) _____

3. For each type of mineral below state one of its uses.

i) Gold_____

ii) Copper_____

iii) Nickel_____

4. State a social and environmental effect of mining in Papua New Guinea.

i) Social effect

_____

_____

ii) Environmental effect

_____

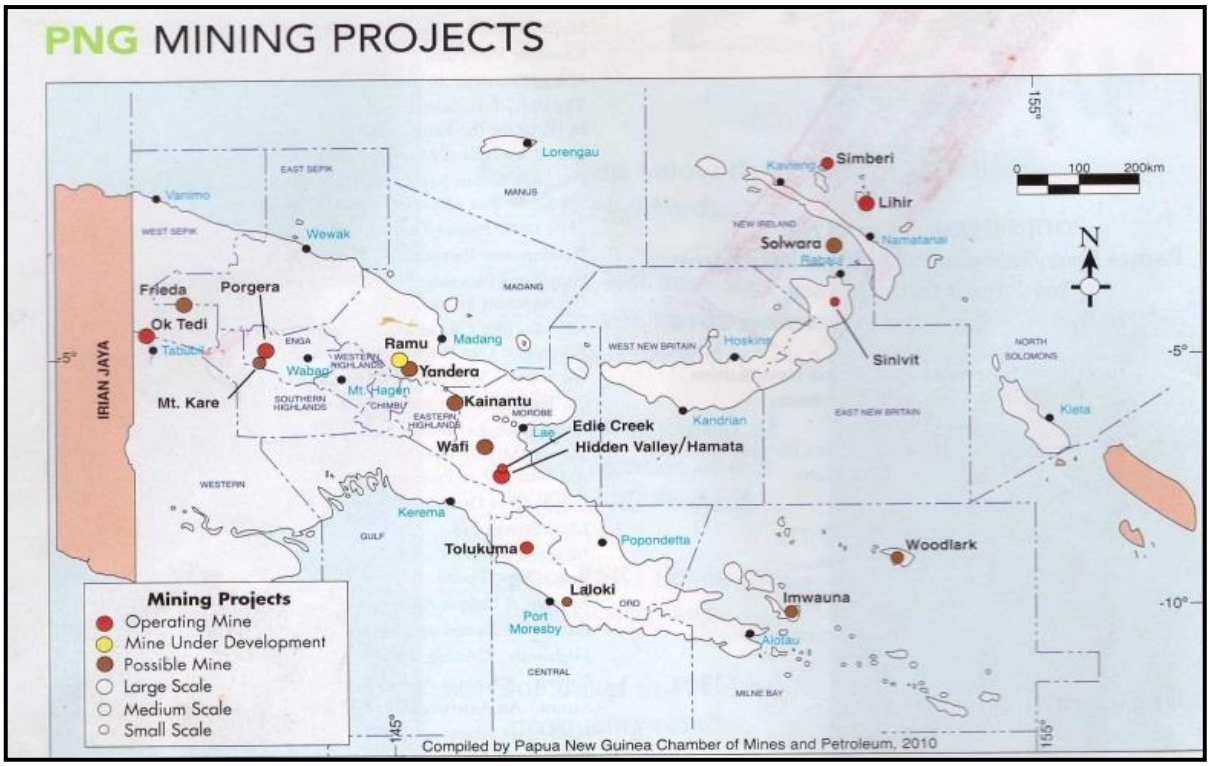
_____

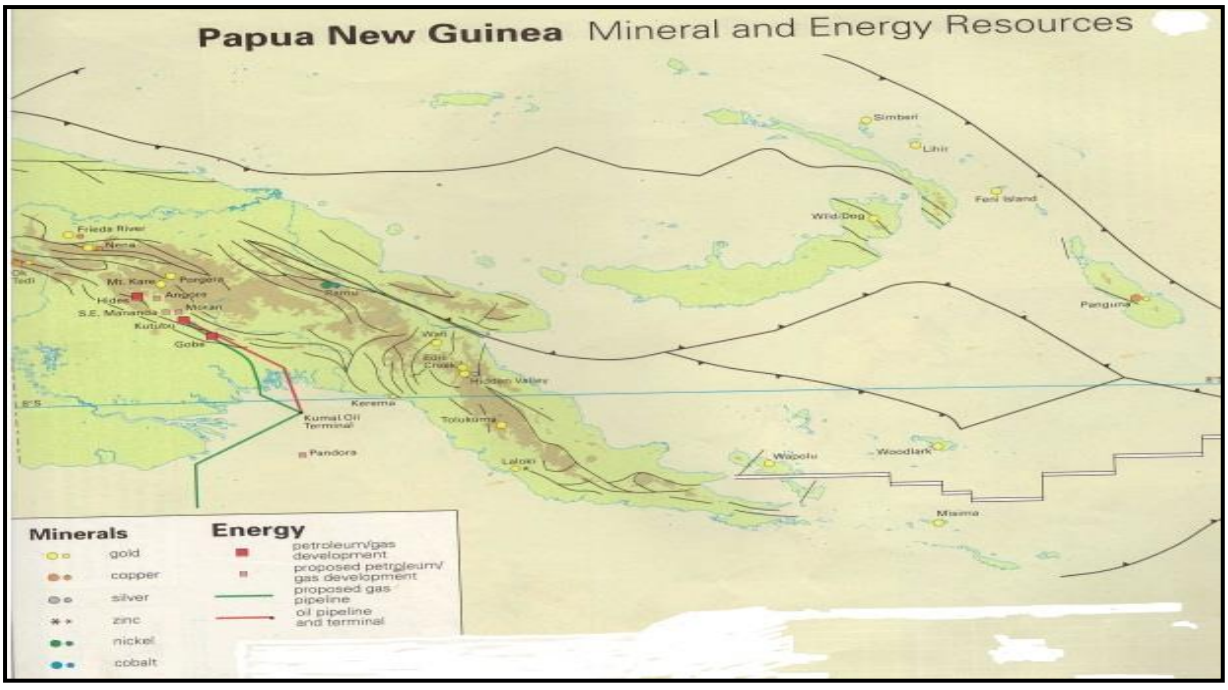
5. Write down two benefits of mineral resources.

(i) _____

(ii) _____

6. Use the two PNG Mining maps on the next page to answer the questions that follow.





6.1 Name four large operating mines in Papua New Guinea today and for each state what mineral is being mined.

a) _____ _____

b) _____ _____

c) _____ _____

d) _____ _____

6.2 a) Which mine is now under development?

_____

b) What is being mined here?

_____

6.3 Name four areas of possible mines and state what is expected to be mined.

a) _____ _____

b) _____ _____

c) _____ _____

d) _____ _____

NOW CHECK YOUR ANSWERS AT THE END OF THE TOPIC

Lesson 12: Non-Renewable Energy Resources.

Welcome to Lesson 12**.** In the previous lesson we have looked at mineral resources, their uses and their benefits and problems of mining minerals. In this lesson we will learn about non-renewable resources.

Your Aims

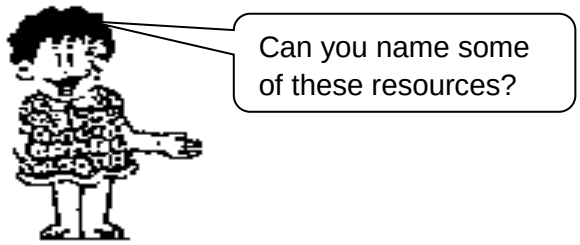
- define non-renewable energy resource
- identify examples of non-renewable energy resources and their uses
- explain the advantages and disadvantages of non-renewable energy sources
- identify energy conservation practises and policies in PNG and other parts of the world.

What are non-renewable energy resources?

Non-renewable energy resources are referred to as fossil fuel because they are formed underground from remains of living things (organic) millions of years ago. Fossil fuel includes oil, natural gas, coal and nuclear energy

Energy sources produce power. Power is needed to run transportation, lighting, factories and machines. We often call energy sources just ‘energy’.

There are both renewable and non-renewable energy sources. Petroleum (also called mineral oil, or just oil), natural gas and coal are non-renewable sources of energy.



Petroleum or oil

Crude oil, commonly known as petroleum, is a liquid found within the earth. It is made of hydrocarbons, organic materials and small amount of metal. Crude oil is created through the heating and compression of organic materials over a long period of time. It can be made into gas, petrol, kerosene, diesel fuel, oils and bitumen. These products are used in houses for heating and cooking and in factories as heat energy. They are also used in power stations and to provide fuel for transport. However their use, especially petrol and diesel, produces large amount of carbon dioxide emissions. It also produces other poisonous gases that may harm the

environment and people's health. Another common use of petroleum is in producing petrochemicals such as plastics.

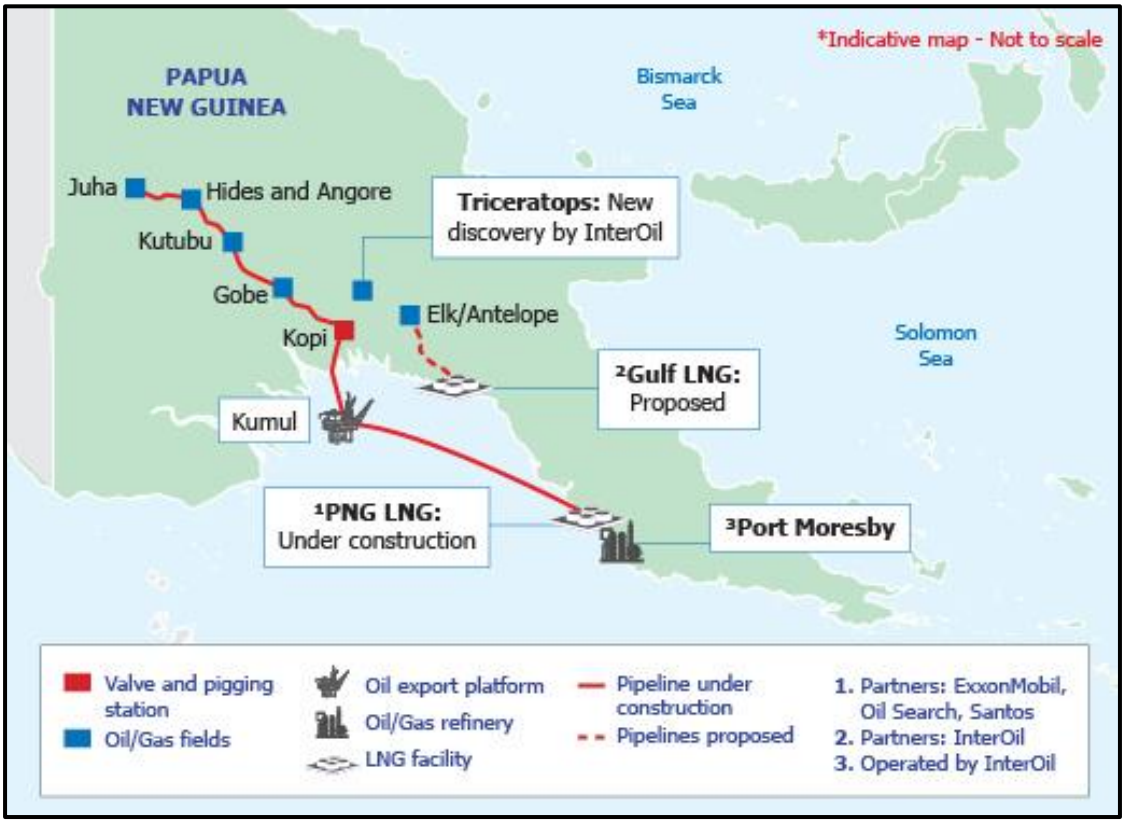
Papua New Guinea is fortunate to have oil and gas found in the country. This two non-renewable energy resources have been developed and are now been exported overseas.

A lot of jobs have been created for Papua New Guineans and money is now coming in from the exports of our oil and gas. This may improve our economy and the general living standards of the people.

The map below shows the oil and gas fields in Papua New Guinea.

Kumul terminal in Gulf – this is where crude oil is loaded onto tankers to be transported to refinery sites.

OIL AND GAS FIELDS IN PAPUA NEW GUINEA



The table below shows what becomes of a barrel of oil

Uses of Oil

Litres	Product
80	Gasoline
11	Jet fuel
34	Distillates for low grade fuels such as kerosene and diesel; and Petrochemical feedstock for plastics, fertilisers and many other products
15	Lubricants
11	Heavy residue such as asphalt, pitch and tar

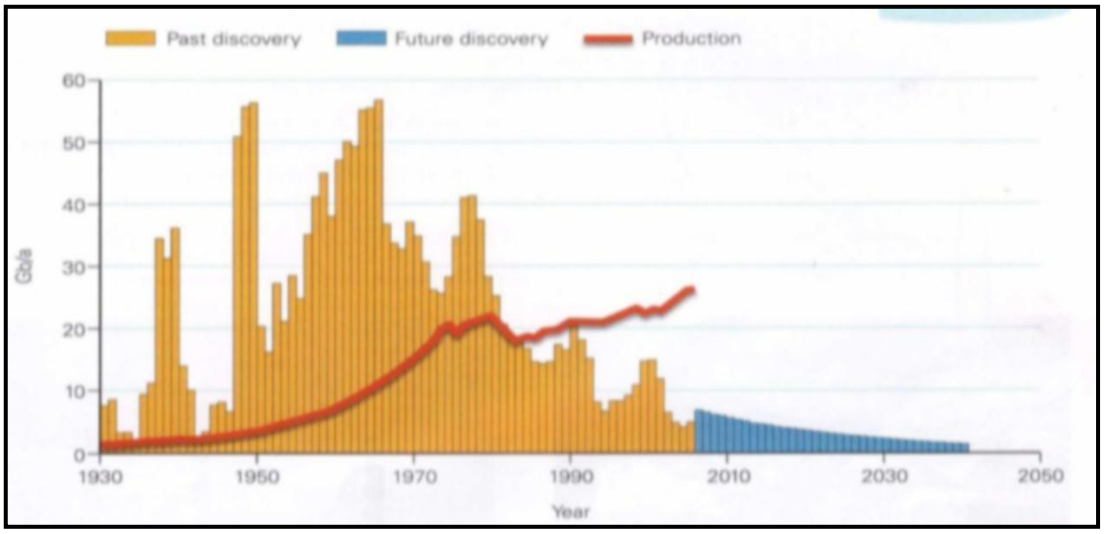
Petroleum is becoming scarcer. The world may have reached **peak oil**. This means that production has peaked. The 'peak' is the top.

The graph below illustrates the idea of peak oil. The line for production is starting to fall. The peak has been reached. once before, around 1980, and then went up again. It now appears that it will unlikely grow again. We may have been near or may have passed the peak.

PEAK OIL is the point where oil production stops growing and oil becomes scarcer and scarcer resulting in less production each year.

The graph below shows the general decline in the oil discovery.

OIL DISCOVERY AND PRODUCTION



Gb stands for billions of barrels. A barrel of oil is about 159 litres.

Natural Gas

Natural gas is a gas that occurs deep beneath the earth's surface. Natural gas consists mainly of methane (a gas).

Natural gas is a cleaner non-renewable energy source than oil, but it still has pollution problems. It must be cleaned to become pure methane gas to be used as fuel. Natural gas can be used as a fuel or to make materials and chemicals.

What is liquefied natural gas?

Liquefied natural gas (LNG) is natural gas that has been cooled to a liquid state, for shipping and storage.

The volume of natural gas in its liquid state is about 600 times smaller than its volume in its gaseous state. This process, which was developed in the 19th century, makes it possible to transport natural gas to places pipelines do not reach

They are likely to become scarcer. As gas becomes scarcer the price will go up. This means gas companies in PNG should earn more money and pay more taxes.

PNG liquefied natural gas (LNG) project in Hela is now exporting gas overseas while the Papua LNG project in Gulf province is currently underway. The Project in Hela will produce 6.9 million tonnes of LNG per year.

The project is expected to improve the quality of life for Papua New Guineans. Landowners will benefit from direct royalty payments as well as social and infrastructure development.

Coal

Coal is a black or brown rock formed from organic matters that have changed over millions of years.

Coal is still an important fuel. It powers many electricity stations around the world and is a source for industry.

As coal is burnt it produces large amount of carbon dioxide, one of the gasses responsible for the enhanced greenhouse effect (the increase in the world's temperature due to the increased insulation effect of the earth's atmosphere). There is at least a 100-year supply of coal running.

Workers sort coal by hand at a mine outside Jen Cheng in central China.

The world's largest coal producers are Russia, Australia, China, India, the USA, Indonesia and South Africa. The largest known reserves are held by the US, Russia, China, Australia and India. These countries have more interest in coal. It is part of their natural resource wealth.

Nuclear energy

Nuclear energy is the energy released when atoms are either split or joined together. Minerals called uranium is needed for this process.

Heat energy and steam produced can drive an electricity generator in a power station, or provide direct mechanical power in a ship or submarine. At each stage of the process various types of radioactive waste are produced. This waste is poisonous and can cause harm to people and the environment coming into contact with it.

Generally all non-renewable energy resources have benefits and problems too.
These can be expressed as advantages and disadvantages of using non-renewable energy resources.

Some advantages are:-

- Very convenient as it produces electricity for light at homes and heat for cooking.
- Produces fuel for transportation.
- Provides fuel for machines in factories.
- Brings about income for the country.
- Produces wealth for ordinary citizens.
- Generally makes life easier.

Some disadvantages are:-

- Thick smoke and gases produced from the factory pollutes the air.
- Car exhaust pollutes air, plants and affects people's health.
- Can never be easily replaced.
- Too much dependent on this has caused people to become very lazy.

- Economy can be crippled if production level drops.
- It is costly to use such energy resource.
- Much of gases produced are now causing global warming.

Conservation of non-renewable resources

Running out of non-renewable resources

Non-renewable resources in the world will run out one day. There will be less to extract, the demand of non-renewable resource will increase causing the prices to go higher and higher. What will happen when non-renewable resources become scarcer? Here are four possible results:

- Paying more and more – The cost of these energy resources will become more expensive.
- Using substitutes – We may find a substitute for these resources. Beeswax candles, sperm whale oil or pandanas torches can be used for light instead of kerosene lamps.
- Just doing without – We just have to do without these resources.

- More recycling – We may be able to recycle and reuse materials. Again this depends on prices and substitutes. Recycling works when prices of mineral are high enough.

Summary

You have come to the end of the lesson. In this lesson you have learned that:

- non-renewable energy resources can also be known as fossilised fuels.
- these resources are very important because they are a source of energy which is useful to mankind. Such as transportation, manufacturing and household uses.
- there are also major issues affecting the world today because of the great demands it has on people. The pollution of air, sea and land, the global warming and general people's attitude.
- measures taken to control exploitation of such resource are minimal as the energy sources are a need.

NOW DO PRACTICE EXERCISE 12 ON THE NEXT PAGE

Practice Exercise 12

1. Define non-renewable energy resource?

   _____

2. Complete the table below by filling in missing space with correct terms or appropriate sentences.

ENERGY SOURCE	ITS USES	THE ADVANTAGES	THE DISADVANTAGES
i)_____	Burned in power stations, to make electricity and a source of heat.	Quite cheaper	Produces large amount of carbon dioxide.
Natural gas	ii) _____ _____ _____	Can easily be used at home for cooking and reduce gas emissions.	iii) _____ _____ _____
iv)_____	When atoms are split or joined together it produces heat which can drive electricity generators in power stations.	v) _____ _____ _____	Produce radioactive waste which is poisonous to living things.
Petroleum (Oil)	vi) _____ _____ _____	Can be made into a variety of fuel (heat energy sources) such as gas, petrol, kerosene, etc...	Produces large amount of carbon dioxide emissions

3. Which of the above are fossil fuels and why are they referred to as that?

   _____

   _____

4. What does it mean by peak oil?

   _____

   _____

5. Use the graph on page 98 to do the following.

i) In which year was the highest discovery in oil made?

_____

ii) In what year did the oil reach its peak for the first time?

_____

iii) The second peak in the graph shows positive signs of improvement. What could be the possible reason for this?

_____

_____

_____

6. Use the table on page 98 to answer these two questions.

i) In which product is oil used the most?

_____

ii) A barrel of oil is equivalent to 159 litres of oil. How many litres of oil is left for other uses?

_____

7. What may happen if the non-renewable energy resources become more and more scarce?

_____

_____

8. What are four (4) possible results if we run out of non-renewable resources?

_____

_____

9. Who will benefit directly from the PNG LNG Project?

_____

NOW CHECK YOUR ANSWERS AT THE END THE TOPIC

ANSWERS TO PRACTICE EXERCISE 10-12

Answers to practice exercise 10

1. Non-renewable resources are those that cannot be replaced or can be replaced over a very long time.

2. They are found in the lithosphere and are extracted through mining.
   They are limited
   Extracting minerals, petroleum and gas costs a lot of money
   Non-renewable mineral resources are mainly located along the edges of the continental plates.
   They are also located where the plates uplifted in the past

(Any two of the above)

3. 3 mining sites

4. Gold and silver

Answers to practice exercise 11

1. Mineral resources are part of non-renewable resources which are extracted from the ground.

2. Four examples of mineral resources;

   i) Gold
   ii) Copper
   iii) Silver
   iv) Nickel, Cobalt etc.

3. The uses of
   i) Gold – is used in jewellery
   ii) Copper – excellent conductor of electricity; used for wire, coins plumbing etc.
   iii) Nickel – used in alloys, batteries, plating and coins.

4. I) Social effect can be unwanted immigrants, gambling, prostitutions, etc.
   (ii) Physical effect can be flooding downstream, causing sedimentation, destruction of river bank gardens, fish and plant life.

5. Benefits of minerals can be; tax money for national, provincial and local governments. Compensation and royalty for landowners, etc.

6.

   6.1 a) Ok Tedi – Copper
   b) Porgera – Gold
   c) Hidden Valley – Gold
   d) Lihir – Gold

   6.2 Ramu – Nickel

6.3 a) Frieda – Copper & Gold
b) Yanderra – Copper - Molybdenum
c) Kainantu – Gold
d) Wafi – Gold
e) Solwara 1 -Gold

Answers to Practice Exercise 12

1. Non-renewable energy resources are things that taken out from the ground and cannot be replaces.

2.

ENERGY SOURCE	ITS USES	THE ADVANTAGES	THE DISADVANTAGES
i) Coal			
	ii) Used in stoves and hot water systems.		iii) If not careful can easily explode to burn homes - Quiet expensive
iv)Nuclear energy		v) Heat energy and steam produced can drive an electricity generator in power station.	
	vi) Used in house for heating and cooking and in factories as a source heat energy.		

3. Coal, oil and natural gas are also called fossil fuels because they were formed from fossilised remains of plants and animals that lived long ago.

4. It is the point where oil production stops growing and oil becomes scarcer and scarcer as less is produced each year.

5. i) 1965
ii) 1980
iii) Because of new discovery of oil.

6. i) Gasoline
i) 8 litres

7. The cost of oil will increase.

8. There are four possible results.

i) Paying more and more
ii) Using substitutes
iii) Just doing without
iv) More recycling

9. Landowners will benefit from direct royalty payments as well as social and development infrastructure.

YOU HAVE COME TO THE END OF TOPIC 2. NOW TURN TO YOUR ASSIGNMENT BOOK 1 AND COMPLETE TOPIC TEST 2 BEFORE YOU PROCEED TO THE NEXT TOPIC.

TOPIC 3

PEOPLE AND THE EARTH

In This Topic You will Learn About:

- **Land Use by Hunters and Gatherers**
- **Land Use by Early Farmers**
- **Changing Resource Use after Industrial Revolution**

TOPIC INTRODUCTION

In this topic you will study the impact of peoples' early activies on the environment. The topic is made up of three lessons. They are;

Lesson 13 : Land Use by Hunters and Gatherers
Lesson 14: Land Use by Early Farmers
Lesson 15: Changing Resource Use after Industrial Revolution

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

- Describe the lifestyle of hunters and gatherers and state how they used land and the impact it had on the environment.
- Explain how land was used by early farmers and the impact it had on the environment.
- Define industrial revolution and identify resources used during this time.
- Describe the impact of industrial revolution on our environment.
- Discuss how the growth of factories affects the demand for resources.

We hope you will enjoy this topic.

Your teacher

Lesson 13: Land Use by Hunters and Gathers

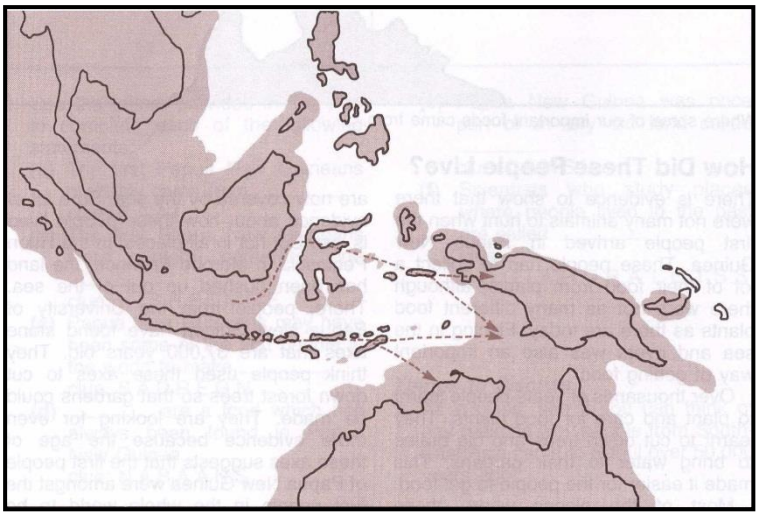
Welcome to lesson 13. In the previous lesson we learnt about non-renewable energy resources, their uses, the benefits and problems relating to the use of energy sources. In this lesson we will be looking at how our ancestors used land long ago.

Your Aims

- Discuss land use by hunters and gatherers
- Explain the lifestyle of hunters and gatherers.
- Discuss the impact of hunting and gathering.

Historians think that the first people came to Papua New Guinea from South East Asia. From studies they say man came to our part of the world about 40,000 to 50,000 years ago. The map below shows the route in which they took to travel.

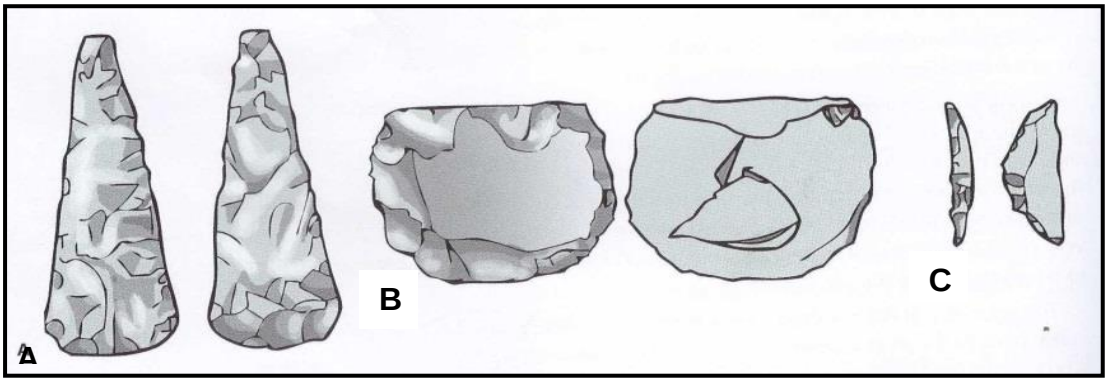
EARLY MIGRATION ROUTE



The lifestyle of the early Pacific people

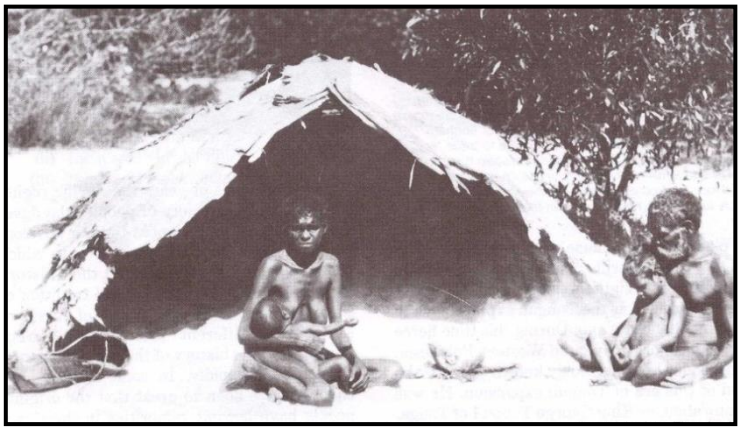
These early people did not develop any form of advance technology. Their tools and weapons were very simple and primitive suited to their needs. They developed technologies to gather these resources. They had limited control over nature, but they had the intelligence to learn and adapt to many different environments. They learned to make stone and other tools. Their most powerful tool was fire.

Hunters provided the protein necessary to support human brains. All types of protein were hunted: insects, birds, fish and animals. Women would hunt with traps, nets and baskets to collect protein rich food sources. Men used rocks, poles, spear, slings, traps and bows and arrows. Both men and women collected vegetable foods, from nuts and seeds to tubers, vegetables, fruits and edible leaves.



These are examples of Australian Small Tool Tradition. It started 5000 to 6000 years ago. (The tool marked A are spear points, B are choppers, C are scraping tools or small cutting blades).

The Pacific people lived a self-sufficient or self-reliant way of life. They gathered and produced most of their needs from their own environment. Other needs were obtained by trade. Their methods of obtaining food were different in different places. Some were nomadic hunters and gatherers who moved within their traditional tribal boundaries following the annual food supplies. The Aboriginal people of Australia obtained their food in this way. Their land use was extensive (this meant that people used large areas of land). In the swamp lands of Papua New Guinea, wild sago was processed to provide the staple food to be eaten with hunted and gathered food.



A traditional Aboriginal Family

These early Pacific people did not need high level technology to survive. Their **material culture** (tools, weapons, household equipment and so on) was simple, but suited to their needs. Their clothes were made of leaves and bark of trees. They dressed briefly or even went naked. Their **non-material culture**, however, was probably very complex. The non-material culture includes things such as the relationships and expected behaviour between people and groups, the organisation and rules of the society, the religious beliefs and the relationship between the real world and the spiritual world. Much later in history, when Europeans came to the pacific, the Europeans usually judged the people by their material culture and had no understanding of their rich and complex non-material culture.

The effect of hunting and gathering on the environment

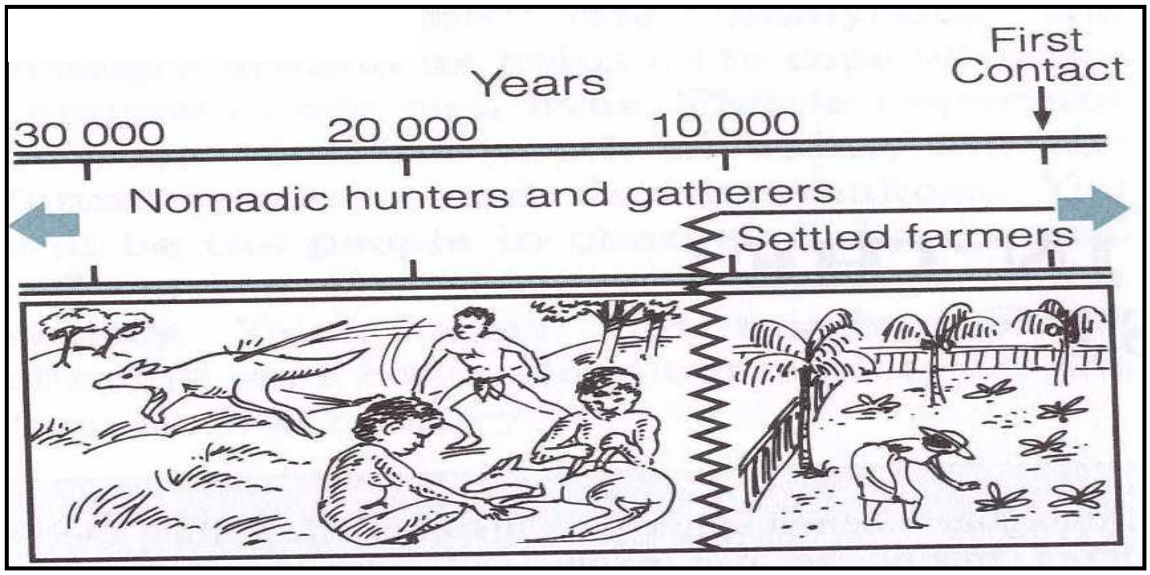
Different groups of hunter-gathers had very different cultures. This changed some aspects of land use. An animal was sacred in one culture but not protected in another. In some places, hunter-gatherers changed the vegetation with the use of fire. Burning year after year could keep grasslands clear. In many parts of the world, this would have been done on a small scale. Human may have helped change vegetation where climate was also changing. They may have sped up process of climate change.

Pacific people had led isolated, unchanging lives for thousands of years. In the process of seasonal migrations following food supplies, these early ancestors have gained new experiences as well as problems. Some of these were:

- Plants and animals required for hunting and gathering become scarce.
- Big trees and bushes were cleaned to make way for plants that can be domesticated (look after)
- In doing so the animals migrated or become extinct (died out)
- Offshore island people of New Guinea who ran out of animals for hunting brought in new animals from the mainland.
- People began to live more settled life to care for plants and animals to provide them with more food.
- People began to trade with neighbouring communities for their needs.

Refer to the time line below to understand the changes in lifestyles of hunters and gatherers.

TIMELINE SHOWING CHANGES IN LIFESTLE OF EARLY PEOPLE



Human societies evolved or change in stages over thousands of years. The first stage was hunting and gathering. The second stage was hunting, gathering and agriculture. In the third stage, people learned to make gardens and raise animals.

SUMMARY

You have come to the end of lesson 13. In this lesson you have learned that:

- the ancestors of Papua New Guinea arrived from South East Asia about 40,000 to 50,000 years ago.
- they have lived as nomads, hunters and gatherers for much longer time than as settled farmers.
- their material culture was very simple, however had complex non-material culture.
- the impact of hunting and gathering gradually changed the environment and their lifestyle.

NOW DO PRACTICE EXERCISE 13 ON THE NEXT PAGE

Practice Exercise 13

1. The ancestors of Pacific people have migrated from the west. Which country is west of PNG?

   _____

2. What does it mean by nomadic lifestyle? Write a paragraph to describe this.

   _____

   _____

   _____

   _____

   _____

   _____

3. Define these terms:

   i) Material culture

   _____

   ii) Non-material culture

   _____

4. Study the two timelines shown in the lesson and answer the following questions.

   i) Approximately how long did our ancestors live a nomadic lifestyle since their arrival in the Pacific?

   _____

   ii) When did people begin to live a life of subsistence farming?

   _____

   iii) When did people begin to live in the highlands?

   _____

iv) There have been three (3) stages in the Pre-History of Papua New Guinea. List them.

a) _____

b) _____

c) _____

5. Write two effects of hunting and gathering on the environment.

i) _____

ii) _____

NOW CHECK YOUR ANSWERS AT THE END THE TOPIC

Lesson 14: Land Use by Early Farmers

Welcome to lesson 14. In the previous lesson we have learnt about land use by hunters and gathers. In this lesson we will learn about land use by early farmers.

Your Aims

- describe the early farmers
- explain the land use by early farmers
- describe the impact of the early farming on the environment
- Identify places and periods where early farming took place

Land use by Early Farmers

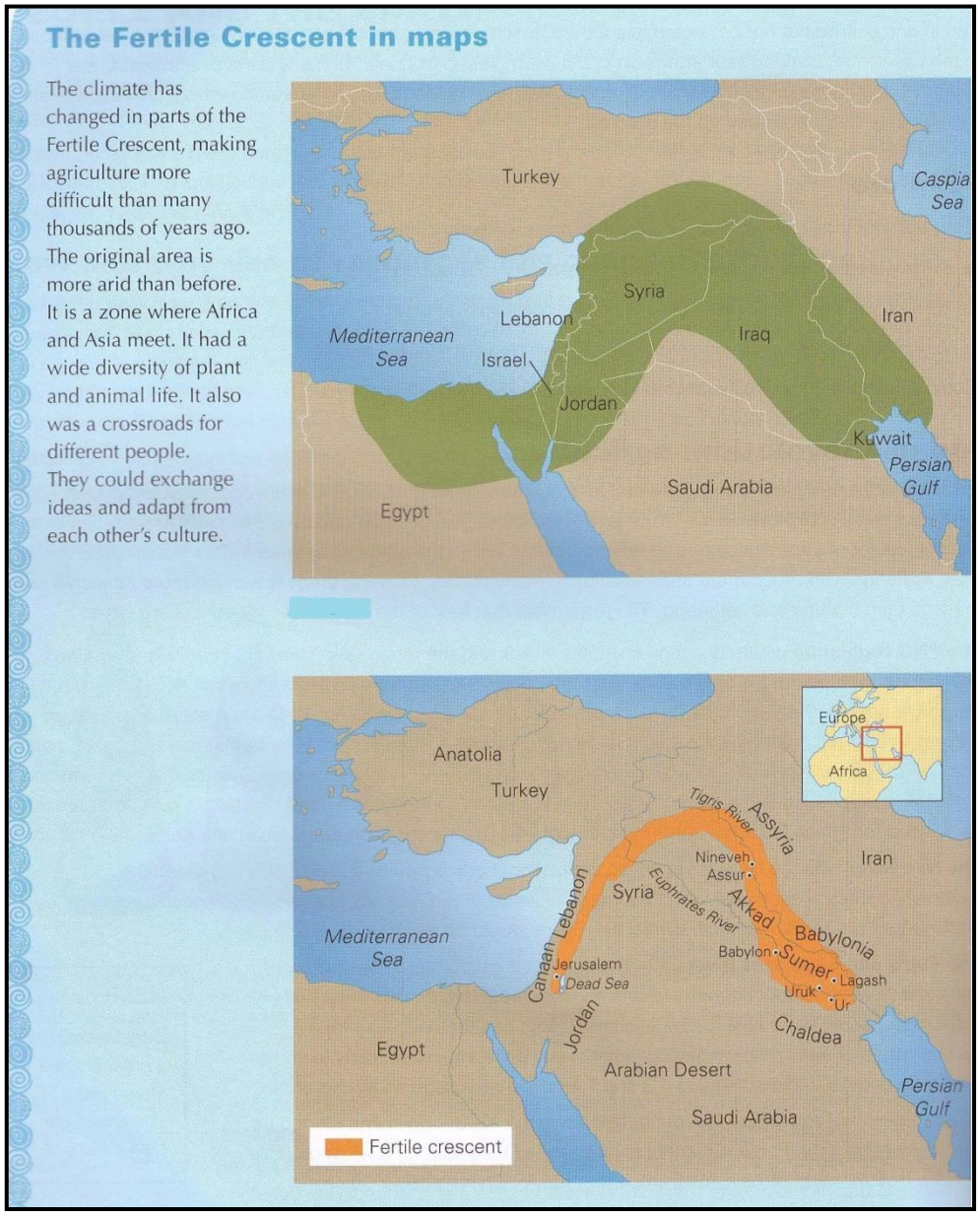
Humans moved from hunting and gathering to agriculture some 9,000-10,000 years ago. Maybe this happened earlier in some parts of New Guinea. You have studied the changes that agriculture brought to societies and the land in earlier grades. Agriculture allowed people to build permanent settlements which gradually led to the development of cities. People began to specialise in doing different tasks which then changed the land use from extensive to intensive. Farming land now became intensive because extensive use of land became unpopular.

Papua New Guinea has had a long history of farming. Our ancestors were some of the world's early farmers. The first four places of agriculture were:

- **The Highlands of Papua New Guinea** where drainage channels at Kuk and the terraces of Yonki show how land use was changed by agriculture. No one is sure of what the people were growing. Taro is the most likely crop, but it may have been something else. The earthworks of both places show that large-scale social organisation was required. This must have taken generations to develop. There are other hints that forest management and possible other types of agriculture invention happened earlier in Papua New Guinea. The ancient stone blades were found at Sialum on the north coast of Morobe province. No one is sure what this was used for. Much later, the same type of tool was used for agriculture in Japan and Korea.

- **The Nile River** was the base of Egyptian civilization. Early agriculture there used irrigation. The river replenished the soil each year with flooding. The water of the Nile has been used for agriculture for at least 7,000 years. It is a vital resource. Without it, Egypt would be a barren desert.

- **The Tigris and Euphrates River** is part of what is called the Fertile Crescent. These are developed agricultural sites for grains and legumes. These sites had wild wheat and barley that people were able to grow. They also had the wide base for a number of other crops including lentils.



China developed agriculture independently along the Yellow River and started its own civilisation. (Fertile Crescent is often called the cradle of civilisation. This may be true for parts of Asia and Europe, but not for China or New Guinea.)

The development of agriculture (both arable farming and domestication of animals) caused major changes in lifestyle in Papua New Guinea. People began to settle in one place for longer periods of time and built more permanent house. Agriculture made it possible for people to have more control over their food supply and so they had more time to spend on activities such as carving, dancing and story-telling. They had to organise their societies in new ways with new laws. New roles developed and women gained new status because of their importance in farming. Making gardens also meant that people began to change their environment and to develop new knowledge and beliefs about land use.

Summary

You have come to the end of the lesson. In this lesson you have learned that:

- humans moved from hunting and gathering to agriculture some 9,000-10,000 years ago.
- agriculture allowed people to build permanent settlements.
- archaeological evidence suggests that the Euphrates and Tigris River, the Nile River and Papua New Guinea may have been the birth place of agriculture.
- the Tigris and Euphrates River is part of what is called the Fertile Crescent.
- china developed agriculture independently along the Yellow River and started its own civilisation.
- the development of agriculture (both arable farming and domestication of animals) caused major changes in lifestyle in Papua New Guinea. People began to settle in one place for longer periods of time and built more permanent house.

NOW DO PRACTICE EXERCISE 14 ON NEXT PAGE

Practice Exercise 14

1. What kind of lifestyle did the early humans have before the introduction of agriculture?

   _____

2. What major change took place in their lifestyle?

   _____

3. What kind of artefact was discovered in Sialum?

   _____

4. Why is the Fertile Crescent difficult for agriculture today?

   _____

NOW CHECK YOUR ANSWERS AT THE END OF LESSON 14

Lesson 15: Changing Resource Use after Industrial Revolution

Welcome to Lesson 15.. In this lesson you will learn about the changing resource use after the Industrial Revolution.

Your Aims:

- define Industrial Revolution
- identify the natural resources used during the Industrial Revolution and their significance
- explain the impact of Industrial Revolution on our environment
- discuss how the growth of factories affect the demand for resources

The Industrial Revolution

The Industrial Revolution, which began in England, was a period in the late 18th and early 19th centuries when the life of ordinary people was changed dramatically forever. It was a time of numerous inventions, so industry developed so fast that society could barely keep up.

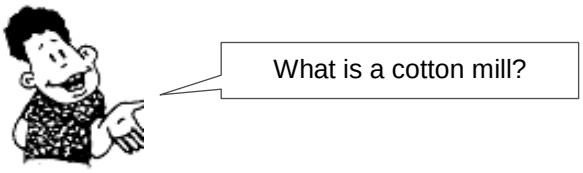
Before the Industrial Revolution, life for most people in England was a farming and rural lifestyle. Communications and travel were limited. Manufacturing was done by natural means, such as windmills. Life was hard, and people worked hard to pay the rent and put food on the table. Education was not available for ordinary people.

A Painting of Industrial Activities during the Industrial Revolution in England

The Industrial Revolution started in England around 1733 with the first cotton mill. A more modern world had begun. As new inventions were being created, factories followed soon thereafter. England wanted to keep its industrialization a secret, so they prohibited anyone who had worked in a factory to leave the country. Meanwhile, Americans offered a significant reward to anyone who could build a cotton-spinning machine in the United States. Samuel Slater, who had been an apprentice in an English cotton factory, disguised himself and came to America. Once here, he reconstructed a cotton-spinning machine from memory. He then proceeded to build a factory of his own. The Industrial Revolution had arrived in the United States.

An apprentice is a young person who works for an employer for a fixed period of time in order to learn the particular skills needed in their job.

The Industrial Revolution brought severe consequences to society. Factory owners, needing cheap, unskilled labor, profited greatly by using children and women to run the machines. By the age of 6, many children were already working 14 hours a day in factories! These kids had no free time to do anything else and earned low wages. Some got sick and died because of the toxic fumes, while others were severely injured and sometimes killed working at the dangerous machines in factories. Obviously, the Industrial Revolution had both good and bad sides.



A cotton mill is a factory that houses spinning and weaving machinery, typically built between 1775 and 1930.

Was Natural Resources Needed During the Industrial Revolution?

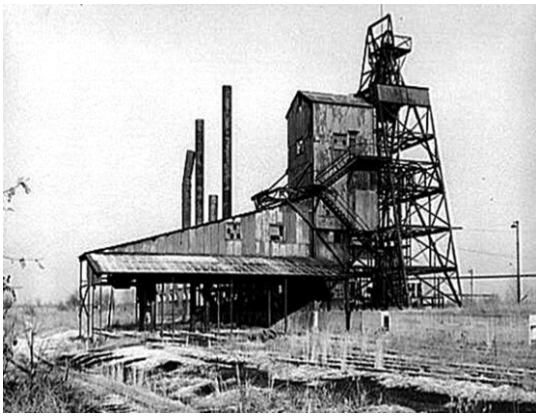
A good supply of natural resources is a vital need for an industrial revolution. Without natural resources it would be impossible for a nation to enter into an industrial revolution. Natural resources are needed for a variety of things, such as energy sources and material used to make goods. Also natural resources are needed to build equipment to be able to produce goods.
This Industrial Revolution took place in Great Britain almost a century before any other country. At the time Great Britain was a very powerful country that controlled many colonies. The country gained abundant, useful resources from these colonies that aided its growth. The country had also just experienced an Agriculture Revolution that led to many farmers being put out of work as well as an abundance of new ideas and inventions. Great Britain not only had a large population that could support the demand for workers in factories, they also had those many farmers who were out of work and looking for employment. During the Industrial Revolution the government of Britain was stable, wealthy and supportive of economy growth. Great Britain was industrialized first because they had access to abundant natural resources, enough money, machines and ideas from the Agriculture Revolution. There were enough people to support the demand for workers, and the government was very keen on improving the country's economy.

Steam Engine

One very important natural resource needed during the industrial revolution was **coal**. Coal was for the most part used as a source of power. Power was needed to run machines. Coal could be burned to produce heat to run steam engines. Coal replaced the use of timber as something to burn. Coal was adopted by the brewing, metalworking, and glass and ceramics industries, demonstrating its potential for use in many industrial processes. Another use of coal was discovered by English industrialist Abraham Darby who successfully used coke, which was a high-carbon, converted form of coal, to produce iron from iron ore. Using coke eliminated the need for charcoal. This was good because charcoal was more expensive and less efficient as fuel. After this, metal makers discovered ways of using coal and coke to speed the production of raw iron, bar iron, and other metals.

Coal Mine

Another natural resource that was very important for the success of the industrial revolution was iron. It was possible to produce iron because of the recent advancements in uses of coal to produce iron from iron ore. This gave to opportunity for metal workers to use coal and coke to speed the production of raw iron, bar iron, and other metals. The most important progress in iron production occurred in 1784 when Englishman Henry Cort invented new techniques for rolling raw iron.



Coal Smelter in the Industrial Revolution

This was a finishing process that shaped iron into the shape and size that was needed. All of this enabled iron to be used in many new and different ways, such as building heavy machinery. Without the heavy machinery that was made out of the iron much of the work that was done during the Industrial Revolution would not have been accomplished. Another very important use of iron was the use in railroads. This led to great advancements in transportation during the Industrial Revolution.

Iron

It is because of these main natural resources and many others the Industrial Revolution caused the nation to thrive and take huge steps in industrialization. The 18th and 19th centuries completely changed the nation. This would not have been able to happen without the abundance of natural resource within the nation.

Now do activity one (1) below.

Activity 1

1. In which country did Industrial Revolution start?

   _____

2. List three conditions in this country that made Industrial Revolution possible.

   i. _____

   ii. _____

   iii. _____

3. To which country did Industrial Revolution spread to and how did this happen?

   _____

   _____

   _____

4. Which natural resource was used as a source of power in the Industrial Revolution?

_____

NOW CHECK YOUR ANSWERS AT THE END OF PRACTICE EXERCISE 15

Environmental Impact of the Industrial Revolution

The birth of the industrial economy' meant there was massive increase in energy use, obtained by burning fossil fuels. This powered the development of new industries, transport and a massive tproductiont of material, and also allowed a large increase in the UK population.

These impressive increases in material flows, enabled by Great Britain's control of powerful sources of energy, then transformed by new technologies into machines and goods, cameb the basis of much of the material wealth of a newly industrialized Britain. The industrial base also backed its military competency which allowed it access to the resources of a growing empire, but that is another story. Another effect of the Industrial Revolution was the mass migration of populations from the countryside to the fast growing towns and cities where the factories and work were to be found.

These cities had smoke hung over them and filth saturated them. The basic public services such as water supply, sanitation, street-cleaning and open spaces could not keep pace with the mass migration of men into the cities, thus producing, especially after 1830, epidemics of cholera, typhoid and an appalling constant toll of the two great groups of nineteenth century urban killers – air pollution and water pollution or respiratory and intestinal disease.'

Air and water pollution came, for example, from coal burning, as well as most stages in the production of metals and basic chemicals. In the absence of suitable sanitation and refuse collection, waste from domestic sources caused additional problems. The impact on the health of urban populations from water-borne diseases like cholera and typhoid, from air pollution, and occupational exposure to hazardous materials was often devastating, and particularly affected working families housed close to the industrial sources. Often the simple way of dispersing the pollutants more widely, by using a high chimney, for example, seemed sufficient to solve the problem.

The Industrial Revolution had many effects on the agricultural world as well. The Revolution allowed for greater production of food by the new machines that were created. This higher production of food led to a population explosion which in turn called for more food and turned into a cycle of more food and then more people.

Some things that changed the agricultural world that resulted from the Industrial Revolution were:

- **The seed drill.** The seed drill was a machine designed by Jethro Tull which mechanically planted seeds at a much faster and more efficient rate than hand seeding.

- **Fertilizers** were improved and these improved the quality of the soil, which in turn allowed higher production of better food. This led to a greater amount of people being fed, which led to a higher population.

- **The Enclosure Movement** was the consolidation of many small farms into one large farm. This increased the size of the farms. This movement left many people jobless and homeless. These people moved to the cities and were the work-force for the factories.. With all these people moving to the cities, the cities became crowded, unhealthy and extremely dirty, since they didn't have many modern facilities as sewage, garbage disposal, and other facilities.

A Modern Day Seed Drill

Jethro Tull's Seed Drill

An Artist Impression of a Typical European Society of the Industrial Revolution

Now do activity 2 below.

Activity 2

1. How was energy obtained during the industrial economy?

_____

_____

_____

2. Discuss an impact of the Industrial Revolution on the agricultural world?

_____

_____

_____

3. What was the advantage of the 'seed drill' invention?

_____

_____

_____

NOW CHECK YOUR ANSWERS AT THE END OF PRACTICE EXERCISE 15

Growth of Factories and the Demand of Resources

The growing demand for fossil fuels to power factories, cities and vehicles led to exploitation of more natural resources, for instance, the demand for coal to use in the steam engines. Between 1860 and 1900 there were many needs in the industry. These needs included communication, natural resources, power sources, cheap labor and applied technology. In the 1850s, 52% of all power came from animals while only 35% came from water and coal. By 1900s, the use of water and coal more than doubled to 73% of power sources. As factories grew and expanded the increased demand for more resources lead to over-exploitation of natural resources.

Recap the main points in the summary on the next page.

Summary

You have come to the end of Lesson 15. In this Lesson, you have learnt that:

- the Industrial Revolution started in England around 1733 with the first cotton mill.
- before the Industrial Revolution, life for most people in England was a farming and rural lifestyle.
- industrial Revolution brought severe consequences such as factory owners needing cheap, unskilled labor, profited greatly by using children and women to run the machines.
- the birth of the industrial economy' meant there was massive increase in energy use, obtained by burning fossil fuels.
- at that time Great Britain was a very powerful country that controlled many colonies. The country gained abundant, useful resources from these colonies that aided its growth.
- another effect of the Industrial Revolution was the mass migration of populations from the countryside to the fast growing towns and cities where the factories and work were to be found.
- there were many health and environmental problems associated with the massive growth during the Industrial Revolution
- three inventions, the Seed Drill, Fertilizers and the Enclosure Movement changed the agricultural world during the Industrial Revolution.

NOW DO PRACTICE EXERCISE 15 ON THE NEXT PAGE

Practice Exercise 15

1. List four problems that arose as a result of mass rural-urban migration during the Industrial Revolution in the United Kingdom.

   I. _____

   II. _____

   III. _____

   IV. _____

2. Explain how the burning of coal as a fossil fuel would have created air pollution in the cities.

   _____

   _____

   _____

   _____

3. List two disadvantages of the Enclosure Movement in the agricultural sector.

   a) _____

   b) _____

CHECK YOUR ANSWERS AT THE END OF TOPIC 3

ANSWERS TO ACTIVITY 1

1. Industrial Revolution started in England.

2. i. Great Britain was a very powerful country that controlled many colonies. The country
   gained abundant, useful resources from these colonies that aided its growth.

   Ii. Great Britain not only had a large population that could support the demand for workers in factories, they also had those many farmers who were out of work and looking for employment because of the technological replacements in their agricultural sector.

iii. Great Britain was industrialized first because:
- ✓ they had access to abundant natural resources,
- ✓ they had enough money, machines and ideas from the Agriculture Revolution,
- ✓ there were enough people to support the demand for workers, and the
- ✓ government was very keen on improving the country's economy

3. England wanted to keep its industrialization a secret, so they prohibited anyone who had worked in a factory to leave the country. Meanwhile, Americans offered a significant reward to anyone who could build a cotton-spinning machine in the United States. Samuel Slater, who had been an apprentice in an English cotton factory, disguised himself and came to America. Once here, he reconstructed a cotton-spinning machine from memory. He then proceeded to build a factory of his own. The Industrial Revolution had arrived in the United States.

4. Coal

ANSWERS TO ACTIVITY 2

1. Energy was obtained by burning fossil fuels and the main one being coal.

2. The Industrial Revolution allowed for greater production of food by the new machines that were created. This higher production of food led to a population explosion which in turn called for more food and turned into a cycle of more food and then more people.

3. The 'seed drill' mechanically planted seeds at a much faster and more efficient rate than hand seeding.

ANSWERS TO PRACTICES EXERCISE 13-15

EXERCISE 13

1. Indonesia

2. Nomadic lifestyle refers to how our ancestors lived by moving from place to place in search of food and water. Our ancestors were first hunters and gatherers and followed food resources seasonally. Men, women and children had different roles to play. Men hunted for animals while women collected and gathered food. Each female child helps with mothers chores.

3.

i) Material culture: refers to anything such as household equipment, tools and weapon that people have to determine their level of technology

ii) Non-material culture; a complex part of our culture which involves the relationships and expected behaviour between groups of people, organisation and rules of society.

4.

i) 30,000 to 40,000 years
ii) 10,000 years ago
iii) About 30,000 years ago

a) The first stage was hunting and gathering
b) The second stage was hunting, gathering and agriculture.
c) In the third stage people learnt to make gardens, plant crops and breed animals.

5.

i) Food supplies ran out and animals migrate.
ii) Change of the virgin forest.

EXERCISE 14

1. Hunting and gathering / nomadic lifestyle

2. People began to settle in one place for longer periods of time and built more permanent house. Agriculture made it possible for people to have more control over their food supply and so they had more time to spend on other activities.

3. The ancient stone blades

4. The change in climate had caused the fertile crescent to become arid and difficult for agriculture.

EXERCISE 15

1. i. Overcrowding
   ii. Absence of suitable sanitation and refuse collection
   iii. Increase in water borne diseases like cholera and typhoid
   iv. Air pollution

   (Accept any answers similar to the above found in the lesson notes)

2. Smoke and fumes from the factories and vehicles stay around in the atmosphere and was inhaled by people

3. a) The consolidation of many small farms into one large farm increased the size of the farms.
   b) This movement left many people jobless and homeless.

YOU HAVE COME TO THE END OF TOPIC 3. NOW TURN TO YOUR ASSIGNMENT BOOK AND COMPLETE TOPIC TEST 3 BEFORE YOU PROCEED TO THE NEXT TOPIC.

TOPIC 4

GOVERNMENT RESOURCE DEVELOPMENT AND MANAGEMENT IN PAPUA NEW GUINEA

In This Topic You will Learn About:

- **Resource Development and management**
- **Resource Management Policies**

TOPIC INTRODUCTION

In this topic you will study Populatopn Density and Distribution. The topic is made up of four lessons. They are;

Lesson 1 : Resource Development and Management

Lesson 2: Resource Management Policies

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

- State the different government departments and their agencies that are involved in the management of our natural resources.
- Identify the key resource management policies administered by the government departments through their state agencies.

We hope you will enjoy this topic.

Your teacher

Lesson 16: Resource Development and Management Policies

Welcome to Lesson 16. In the last lesson you learnt about the changing resource use after the period of Industrial Revolution. In this lesson you will learn about resource development and its management policies in Papua New Guinea

Your Aims:

- explain resource development and management policies
- discuss the role and the functions of the government in resource development and management through its various agencies
- identify the key resource management legislations and policies administered by the government departments through their state agencies

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This lesson will look at the natural resource development in the Mining, Fisheries and Forestry sectors and their management policies within their agencies.

Resource Development

'Resource' is defined as everything available in our environment which can be used to satisfy our needs, provided, it is technologically accessible, economically feasible and culturally acceptable. Equally important is developing the human resource, mainly through education.

How do we transform things into a resource? We transform things into resources with the help of nature, technology and institutions. The process of transformation of things involves an inter-dependent relationship between these components. Human beings interact with nature through technology and create institutions to accelerate their economic development. This of course is the process of resource development. When we process and refine them into a form where we can easily access and use to satisfy our needs and wants. For example, you can look at the simple carving of timber by a villager to make a canoe and compare this with the complex milling processes of copper ore in the mines. They are both examples of resource development.

A rural economy can undergo development if infrastructure is constructed to tap into valuable mineral deposits, like ore or oil. Oil extraction infrastructure can be constructed to extract crude oil as in the Southern Highlands Province. Further development might mean refining the oil into petroleum. You can develop human resources, as is what most companies aim to do when they wish to attract undergraduates or new talents.

Can you recall the meaning of Crude Oil? You may have come across this term in your Science Lessons.

Crude Oil is a mixture of hydrocarbons that exists with all its impurities as a liquid in natural underground reservoirs and remains liquid when brought to the surface.

It is important that resource development is done with some form of planning. We call this Resource Planning. This is usually a technique or strategy for the careful use of resources in a country.

The resource planning is necessary due to the following:

1. An equitable distribution of resources is essential for a sustained quality of life and global peace.
2. If the present trend of resource depletion by a few individuals and countries continues, the future of our planet is in danger.
3. It is essential for sustainable existence of all forms of life.
4. It is important in a country like Papua New Guinea, which has enormous diversity in the availability of resources.

Resource Management and Policies

Management is all about the organization and coordination of the activities of an enterprise in accordance with certain policies and in achievement of clearly defined objectives. Therefore, Natural resource management can be seen as the management of natural resources such as land, water, soil, plants and animals, with a particular focus on how management affects the quality of life for both present and future generations (stewardship).

Stewardship is an ethic that shows the responsible planning and management of resources.

Stewardship deals with managing the way in which people and natural landscapes interact. It brings together land use planning, water management, biodiversity conservation, and the future sustainability of industries like agriculture, mining, tourism, fisheries and forestry. It recognizes that people and their livelihoods rely on the health and productivity of our landscapes, and their actions as stewards of the land play a critical role in maintaining this health and productivity.

Natural resource management also goes well with the concept of sustainable development which is a scientific principle that forms a basis for sustainable global land management and environmental governance to conserve and preserve natural resources. It specifically focuses on a scientific and technical understanding of resources and ecology and the life-supporting capacity of those resources. Environmental management is also similar to natural resource management.

Ecology is the study of the interaction of people with their environment.

Natural resource management issues are obviously complex as they involve the ecological and hydrological cycles, climate, animals, plants and geography. All these are dynamic and inter-related. A change in one of them may have far reaching and/or long term impacts on the others and the damage done may even be irreversible or permanent. In addition to the natural systems, natural resource management also has to manage various stakeholders and their interests, policies, politics, geographical boundaries, economic implications and the list goes on. It is very difficult to satisfy all aspects at the same time. This results in conflicting situations.

Directors and managers have the power and responsibility to make decisions to manage an enterprise when given the authority by the shareholders. As a discipline, management comprises the interlocking functions of formulating corporate policy and organizing, planning, controlling, and directing the firm's resources to achieve the policy's objectives. The size of management can range from one person in a small firm to hundreds or thousands of managers in multinational companies. In large firms, the board of directors formulates the policy that the chief executive officer implements.

Now that you have this background information in mind, we shall examine how the government of Papua New Guinea develops and manages its natural resources in the country. The planning and development of all resources is done through the various government departments and their agencies. These processes are regulated by the relevant laws, regulations and policies.

Before we continue with the lesson, it is important that we distinguish between Laws, Regulations and Policies.

Policies in general are operating rules that can be referred to as a way to maintain order, security, consistency, or otherwise further a goal or mission. For example, a town council might have a policy against hiring the relatives of council members for civic positions. Each time that situation arises; council members can refer to the policy rather than having to make decisions on a case-by-case basis.

Laws are created by the Act of Parliament when legislative bills are passed. Basically, bills that go through the legislative process and are signed by the Governor General becomes law while regulations are proposed by the administrative branch. These go through the public hearing process and are approved by the Governor General and have the force of law. Policies are put into place by the administrative branch, may or may not go through a public hearing process, and while they do not have the force of law, they can greatly impact how programs and services are implemented.

Public Policies on the other hand must be formulated and implemented within a nation’s legal framework. They can be regulatory, distributive, or redistributive, material or symbolic, substantive (what government intends to do) or procedural (how something will be done and who will do it). Public policy is the sum of government activities, whether acting directly or through agents, as it has an influence on the life of citizens.

Therefore, *Management Policy* is about enforcing the policy (rules and regulations) of the organization.

Now do activity one (1) below.

Activity 1

1. How do we transform things into a resource?

_____

_____

_____

2. Give two reasons why Papua New Guinea needs to do resource planning.

I _____

_____

Ii _____

_____

3. Why is natural resource management seen to be complex?

_____

_____

_____

_____

_____

4. What is Sustainable Development?

_____

_____

_____

_____

_____

NOW CHECK YOUR ANSWERS AT THE END OF PRACTICE EXERCISE 16

We now take a look at some government agencies and what they do.

- **Papua New Guinea online**
  Has listing of most government departments and governmental agencies.

- **Prime Minister's Department**
  The Prime Minister's official website, which publishes his press and policy statements, provides up-to-date information about our Government generally, Ministers of Cabinet, our major policies, and the Government's vision for its people, and related information.

- **Department of Environment & Conservation**
  This department ensures that the natural resources are managed to sustain environmental quality and human well-being. Natural resources have been the focus of DEC's policy responsibilities which are the five environmental values: water, biodiversity, soil, air and a new environmental value, carbon which are being monitored, protected, conserved and sustainably managed.

- **Department of Mineral Resources**
  The Department of Mineral Resources is the department responsible for the regulating, monitoring, promoting and recording of mineral exploration and mining activity in Papua New Guinea

- **Department of Fisheries and Marine Resources**
  Papua New Guinea has an extensive and valuable fisheries sector ranging from inland river fisheries, aquaculture, and coastal beach de mer and reef fisheries to the prawn trawl and large scale deep-water tuna fisheries. The range of participants' covers artisanal community to medium sized domestic prawn and tuna long line operators to large international purse seine fleets in the deep water tuna fisheries.

The Papua New Guinea Mineral Resource Authority (MRA)

The Mineral Resources Authority (MRA) is the Government Agency responsible for the management, exploitation and development of Papua New Guinea's mineral resources, and regulatory and administrative decisions relating to such matters. The Authority promotes the orderly exploration for and development of the country's mineral resources.

- The MRA was established by an Act of Parliament in 2005 and commenced operations officially in June 2007. The principal structural framework comprises the establishment of:

  a) a Board of Directors;

  b) a Managing Director; and

  c) five (5) functional divisions

- Currently, with the growth, diversification and expansion of the mining industry in PNG, the MRA is geared towards meeting these challenges by putting in place internal systems and processes to better manage and respond to the demands of the industry.

- Similarly, the PNG Government is performing a review of its principal Act, the Mining Act 1992 and the Mining (Safety) Act 1977. MRA is working closely with other line agencies to ensure that other associated legislative and policy determinations are clear, concise and easily accessible by prospective investors
- A separate Government Agency called the Department of Mineral Policy & Geohazards Management (DMPGM) is responsible for setting the general government policy directives on mining and minerals. The MRA implements these government policies to allow a clear demarcation between policy and regulatory functions.

The PNG National Fisheries Authority

The PNG National Fisheries Authority is the primary regulatory and management body for the sector and it provides support and coordinate fishery development in the country. It also facilitates export certification and regulation and manages fisheries resources for sustainable growth.

Papua New Guinea has an extensive and valuable fisheries sector ranging from inland river fisheries, aquaculture, coastal beche-de-mer and reef fisheries to the prawn trawl and large-scale deepwater tuna fisheries. The range of participants covers artisanal community to medium sized domestic prawn and tuna longline operators to large international purse seine fleets in the deepwater tuna fishery.

The PNG fisheries zone of 2.4 million square kilometers is the largest in the South Pacific. This zone includes an extended reef system, numerous islands and an extensive coastline. These create huge opportunity but also present an enormous challenge for monitoring and control.

PNG FISHING EXCLUSIVE ECONOMIC ZONE MAP

The total market value of PNG catch is estimated at K350 to K400 million on average although information on the true value of artisanal fisheries is difficult to obtain and cyclical factors and commodity price movements especially for tuna because huge value swings from year to year. It is believed that there is significant potential to

increase the economic value and returns to PNG of these fisheries through better management and development programs.

Export earnings are important, but the importance of fisheries to the local markets and subsistence economy is also of major importance to the PNG people and economy. Reliable data on these markets is not available.

Access fees from deep-water fishing nations currently form the bulk of the revenues received and managed by National Fisheries Authority. Other sources include license fees from other operators, assistance from donors and penalties arising from prosecutions under the Fisheries Management Act

The purpose of the National Fisheries Authority is to pursue their Vision through the operation of best practice service in order to fulfill their national and global obligations. NFA pursues this through their Business Groups.

1) **Directorate**
Providing dynamic and transparent leadership, informed decision making, and international recognition for fishery development and management practices

2) Board
Ensuring Good Governance and giving effect to Government Policies in Fisheries Development and Management

3) Corporate Services

Providing Efficient and Effective Administrative and Organizational Services in:

- Human Resources Management
- Legal Services
- Property Management
- Information Technology and Management
- Communication and Public Relations

4) Finance and Accounts
Ensuring excellence in accounting and financial practice, investment, risk management, payroll and asset management

5) Fisheries Management
Achieving sustainable fisheries through dynamic, innovative and consultative fishery management practices and aquaculture development

6) Licensing and Data Management
Delivering a customer focused and timely license processing, data collection, entry and utilization

7) Monitoring, Control and Surveillance
Adopting and sustaining best practice systems in pursuit of full compliance with national, regional and international regulations, laws and codes of conduct

8) Provincial Support and Industry Development
Growing vibrant partnerships and well defined working relationships in pursuit of sustainable and equitable community fisheries, and cost effective management; and ensuring maximized investment, social and economic benefits through strategic relationships and alliances in commercial and industrial fisheries

9) Project Management
Establishing and implementing strategic and innovative project initiatives in support of agreed NFA strategies

10) Institute of Sustainable Marine Resources
Undertaking strategic and sustained intervention in support of sectoral skill development and enhancement, and effective policy implementation

Here are some of the Laws and Policies that governs the operations of The National Fisheries Authority.

1) The National Fisheries Act
2) The National Seas Act
3) The Whaling Act
4) The Trial Fishing Policy
5) The National Fish Aggregate Devise Managements Policy
6) The Barramundi Fishery Management Plan
7) The Shark Fishery Management Plan
8) The National Lobster Fishery Management Plan
9) The Beche de mer Fishery Management Plan

Papua New Guinea Forest Authority (PNGFA)
The Papua New Guinea Forest Authority (PNGFA) was established in 1993 under the Forestry Act, 1991. It replaced the former Department of Forest and unified all the Provincial Forest Divisions and the Forest Industries Council. This restructuring was the result of the 1989 Barnett Commission of Inquiry into forestry in Papua New Guinea.

The PNGFA, with its headquarters at Hohola in the National Capital District, has 19 provincial offices which include five regional offices. It has over 386 permanent employees throughout the country that includes foresters as well as non-foresters such as economists, lawyers and accountants. The Authority also has about 300 casuals that include labourers, cleaners and drivers.

The PNGFA is overseen by the National Forest Board, which advises the Minister for Forests and gives directions to the National Forest Service, the operational arm of the PNGFA.

The PNGFA mission statement is in harmony with the country's constitution and aims to: *'Promote the management and wise utilization of the forest resources of Papua New Guinea as a renewable asset for the well- being of present and future generations'.*

The Authority's main objective therefore is working towards achieving sustainable forest management in Papua New Guinea. The current Forestry Act provides that all relevant stakeholders must participate in the harvesting and management of the national forest resource. Forestry functions in many ways are decentralized wherein the respective Provincial Forest Management Committees established under the provision of the Forestry Act make decisions relating to the management of the forest resource. There are three (3) key arms of the PNGFA namely:

1. National Forest Board
The prime role of the Board is to advise the Minister for Forests on forest policies and legislations and give directions to the National Forest Service through the Managing Director consistent with the objectives of achieving sustainable forest management. Some of the functions and powers of the Board have been delegated to the Managing Director to ensure smooth flow of operations at project and industry levels. The Board is made up of major stakeholders of the forestry sector namely national and provincial governments, landowners, NGOs, Chamber of Commerce and Industries and the National Council of Women.

2. Provincial Forest Management Committee
These committees were established for each of the provinces and again comprise of major stakeholders. Their role is to provide a forum for consultation and coordination on forest management between national and provincial governments and recommend to the National Forest Board on matters regarding forestry related activities in the respective provinces.

3. The National Forest Service (NFS)
The NFS is the operational or implementing arm of the PNG Forest Authority, which is headed by the Managing Director and comprises of various Directorates.

The PNGFA Headquarters is made up of the Office of the Managing Director and five directorates. They are Corporate Services, Forest Policy & Planning, Project Allocation, Forest Development and Field Services which the five regional offices of Momase, Southern, New Guinea Islands, West New Britain and Highlands report to.

The Papua New Guinea Forest Research Institute (PNGFRI) located in Lae, Morobe Province is part of the Papua New Guinea Forest Authority and is treated as a directorate also.

PNGFA's Core Objectives:
The Authority pursues the following objectives as mandated by the Forestry Act 1991 (as amended):

- The management, development and protection of the Nation's forest resources and environment in such a way as to conserve and renew them as an asset for succeeding generations;

- The maximization of Papua New Guinea participation in the wise use and development of the forest resources as a renewable asset;

- The utilization of the nation's forest resources to achieve economic growth, employment creation and industrial and increased 'down-stream' processing of the forest resources;
- The encouragement of scientific study and research into forest resources so as to contribute towards a sound ecological balance, consistent with the National development objectives;

- The increased acquisition and dissemination of skills, knowledge and information in forestry through education and training;

- The pursuit of effective strategies, including improved administrative and legal machinery, for managing forest resources and the management of national, provincial and local interests.

Core functions are:

The Authority undertakes the following functions, as mandated by the Forestry Act 1991 (as amended):

- To provide advice to the Minister on forest policies and legislation pertaining to forestry matters;

- To prepare and review the National Forest Plan and recommend it to the National Executive Council for approval;

- Through the Managing Director, to direct and supervise the National Forest Service;

- To negotiate Forest Management Agreements;

- To select operators and negotiate conditions on which timber permits, timber authorities and licenses may be granted in accordance with the provisions of this Act;

- To control and regulate the export of forest produce;

- To oversee the administration and enforcement of this Act and any other legislation pertaining to forestry matters, and of such forestry policy as is approved by the National Executive Council;

- To undertake the evaluation and registration of persons desiring to participate in any aspect of the forestry industry;

- To act as agent for the State, as required, in relation to any international agreement relating to forestry matters;

- To carry out such other functions as are necessary to achieve its objectives or as are given to it under this Act or any other law.

Progress towards achieving Sustainable Forest Management in PNG

- There have been a lot of achievements in the forestry sector as a result of the reform PNGFA has gone through. Listed below are some of the notable achievements over the last 15 years:

- A new National Forest Policy was formulated in 1990 to remedy the short-comings of the previous policy of 1979 and to address the recommendations of the Barnett Inquiry and place emphasis on sustainable forest management principles in the forestry sector.

- A new Forestry Act was enacted by Parliament replacing three previous legislations on forestry matters that came into force in June 1992.

- Various amendments have been made to sections of the Forestry Act to ensure transparency and accountability in the management and utilization of the nation's forest resources. This took place in 1996, 2000, 2005 and 2007.

- The writing of the 1996 Forestry Regulation which provides the legal status for the implementation of many of the requirements specified under the Forestry Act;

- Establishment and operation of the PNG Forest Authority that came into effect in October 1993;

- Formulation and approval of the National Forest Development Guidelines in 1993;

- Establishment of the National Forest Board;

- Establishment of the Provincial Forest Management Committees;

Summary

You have come to the end of Lesson 16. In this Lesson, you have learnt that:

- The Industrial Revolution started in England around 1733 with the first cotton mill.
- Before the Industrial Revolution, life for most people in England was a farming and rural lifestyle.
- Industrial Revolution brought severe consequences such as factory owners needing cheap, unskilled labor, profited greatly by using children and women to run the machines.
- The birth of the industrial economy' meant there was massive increase in energy use, obtained by burning fossil fuels.

- At that time Great Britain was a very powerful country that controlled many colonies. The country gained abundant, useful resources from these colonies that aided its growth.
- Another effect of the Industrial Revolution was the mass migration of populations from the countryside to the fast growing towns and cities where the factories and work were to be found.
- There were many health and environmental problems associated with the massive growth during the Industrial Revolution
- Three inventions changed the agricultural world during the Industrial Revolution: The Seed Drill, Fertilizers and the Enclosure Movement

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NOW DO PRACTICE EXERCISE 15 ON THE NEXT PAGE

Practice Exercise 16

1 List four problems that arose as a result of mass rural-urban migration during the Industrial Revolution in the United Kingdom.

(i)_____

(ii)_____

(iii)_____

(iv)_____

2. Explain how the burning of coal as a fossil fuel would have created air pollution in the cities.

_____

_____

_____

_____

3. List two disadvantages of the Enclosure Movement in the agricultural sector.

c) _____

d) _____

_____

CHECK YOUR ANSWERS AT THE END OF TOPIC 4

ANSWERS TO ACTIVITY 1

1. Things are transformed into a resource through the interaction between human beings, nature and technology.

2. An equitable distribution of resources is essential for a sustained quality of life and global peace.

   If the present trend of resource depletion by a few individuals and countries continues, the future of our planet is in danger.

   It is essential for sustainable existence of all forms of life.

   It is important in a country like Papua New Guinea, which has enormous diversity in the availability of resources.

(*Any two reasons above can be correct*)

3. The management of the natural resources is seen to be complex because it involves all aspect of the natural environment. A change in one part of the environment has a far reaching effect on the others. It also involves the management of various stake holders and their interests. It is very difficult to satisfy all aspects at the same time.

4. It is a development that meets the needs of the present generation without depleting the resources for the future generations.

Lesson 17: Sustainable Use of Resources in Papua New Guinea

Welcome to Lesson 17. In this lesson you will learn about sustainable use of our natural resources in Papua New Guinea.

Your Aims:

- explain sustainable use of resources
- identify sustainable practices of natural resource use in Papua New Guinea

Can you recall the meaning of sustainable development in your last lesson? If so, good. In this lesson, we will continue to look at concepts and ideas of sustainable resource use. You will realize that some examples of sustainable resource uses and practices were covered in the last lesson.

What is Sustainability?

Environmental sustainability involves making decisions and taking actions that are in the interests of protecting the natural world, with particular emphasis on preserving the capability of the environment to support human life. Sustainability is the capacity to endure. It is an important topic at the present time, as people are realizing the full impact that businesses and individuals can have on the environment.

Humans are altering the earth's landscape at a rate and in ways never seen in times past. Their land uses are impacting local environments in ways that are irreversible. In Ecology, sustainability describes how biological systems remain diverse and productive over time.

Some of the common environmental concerns include:

- damaging rainforests through logging and agricultural clearing
- polluting and over-fishing of oceans, rivers and lakes
- polluting the atmosphere through the burning of fossil fuels
- damaging prime agricultural and cultivated land through the use of unsustainable farming practices

For much of the past, most businesses and resource developers have acted with little regard or concern for the negative impact they have on the environment. Many large and small organizations are guilty of significantly polluting the environment and engaging in practices that are simply not sustainable. However, there are now an increasing number of businesses that are committed to reducing their damaging impact and even working towards having a positive influence on environmental sustainability.

Environmental sustainability forces businesses to look beyond making short term gains and look at the long term impact they are having on the natural world. You need to consider not only the immediate impact your actions have on the environment, but the long term implications as well. For example, when manufacturing a product, you need to look at the environmental impact of the products entire lifecycle, from development to disposal before finalizing your designs.

Population Pressure and Shifting Cultivation

In Papua New Guinea, the growing population puts more and more pressure on the use of natural resources. To meet the needs of the growing population, the Government allows for increased exploitation of natural resources in terms of logging, fisheries and mining and petroleum. Hence, sustainable use of resource use is getting widespread attention as people realize the need to protect, conserve and develop natural resources wisely.

Today, the traditional shifting cultivation farming method is becoming increasingly unsustainable due to the shorter fallow periods. In times past, the fallow period was 7 to 10 years. The current trend of increasing population means going to the same plot of land in less than 2 or 3 years to cultivate so as to feed the increasing population. Due to this, the soil does not recover its nutrients quickly when the land is frequently cultivated. Yield per crop then declines thus producing less to feed everyone.

Fallow Period is the time left for the soil to regain its fertility in shifting cultivation

---

Now do activity one (1) below.

Activity 1

1. What is environmental sustainability?

   _____
   _____
   _____

2. List the main environmental concerns that developers of natural resources should be considerate of.

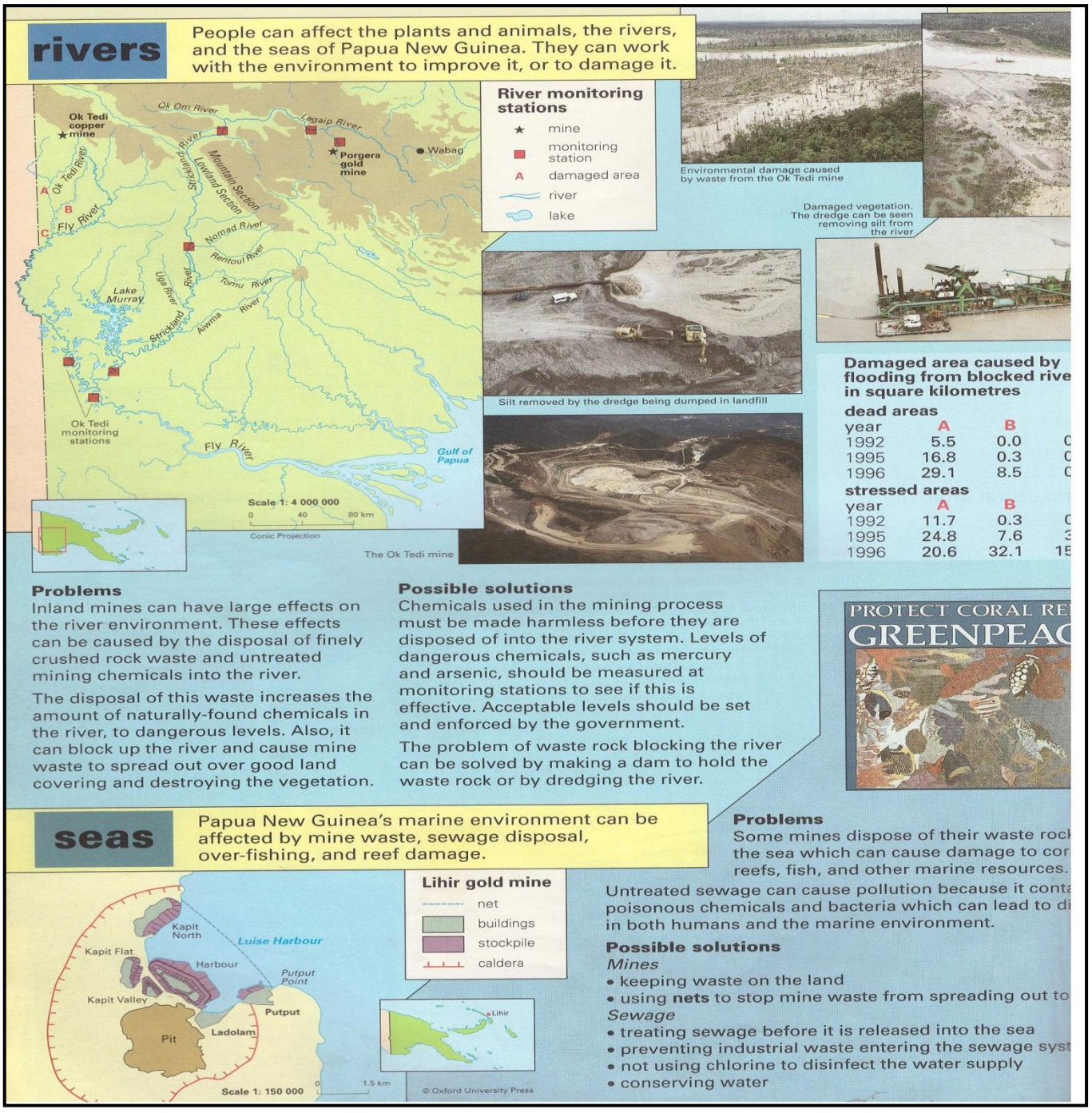
   1) _____
   2) _____
   3) _____
   4) _____
      _____

3. Discuss the impact of increasing population on traditional lands in PNG?

   _____
   _____
   _____

NOW CHECK YOUR ANSWERS AT THE END OF PRACTICE EXERCISE 17

The diagram of Ok Tedi Mine below shows some poor environmental practices and ways to sustainably develop the resources.



Now do activity two (2) on the next page.

Activity 2

1. Explain how untreated waste can cause pollution on the marine or sea environment.

   _____
   _____
   _____
   _____

2. What is the main problem of inland mines like Ok Tedi on the river environment?

   _____
   _____
   _____

NOW CHECK YOUR ANSWERS AT THE END OF PRACTICE EXERCISE 17

Our first example of sustainable resource use in Papua New Guinea is taking a look at the New Britain Palm Oil Limited (NBPOL). Now read what they have to say about sustainable resource.

> "Our vision statement is to demonstrate that palm oil can be produced and consumed responsibly and sustainably – creating livelihoods and opportunities for tens of thousands in the provinces where we grow palm oil and nutrition for millions where we sell palm oil. At NBPOL, we define sustainable development as encompassing responsible resource stewardship, effective pollution prevention and the capacity to produce efficiently. The goal of sustainable development will be achieved by balancing the considerations for People, Planet and Prosperity in all management decisions.
>
> We will continue to look into ways to improve our sustainability performances by embedding it deeper into our business processes. While we believe that sustainability must be integrated in both everyday operations and strategic decisions, we are also aware that we must have in place a sustainability framework and policies that allows for sharing of lessons and implementation support.
>
> We recognize that not everyone will be convinced of our efforts but we look forward to our continued partnerships with stakeholders across the world to search for better solutions which benefit our business, the environment and our communities".

Environmental sustainability of oil palm cultivation in Papua New Guinea

Villagers in the highlands of Simbu Province are taking an active role in improving their standard of living and moving towards sustainable development. The majority of the residents are local subsistence farmers. There is very little economic opportunity and few government services. A rapid increase in population has put pressure on land use. Land that was once left fallow to regain its nutrients is now in constant use and virgin forests are being logged or cleared for cultivation. This has led to the erosion of top soil and the destruction of watersheds. Medicinal plants are being over harvested or destroyed as the forest is cleared.

We take a look at the United Methodist Committee on Relief (UMCOR) which is a non-government organization helping out with sustainable programs in Simbu Province.

Below is their vision and mission statements:

VISION

"As the humanitarian relief and development arm of The United Methodist Church, UMCOR transforms and strengthens people and communities".

MISSION

"Compelled by Christ to be a voice of conscience on behalf of the people called Methodist, UMCOR works globally to alleviate

UMCOR has been supporting development efforts in Simbu Province since 1998, beginning with the approval of funding for the Mindima Water Supply project. With $40,000 given by UMCOR over the course of two years, several villages with a total population of 8,000 constructed a dam in a mountain stream, dug ditches, laid pipes between the villages, and installed standpipes. Technicians from the local Department of Works supervised volunteers who constructed the water supply system. Villagers are responsible for maintaining the system.

A village water tank receiving water from the dam

Village people enjoy the benefits of sustainable development in Simbu Province

The benefits from this project are many: clean water for drinking, cooking, and washing; a decrease in water-borne diseases; the elimination of a 1-2 kilometer walk to collect water; and the ability to garden during the dry season. With just a two-year

grant through the UMCOR Advance, the Mindima community was able to complete a water system that will improve their health and living standards.

In the 2001-2004 quadrennium, UMCOR has approved two more projects in Simbu Province for Advance funding: Assistance for Women and Children, and Guiye/Waiye Environmental and Conservation Project. The goal of the women and children's project is to teach mothers how to solve the health and nutrition problems faced by the women and children in the Kerowagi District. Activities include a public awareness campaign on children's health, training for mothers, counseling for sick children and their mothers, and the distribution of printed materials. Improving the status of health and nutrition for women and children will enhance the overall health and strength of the community.

The Guiye/Waiye Environment and Conservation Group is working to create awareness among local residents of the importance of conservation. The project will train and educate villagers on environmental issues such as soil degradation and conservation, and promote the sustainable use of natural resources. There are four different tribes, numbering 40,000 people who will benefit from the project. Activities include: a community awareness campaign; establishing tree nurseries; planting trees; collecting local seeds; distributing printed awareness materials; and researching and conserving medicinal plants. Through this project, villagers will become involved in land and forest conservation. They will learn about the long-term benefits of conserving the forests and animals. They will work to promote eco-tourism and the research of medicinal plants which will bring long-term benefits to the villagers, the forest and its inhabitants. The overall goal is to achieve sustainable development at the community level.

The third example of sustainable resource use in PNG is The PNG Sustainable Development Program Limited (PNGSDPL).

This was established in 2002, when BHP Billiton divested its 52 percent shareholding in its Ok Tedi Mining Limited following concerns about the long-term environmental impact of the mine, and the social and economic consequneces of this impact. PNGSDP has the task of applying the funds coming from OTML which are assigned for the development of PNG, in particular the people of the Western Province where the Ok Tedi Mine is located.

The paragraph below is taken from their company profile:

David Sode -

"PNGSDP's objective is to support selected Sustainable Development Programs through projects and initiatives to benefit PNG. When the Ok Tedi Mining operation ends in the Western Province this year (2013), its charter is to ensure that ongoing and lasting benefits remain with the people of the Western Province and PNG as a whole.

Our country has vast natural and mineral wealth and our people are enterprising and talented. However we face significant development challenges. PNGSDP plays a vital role in addressing these challenges. The work we do is also in keeping with the aims and aspirations outlined in the UN Millennium Development Goals."

Road extension provides vital access to services for the women of Homaria Community, Southern Highlands Province. This is an example of Sustainable development benefits extended to the country from PNGSDP.

Completed section of road, Ormond Bridge to Bukuku along Magi Highway, Central Province.

Kiunga - Kokonda Road after construction, North Fly District, Western Province.

Daru Trestle Wharf, South Fly District, Western Province.

Students from Western Province selected to study at Royal Melbourne Institute of Technology, Melbourne, Australia.

Summary

You have come to the end of Lesson 17. In this Lesson, you have learnt that:

- Environmental sustainability involves making decisions and taking actions that are in the interests of protecting the natural world, with particular emphasis on preserving the capability of the environment to support life
- There are an increasing number of businesses and resource developers that are committed to reducing their damaging impact and even working towards having a positive influence on environmental sustainability.
- Governments, developers and managers of natural resources need to consider not only the immediate impact of resource use on environment but the long term implications as well.
- In Papua New Guinea, the growing population puts more and more pressure on the use of natural resources.
- In PNG, sustainable practice of resource use is getting widespread attention as people realize the need to protect, conserve and develop natural resources wisely
- There are government and non-government organizations that are working with village communities to promote sustainable resource use in PNG.

NOW DO PRACTICE EXERCISE 17 ON THE NEXT PAGE.

Practice Exercise 17

1 What is the definition of Sustainable development according to NBPOL?

_____

_____

_____

2. How would NBPOL achieve its goal of sustainable development?

_____

_____

3. List three benefits brought about by the UMCOR Water Supply Project.

1) _____

2) _____

3) _____

4. What was the goal of the Guiye/Waiye Environmental and Conservation Project?

_____

_____

5. Discuss actions which the Guiye/Waiye Environmental and Conservation Group will adopt to bring across the message of sustainable resource use and conservation at the community level.

_____

_____

_____

_____

_____

_____

6. What is the main objective of the PNGSDP?

_____

_____

_____

_____

CHECK YOUR ANSWERS AT THE END OF TOPIC 3

ANSWERS TO ACTIVITY 1

1. Environmental sustainability involves making decisions and taking actions that are in the interests of protecting the natural world, with particular emphasis on preserving the capability of the environment to support human life.

2.
- damaging rainforests through logging and agricultural clearing
- polluting and over-fishing of oceans, rivers and lakes
- polluting the atmosphere through the burning of fossil fuels
- damaging prime agricultural and cultivated land through the use of unsustainable farming practices

3. The traditional shifting cultivation is very unsustainable due to the shorter fallow periods. Traditionally the fallow period was 7 to 10 years. The increasing population means going to the same plot of land in less than 2 or 3 years to cultivate so as to feed the increasing population. Due to this, the soil does not recover its nutrients quickly when the land is frequently cultivated. Yield per crop then declines producing less to feed everyone.

ANSWERS TO ACTIVITY 2

1. Untreated waste can cause pollution because it contains poisonous chemicals and bacteria which can lead to diseases both in both humans and the marine environment.

2. The main inland mine problem is disposal of finely crushed rock waste and untreated mining chemicals into the river.

ANSWERS TO PRACTICE EXERCISE 16-17

EXERCISE 16

1. i. Overcrowding
   ii. Absence of suitable sanitation and refuse collection
   iii. Increase in water borne diseases like cholera and typhoid
   iv. Air pollution

(Accept any answers similar to these found in the lesson notes)

2. Smoke and fumes from the factories and vehicles stay around in the atmosphere and was inhaled by people

3. The consolidation of many small farms into one large farm increased the size of the farms. This movement left many people jobless and homeless.

EXERCISE 17

1. 'Encompassing responsible resource stewardship, effective pollution prevention and the capacity to produce efficiently'.

2. The goal of sustainable development will be achieved by balancing the considerations for People, Planet and Prosperity in all management decisions.

3.
   1) clean water for drinking, cooking, and washing;
   2) a decrease in water-borne diseases;
   3) the elimination of a 1-2 kilometer walk to collect water;
   4) and the ability to garden during the dry season.

4. To achieve sustainable development at the community level.

5. UMCOR is working to create awareness among local residents of the importance of conservation. It will train and educate villagers on environmental issues such as soil degradation and conservation and promote the sustainable use of natural resources. The four different tribes of 40,000 people will benefit from the project.

   Activities include: a community awareness campaign; establishing tree nurseries; planting trees; collecting local seeds; distributing printed awareness materials; and researching and conserving medicinal plants. Through this project, villagers will become involved in land and forest conservation. They will also learn about the long-term benefits of conserving the forests and animals. They will work to promote eco-tourism and the research of medicinal plants which will bring long-term benefits to the villagers, the forest and its inhabitants.

6. PNGSDP's objective is to support selected Sustainable Development Programs through projects and initiatives to benefit PNG. When the Ok Tedi Mining operation ends in the Western Province in the year 2013, its charter is to ensure that ongoing and lasting benefits remain with the people of the Western Province and PNG as a whole.

YOU HAVE COME TO THE END OF UNIT 1. NOW COMPLETE ALL THE QUESTIONS IN TOPIC TEST 4 IN YOUR ASSIGNMENT BOOK 1. WHEN YOU COMPLETE TOPIC TEST 4, CROSS CHECK YOUR ANSWERS FOR EACH TOPIC TEST IN THE ASSIGNMENT BOOK. WHEN YOU ARE SATISFIED WITH ALL YOUR ANSWERS, SEND THE COMPLETED ASSIGNMENT BOOK TO YOUR PROVINCIAL CENTRE FOR MARKING.

References

1 Stephen Ranch, 2011, 'Outcomes Edition for Papua New Guinean Social Science Grade 10', Oxford University Press, Victoria, Australia.

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3. Department of Education, 1991, 'Changing World'' John Wiley and Sons Australia, Queensland, Australia.

4. Department of Education and Oxford Press, 1999, 'Papua New Guinea Secondary School Atlas', Papua new Guinea.

5. Internet Access:

i. http://www.livestrong.com/article/140480-ways-control-air-pollution/#ixzz2Qig1nAG9

ii. http://www.articlesnatch.com/Article/The-Importance-Of-Clean-Air/35942#ixzz2QihHBUyz

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iv. www.ashden.org/photo

v. www.paulscarpetclean.com

vi. http.//edugreen.ter.res.in/explor/explor.htm.

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viii https://en.wikipedia.org/wiki/**Water_pollution**

FODE PROVINCIAL CENTRES CONTACTS

PC NO.	FODE PROVINCIAL CENTRE	ADDRESS	PHONE/FAX	CUG PHONES	CONTACT PERSON		CUG PHONE
1	DARU	P. O. Box 68, Daru	6459033	72228146	The Coordinator	Senior Clerk	72229047
2	KEREMA	P. O. Box 86, Kerema	6481303	72228124	The Coordinator	Senior Clerk	72229049
3	CENTRAL	C/- FODE HQ	3419228	72228110	The Coordinator	Senior Clerk	72229050
4	ALOTAU	P. O. Box 822, Alotau	6411343 / 6419195	72228130	The Coordinator	Senior Clerk	72229051
5	POPONDETTA	P. O. Box 71, Popondetta	6297160 / 6297678	72228138	The Coordinator	Senior Clerk	72229052
6	MENDI	P. O. Box 237, Mendi	5491264 / 72895095	72228142	The Coordinator	Senior Clerk	72229053
7	GOROKA	P. O. Box 990, Goroka	5322085 / 5322321	72228116	The Coordinator	Senior Clerk	72229054
8	KUNDIAWA	P. O. Box 95, Kundiawa	5351612	72228144	The Coordinator	Senior Clerk	72229056
9	MT HAGEN	P. O. Box 418, Mt. Hagen	5421194 / 5423332	72228148	The Coordinator	Senior Clerk	72229057
10	VANIMO	P. O. Box 38, Vanimo	4571175 / 4571438	72228140	The Coordinator	Senior Clerk	72229060
11	WEWAK	P. O. Box 583, Wewak	4562231/ 4561114	72228122	The Coordinator	Senior Clerk	72229062
12	MADANG	P. O. Box 2071, Madang	4222418	72228126	The Coordinator	Senior Clerk	72229063
13	LAE	P. O. Box 4969, Lae	4725508 / 4721162	72228132	The Coordinator	Senior Clerk	72229064
14	KIMBE	P. O. Box 328, Kimbe	9835110	72228150	The Coordinator	Senior Clerk	72229065
15	RABAUL	P. O. Box 83, Kokopo	9400314	72228118	The Coordinator	Senior Clerk	72229067
16	KAVIENG	P. O. Box 284, Kavieng	9842183	72228136	The Coordinator	Senior Clerk	72229069
17	BUKA	P. O. Box 154, Buka	9739838	72228108	The Coordinator	Senior Clerk	72229073
18	MANUS	P. O. Box 41, Lorengau	9709251	72228128	The Coordinator	Senior Clerk	72229080
19	NCD	C/- FODE HQ	3230299 Ext 26	72228134	The Coordinator	Senior Clerk	72229081
20	WABAG	P. O. Box 259, Wabag	5471114	72228120	The Coordinator	Senior Clerk	72229082
21	HELA	P. O. Box 63, Tari	73197115	72228141	The Coordinator	Senior Clerk	72229083
22	JIWAKA	c/- FODE Hagen		72228143	The Coordinator	Senior Clerk	72229085

SUBJECT AND GRADE TO STUDY

GRADE LEVELS	SUBJECTS/COURSES
Grades 7 and 8	1. English
	2. Mathematics
	3. Personal Development
	4. Social Science
	5. Science
	6. Making a Living
Grades 9 and 10	1. English
	2. Mathematics
	3. Personal Development
	4. Science
	5. Social Science
	6. Business Studies
	7. Design and Technology- Computing
Grades 11 and 12	1. English – Applied English/Language& Literature
	2. Mathematics - Mathematics A / Mathematics B
	3. Science – Biology/Chemistry/Physics
	4. Social Science – History/Geography/Economics
	5. Personal Development
	6. Business Studies
	7. Information & Communication Technology

REMEMBER:

- For Grades 7 and 8, you are required to do all six (6) courses.
- For Grades 9 and 10, you must study English, Mathematics, Science, Personal Development, Social Science and Commerce. Design and Technology-Computing is optional.
- For Grades 11 and 12, you are required to complete seven (7) out of thirteen (13) courses to be certified.

GRADES 11 & 12 COURSE PROGRAMMES

No	Science	Humanities	Business
1	Applied English	Language & Literature	Language & Literature/Applied English
2	Mathematics A/B	Mathematics A/B	Mathematics A/B
3	Personal Development	Personal Development	Personal Development
4	Biology	Biology/Physics/Chemistry	Biology/Physics/Chemistry
5	Chemistry/ Physics	Geography	Economics/Geography/History
6	Geography/History/Economics	History / Economics	Business Studies
7	ICT	ICT	ICT

Notes: You must seek advice from your Provincial Coordinator regarding the recommended courses in each stream. Options should be discussed carefully before choosing the stream when enrolling into Grade 11. FODE will certify for the successful completion of seven subjects in Grade 12.

CERTIFICATE IN MATRICULATION STUDIES		
No	**Compulsory Courses**	**Optional Courses**
1	English 1	**Science Stream:** Biology, Chemistry, Physics
2	English 2	**Social Science Stream:** Geography, Intro to Economics and Asia and the Modern World
3	Mathematics 1	
4	Mathematics 2	
5	History of Science & Technology	

REMEMBER:
You must successfully complete 8 courses: 5 compulsory and 3 optional.