DEPARTMENT OF EDUCATION

GRADE 8

MAKING A LIVING

STRAND1: MANAGING RESOURCES

COURSE BOOK 1

NAME:

ADDRESS:

DISTRICT OR PROVINCE:

FLEXIBLE OPEN AND DISTANCE EDUCATION
PRIVATE MAIL BAG, P.O.WAIGANI, NCD
DEPARTMENT OF EDUCATION
PAPUA NEW GUINEA
2016

COMPILED BY:	Lucy Joseph
	Doris Payok
	Diana Akis
DEPARTMENT EDITORS	Ursula Miria
	Doris Payok
SUBJECT CONTENT EDITORS:	Silas Umaropi
	Bessie Kilavanua
	Ruby Kaleva
SUBJECT EDITORS:	Late Andala Ipata
	Armstrong Rupa
	Celina Vavetaovi
	Bessie Kilavanua
	Margaret Kakas
	Loreta Mekesi
	Ruby Kaleva

GRADE 8

MAKING A LIVING

STRAND 1

MANAGING RESOURCES

COURSE BOOK

SUBSTRAND 1: LAND AND WATER MANAGEMENT

SUBSTRAND 2: ENVIRONMENT

SUBSTRAND 3: CROP AND ANIMAL MANAGEMENT

Acknowledgements

We acknowledge the contributions of all Primary Teachers who in one way or another helped to develop this course.

Special thanks to the staff of MAL and Business Studies Department of FODE who played an active role in coordinating writing workshops, outsourcing lesson writing and editing processes.

We also acknowledge the professional guidance provided by Curriculum and Development Assessment Division throughout the processes of writing and, the services given by member of the Primary Section and Academic Committees.

The Course Book was developed with the support and funding of the GO- PNG FODE World Bank Project.

DEMAS TONGOGO
PRINCIPAL

Written by: Ursula Miria, Lucy Joseph and Doris Payok

Published in 2016 by the Flexible, Open and Distance Education

Printed by the Flexible, Open and Distance Education
ISBN: 978-9980-87-201-2
National Library Services of Papua New Guinea

Table of Contents

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 part and parcel of the new reformed curriculum – the Outcomes Based Education (OBE). Its learning outcomes are student – centred and written in terms that allow them to be demonstrated, assessed or measure.

It maintains the rationale, goals, aims and principles of the national outcome based 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 which has been coupled with a lack of access to secondary and higher educational institutions.

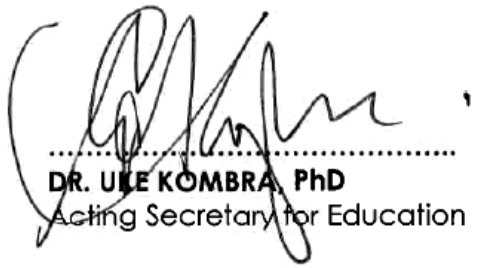
Flexible, Open and Distance Education curriculum is guided by the Department of Education's Mission which is fivefold:

- To facilitate and promote the integral development of every individual
- To develop and encourage an education system which 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 Guneans harness all appropriate and affordable technologies to pursue this program.

I commend all those teachers, curriculum writers and instructional designers who have contributed so much in developing this course.



.....

DR. ULE KOMBRA, PhD
Acting Secretary for Education

COURSE INTRODUCTION

Dear Student,
Welcome to Grade 8 Making A Living Course. This course continues from your Grade 7 Making A Living Course. The course will teach you practical knowledge, skills, attitudes and values required for you to become independent and creative in using your local resources wisely to improve your quality of life. The course will also teach you skills that will help you to live productive lives in your communities after you complete school.
Grade 8 Making A Living Course contains strand books, supplementary readings and assessment books.

1. Strand Books

There are three strand books. They are as follows:

- **Strand 1: Managing Resources**
  In this Strand you will have an opportunity to:
  - Investigate and evaluate current land and water resource management in your local area, and plan a small project identifying appropriate management practices that will generate income.
  - Investigate and implement practical environmentally friendly ways of managing your local environment
  - Discuss the plan of a crop or animal project for your local area that will be aimed at generating an income

  Strand 1: Managing Resources has three substrands. They are as follows:
    - Substrand 1: Land and Water Management
    - Substrand 2: Environment
    - Substrand 3: Crop and Animal Management

- **Strand 2: Better Living**
  In this Strand you will have an opportunity to:
  - Plan practical ways to produce food for personal consumption or to generate an income.
  - Discuss how to work as a team to undertake specific projects to benefit the school or local community.
  - Identify and evaluate goods and services provided by a range of organisations and form specific guidelines that can be applied in assessing those services to determine which best meets the needs of your community.
  - Identify appropriate materials that will allow you to design, make and evaluate a product relevant to your needs.

  Strand 2: Better Living has four substrands. They are as follows:
    - Substrand 1: Healthy Living
    - Substrand 2: Care and Management
    - Substrand 3: Wise Consumer
    - Substrand 4: Making Things

- **Strand 3: Community Development**

  In this Strand you will have an opportunity to:
  - Apply knowledge of your local community to assist the community in devising cooperative plans for economic and social benefits.
  - Use effective communication skills and mediums to ensure that all stakeholders within a community are aware of specific issues that have a direct impact on the community and facilitate this awareness
  - Discuss a plan of a project that will generate an income and allow you to make a living

  Strand 3: Community Development has three substrands. They are as follows:
  - Substrand 1: Knowing Your community
  - Substrand 2: Communication
  - Substrand 3: Community Projects

2. Supplementary Readings

There are Supplementary Readings. They follow each lesson:
- Strand 1: Managing Resources- Supplementary Readings
- Strand 2: Better Living- Supplementary Readings
- Strand 3: Community Development - Supplementary Readings

3. Assessment Books

There are two types of assessment in each strand . They are as follows:

- **Assignment Books:** The assignment books contain Substrands Tests, Strand Examination and projects which contain tasks that cover skills and knowledge from the strands..

Examination: There will be an examination at the end of the year. It will covers skills and knowledge from the three strands. You will sit for your examination only if you have completed all assessments for the three strands.

The Tests, Projects and Examination are marked by your distance teacher. The marks you score will count towards your final mark and grade.

Course Duration: It should take about 8 to 9 weeks to complete one strand.

Strand 1: Managing Resources……. Approximately 8 -9 weeks
Strand 2: Better Living……. Approximately 8 -9 weeks
Strand 3: Community Development…….. Approximately 8 -9 weeks

STRAND 1 INTRODUCTION

Welcome to the first strand in your Grade 8 Making A Living Course.

In this strand, you will learn to evaluate current practices of land and water resource management. After you have evaluated the current practices of land and water resource management, you will then learn how to design sustainable resource management projects to generate income.

The strand will also teach you to reflect on the economic, cultural and ecological values of natural, social and built resources. You will also learn how to apply environmentally friendly ways of managing the environment.

Finally; the strand will teach you how to plan and design a crop or animal management project suited to local conditions and how to use local resources. You will also learn how to plan and design this project to generate an income.

Managing Resources incorporates the substrands:

- Land and water management,
- Environment,
- Crops and animal management.

Substrand 1: Land and Water Management

In this substrand, you will learn about the current practices of land and water resource management. Furthermore, you will learn how to design sustainable resource management projects to generate income.

Substrand 2: Environment

In this substrand, you will learn about the environment in the aspects of economic, cultural and ecological values of natural, social and built resources. Furthermore, you will learn how to apply environmentally friendly ways of managing the environment.

Substrand 3: Crop and Animal Management

In this substrand, you will learn the skills and knowledge of how to plan and design a crop or animal management project aimed at generating an income.

STUDY GUIDE

Step 1: Start with Substrand 1, study Lesson 1 and do the Lesson Activities as you go along. When you have completed Lesson 1, do Practice Exercise 1.

Step 2: When you have completed Lesson 1 Activities and Practice Exercise 1, turn to the back, at the end of the Substrand 1 in the Strand Book to correct your answers. The answers for your Practice Exercises are at the end of the Substrand 1. While the answers for your Lesson Activities are at the end of the Strand Book.

Step 3: If you make any mistake, go back to the Lesson or your Readings in the Supplementary Book, revise well and try to understand why you gave an incorrect answer

Step 4: When you have completed steps 1 to 3, tick the box for Lesson 1 on the contents page (page 3) like this,

Substrand 1: Land and Water Management

☑ Lesson 1: Importance of Land Resources

Step 5: Go to Lesson 2 and repeat the same process until you complete all the Lessons in Substrand 1

Step 6: After completing your Lessons and Practice Exercises in each Substrand; then, complete each Substrand Test in the Assignment Book 1

Step 7: After you have studied the whole Strand, do also the Strand Examination in the Assignment Book 1

Step 8: Check through your Assignment Book 1; and when you are satisfied, then go ahead and do Project Book 1

Icons

			
Introduction	Lesson Activity Practice Exercise	Reading	Summary

Assessment

There are two types of assessments books for this Strand. The first one is the Assignment Book which contains the substrand tests and the strand test followed by the Project tasks. Both are out of 100 marks.

Your Assignment and Project tasks will be marked by your distance teacher. The marks you score will count towards your final mark and grade.

If your score is less than 50%, you must repeat that Assessment. If you continue to score less than 50% in your assessment three times, then, your enrolment will be cancelled, and you need to re –enroll if you wish to continue this Course.

Study Schedule

Here is a Study Schedule. It will guide you to complete your Strand 1: Managing Resources Course Book and its assessment.

WEEKS	SUBSTRAND / LESSON NUMBER	ASSESSMENT	COMMENTS
1- 3	Substrand 1 Lessons 1-6	Substrand 1 Test	
4- 6	Substrand 2 Lessons 7-12	Substrand 2 Test	
7- 8	Substrand 3 Lessons 13-18	Substrand 3 Test	
9		Strand Examination and Project 1	
9	Submit your Assignment Book 1 and Project Book 1 to your Provincial Centre for marking.		

Remember

As you complete each lesson, tick the box on the contents' page. This helps you show what you have done and what you still have to do in each Substrand.

All the best and enjoy your studies with FODE – Making a Living

SUBSTRAND 1

LAND AND WATER MANAGEMENT

In this Substrand, you will:

- **identify and discuss land ownership in PNG**
- **identify and discuss land resource issues in PNG**
- **discuss land as a source of income**
- **discuss water as a source of income**
- **discuss conservation of land resources**
- **discuss conservation of water resources**

SUBSTRAND 1: LAND AND WATER MANAGEMENT

Welcome to Substrand 1: Land and Water Management. In this substrand, you will learn about the current practices of land and water resource management and how to design sustainable resource management projects to generate income.

This Substrand contains six (6) lessons.

Lesson 1: Land Ownership in Papua New Guinea
This lesson discusses state and customary land and the systems that govern land ownership in PNG. It also discusses the documents that prove ownership of land and identifies areas in PNG where land right is passed through the mother and areas where land is acquired through the father.

Lesson 2: Land Resource Issues in PNG
This lesson covers the land use in both rural and urban areas. This includes land development and land acquisition in rural and urban areas.

Lesson 3: Land as a Source of Income
This lesson covers the traditional practices of using land resources; and the ways that traditional practices have changed, improved or can be improved. It also teaches about identifying projects that can be established to earn an income using the land resource.

Lesson 4: Water Resources as a Source of Income
This lesson covers the traditional practices of using water resources and the ways that traditional practices have changed, improved or can be improved. It also teaches about identifying projects that can be established to earn an income using the water resources.

Lesson 5: Conservation of Land Resources
This lesson teaches you to identify practices that require the conservation of land resources in the community. It also teaches you to identify mismanagement practices in a national land project; and to discuss ways to stop; reduce or correct the mismanagement or destruction.

Lesson 6: Conservation of Water Resources
This lesson teaches you to identify practices that require the conservation of water resources in the community. It also teaches you to identify mismanagement practices in a national water project; and to discuss ways to stop, reduce or correct the mismanagement or destruction.

Lesson 1: Land Ownership in Papua New Guinea

Introduction

Welcome to Lesson 1 of Strand 1. In Grade 7, you learnt about the importance of land and water resources and the causes and effects when they are not managed well. You also learnt about the use of appropriate management practices to sustain and preserve the land and water resources. In this lesson, you will learn about land ownership in Papua New Guinea.

Your Aims

- Define customary and state land and the systems governing land ownership in Papua New Guinea
- Discuss the differences and similarities of state and customary land ownership
- Identify documents that prove ownership of land
- Identify areas in Papua New Guinea where land right passes through the mother and areas where land is acquired through the father

Systems of land Ownership

There are two systems of land ownership. The first one is customary ownership and the second one is state ownership. State ownership is also known as free-hold ownership. Let us begin by revising to understand what land is.

What is land?

Land is the solid surface of the earth. It refers to the soil or the ground. It is the substance on which plants grow, rivers flow through. Houses, roads and bridges are also constructed on the land. Furthermore; both the inside and surface of the land are known to contain natural resources such as gold, silver, copper, oil and gas.In Papua New Guinean societies, land is very important. A person who owns land has status in the village and the community. Land is the source of livelihood for many citizens of the country. It provides food, work, home, and a place to enjoy life.

What is Customary Land?

Customary land is land which is owned by the customary land owners. More than eighty-five percent (85%) of the total land-mass in Papua New Guinea is customary land. This means that a clan or tribe controls the use, division and transfer of land. The custom of a particular society and the relationship of the traditional people with their land determine the ownership of customary land. Customary land has been passed on from generations or it is land owned according to the custom of that area. In many traditional societies in Papua New Guinea , land is owned by family, clan, tribe or is communally owned.

Where the land is communally owned, an individual who occupies and uses the land is a temporary user. He or she does not have any authority to transfer the ownership to anyone outside the family or the landowning clan. When he or she dies, the land remains as the property of his family, clan or tribe.

Customary land is used collectively for hunting, fishing, gathering plants for food or collecting fire wood. Rights to use certain areas for gardens or houses are divided among individuals and can be transferred to their descendents. Boundaries are marked by natural

features such as trees, rocks, ridges and rivers. Knowledge of these rights is passed by word of mouth from one generation to another.

However, there is a trend where in some traditional societies; land is given out of the family or the landowning clan or tribe. This happens particularly where other persons come to settle with them as part of their family, clan or tribe.

In situations where land has been transferred to a person outside of the family, clan or tribe, disputes may arise years later. This happens after the person who gave away the land had died. Usually, the surviving members of the family, clan or tribe reclaims ownership and this gives rise to a land dispute.

Activity 1.1: Answer these questions below

(a) Find out from your parents or grandparents whether you own land and how that was acquired.

_____

_____

(b) Does the law recognise customary land ownership?

_____

_____

The law in Papua New Guinea recognises the traditional ownership of land. It starts from the National Constitution, which recognises ownership of the customary land and protects the rights and use of the customary land.

In 1996, the National Parliament passed a law called the Lands Act. This law provides everything to do with the land including customary land. Most importantly, this law recognises and protects customary land ownership and the rights and interests in the customary land.

There are other laws such as the Forestry Act 1991, Mining Act 1992, Oil and Gas Act, 1998, which deal with natural resources found in or on the customary land. These laws also recognise the customary land ownership.

This means that, any person who deals with customary land should consult with the landowners and get their consent because the landowners have the right under the law to refuse to anything that takes place on their land. Generally, the Constitution of Papua New Guinea, and other laws give protection to the landowners in a customary land. The same protection is also given to the rights of land in towns and cities; for which titles have been obtained. Title refers to registration of a land under a person's name. Title could also be registered under an organisation name or business name.

Our traditional ways of dealing with customary land is also recognised by the modern law. If other persons, for example, the state, foreign company or business people, wish to use the customary land or take out anything from it, it is important that:

(i) the customary landowners freely agree with them for them to use their customary land or take things out of it, or
(ii) there must be an Act of Parliament or law that allows other people to use the customary land or take things out of the customary land.

State land
State land is owned by the government. About 16,000 hectares of land in Papua New Guinea is ownership by missions and private individuals. These individuals got the title early in the colonial era. For many years, only the government has been able to buy land directly from the customary land owners. The government owns about 1 250 000 hectares and has leased one-fourth of it to missions, individuals and companies for agricultural, businesses or housing purposes.

Before buying land, government officials must make detailed studies to learn who the rightful owners are and make sure that their claim is proper. They must also make population projections to ensure that the owner group will have enough land left for its future needs. The land boundaries must be surveyed and described in legal terms. A value must be set for the land and any food trees or crops.

Activity 1. 2: Answer these questions below.

(a) Find out the proper title of people whose job is to survey and give legal descriptions to pieces of land.

_____

(b) What do we call the person who sets the value on Land and food trees or crops on a piece of land?

_____

Differences and similarities of customary and state land

Differences	
Customary land	State land
• Owned by customary land owners • Used by tribe and clan • Clan and tribe controls it	• Owned by the government • Used by the missions, private individuals, businesses and government • Government controls it

Similarities	
Customary land	State land
• Land boundaries are marked • Laws with customary • Protection of land through laws	• Land boundaries are marked • Laws with modern • Protection of land through laws

Land Registration
This is the process of sorting out and formally recording land ownership. It requires setting out specific boundaries and identifying specific owners. Only about 3 per cent of land in

Papua New Guinea is registered. The rest remain in traditional informal ownership. People who support land registration believe that it is necessary to promote development. Companies want to be assured of who owns the land before they spend large amounts of money to develop it. Those who are against land registration believe that it allows for land to be taken away from traditional owners. They claim that people do not understand the monetary value of land. If they sell their land, it would never be theirs again.

The government department that is responsible for carrying out the regulations concerning land. State land is the Department of Lands and Physical Planning. It includes the Land Board, Papua New Guinea Land Board, PNG Valuers Registration Board and the National Physical Planning Board.

Land Title

Land title is free registration of land under a person's name. Title could also be registered under an organization name or a business name. It is regulated by the Land Registration Act.

Generally, the protection given by the constitution and other laws to the landowners rights in a customary land is same as the protection given to the rights of freehold land. Freehold land refers to land in towns and cities which we have titles to. Land Title therefore, is a legal document that proves ownership of land.

Activity 1.3: Answer the question below.

(a) What are the similarities and differences between customary and free-hold or state land?

_____

_____

_____

Land Ownership through Mother

There are areas in Papua New Guinea where the land is owned by the woman. These areas are referred to as the maternal societies. Matrilineal means relating to mother or inheriting from the mother's side. In Matrilineal Societies, the first born daughters are the owners of the land. They have the power to distribute the land to their siblings. Every first born daughter from the first born female immediately inherits the power and right over the land when she (mother) dies.

Example of areas where land ownership is gained through mother are; Autonomous Region of Bougainville, New Ireland and East New Britain.

Land Ownership through Father

Most land in Papua New Guinea is owned by the man. These areas are referred to as the or patrineal societies. Patrineal means relating to father or inheriting from the father's side. In patrineal societies, man is the owner of the land and everything in it. Man inherits the power and right to own the land by birth. He passes the land right and ownership to his sons. A father distributes his land to his sons. The passing of power and right to own the land by birth continues from generation to generation.

Example of areas where land ownership is gained through father are; the Highlands Region, the Southern Region, and the Momase Region.

Summary

You have come to the end of Lesson 1. In this lesson you learnt that:

- Customary land refers to land that is owned by the customary landowners.
- The custom of a society and the relationship of the traditional people with their land determine the ownership of customary land.
- Customary land has been passed on from generations according to the customs of an area or society.
- In many traditional Papua New Guine societies, land is owned by family, clan, tribe or is communally owned.
- Where land is communally owned, an individual who occupies and uses the land is a temporary custodian or user.
- State land or Freehold land refers to land which has been bought from the customary landowners by the government.
- Land registration refers to the process of formally recording who owns land.
- When Land is registered under a person's name, it is known as a title.
- Land title is a legal document that proves ownership of land.
- Example of areas where land ownership is gained through mother are; Autonomous Region of Bougainville, New Ireland and East New Britain.
- Example of areas where land ownership is gained through father are; the Highlands Region, the Southern Region, and the Momase Region.

NOW DO PRACTICE EXERCISE 1 ON THE NEXT PAGE

Practice Exercise 1

1. What is customary land?

2. What percent of the total land mass in Papua New Guinea is customary land?

3. Describe how land is acquired or passed on in Papua New Guinean societies.

4. What are two important factors that determine ownership of customary land?

5. Explain what State or freehold land means.

6. Does the law recognize customary land ownership in Papua New Guinea? Explain.

7. What does land registration mean?

8. Explain what a Land title is.

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 1.

Supplementary Reading 1- Land and the Law

In most Papua New Guinea societies, traditional or customary land is regarded as part of life. Bonds with the land are so strong that introduction of any modern ideas and government policies on land ownership encounter extreme opposition and difficulty to put together.

In the recent past, there have been natural resource developments on customary land. Customary land owners are benefiting from these natural resource developments particularly through the royalty and equity payments. The landowners also benefit from engaging in spin-off business opportunities that the resource developments provide.

However, many landowners have shown dissatisfaction over the benefits they receive and complained about their disassociation with their traditional bonds with the customary land as a result of the natural resource developments.

In our study we will learn what customary land means and issues relating to ownership of customary land and natural resources. We will also learn about land dispute and the processes involved in solving it. This will include study of mediation process and different levels of the land court.

The study of land and what the law says about land ownership, natural resource ownership and land dispute settlement processes are very important. It will help us to understand the landowner's position and the State and the developer's positions. This will also help us to resolve landowner issues and maintain peace and working relationships in natural resource development. Further, it will help us understand why some customary landowners still complain that they are not receiving enough benefits from the resource developments.

Land Ownership and Natural Resources
Here we are concerned with ownership of land and ownership of natural resources. Natural resources mean useful things (resources) which naturally exist in or on the land. It refers to resources that exist in or on the land without being put in place by anyone. The main natural resources in our country include; forests, water, oil, gas, gold, copper and nickel. Who owns these resources? We will discuss the answer to this question below.

Who owns forest and forest resources?
More than 90% percentage of forests in Papua New Guinea is found on the customary land. The Forestry Act, 1991 regulates forestry sectors and recognises the rights of the landowners. In this study we will refer to the Forestry Act 1991 as the law. This law says that the customary landowners own forests and other resources found in the forest.

If the government or the State wants a company to harvest the forest on the customary land, it must obtain permission from the customary landowners. That is done through an agreement between the State and the customary landowners. This agreement is called the Forestry Management Agreement (FMA). Through this agreement, the customary landowners will transfer their rights to the State to negotiate with the developer and issue licenses to harvest the forest.

We should be very careful here. In the forest, the customary landowners have many rights over forests or trees as well as other resources in the forests such as bush materials, ropes, secret sites, caves, waterfalls, creeks, forest foods and hunting sites. When we give

away our rights over forestry (trees) to the state by an agreement through the FMA, we still have our rights and interests in other forest resources.

Under the law, the customary landowners have the right to negotiate directly with the developer and ask for fair compensation for destruction and loss of other forest resources apart from the trees. Sometimes, the customary landowners forget about these other rights and interests in the forest. We ignore them simply because we may not be aware or we are so excited about the royalty payments which we are promised to receive from the forest development.

If other rights or interests in the forests are destroyed or likely to be destroyed as a result of harvesting the trees, we can ask for fair compensation.

As many customary landowners are uneducated on such issues, we may not take steps to protect our rights over other resources in the forests.

However, in traditional context, these other forest resources are highly valuable and useful in different ways. Therefore, if the customary landowners lose them without proper and fair compensation, it is possible that the customary landowners may express dissatisfaction over that particular forest development after few years. This happens when the landowners tend to feel that they are not receiving enough benefits. This can lead to disharmony in the forest development and the community.

If the landowners do not benefit from losses and destruction of other forest resources, they have the right to make claims through peaceful ways. Basically, the landowners may demand for appropriate compensation to be paid. If the developer does not listen to their demands, they may take legal action in court and ask for compensation for what they have lost through the forest development.

Also, if the landowners have this type of dissatisfaction, they should avoid physical threat on anyone or use of force to stop the forest development. Resorting to non-peaceful ways to show dissatisfaction may affect landowners, the company as well as our general economy. To avoid this kind of situation, the State should ensure that the landowners receive fair compensation for loss of their rights and interests in the forest. Payments of compensation for loss of rights in the forest will not come from the State. The company that develops the forest should make these compensation payments.

The State has a duty to assist landowners and educate them about what rights they are losing and help them to negotiate with the developer to get fair compensation. On the other hand, both the State and the landowners should work closely with the developer so that any arrangements on payments for loss and destruction to other forest resources can be agreed by both parties and resolved in harmony.

Who owns water and water resources?

Water flows or sits on the land. Water as in substance is a resource because it is useful to human life. Also, in the water there are other resources such as fish, turtle or prawn. The law that governs water resources is called Water Resources Act. This law says that the land owners who own the land that the water flows or sits on own the water resources. Once water flows or sits on the land, the landowners of that land own resources in the water. Water as in substance cannot be owned because it flows and it does not sit at one land.

If any person wants to use any resources in the water, they should get permission from the land owners. If any destruction is done to water resources, the landowners have the right to claim for fair compensation.

Who owns oil, gas, gold, Copper and nickel (minerals)?
We have studied above that under our custom land includes the soil and everything that is found on or in the soil. Does this mean that the gold, copper, nickel, oil or gas found in customary land belongs to the land owners?

The national Parliament has made laws called the Mining Act in 1992 and Oil and Gas Act in 1998. These two laws clearly answer the question on who owns gold, copper, nickel and oil and gas. The Mining Act says that gold, copper, nickel and other minerals are properties of the State. This means that if gold or copper is found in or on the customary land, the customary landowners do not own them. They are owned by the State.

The Oil and Gas Act also says that oil and gas belong to the State, so if oil or gas is found in the customary land, the customary landowners do not own it.

From this study, we should understand that the State owns all minerals and oil and gas. It does not matter whether minerals such as gold, copper or nickel and oil and gas are found in or on the customary land or private owned land, the landowners only own the land but not minerals or oil and gas.

Does royalty payment to the landowners mean that the landowners own the minerals (e.g. gold, copper) or oil and gas?
In our country the law says that the developer of minerals, oil or gas is required to pay royalty to the State. The law does not say that the developer of minerals, oil or gas should pay royalty to the landowners, the local-level government or the provincial government from which the minerals, oil or gas is located.

The royalties for minerals, oil or gas is paid to the State because by definition, royalty is a payment to a person who owns property. For example, in relation to minerals, oil or gas the law says that they are owned by the state, therefore, the developer pays the royalties to the State and not the landowners, local-level government or the provincial governments. The law also says that the State should allocate some of its royalty monies to the landowners, the local-level government and the provincial government. The landowner, local-level government and the provincial government only receive the State's share of the royalty. The developer of minerals, oil or gas does not pay any direct royalty to the landowners. This is the arrangement under our laws.

Therefore, the payment of royalty to the landowners, do not indicate that the landowners own the minerals, oil or gas. If we have thought like that in the past, it was a misunderstanding. The law is very clear so we should respect it and take the position in law that the landowners do not own the minerals, oil or gas. In fact the royalty that the landowners receive is from the State and not directly from the developer.

Supplementary Reading 2- What is Customary Land Dispute?

Customary land dispute is when there is a disagreement in relation to ownership of a particular customary land or where the boundary between two customary lands should be placed. It is when two or more parties claim ownership of the same piece of customary land. Customary land dispute can arise between two individuals, families, clans, villages or tribes.

Some land disputes have been in small scale but others have been of large scale and became violent and have gone to the highest land court in the country. The land disputes that have reached the highest court in Papua New Guinea include the Hides Gas Case and the Gobe landowners dispute in Southern Highlands Province.

Customary land disputes are very complicated, risky and result in conflict between different families, clans, tribes or villages. It causes a lot of damage to lives of many people in our communities. Therefore, it is important that we know the processes and procedures involved in solving customary land disputes through the land mediation or land courts under the laws of our country.

Understanding the land dispute resolution processes and procedures can help landowners who are in dispute to prepare themselves and take a more educated approach in a land dispute. It can also help us to respect any decisions reached at different stages of the processes and uphold the rule of law.

To solve land dispute without further trouble or fighting, land mediators, Local Land Court Magistrates, Village Court Magistrates and Village Peace officers should know their roles and powers under the law. These officers must act within their powers and be neutral and not favour other party.

Sometimes, unfair and misleading decisions made by people who are involved in assisting the parties to resolve land dispute lead to serious conflict and tribal warfare between the parties. Whenever there is land dispute the first step should be mediation through consultation and reaching decisions accepted by both parties. We will study land mediation processes later.

Is there law on customary land dispute?
The law that provides for the customary land dispute settlement is called Land Disputes Settlement Act. It provides for powers and function of land mediator, Local Land Courts and the District Land Courts in mediating and reaching settlements in land dispute. When dealing with customary land dispute, this law is important as it provides the guidelines and directions for us to follow to reach a peaceful solution.

The land mediators, Local Land Courts and the District Land Courts should not make decisions or do anything outside of this law.

The Land Titles Commission is established under the Land Titles Commission Act to deal with land dispute settlements.
If you want to know more about customary land mediation and dispute settlement, read about it in the book “Law awareness for Papua New Guinea, A guide to the Rule of Law” by Stanley Kuli Liria.

Lesson 2: Land Resources Issues in PNG

Introduction

Welcome to Lesson 2 of Strand 1. In your last lesson, you discussed land ownership in PNG. You learnt about state and customary land and how they are governed. You also learnt about areas in PNG where land is inherited through either the father or the mother. In this lesson, you will learn about land resource

Your Aims

- Identify land use in both rural and urban areas
- Enumerate problems faced with using, developing and acquiring land in rural communities and in urban areas such as population growth, soil fertility, tribal fights, land compensation, squatter settlement, environmental damages, pollution, destruction of ecosystem, and many others, too.

Land uses in Rural and Urban Areas

Land is further described as the "source of livelihood" for many citizens of Papua New Guinea. For it is the land that provides food, work, home, and a place to enjoy life.

The table below lists some common uses of land in rural and urban areas.

Land uses in Rural Areas	Land uses in Urban Areas
1. Subsistence Farming	1. Building factories
2. Subsistence Gardening	2. Building houses
3. Traditional Fishing	3. Building schools and hospitals
4. Commercial farming	4. Building roads and bridges
5. Commercial fishing	5. Building National Projects
6. Building houses, schools, health centres, roads and bridges, airstips	6. Building Government Department Buildings

While using land to build better things to help us survive are good but there are also the problems and issues that arise, too. We will discuss some of these problems and issues in the next part of our lesson.

Problems faced with using, developing and acquiring land in rural and urban communities

Geography

Geography is the study of the earth's physical features. The earth's physical features include climate, the distribution of plants, animal and human life. It also includes the physical features of a place or region and rivers and mountains.

The rural area of Papua New Guinea include, coral islands, coastal lowlands, swamps mountainous and high land valleys. These physical features occupy only 27 per cent of PNG's land. The rest of the land is too steep, too high, too isolated, or too close to active volcanoes and often experience seasonal or permanently flooding.

Population
Population densities and the nature and quality of rural life vary widely from place to place, even within the same province. The densities range from 1 person per square km in remote mountain areas to more than 500 per square km on some small islands. The quality of life is affected by many things. Most basic is having enough land with good soil to produce food for the family and cash crops to help pay for clothing, cooking utensils, store foods such as rice and tinned fish, and cultural exchanges.

Many rural people have intensified their crop growing to keep pace with growing populations on their limited land area. They shorten bush fallows, crop the land for longer periods and adopt more efficient crops, such as sweet potato, Chinese taro, and triploid bananas. If land management practices aren't improved, the land gets degraded and gardens produce less food.

About 40 per cent of PNG's rural population lives in environments with low to very low land potential, according to detailed surveys of PNG's 85 rural districts in Papua New Guinea Development Handbook (see Sources of Information / General on page 253). The land is limited by some combination of these factors: steep slopes, poor soils, high rainfall, long dry season, low temperatures and frosts, frequent flooding, and / or excessive cloud cover.

The surveys found that 15 per cent of PNG's rural population lives an 'extremely disadvantaged' existence. This rating is based on land potential, whether land is being over-used and worn out, access to services, income from farming, and child malnutrition. The most disadvantaged are in 13 districts in the remote provincial border areas of the main island. The 5 worst off are Middle Ramu and Usino-Bundi, Madang, Telefomin, Sandaun, Kandep, Enga; and Pomio in East New Britain province.

At the other hand, 23 per cent of PNG's rural population lives in 17 districts rated as 'not disadvantaged'. They are in the fertile valleys of the Central Highlands, Gazelle Peninsula lowlands in East New Britain, North Bougainville and Sohe district in Oro province.

Rainfall
Rainfall is defined as the amount of rain that falls in a location over a period of time. Rainfall has a strong influence on rural life. People have to plant food according to the seasons in order to have food to feed the population. Furthermore, due to effects of climate change, rainfall does cause floods that greatly affect gardens, homes and developments such as roads and bridges, too.

Access to Services
Having access to health, education, banking, market and information services is a problem too. Accessing services has become more critical as the rural roads and bridge network built in the 1950s and 60s has deteriorated due to lack of maintenance. About 25 per cent of the people do not have immediate access to a road, and 10 per cent have to walk more than a day to reach a service center. Rural people are served by 481 airstrips, but this form of transport is expensive.

Migration
There has been significant migration from rural areas to towns or to oil palm estates. At the same time, urban officials are encouraging unemployed urban migrants to return to their villages. The government has tried to attract business development in rural areas with a tax incentive. New agriculture, construction, manufacturing, and tourism businesses in 41 rural development areas are granted a 10 year exemption from income tax. The business must not be dependent on use of natural resources for its development. International aid donors have focused on developing safe water systems in villages, both for health reasons and to relieve women of the burden of fetching water from distant sources.

Let us now consider issues affecting land resources in towns and cities in PNG.

Settlements
The harsh conditions in rural areas and difficulties in accessing services have forced many people to migrate to towns and cities. You know that government owns very small percentage of land area in the country. Most of it is where towns and cities are built. Migration to towns and cities have increased the number of squatter settlements resulting in the of not enough land and money to build houses.

Population
Rapid increase in the growth of population also results in less land and money to build houses. It also leads to food shortage. Now, there is not enough land as well to grow food crops. Soil fertility has become a problem because the same piece of land is used over and over again to plant food crops. As a result production of food has decreased and is continuing to become less.

Pollution
With increased population, more pollution and destruction to ecosystems is also experienced. More tribal fights and land disputes occur with individuals claiming ownership and title to land. We see a chain of issues and problems because of lack of care and abuse of land resources.

Land is a non-renewable resource, therefore careful management of land is needed in Papua New Guinea.

Activity 2.1 Answer the question below

As an educated citizen of Papua New Guinea, what is your suggestion to reduce squatter settlements in towns or the urban areas?

_____
_____
_____

Land Compensation

In PNG, compensation for land and materials is a major hurdle for road projects. Other development projects are also affected. It takes between 3 years and 10 years to resolve land issues. For example, for a national road to be built, the route must firstly be established. The owners of the land must be identified. Negotiations must be conducted for compensation royalties. Compensation must be paid for the strip of land. National roads need to be 40m wide and others 20.

Compensation must also be paid for land to be used as a source of road building materials like quarry as well as for loss of garden plots, garden crops, and trees of commercial value for any buildings that will be destroyed.

Royalties must also be negotiated for landfill and gravel taken from the quarry.

There is a 3 step process for settling disputes: They are; Mediation, Local Land Court and District Land Court.

A study carried out in year 2000 found that a typical cost for land acquisition process, surveys, reports, land and other compensation amount to K54,000 per km of road and can go as high as K100,000.

However, not all landowners demand compensation for roads across their land.

Summary

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

- More than 85% of Papua New Guineans live in rural areas.
- Rural areas include coral islands, coastal lowlands, swamps, mountains and highland valleys.
- Urban areas in Papua New Guinea include the main towns and cities in the country.
- Each Province in Papua New Guinea has a capital or main town.
- Port Moresby is the capital city of Papua New Guinea.
- Harsh conditions in rural areas force many people to migrate to towns and cities.
- The government owns very little land and therefore cannot provide services to all the citizens.
- Shortage of land and housing in towns and cities has resulted in the development of squatter settlements and social problems.
- Increased population in towns and cities leads to social unrests like fighting and criminal activities.
- Land is a non-renewable resource which must be managed properly.
- Compensation and royalty payments for land is a major hurdle for

NOW DO PRACTICE EXERCISE 2 ON THE NEXT PAGE

Practice Exercise 2

1. Papua New Guinea can only use about 27% of its land, why?

_____

_____

_____

2. The Quality of life in rural areas is affected by many factors. List some of them.

_____

_____

_____

_____

3. What percentage of people in rural areas do not have immediate access to roads?

_____

_____

_____

4. There are 481 airstrips serving rural people. Why can't rural people use the service?

_____

_____

_____

5. How does rainfall affect people in rural areas?

_____

_____

6. How has cash crops affected land in rural areas?

_____

_____

7. How has increased population affected agriculture or growing food crops?

_____

_____

8. There has been a significant migration to towns and cities because of problems encountered in rural areas. What has the government done to help with this situation?

_____

_____

_____

9. If you are a landowner, what are some things that you can do to help yourself?

_____

_____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 2.

Supplementary Reading 3: Bougainville Crises

A Brief Back Ground History of Bougainville Crises

Bougainville was formally known as North Solomons Province. Bougainville is a very rich province with resources such as copper, gold, cocoa and copra. Bougainville contributed productively to the economy of Papua New Guinea through the exporting of copper and gold. However, this came to a stop in 1989 when militants led by Francis Ona waged a deliberate destruction and killing which closed the mine on the 15 May 1989. Francis Ona demanded independence, permanent closure of the mine, and K10 000 000 000 (ten thousand million) in compensation. His actions were supported by some church leaders and expatriates who had been critical of environmental damage and social disruptions caused by the mine.

Ona's Bougainville Revolutionary Army (BRA) attracted supporters from outside the mine area. These included people who felt economic development was undermining customs and traditional social structures, or who were angry about the success of businessmen or mine and plantation workers from outside the mine.

After that Bougainville, made a formal withdrawal from the Papua New Guinea Government. In 2002, Parliament granted Bougainville a new form of Government. It includes more local control than other provinces and the promise of a vote on future political status, including full independence, between 10 and 15 years after the first election of an Autonomous Bougainville Government.

Bougainville Copper Mine to Reopen

Papua New Guinea hopes to reopen its huge Bougainville copper mine by 2012, two decades after secessionist violence forced it to close, and to play a bigger role in world copper markets, the nation's prime minister said on Monday.

"We could see the reopening of Bougainville at a cost of about $4 billion," Prime Minister Michael Somare told a Papua New Guinea investment conference in Sydney.

Papua New Guinea regularly talks up the prospect of the Bougainville mine reopening, but industry analysts now take this possibility more seriously, given rising investor confidence in the country and surging demand for the metal from Asia.

Bougainville's secessionist movement has also faded away.

"PNG is in the throes of becoming a major world supplier of copper," Somare told the conference, which serves as a regular investment road show for the country with Australian financiers.

In 1990, miner RTZ (now Rio Tinto) closed the mine, one of the world's richest copper deposits, after angry villagers attacked workers and sabotaged mine operations.

World copper demand, especially from China, now represents an unprecedented opportunity for Bougainville, said Greg Anderson, head of Papua New Guinea's Chamber of Mines and Petroleum.

"There is a real appetite to get Bougainville up and running again as soon as possible," he told Reuters.

Copper on the London Metal Exchange fetches about $8,700 a tonne and gold $1,400 an ounce compared with $3,000 for copper and $450 for gold when the mine was abandoned.

Source: From the National Newspaper of Papua New Guinea

Supplementary Reading 4: Factors Affecting Commercial Farming and Fishing

Soil Erosion
Soil and its nutrients are essential for plants to grow. As people clear forests to grow cash crops, soil erosion occurs because there are not enough plant roots and organic materials in the soil to keep it in place during wind and rain. Once the top soil, which contains all the nutrients, has been washed or blown away, the soil becomes infertile and crop yield is very low. Many plantations are addressing this problem, but much more needs to be done to ensure forest clearing is regulated. Reforestation programs need to be put in place.

Destruction of Traditional Hunting Grounds
Traditional hunting is still a way of living for many people, and the destruction of these grounds means that people have lost one form of food supply, as well as materials for everyday living and ceremonial artefacts. Government regulations need to balance economic development with traditional ways of living.

Water and Air Pollution
All large-scale agricultural enterprises bring with them environmental concerns, such as air and water pollution. Water pollution from chemicals used in farming is a common complaint and air pollution, especially from large- mining, is evident in some regions. Regulations need to be set in place and enforced.

Factors Affecting Fishing
Fishing is a small industry in Papua New Guinea, although our country has excellent fishing waters. Fisheries estimate that Papua New Guinea's seas could produce 500 000 tonnes of fish a year without risking future stocks. There is also a sizeable potential market, but despite this, the fishing industry has not grown significantly. Why?

- Fish prices are low compared with the costs and risks involved in catching them
- Traditional land rights sometimes prevent fishermen from entering the best fishing or bait- gathering areas
- Harvesting prawns, lobster tails and barramundi, and tuna fishing, are mostly in the hands of the foreign companies. Their boats have specialist equipment for large-scale fishing.

Shifting Cultivation
Shifting cultivation is a farming method. It is the main system by which food is grown throughout Papua New Guinea. It can take two forms:

- Clearings from forest
- Clearings from grasslands

The main problem with shifting cultivation is that if the land's resting time is too short, the soil does not recover its fertility. When this happens, food yield per unit of land is low. To increase crop yield, people need to find different ways to keep the soil fertile.

Factors affecting PNG Climate
The length of daylight is about the same all year in PNG because of its location close to the equator. This keeps temperatures fairly constant. Another factor is PNG's location between Asia and the South Pacific. Rain-bearing winds blow across PNG from the colder to the warmer of these two areas. The winds blow from the northwest from

December to April, when the Asian continent is cold. They blow from the southeast from May to October when the Asian continent is warm. These seasonal winds cause different patterns of rain in each area. On the mainland and larger islands, the pattern is affected by local mountains, which cause air blowing from certain directions to rise, cool and drop its moisture as rain. This is why Lae, near mountains, gets about 4 times as much rain as Erap, which is only 40 km away in the Markham valley flats. Smaller islands get rain during both prevailing wind seasons and have almost no dry season. Mountain valleys have an almost daily pattern of morning fog, which rises to form clouds on the mountain tops during midday and then rain in the afternoon or evening.

Lesson 3: Land as a Source of Income

Introduction

Welcome to Lesson 3 of Strand 1. In lesson 2, you learnt about land uses in both rural and urban areas. You also identified problems faced with using, developing and acquiring land in rural communities and in urban areas. In this lesson, you learn about how land can be used as a source of income.

Your Aims

- Identify the traditional practices of using land resources
- Identify ways that the traditional practices have changed, improved or can be improved
- Identify projects that can be established to earn an income using the land resources
- Identify a particular commercial project or activity from the possible ones and discuss the proposal to use and make it earn

Traditional use of land

Before we move into our lesson notes, answer this very simple question. Was land used as a source of income in traditional times? Yes or No

The possible answer will be “No”. Land was not directly used to earn money.

Land in traditional times was used mainly as a source to survive. Remember the three (3) basic needs for survival? They are food, water and shelter. How did people in traditional times satisfy these basic needs?

Selling bananas at a Food Market

Well, people produced things mainly to supply their own needs. But we can agree that people in traditional times used land to make extra goods too, which they exchanged for other goods. They also used land to rear animals like pigs which gave them status and wealth in their communities.

In many regions of Papua New Guinea, shifting agriculture was practiced. This meant that areas of rain forest or jungle were cut, burnt and food crops were planted. After a time, when the soil no longer produced good yields, people moved to new areas of rain forest and made new gardens. Now, the methods used and the food crops grown have changed.

Activity 3.1 Answer the question below

What happened when the first Europeans settlers and missionaries came? What did they introduce? Name two things.

(a) _____

(b) _____

The first colonials that came to PNG acquired large areas of fertile land and established cash crop plantations in parts of country. With the growing of cash crops, they introduced money and clothes. The introduction of these new things brought about lifestyle changes to the people. Land was no longer used only to provide the basic needs of food, clothes and shelter but also as a source of income.

Land Resources as a Source of Income

Many families in Papua New Guinea are now engaged in one or more activities to earn money from the land.

From the information provided by the 2000 National census, there were a total of 943,767 families or households involved different activities to earn money from the land.

TYPES OF ACTIVITIES TO EARN MONEY

Activity	Percent %	Activity	Percent %
1. Raise food crops	73.5	9. Raise livestock	42.5
2. Grow coffee	42.1	10.Grow betel-nut	38.6
3. Grow coconut	34.5	11. Raise poultry	22.3
4. Grow cocoa	16.0	12. Grow oil palm	2.1
5. Grow rubber	1.3	13. Sell food crops / cooked food	49.9
6. Sell betel-nut	32.8	14. Sell meat at market / roadside	19.0
7. Sell hand-made things	13.7	15. Sell fish	9.7
8. Run a trade store	3.8	16. Run a PMV	1.5

All the activities listed above require the use of land. Land is used to grow cash crops like coffee, betel-nut, coconut, cocoa, oil palm, rubber, raise poultry, pigs and establish trade stores and PMV business. Land resources are also used to make tools, crafts and grow food crops to earn an income.

Taro plot

Population has increased because of better health care and education and economic opportunities. Better transport system has enable people to move around easily to sell produce and participate in more trading and income generating activities.

People are able to communicate with others around the country and overseas. They are also able to access more information and so the volume of trade has increased significantly.

Activity 3.2 Answer the question below

(a) Look at the activities given in the table on page 26 and choose the kind of activity that you would like to do to earn an income when you complete your studies.

(b) Is there anything you can do which is not listed? Why did you choose the activity?

_____
_____
_____

The proposal

A proposal is a written up suggested idea or plan. It is put forward formally or officially to be accepted. So after you choose the kind of activity that you would like to do to earn an income when you complete your studies, you will have to write up a proposal for it. In the proposal, you will write about the name of the project, what are the aims, how will the project be carried out, how many people will be involved, what materials or resources to use, other resource people who are going to help in your project, how much money will be used and how to assess the project. Usually, small projects have lesser things to write about while bigger projects have many things to write or include in the proposal.

A SIMPLE PROPOSAL LAYOUT FOR A PROJECT

Your Project's Name	:	…… …… ……
Aims of the Project	:	…… …… ……..
Resources	:	…… …… ……
Implementation	:	…… …… ……
Budget	:	…… …… ……
Evaluation	:	…… …… ……..

Summary

You have come to the end of Lesson 3. In this lesson you learnt that:

- Land in traditional times was used as a means to survive.
- Land provided the basic human needs for food, shelter and clothing.
- Land is now being used more to generate incomes with the introduction of money, cash crop and education. The way and the amount of land that is being used to earn money has also changed.
- Population has increased because of better health care and education and economic opportunities.
- Better transport system has enable people to move around easily to sell produce and participate in more trading and income generates activities.
- People are able to communicate with others around the country and overseas. They are also able to access more information and so the volume of trade has increased significantly.
- A proposal is a written up suggested idea or plan. It is put forward formally or officially to be accepted.

NOW DO PRACTICE EXERCISE 3 ON THE NEXT PAGE

Practice Exercise 3

(1) Identify and prepare a commercial proposal following these guidelines.

(a) Describe the planned activity eg. Growing and selling beans at the market.

_____

_____

(b) Why did you choose this activity?

_____

_____

(c) How much money will you need to start the activity?

_____

_____

(d) How much do you plan to rise?

_____

_____

(e) For how long (period) will the activity go on?

_____

_____

(f) Where will you get the money to start the project?

_____

_____

(g) Where will you market the product?

_____

_____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 3.

Supplementary Reading 5: Subsistence & Commercial Farming

Subsistence Farming - Gardening

Subsistence agriculture means growing enough food for you and your family to eat. Today, there are only a very few people in the remotest areas of Papua New Guinea who are sole subsistence farmers. The introduction of money or the cash economy has brought about rapid change.

It is commonly accepted that subsistence farming is growing food and materials to support the life of the farmer and his or her immediate family. All the food that is grown is usually used up. Any food left over can be sold to buy essential items that the family needs.

There are many different types of subsistence farming in Papua New Guinea because of the many different environments, customs and values.
Subsistence farming involves:

- Crop rotation
- Planning new garden sites
- Use of traditional tools
- Different roles for those involves in gardening practices

The combination of these efforts ensures a successful harvest. Today, subsistence – farming practices are changing because there are more and more people living in the country. New farming methods are being introduced and these new methods when combined with the old ways of farming benefit everybody. This very important because the country's population is growing and farmers must grow more crops and raise more livestock to feed their own families and also sell to markets to feed urban dwellers.

Highlands Areas:
Highlanders have developed an intensive farming system. They use land for long periods of continues growing and, where necessary, use fallow land after as little as two years. They enrich the soil with decaying matter and rotate crops to help keep the soil fertile. Most highlanders plant on mounds. Mounds contain concentrate nutrients, drain off water, and help protect the plants from frost. Foods planted by subsistence farmers in the highlands include: sweet potato, taro, sugar cane, pitpit, winged beans and many Chinese and European vegetables.

Lowland Areas:
A system of shifting agriculture and bush fallow is used in most lowland areas. Garden lands are cleared and the bush is burnt to return nutrients to the soil before crops are planted. Taro harvesting can begin after three months, yams after six or seven months. The land maybe used for six months to three years. Then it is abandoned and natural bush is allowed to grow. This bush fallow restores nutrients to the soil. The length of the bush fallow depends on the soil's fertility and also on how much other land is available. It ranges from seven to forty years, usually more than fifteen years. Foods planted by subsistence farmers in the lowlands include: sago, taro, yam, banana, cassava, coconut, breadfruit, pawpaw, mango, marita, galip, okari nuts and greens.

Commercial Farming - Gardening

Some farmers in Papua New Guinea only grow cash crops. They plant a crop that they won't use, but someone else wants to buy. Cash crops are crops that are specifically grown to sell for money. These crops are grown by different groups of people in different ways.

- Plantations: These are large areas of land, usually owned by foreigners or companies. On plantations, machinery is used, and labour is often brought in from outside the local areas. In Papua New Guinea, plantations grow copra, cocoa, coffee, rubber and tea.
- Smallholders: These are usually subsistence farmers who also grow cash crops to raise money. In the Highlands the main cash crop is coffee with some pyrethrum and cardamom. In the lowlands cocoa, copra, some coffee and rubber are grown.
- Nucleus estates with smallholder settlers: These are schemes whereby a large estate is owned by a company and surrounded by lots of smallholdings that grow the same crop as the estate. The smallholders can use the company's machinery and sell their crops to the company. Most rural people are both subsistence and cash crop farmers.

In addition to agriculture, people also raise fish, pigs, chickens, cattle, goats or sheep, which is another kind of modern, cash-farming enterprise.

Most of the produce from cash crops is exported to overseas markets. Growing cash crops requires a large number of labourers or machinery as well as large areas of land. In addition, higher management and accounting skills are required for the smooth operation of the farm. The overall aim is to make huge profits to expand the farm or finance new developments. Although cash crops bring in much needed money for our country, some aspects of commercial agriculture create problems that need to be addressed.

Lesson 4: Water as a Source of Income

Introduction

Welcome to Lesson 4 of Strand 1. In Lesson 3, you learnt about traditional practices of using land resources and how these practices can be changed or improved. You also learnt to identify projects that can be established to earn an income using the land resource. Finally, you identified a particular project or activity from the possible ones and discuss the proposal to use and make it

Your Aims

- Identify the traditional practices of using water and its resources
- Identify ways that the traditional practices have changed, improved or can be improved
- Identify commercial projects that can be established to earn an income using the water resources
- Identify a particular commercial project or activity from the possible ones and discuss the proposal to use and make it earn an income

Water Resources

Water resources include rain, dams, tanks, wells, oceans, rivers, coral reefs, lakes, mangroves, wetlands and swamps. You discussed these in Grade 6 and Grade 7, Remember!

Water is essential for life

Traditional Practices of Using Water Resources

Traditionally, water resources have been a source of food to sustain life. They were also in trade. River and the sea were used as a means to transport goods from one place to another. Apart from using the river system and the sea to travel, the goods used in trade were also taken from the water.

The famous Hiri trade between the Motu and the Kerema people is an example. In those times, people exchanged goods for goods. Some of the goods were from the sea, like fish, shells and ornaments made from shells and corals taken from the sea.

You can read about the Hiri Trade in the supplementary book. There was also the Kula trade that took place in the Milne Bay islands. Valuable items like shell money (Bagi) was traded. Many different kinds of resources from the sea, rivers, lakes and mangroves were used in traditional trade.

Activity 4.1: Answer these general questions to help you revise.

1. Rain water is used for what main purposes?

_____

2. Give two examples of dams in Papua New Guinea.

   _____

3. The government through its agencies and NGO organizations has supplied villages around Papua New Guinea (PNG) with tanks.
   Why?_____

4. In which areas of PNG are water wells used?_____
   _____
5. Name two resources taken from the ocean. _____
6. List two uses of the coral reefs._____
7. Name the three largest rivers in Papua New Guinea._____
8. Name two lakes in Papua New Guinea ._____
9. Name two uses of mangroves._____
10. Wetlands maybe useless for farming. What is one importance of wetlands?
    _____

Ways Traditional Practices Have Changed, Improved or Improved

Subsistence Fishing

Subsistence fishing is an important job in Papua New Guinea (PNG). One-fourth of the rural families do it. Papua New Guinea (PNG) consumes an estimated 15 130 tonnes of fresh fish each year. Fish are the major source of body-building protein for most coastal and river people. Both men and women fish, sometimes together but often in separate specialties. Outboard motors, nylon nets, and other new material have changed the way that much fishing is done. However, people still use many traditional fishing practices and methods. These include;

- **Bows and arrows** are used to shoot fish from rocks or canoes.

- **Dams** are built across inland streams to catch fish which swim long distances to lay their eggs. The pools are drained and the fish captured.

- **Dip and scoop nets**, with frames of bamboo or wood, are passed through the water along the shore or from a canoe.

- **Explosives** are used to stun or kill fish. Some villages forbid this technique because the explosive destroys coral and other sea life too. Fishermen are sometimes killed accidentally by explosives.

- **Fences** are built around coral areas or across stream mouths. At low tide, the stranded fish are caught by hand or with spears.

- **Hooks and lines** are widely used. In many places, metal hooks have replaced the traditional hooks made of turtle shell, bone, wood or other materials.

- **Nets** are used in several ways. In one, teams of men stretch long nets across

Men Using Nylon Net to Fish

shallow coral areas, and other people splash and make noises to drive schools (large groups) of fish into them. In another technique, floats and weights hold a net with fairly large openings upright in the water. The net is left unattended. It entangles the gills (breathing slits) of fish which attempt to pass through it. Nylon gill nets are so effective that they have caught most of the big fish in many areas. Some villages have banned their use.

- **Plunge baskets** are used in muddy water. They are pushed down quickly with the hope of catching a fish on the ground underneath. Plunge baskets are also used like dip nets.

- **Poisons**, usually made from plants, are poured into natural or man-made pools along rivers or on reefs. The dead fish are collected when they rise to the water's surface.

- **Spears** are used from canoes and for fish trapped in pools at low tide.

- **Spear guns** use a strong rubber band to shoot a short arrow.

- **Traps** made from bush materials are used both in land and on reefs.

Spear gun

Activity 4.2: Read the notes on Subsistence Fishing and answer the following questions.

1. What proportion of Papua New Guinea's (PNG's) population is engaged in subsistence fishing?

_____

2. How much fresh fish is consumed in Papua New Guinea (PNG) annually?

_____

3. What has changed the way fishing is done today?

_____

Modern period

Do you agree that there are many changes to the ways water resources are used today? Not only that but the technique and methods used in exploiting water resources have greatly changed. Today water is used extensively than in the past. As the result; many changes happened in the way water and its resources are being used. New techniques and methods used today to exploit water resources have greatly change the way water was used in the past.

Reasons for change to the ways water resources are used today

- Growth in population
- Harvesting resources to sale and earn an income
- Techniques and methods used to harvest resources have become more efficient and effective.
- Export to other countries to meet demands of consumers in other countries.

These are just some reasons for the changes in the way the resources are being exploited. These reasons are also causing us to consider conservation in order to sustain the availability of the resources.

Commercial Projects That Can Be Established To Earn an Income
Commercial project can be started using anything from the sea, lakes or rivers. These can be activities such as;

- Fish farm
- Crocodile skin selling
- Selling of gray fish, sea cucumbers, prawns,
- Eel farming for tourism business, etc

Let us take fish farming as an example:

Fish farming is raising fish in enclosed tanks. They are been fed, looked after to adult stage before they are sold for money.

We already learnt about what a proposal is in our last lesson. So, below are guided questions that can be answered to draw information for a proposal for a Fish Farming Project.

GUIDED QUESTIONS

1. **Name of Activity:** *Fish farming*
2. **Description of the Activity:** *To sell fish to the community*
3. **What is the purpose of the Activity?** *To provide another alternate of potien supply for the community to have nutritious meals or eat healthy*
4. **Who are your customers?** *Everyone in the community (highlands)*
5. **What materials do you have?** *Tanks, nets, water pump,*
6. **How much to start with?** *About K10,000*
7. **Where will you get the money to start with?** *A loan from the micro-bank or help from an NGO.*
8. **How long will the activity go on?** *five to ten years*

Summary

You have come to the end of Lesson 4. In this lesson you learnt that:

- Water is essential for living and has now become an important commodity. The water itself and its resources can be used and sold for cash.
- Traditionally water and its resources were used to feed families, end death rituals, feasts, trade etc and still continue to do today.
- Over the years population has increased so the need and demand in these activities have increased too. There are new demands such as paying schools fees, especially for parents to send their children to school. The need for water and it's resources to provide for its inhabitants is really big.
- Today with the creation of towns and cities there is also a big demand for water for comfort, quench thirst, food, manufacturing, farming, electricity and many more activities.
- Water can be found in seas, lakes, dams, mangroves, rivers, wetlands etc and plays an important role in the lives of people animals and the earth itself.
- Traditional practices have changed, better, improved and new inventions are used to meet these big demands.
- People have designed, bows and arrows, dip and scoop nets, explosives, fences hooks and lines, plunge baskets root poisons, and spear guns to obtain fish and other marine resources for selling and for personal use. Papua New Guinea needs to conserve these resources and use them in a sustainable manner to benefit the future generation.

NOW DO PRACTICE EXERCISE 4 ON THE NEXT PAGE

Practice Exercise 4

1. Make a list of possible projects you can establish in your village and or community, using water resources.

   _____
   _____
   _____

2. Decide on a particular project you want to establish from the list you have drawn.

   _____
   _____
   _____

3. Prepare a simple proposal for a project. Use the steps and methods you learned in Grade 6 and 7. A sample is provided to help you.

PROJECT PLAN

Your Project's Name	:	…… …… ……
Aims of the Project	:	…….. …… ……..
Resources	:	…… …… ……
Implementation	:	…….. …… ……
Budget	:	…… …… ……
Evaluation	:	…….. …… ……..

4. Poem: "When all the trees are cut, silver and gold dug up, fish are caught, and the last river dried up, then we will know that we cannot eat money". Explain this poem.

   _____
   _____
   _____
   _____
   _____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 4.

Supplementary Reading 6: Hiri Trade

Hiri is one well known example of traditional trade within Papua New Guinea. You may also be familiar with kula trade which existed in the Trobriand Islands.

The Hiri was conducted between the Motu villagers of the Port Moresby and Gulf Districts. It was common until 1957. It was traditional for the Motu of the Port Moresby area to build and sail boats known Lagatoi across the several hundred miles of the rough Papuan Gulf to barter pots for much needed sago and betelnuts. Singing, dancing and feasting were an important part of the Hiri. There was considerable prestige and honour for the big man who was able to generously look after his guests, while at the same time earning himself a reputation as a hard trader. The Hiri was also considered to be very important in establishing lasting relationships which would be valuable for later Hiri.

To some extent the hiri had a very important social function. Friendships were made that were of immense importance to the people involved. But we should remember that the commercial and economic aspects of the hiri were just as important. Without the hiri many of the Motu people would have found it difficult to survive. In poor seasons they often found that the crops from their own gardens did not provide enough food. Sometimes they could not catch enough fish to trade with hill clans for bananas.

Torres Strait Treaty

Torres Strait Treaty sets the legal boundaries between Papua New Guinea and Australia and controls the exploitation of sea life and minerals in certain areas.

The Treaty became effective on 15 February 1985. It sets political, mineral resource, and fishery boundary lines. Almost all of the islands belong to Australia. These include Aubusi, Boigu, Dauan, Kaumag, Moimi, and Saibai, which are less than 11 km off the Papua New Guinea mainland. Kawa, Mata Kawa, and Kussa, which are uninhabited islands close to the mainland, belong to Papua New Guinea.

The treaty protects the right of the traditional inhabitants of the area to continue traditional non-commercial activities, regardless of these boundaries. They can move about freely for gardening, food collecting, hunting, fishing (except commercial fishing), weddings, funerals, others social gatherings, and barter/market trade. They must obey restrictions on carrying goods, plants, and animals between the two countries. They must go through normal immigration procedures when they are travelling for non-traditional activities.

Papua New Guinea and Australia consult each other to set commercial fishing catch limits in the Torres Strait area. The Treaty also commits them to work together to avoid pollution of Torres Strait waters and to conserve its sea life. The Treaty bars exploration for oil in the strait. A joint advisory committee meets regularly to discuss problems that cannot be worked out by local officials.

Lesson 5: Conservation of Land Resources

Introduction
Welcome to Lesson 5 of Strand 1. In Lesson 4, you learnt about traditional practices of using water resources and how these practices can be changed or improved. You also learnt to identify projects that can be established to earn an income using the water resources. Finally, you identified a particular project or activity from the possible ones and discuss the proposal to use and make it

Your Aims
- Identify practices that require the conservation of land resources in the community
- Identify a national land project and discuss the mismanagement practices the project employs then suggest ways to stop, reduce or correct the mismanagement or destruction.

What does Conservation mean?
To conserve means to protect and use wisely. Conserving land will allow for land to be available and used for a longer period of time. It refers to sustainable use of land resource in this case.

The government of Papua New Guinea through the Department of Environment and Conservation wants all its citizens to be educated about using resources in a sustainable manner. Sustainable manner refers to ways in which resources can be of how to use resources carefully so they will be available for the people in the future too. It involves management and protection of resources.

Conservation is important to PNG because it has a great diversity and number of unique species because it has many different environments and climates.

Practices That Require the Conservation of Land Resources
We will now discuss examples of practices that require the application of conservation methods to land resources.

1. Permaculture

What is permaculture? It is a system of agriculture that uses a mix of trees, bushes, other perennial plants. Perennial plants are plants that last for more than two growing sessions or plants that grow continuously. Having these type of plants put together with livestock creates a self- sustaining ecosystem that yields crops and other products. Permaculture is also known as sustainable agriculture. It takes care of the environment and encourages self-sufficiency and sustainable living.

There are certain things that permaculture emphasizes. These are:
- Perennial plants rather than annual planting of crops. This reduces soil erosion as there is no plowing the soil.
- A mix of plant sizes and types planted together. Often one plant provides good conditions for the growth of another plant species. Weeds and pests are less of a problem.
- Plants and animals are farmed together. Animals can feed on grasses and excess or waste plant produce. In turn, animal manure can be used to fertilise plants.

- Local production for local consumption reduces the need for transport and the pollution that comes from transport.

2. Mixed Cropping

Mixed cropping is the traditional way of planting crops in Papua New Guinea and most parts of the Pacific region. It is about planting various crops in the same garden at the same time without any definite spacing and without rows or lines. This method provides a variety of crops for harvest all year round.

Each mixed crop must contain at least one of each of the following crop categories: leafy legumes, tuberous and fruit bearing vegetables that mature at different times. In this way, a family has vegetables available throughout the year. This practice also helps with pest control as certain intercrops act as insect repellents.

3. Organic farming

Organic farming means growing crops using compost, manure and other natural plant foods, without the use of chemical fertilisers. This is the cheapest and best method of growing crops for human consumption.

4. Reusing and conserving resources

People must preserve, protect, improve and manage natural resources such as forest, coral reefs and water so that they are there for future generations. Combine traditional and modern practices to ensure that these resources are fully utilized and benefit all people. The principles of ecology can be used to help communities manage their environment wisely. Diverse environments are stable and can be managed more easily. In Papua New Guinea, people have traditionally managed their environment wisely.

Land Projects

Let us take the timber industry in Papua New Guinea as an example.

Timber industry is an organized economic activity connected with the production and manufacture of timbers. Timbers come from logs which are extracted by the timber companies that are engaged to work.

When the companies extract logs, there are some serious damages done to the environment. This has become a concern for organizations like the World Bank who gives out major development loans for companies to operate in Papua New Guinea.

The World Bank insisted on the moratorium as a condition for granting PNG major development loans. Its main concern is about destruction of PNG‘s forest resources and the biodiversity contain in the forest.

The World Bank strongly required from PNG Government a report on the environmental social impact of forest activities in the country- especially the logging industry.

The report should contain the following information:

- Detailed surveys of the forest resources
- The informed consent of the affected landowners; before the Forest Management Agreements (FMA) are issued.
- A National Forest Plan that shows how national and provincial governments will manage and use forest resources in the long run.

The government had to fall in line with what the World Bank expects by developing a small-scale eco-forestry programme, with funding support from the European Union. Villagers will harvest, process, and market their own timber products. They were being trained in conservation, industry practices, and marketing at Omsis Community Forestry Training Centre near Lae.

Example of wise management practice
Now, let us read about some practices put in place by the government.

1. The government has established National Parks to preserve native animals and plants that are significant to Papua New Guinea. Due to increased fishing, hunting, gardening, logging and mining activities, some plants and animals are in danger of extinction. The government has declared these ‗National Animals' in order to protect them. They can only be caught or collected by Papua New Guineans using traditional methods and they can only be used for traditional purposes.

2. The government has also established wildlife management areas. In these areas local landowners establish their own rules in order to limit damage and protect the natural environment. These rules are usually based on traditional management. If the environment is not used and managed wisely, more and more plants and animals will become endangered.

Summary

You have come to the end of Lesson 5. In this lesson you learnt that:

- To conserve means to protect and use wisely.
- Sustainable development involves the management and protection of resources.
- Conservation is important to PNG because it has a great diversity and number of unique species because it has many different environments and climates.
- Permaculture is a system of agriculture that uses a mix of trees, bushes, other perennial plants with livestock to create a self-sustaining ecosystem that yields crops and other products.
- Mixed Cropping is about planting various crops in the same garden at the same time without any definite spacing and without rows or lines. This method provides a variety of crops for harvest all year round.
- Organic farming means growing crops using compost, manure and other natural plant foods, without the use of chemical fertilisers.
- People must preserve, protect, improve and manage natural resources such as forest, coral reefs and water so that they are there for future generations.
- Timber industry is an organized economic activity connected with the production and manufacture of timbers.
- Organizations like the World Bank who gives out major development loans for timber companies to operate in Papua New Guinea is concern with the environment and social impacts that are done by timber companies.

NOW DO PRACTICE EXERCISE 5 ON THE NEXT PAGE

Practice Exercise 5

1. Since 1994, the exports have dropped, due to a moratorium on the issuance of new timber permits. This has brought about changes in the world market. Given below is a comparison between the peak years of 1994 and 2001.

	1994	**2001**
Log volume	3 000 000 m^3	500 000 m^3
Log value	K563 000 000	K283 000 000
Export tax	K134 000 000	K 96 000 000
Royalties	K 43 500 000	K 31 000 000
Processed value	K 11 000 000	K 98 000 000

1. The export of tropical logs has dropped since 1994. Why?

   _____

   _____

2. Why did the World bank insist on a moratorium as a condition for granting PNG major development loans?

   _____

   _____

3. What do the letters FMA stand for?

   _____

4. Do you agree with (the changes) what the government has done to the Timber Industry? Recommend improvements if necessary.

   _____

   _____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 5.

Supplementary Reading 7: New protected Areas in Papua New Guinea

Introduction: New protected areas for Papua New Guinea

Some 80,000ha of rainforest around Papua New Guinea's Mt Bosavi (2400m) in the Kikori River Basin have been designated protected areas.

Local tribes attended ceremonies on the slopes of Mount Bosavi to celebrate the creation of the three new protected areas. Musula and Wabimisen, Papua New Guinea – Local communities in Papua New Guinea gathered along the volcanic slopes of Mount Bosavi in the country‘s Southern Highlands to celebrate the creation of three new protected areas.

Land owners of Mt Bosavi

The new wildlife management areas, covering 80,000ha of PNG‘s Kikori River Basin, are home to pristine rainforests and rich wildlife such as the world‘s longest lizard and giant pigeons and butterflies. It is also the region where eight new orchid species were recently discovered by WWF.

—Today‘s announcement is an important milestone in strengthening the system of protected areas in PNG and gives a boost to the efforts of WWF and its partners in achieving big conservation results in the Kikori region,” said WWF PNG protected areas officer Saina Jeffrey.

—The declaration signifies a commitment by local landowners to conserve and safeguard their land, and to protect it against destructive development such as unsustainable logging.”

The three new protected areas at Sulamesi (70,159ha), Hose (4,830ha) and Arisai (4,661ha) were established on the customary lands of the Kosua and Orogo people in order to help safeguard the forests and its unique biodiversity, as well as to provide sustainable income activities for those that depend on the natural resources.

—Today we recognize the Bosavi people‘s efforts in protecting their land and heritage, including the source of the Kikori River, for future generations,” said WWF PNG‘s Country Programme Manager, Michael Avosa.

Facts About Papua New Guinea

• Papua New Guinea — the world‘s second largest island that is split between Papua New Guinea and the Indonesian province of West Papua or Irian Jaya — has the largest remaining rainforest in the Asia-Pacific region.

• WWF has been working in PNG since 1995, focusing its conservation efforts on linking

community action, science and effective policy to ensure the protection and sustainable use of forests, freshwater and marine resources across the island of Papua New Guinea.

• In 1993, with the PNG National Executive Council‘s approval, WWF Kikori River Programme established a model Integrated Conservation and Development Project in a tropical rainforest of 2.3 million hectares in the Southern Highlands and Gulf Provinces of Papua New Guinea.

Problems In The Forests Of Papua New Guinea

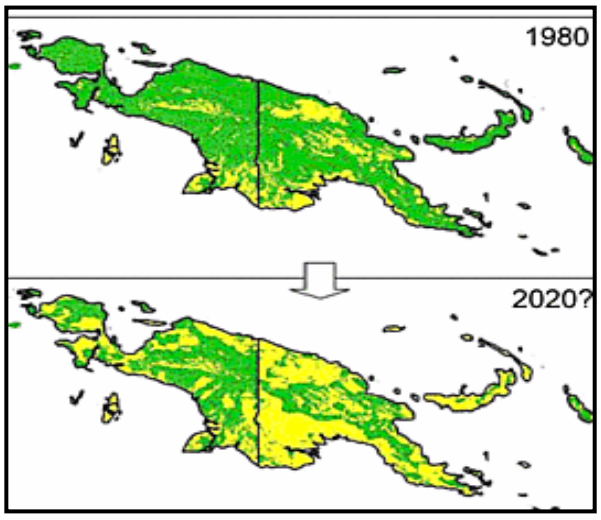
Nothing to worry about?

To fly over Papua New Guinea's seemingly endless forests grants the illusion that the worse destruction scenarios for this massive natural expanse are far, far away.

Logs ready for export

True, a vast majority of not only forests, but also freshwater bodies and wildlife on the island remain intact, perhaps not unlike what the first humans would have found thousands of years ago.

But the picture is misleading. The destructive environmental forces we observe in so many other tropical forests all over the world are already at work here. Deforestation, pollution, over hunting these issues are increasingly common in several places in Papua New Guinea.



The Race for Resources Extraction

Big Difference

The development of some countries often takes place at the expense of others. In Papua New Guinea, many forests are being looted illegally to cover massive demands from the booming economies of China and other countries. Traders and loggers use —hands off” methodologies to access timber at all costs. Illegal logging involving intimidation and corruption is widespread, which can cause resentment, strife, and encourages further bad governance. In addition, forests are being converted to large-scale commercial plantations, often using unsustainable practices.

Riches above and below the ground

But it‘s not just about what is above the ground that is being exploited. Extractive industries also focus on Papua New Guinea‘s significant oil, gas, and mineral reserves.

The track-record of these industries show they can cause severe environmental damage, particularly in fragile wetlands and watersheds.

Targeted wildlife

Hunting, by traditional methods and more recently with firearms, is a major concern for several species. The illegal wildlife trade, a component of the black market in West Papua Province in Indonesia, threatens bird populations such as lories and cockatoos.

Some other species at risk don't have legs to escape. For example, the trees that form the precious agarwood, a fragrant substance found inside them, are at risk of being lost because of intensive trade.

WWF workers on a mission. Success? or fail?

WWF Solutions for Papua New Guinea' Forests

A blueprint to save the Forests of Papua New Guinea

As we continue to lose some of Earth's wildest places, New Guinea increasingly looks like the stuff of dreams such places are made of.

Where we work in New Guinea Incredibly rich in glorious-looking birds, wrapped in lush forests and steeped in thriving traditions, this is an island that has more than earned its top position as a biodiversity treasure through millions of years of evolution. The world‘s second biggest island is more than worthy of protection.

Papua New Guinea‘s forests cover some 50 million ha an expanse roughly the size of Spain. In this huge area, WWF is on the ground to see that conservation activities deliver long-term results. Our goal? Effective collaborative management of the forests, where biodiversity is protected and local people benefit.

The reality of working in New Guinea

This is no straightforward undertaking. **WWF’s** activities take place in occasionally unstable areas, where government policies can change rapidly and the political landscape is equally dynamic. But with over 20 years of experience working in Papua New Guinea, we have learned to adapt to such constraints.

What it will take

The Forests of Papua New Guinea Programme is a large initiative, broad in scope, which works from field to policy level across 3 main targets:

- **Forest, land-use and development planning**
  Communities need a voice, especially where they are afflicted by poverty and

isolation. To deal with this problem, we are working towards a policy and planning framework at the district, provincial and national levels that is more responsive to community and biodiversity needs.

- **Responsible forest management**
  Sound management is the Forests of Papua New Guinea‘s best ally. In promoting responsible forestry, WWF is also pushing for more certification and non-timber forest products. We are also tackling the governance issues related to illegal logging and mismanagement of forest concessions.

- **Protected areas**
  It is imperative that protected areas, the cornerstone of our conservation efforts, better represent and protect the biodiversity of Papua New Guinea. To achieve this, WWF seeks to improve protected area management, and helps develop supportive policies and implementation guidelines.

Setting out priorities

Protecting all the forests of Papua New Guinea would be impossible - so WWF has focused on several priority sites where our chances of delivering conservation results are highest.

An international collaboration

The Forests of Papua New Guinea program calls upon the complementary skills of hundreds of conservation workers scattered across Asia-Pacific.

From the WWF central offices in Jakarta (Indonesia), Port Moresby (Papua New Guinea) and Suva (Fiji), to isolated outposts in the New Guinea montane highlands, WWF staff and partners are pushing ahead to realize the Forests of New Guinea conservation program.

Lesson 6: Conservation of Water Resources

Introduction

Welcome to Lesson 6 of Strand 1. In Lesson 5, you learnt about practices that require the conservation of land resources in the community. You also learnt to Identify a national land project and discussed the mismanagement practices the project employs. Finally, you suggested ways to stop, reduce or correct the mismanagement or destruction.

Your Aims

- Identify practices that require the conservation of water resources in the community
- Identify a national water project and discusses the mismanagement practices the project employs. Then suggest ways to stop, reduce or correct the mismanagement or destruction.

Water Conservation

What does conservation of water resources mean? It means to protect and use water resources wisely.

Why conserve water resources?

Like land resources, water resources are vital for life. Water resources are a source of food and money. The well being of human beings and the environment is dependant on water and its resources.

Activity 1

(i) Name three daily activities that water is used to carry out.

(a)

(b)

(c)

Threats to Conservation

Why has it become necessary for us to practice conservation or impose conservation measures? The reasons are:

- There is a rapid increase in population. Increasing population means that more resources are exploited and consumed.
- Use of new technologies.
  New techniques and technologies have been developed that are capable of harvesting and harnessing large quantities of resources in a short span of time. For example, the use of nets to cash fish, prawns, powerful machines to dig soil and cause destruction to streams and rivers.
- Mining Developments
  Mining companies are polluting river systems with toxic wastes that are killing marine life and making water unsafe for use by humans and animals.

- Manufacturing Industries
  Like mining industry manufacturing industries are polluting water resources and also exploiting them without conservation strategies in place.
- Demand for supply to exports to other countries.
- The need to generate income to meet growing needs.

All the reasons listed above are putting pressure on the water resources. So we must take responsibility now to make sure our children will still be able to enjoy the resources we have today.

Practices That Require the Conservation of Water Resources

1. Sustainable fishing

Good sustainable practices involve taking only what you need for useful purposes. We need to develop good procedures to sustain fishing. These procedures should ensure there will be resources for future use. In this way, people's physical needs are satisfied while safeguarding resources for the next generation. Practice such as dynamite fishing, which kills more fish than necessary and damages the marine environment is wasteful and irresponsible.

2. Protection of Coral Reef

Coral reefs need to be protected from dynamite fishing and other practices. Harmful practices including excessive fishing, interference by humans and damage from boats often destroy marine life and affect reef environment. Starfish numbers need to be controlled, as starfish destroy young coral by sucking out the nutrients.
Community leaders must educate people so that they use the reef wisely to meet their needs as well as sustain it for future generations. Reef protection programs have already started in some coastal areas. For example, the West New Britain local group has established a viable coral reef program.

3. Laws to protect areas

The coastal villages in Manus have community laws to protect areas where green turtles and dugong live and breed. This is because these species of marine life are very rare. These marine protected areas remain untouched so animals can maintain their numbers.
When people use lagoons and coral reefs in a sensible way, the reefs renew themselves naturally, the fish population is maintained and we have what is called 'sustainable' development. In this way, only selected species of fish are harvested, smoked and sold at the Lorengau market for cash.

Activity 2

(i) Name two hydro projects operated by PNG Power Limited in PNG that uses water to provide electricity for its customers.
   (a)
   (b)

(ii) Give one advantage of using water to provide electricity to homes and offices.
   (a)

Water Projects
You will now study about Fishing, particularly the Tuna industry in Papua New Guinea. This should help you to appreciate the importance of conservation and also help you to understand the laws that are in place to sustain the industry.

You should also be able to contribute positively to the fishing industry; in-order to make improvements.

Fishing and the Tuna Industry
Fishing is a small but growing industry in Papua New Guinea, where the country has excellent fishing waters. In addition, to traditional fishing for food, and to sell at local markets, more than fifty (50) locally owned vessels are also providing fish for tuna processing plants.

Local markets: Coastal fishermen catch an estimate of 15 100 tonnes of fish each year. Eighty-five per cent of it is for their own food, and the rest for sale at local markets. The prices paid for fish are often low compared to the costs and risks involved in catching them. Traditional land rights sometimes prevent interested fishermen from using the best fishing or bait-gathering areas.

Fishermen from five (5) villages west of the National Capital District (NCD) have Papua New Guinea's most successful local fishing industry. About 280 fishermen work full-time. Nets are used in various ways for three-quarters of the catch. The rest are caught by spearing, hand-lining, or trawling (towing baited lines behind a boat). The fish are sold fresh in markets, at Koki, Gordons and Gerehu markets in the National Capital District.

Inland villagers catch an estimated 10 000 tonnes of fish from rivers for local consumption.

Tuna
Tuna are big, fast-swimming fish of the open seas. About one-fifth of those in the South Pacific pass through PNG waters. They have become PNG's main commercial fish. Exports totaled K67 000 000 in 2002. Most of the catch is canned, either in PNG or overseas. The rest is sold fresh in PNG or chilled and sent to the specialty sashimi (raw fish) market in Japan.

Traditional Tuna Fishing

Papua New Guinea's northern seas are one of the prime fishing grounds for skipjack tuna in the Western Pacific. In fact, most of the tuna taken from PNG waters; including yellow-fin and big-eye tuna are also. Foreign fishermen have to pay access fees for fishing rights if they want to fish in PNG waters. They are not permitted to fish in PNG's Exclusive Economic Zone or to use the long-line fishing system. PNG-based boats don't have these restrictions, and the tuna fishing fleet has grown to more than 50 boats in recent years. Some foreign boats fish in PNG water illegally without a license. They are difficult to detect and intercept in the country's vast waters. Different surveillance systems are being tried.

Papua New Guinea has 3 tuna processing plants. The RD Tuna cannery at Alexishafen, near Madang, opened in mid-1990s. It handles up to 80 tonnes of raw tuna a day. Its Diana brand

is sold in PNG, Australia and other South Pacific countries. The tuna is sold under other brand names in Europe and the United States. Tuna loining plants at Wewak and Lae were scheduled to begin full operation in 2004. The tuna is boned, cleaned, cooked, vacuum packed and flash frozen for transport to canneries overseas. The Wewak plant was built by South Seas Tuna Corporation. East Sepik Provincial Government and Bank South Pacific are among the shareholders. The Lae plant was built by Frabelle (PNG), a Philippines Company.

Papua New Guinea had a pole-and-line tuna industry until the early 1980s. At its peak, it employed 1200 people and caught 50 000 tonnes a year. Trials were conducted at Rabaul in 1994 on long-line fishing to catch yellow-fin and big eye tuna. The Japanese favour preparing these kinds for sashimi, a raw fish dish.

Activity 3

(i) Name three ways in which water resources are misused in PNG.

(a)

(b) (c)

(ii) List two ways of how PNG can reduce or stop its mismanagement and misuse of water resources?

(a)

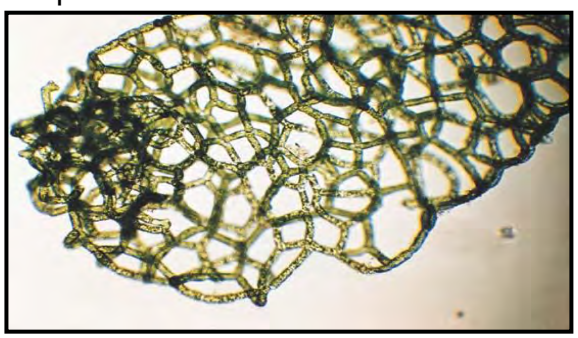
(b)

Other Fishing Practises

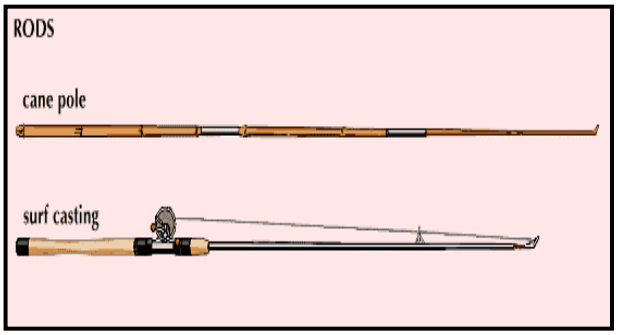
Purse-seiners surround a school of tuna with a big net. They catch the most tuna, mainly skipjack.

Long-liners string a 100km main line along floats. From this, thousands of baited hooks hang 80 to 20 m below the surface. The main line is hauled in each evening. Yellowfin are the main catch.

Pole-and-line fishermen pull fish out of the water on barbless lures. Skipjacks are the main catch. Pole-and-line is the system which has been used by PNG companies. It needs many men and big supply of bait fish, which are tossed into a school of tuna to excite them. To catch bait fish, electric lights are placed in shallow water at night. Thousands of curious anchovies, sprats, and other small fish are attracted. They are scooped from the water in nets, then kept alive in holding wells on the ships. Traditional owners of bait fishing grounds are paid a share of the value of the tuna catch.



Fishing net



Fishing lines

Summary

You have come to the end of Lesson 6. In this lesson you learnt that:

- Conservation means to protect and sustainably use resources.
- Conservation is necessary to ensure the availability of the resources for the future generation.
- Sustainable fishing, Coral reef protection and Laws to protect areas are way to conserve water resources
- Fishing is a small but growing industry in PNG.
- Coastal fishermen catch an estimated 15,100 tonnes of fish each year.
- Inland villagers an estimated 10,000 tones of fish from rivers for local consumption.
- Tuna is one of PNG's main commercial fish
- Tuna exports totaled K67 000 000 in 2002.
- Most of the tuna catch is canned in PNG or overseas.
- PNG's northern seas are one of the prime fishing grounds for skipjacks tuna in the Western Pacific.
- Foreign owned ships catch most of the tuna in PNG waters.
- PNG has 3 tuna processing plants. They are RD Tuna Cannery in Madang, Tuna Loining plants in Wewak and Lae.

NOW DO PRACTICE EXERCISE 6 ON THE NEXT PAGE

Practice Exercise 6

1. Fishing is said to be a small but growing industry, why?

   _____

2. Foreign-owned ships catch most of the tuna in PNG waters. How many locally owned vessels are involved in catching Tuna?

   _____

3. How many tonnes of fish is caught by coastal fishermen each year?

   _____

4. What percentage is sold?

   _____

5. Calculate the amount of fish that is consumed.

   _____

6. How much fish is caught by inland villagers?

   _____

7. What was the value of Tuna (in Kina) exported in 2002)

   _____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND 1

Now turn to your Supplementary Book and read all the Additional Readings for Lesson 6.

Supplementary Reading 8: Conservation of Marine Resources

Since independence PNG has gradually moved from a complex farming and subsistence system to a formal cash economy based on natural resources. The biggest pressure on the natural resources is mainly due to population growth and the fast harvesting of resources to provide for its populations needs.

The key threats now facing the marine and coastal environment are pollutants from mining operations, loss of habitat due to urbanization, exploitation of resources such as mangroves, over fishing especially commercial fishing operations including destructive fishing methods and climate change.

Background
Papua New Guinea has four main islands (Manus, New Ireland, New Britain and Bougainville) and 600 other smaller islands, most of which are located to the east. The mainland PNG and the surrounding islands are demarcated into 19 provinces. Its' coastline stretches 5,152 km, with an Exclusive Economic Zone (EEZ) estimated to cover 3,120km.

It has one of the rugged terrains in the world, with steep mountains leading either to extensive floodplains and swamps or a narrow coastal fringe. There is a central mountain range with a height of 4350m (Mt Wilhelm) and the smaller islands' terrain with high volcanic mountains and low – lying coral atolls.

The environment varies from mountain glaciers to humid tropical rainforest, swampy wetlands to pristine coral reefs. Much of these is characterized by steep gradients, fast flowing rivers and swamps with some parts of the country subjected to active volcanic activities, landslides and tidal waves. Papua New Guinea has over 5,000 lakes and numerous rivers and streams.

Coastal And Marine Resources
Papua New Guinea is surrounded by three major water masses- the Bismarck Sea, the Solomon Sea and the Coral Sea. The total sea area is 3,120,000km and a coastline of 17,000km.

The principal coastal environment include coral reefs mangroves, sea grass beds, sandy beaches, river deltas, rocky shorelines, inter tidal flats with gradual mud or sand buildup estuaries, lagoons and reef walls that drop off the continental slope.

The marine environments of PNG are pristine but are very poorly studied and very little information is available on the marine lives. The National Fisheries Authority with the help of foreign aid and NGOs are trying their best to disseminate general information on our marine resources. Research and monitoring capacity in PNG is very low and most programs are run by non – government organizations (NGOs). There are few or no long term dataset for the country which makes it increasingly difficult to determine the rate of exploitation and may lead to resources being degraded to very low levels before their losses are realized.

Coral Reefs

The coral reefs of Papua New Guinea are among the richest and most diverse in the world, with reefs of the north and east coast lying within in the Coral Triangle. Coral reefs in PNG covers a total area of 40, 000km2 . Within PNG, coral is utilized for traditional jewellery, road construction, building materials by logging companies, and is dried and crushed to produce lime for betel nut chewing.

The coral reefs around Australia and PNG collectively contain approximately 17.2% of the world's total, and includes some reefs with almost the same high biodiversity as those in the biodiversity 'hot spots' of Indonesia and Philippines. The critical difference to those 'hot spots' reefs is that most in those region are under low human pressures and those around Australia are subject to high level research and monitoring activity that is supporting strong resource management. Thus, these reefs remain as some of the least impacted with the best prognosis for the future, with the exception of climate change related coral bleaching and mortality.

Papua New Guinea has a vast area of coral reefs, including fringing, barrier and atoll formations, but there is little information for much of the country and it seems likely that there may be still be large areas of unmapped and possibly unknown reefs. The total area is probably considerably larger than the figure of 13,840 square kilometers provided in reports so far as many reefs remain unmapped in the present work. Lying on the eastern edge of the great center of coral reefs biodiversity in South East Asia , there is every indication that PNG enjoys remarkable high levels of biodiversity.It has suffered very little in terms of human impacts and there are greater opportunities for continued sustainable management and conservation of it's resources.

Recent surveys and sketchy accounts indicate that most reefs in PNG are in good condition. Reefs surveyed have reasonably high coral cover and little evidence of damage from human activity. This in part, reflects the country's dispersed and isolated population and lack of technological development.

Many of the reefs are close to shore and are therefore sensitive to global influences, and in some cases, there is increased access by humans- coral reefs have experienced localized degrading effects.

Threats to reefs results from fishing, boats, motors, anchors, and explosives. In addition, high influx of sediments and fresh water into the marine coral habitats, especially near river mouths, are disruptive to coral reef development. There is evidence coral reef loss near mouths of major rivers and degraded shorelines, with some of the more serious threats coming from terrestrial activities such as large scale – forestry and agriculture, as extensive tracts of coastal forest have been or allocated for logging.

Increased erosion and sedimentation creates turbid waters that cut off light needed for photosynthesis, and clogs and suffocates coral polyps. Studies in the region have indicated a direct relationship between inland activities and sedimentation, partial clearing of virgin forest can generate two to three times as much sediment as non – active forest areas, and clear – cutting can increase sedimentation loads ten - fold.

Over fishing of reef areas is also an increasing threat with top predators such as sharks and invertebrates such as beche- de mer (sea cucumber) coming under increasing threat.

Climate change impacts such as coral bleaching and the threat of rising CO2 (carbon dioxide) emissions leading to ocean acidification are also looming as an increasing threat to the reef ecosystem.

There are few Marine Protected Area (MPAs) and awareness and support for marine resource management is mostly limited to areas where NGOs have active programs such as Kimbe Bay region, Kavieng, Manus and Madang. A system of customary tenure (tambu) for fringing reefs and inshore fishing resources exists in many coastal communities. Temporary closure of a reef is a historical practice that is now declining.

New Britain Province is a large area that includes the Kimbe Bay region (of most well studied areas in PNG) Studies have found at least860 fish and 400 hard coral species in the area. Annual monitoring by James Cook University began in 1996 and has shown coral reefs on the coastal fringing reefs declined from 70 percent in the period 1996 to 2003, however, the reefs have seen considerable recovery in the last five years. Cover of all major coral families has increased including acroporids, pocilloporids and poritids.

Decline in coral reef fish biodiversity in 1997 and 2002 have been followed by almost full recovery of most affected reef fish species between 2002 and 2007. Severe localized bleaching was recorded in early 2008 and macro – algae cover and the amount of unconsolidated sediments have increased gradually over the last ten years.

Four marine reserves were established in 1999 and changes in the coral and fish assemblages in Kimbe Bay is almost identical across all four areas. Since 2002 TNC have been developing an MPA network for Kimbe Bay that incorporates the principles of reef resilience and connectivity as well as social and economic factors.

New Ireland Province includes diverse fringing coral reef, lagoons and mangroves systems. The Wildlife Conservation Society (WCS) PNG Marine Program monitors three ‘tambu’ sites established in 2006 and are establishing new tambu areas with partner communities, which also participates in monitoring six areas through the PNG **LMMA Network.**

Data was collected at six sites – Ungakum (no – take) and Kavulik (open to fishing) in the Tsoi Islands of the archipelago; and Lasigi (no take) Malom (open) Silom (no take) and Dadanot (open) on the northern eastern central coast of the main island.Coral cover dropped in Tsoi Islands from 41% in 2007 to 19% in 2008. Coral cover at the main island sites in 2007 ranged between 24% and 30% with Malom 2008 results as 23%. Macro – algal cover increased at all sites up to 59% in 2007 from 52% in 2006, with further increases at three of the sites in 2008 (72%) Average coral at all sites dropped from 40% in 2006 to 30% in 2007 and declined again to 20% at 3 of the six sites in 2008. The greatest change between 2006 and 2007 was at the central main island sites of Lasigi and Malom where coral cover decreased by as much as 23%.

In Manus Province, WCS is monitoring sites at Andra and Ahus islands, five kilometers off the north coast of the Manus Island. The total coral cover is about 25% at Andra

Island and 24% at Ahus Island, which shows slight decreases from the 30% reported in 2004 Report.

Madang is on the North Coast of PNG and the Madang lagoon is the largest and most ecologically diverse lagoon along this coast. In 2002, 652 species of reef fishes were recorded on the fringing reefs to about 30 meters dept. This represents61% of PNG's known fauna and 24% of the Indo- West / Central Pacific. Madang has four Wildlife Management Areas (WMA) established with the local communities at Tab, Sinub, Tabad and Laugum Islands. These WMAs cover 1,085 hectares of coral reef, mangrove, seagrass and open sea habitat. Approximately 5.9% is protected from extractive use; 17.8% is high level managed fishery with only line fishing permitted; 3.4% is low managed fishery with subsistence fishing allowed using non- destructive methods. The Tab Island WMA is important for dive tourism and as a year around fish spawning site. Monitoring around Madang has been conducted since the mid 1990s. Surveys suggest that Madang lagoon has relatively high coral cover (35- 40%) suggested declines in top predators and an increase in macro- algae.

Mangroves

Mangroves provide a foundation habitat that provides for vital ecological functions in the terrestrial – marine line. They accumulate sediment, stabilizing and protecting the coastline from erosion, and provide a buffering exchange of nutrients between the terrestrial and marine environments. Mangroves also provide a nursery for many coastal fishes. Although New Guinea's episodes of periodic large – scale natural disturbance, including extreme wind events and El Nino mediated drought – associated fires. River meandering is a major force in coastal mangrove areas. New Guinea mangroves are found along extensive lengths of its coastline. There are several disjunct sections along the north coast, including the eastern side of Cenderwasih Bay, adjacent to the mouth of Sepik and Ramu rivers, and Dyke Ackland and Ward Hunt Strait. The longest and deepest stretches of mangroves are found on the South side of the island, especially at the mouths of the Purari, Kikori, Fly, North west and Otakwa rivers, Bintuni Bay, and southern portions of the Vogelkop Peninsular. With the exception of the coast along the Trans Fly region of the southern New Guinea, the climate of the ecoregion is tropical wet, which is characteristic of this widespread, active ecoregion consists of alluvium plans and fans.

Papua New Guinea supports large tracts of extensive coastal mangrove ecosystems (150,000 hectares) and is the centre of biodiversity including 37 species belonging to 20 different genere. Mangroves are largely found on the southern coast of PNG, and in major river systems throughout the country, notably the Fly, Kikori and Purari Rivers.

Mangroves are internationally significant as spawning and nursery grounds for prawns and fin fisheries. There has been some proposal to selectively log mangrove forest for valuable commercial mangrove cedar and other species. If this is achieved the values of commercial fisheries and subsistence fishing will lessen.

The decline in mangrove has not been well documented or monitored, however, there has been a considerable loss of mangrove vegetation along the Hanuabada and Motukea coastline on the outskirts of Port Moresby.

It is well accepted that the decline in mangroves is mainly caused by pollutants, waters from heavy metals from mines tailings, oil spill, industrial wastes and sewerage and as well as fertilizer run-off. Mangrove forest are also utilized for firewood, medicine, and building materials. Large traits of mangrove forest have been cut down, opening up mangrove canopies, which has resulted in short stunted species of some species.

Seagrass

It is generally agreed that there are 13 species of seagrass present in PNG. Seagrass communities in PNG grow on fringing reefs, in protected bays and on side of Barrier Reef and islands. Seagrass beds are a significant feature at several regions in PNG. Manus Island, Wewak, Port Moresby, Milne Bay Province and Tigak Island, Kavieng and scattered areas of sea grasses line much of the coastline of Madang, Morobe and Western Province. There are no total area estimates of seagrass beds in Papua New Guinea available as no broad scale mapping exercises have been conducted.

Fisheries

There are over 3,000 fishes in the PNG region including 300 found in fresh water. The export earnings from the fisheries products amount to about 1% of the total export. Prawns, barramundi and lobster and high value sedimentary species dominate the commercial landings. Tuna is the main off-shore resource. Although the present annual harvest of over 200,000 tonnes is large. Research programs estimated that this may be increased. The benefits to PNG from tuna are restricted to approximately K16 million in license fees.

The three main catalogues of fishing in PNG are subsistence, artisanal and commercial / industrial with recreational being of minor importance. Along the main land and high island coasts and in the smaller communities, fishing activities includes harvesting the

reef flats, spear fishing, shallow water handling from dugout canoes, netting and trapping in the fresh water reaches of the larger rivers. In the swampy lowlands areas, net fisheries for barramundi, cat fish, and sharks occur, while in the Gulf of Papua there is also a village- lobster fishery.

ANSWERS TO SUBSTRAND 1

PRACTICE EXERCISES

ANSWERS TO PRACTICE EXERCISES 1 – 6

Practice Exercise 1

1. What is customary land?

   It is land that is owned by customary land owners or traditional land owners.

2. What percent of the total land mass in Papua New Guinea is customary land?

   85%

3. Describe how land is acquired or passed on in Papua New Guinea societies.

   Land is passed on from one generation to another by word of mouth according to custom.

4. What are two important factors that determine ownership of customary land?

   Custom and the relationship of the traditional people with their land

5. Explain what State or freehold land means.

   State or Freehold land is land that is owned by the government

6. Does the law recognize customary land ownership in Papua New Guinea? Explain.

   Yes, the law in Papua New Guinea recognizes traditional land ownership because the constitution of the country allows for it.

7. What does land registration mean?

   It is the process of formally recording / sorting details about ownership of land.

8. Explain what a Land title is.

   It is a legal / formal document that shows ownership, recording / details about ownership of land.

NOW GO BACK AND STUDY LESSON 2

Practice Exercise 2

1. Papua New Guinea can only use about 27% of its land, why?

   Because the land is too steep, too high, too isolated, seasonally or permanently flooded, or too close to an active volcano.

2. The Quality of life in rural areas is affected by many factors. List some of them.

3. *Having enough land with good soil to produce food for the family and cash crops to help pay for clothing, cooking utensils, store foods such as rice and tinned fish, and cultural exchanges. Other factors are access to health and education services, markets, and information. + rugged terr*ain and other geographical difficulties.

4. What percentage of people in rural areas does not have immediate access to roads?
   About 10 per cent have to walk for days to access a road.

5. There are 481 airstrips serving rural people. Why can't rural people use the service?

   Because this form of transport is expensive

6. How does rainfall affect people in rural areas?

   It affects the people by two ways:
   1. *How much that falls. That is talking about the quantity. too much rain causes flooding and affects garding.*
   2. *The seasons (dry and wet seasons)*

7. How has cash crops affected land in rural areas?

   Rural people have intensified their cash crop growing to keep pace with growing need for cash to buy daily needs. Most of the land is covered by cash crop and food crop are planted very far and in some areas there is land shortages for planting food for survival.

8. How has increased population affected agriculture or growing food crops?

   In the process of meeting the demand of the growing population, the land is over used and it gets degraded and gardens produce less food.

9. There has been a significant migration to towns and cities because of problems encountered in rural areas. What has the government done to help with this situation?

The government has tried to bring basic services to most of the rural people so they do not come or migrate to urban areas in search of them, instead stay at home and enjoy everything there. It has started by meeting the people needs through program such as;

1. *Free education policy*
2. *Free Health policy*
3. *Eradicating corruption through tough measures*

10. If you are a landowner, what are some things that you can do to help yourself?

- *Return to my village*
- *Get into business or community projects*
- *Think of starting tourism business*

NOW GO BACK AND STUDY LESSON 3

Practice Exercise 3

Identify and prepare a commercial proposal following these guidelines.

(a) Describe the planned activity eg. Growing and selling beans.

Sample answer: Growing and selling of vegetables

(b) Why did you choose this activity?

Sample answer: This activity is something that I am good at. I have plenty of land and I also have access to agricultural officers who can help me.

A new mining development is starting in the district, and I could sell to the mine mess.

(c) How much money will you need to start the activity?

Sample answer: Approximately, K5000

(c) How much do you plan to raise?

Sample answer: Plenty to feed 300 people

(d) For how long (period) will the activity go on?

Sample answer: Approximately three years

(f) Where will you get the money to start the project?

Sample answer: Borrow from the micro- bank, from family or use savings.

(g) Where will you sell the vegetables and beans?

Sample answer: Local market or an institution like a hospital, college or the hotels, and mess of a new development company

---

Practice Exercise 4

---

1. Make a list of possible projects you can establish in your village and or community, using water resources.

   Sample answers: raising eels for tourism business, fish farm, selling of fish, sea cucumbers, prawns, crayfish

2. Decide on a particular project you want to establish from the list you have drawn.

   Student's answer: (teacher will use own discretion when marking students work.)

3. Prepare a simple proposal for a project. Use the steps and methods you learned in Grade 6 and 7. A sample is provided to help you.

PROJECT PLAN		
Your Project's Name	:	Sample answer: *Eel farming*
Aims of the Project	:	Sample answer: *To promote tourism in PNG*
Resources	:	Sample answer: *use the waters near the village, use agricultural officers, or marine officers for advice*
Implementation	:	Sample answer: *advertise in newspapers about the business, when visitors come, tell/show them the eels, explain their eating patterns or behavior and so on*,
Budget	:	Sample answer: *Approximately K10 000*
Evaluation	:	Sample answer: *assess to improve in the ways of looking after the eels and attracting more visitors*

4. Poem: "When all the trees are cut, silver and gold dug up, fish are caught, and the last river dried up, then we will know that we cannot eat money". Explain this poem.

   It is about sustainability.
   It is about being wise to preserve our resources rather then exploiting them.

Practice Exercise 5

1. The export of tropical logs has dropped since 1994. Why?

   The drop experienced since 1994 was due to a moratorium on the issuance of new timber harvesting permits and, also to changes in the world market.

2. Why did the World bank insist on a moratorium as a condition for granting PNG major development loans?

   The World Bank was concerned about destruction of PNG's forest resources and the biodiversity they host. About 20% of the original forest had been cut down. Only some had been replanted.

3. What do the letters FMA stand for?

   FMA stands for Forests Management Agreements.

4. Do you agree with (the changes) what the government has done to the Timber Industry? Recommend improvements if necessary.

   Yes, it is fair on the landowners, the government and the company concerned. (Accept any reasonable student answer)

Practice Exercise 6

1. Fishing is said to be a small but growing industry, why?

   Fishing is a growing industry because PNG has excellent fishing waters. Also due to demand and technology improvement

2. Foreign-owned ships catch most of the tuna in PNG waters. How many locally owned vessels are involved in catching Tuna?

   50 locally owned vessels

3. How many tonnes of fish is caught by coastal fishermen each year? *15,100 tonnes*

NOW GO BACK AND STUDY LESSON 5

4. What percentage is sold? *15% is sold*

5. Calculate the amount of fish that is consumed.

$\frac{85}{100} x \frac{15{,}100}{1} =$ *12 835 tonnes of fish*

6. How much fish is caught by inland villagers?

10,000 tonnes

7. What was the value of Tuna (in Kina) exported in 2002?

K67 000 000

NOW DO SUBSTRAND 1 TEST IN YOUR ASSIGNMENT BOOK 1

SUBSTRAND 2

THE ENVIRONMENT

In this sub strand, you will:

- **identify and describe economic and cultural values**
- **discuss government policies on forestry**
- **discuss government policies on marine resources**
- **discuss government policies on mining and petroleum**
- **identify and discuss resource projects in PNG**
- **discuss climate change**

SUBSTRAND 2: THE ENVIRONMENT

Welcome to Substrand 2. In this Substrand, you will discuss the economic, cultural and ecological values of natural, social and built resources. You will also learn about environmentally friendly ways of managing the environment.

This substrand contains six (6) lessons.

Lesson 7: Environment Conservation
In this lesson you will learn about natural, built and social environments. You will also learn about the economic, cultural and ecological values of the environment. Finally, you will learn about the advantages and disadvantages of environment conservation.

Lesson 8: Government Policies on Forestry
In this lesson you will learn about the government environment policies applicable to the forestry industry in PNG and their importance. You will also learn about the government and non-government organisations that are responsible for implementing the government forestry policies.

Lesson 9: Government Policies on Marine Resources
In this lesson you will learn about the government environment policies applicable to the fishing industry in PNG and their importance. You will also learn about the government and non-government organisations that are responsible for implementing the government fishing policies.

Lesson 10: Government Policies on Mining and Petroleum
In this lesson you will learn about the government environment policies applicable to the mining and petroleum industry in PNG and their importance. You will also learn about the government and non-government organisations that are responsible for implementing the government mining and petroleum policies.

Lesson 11: Resource Projects in PNG
In this lesson you will learn about resource projects in PNG and their impacts on the local environment. You will also discuss project compliance to environmental policies.

Lesson 12: Climate Change
In this lesson you will learn the definitions of climate change, carbon emissions and carbon trade and discuss the causes and effects of climate change. You will also identify and discuss the roles and responsibilities of the Office of Climate Change and Environment Sustainability (OCCES) and it's important to PNG. Finally, you will discuss information concerning the Climate Change and Carbon Trade Policies and their important or impact on the environment in PNG.

SUBSTRAND 2

ENVIRONMENTS

In this Sub Strand, you will:

- Identify and discuss environment conservation
- Discuss government policies on forestry
- Discuss government policies on marine resources
- Discuss government policies on mining and petroleum resources
- Identify resources in PNG
- Identify and discuss climate change in PNG

Lesson 7: Environment Conservation

Introduction

Welcome to sub strand 2 of Managing Resources. We"ll be closely looking and talking about the environment. To be more specific environment conservation is the topic in lesson 7. By, now, you should know what the word environment means. As you go through, you will know, tell and also differentiate between the three types of environments. Those are natural, built and social environments. Also you will identify the ecological, economical and cultural values of the environment. Apart from these values we shall also look into the advantages and disadvantage of environment conservation. In this lesson you should be able to

Your Aims

- Define natural, built and social environments
- Differentiate the three types of environments
- Identify the ecological, economical and cultural values of the environment
- Identify the advantages and disadvantages of environment conservation

Three Types of Environments

Activity 1
Read and answer the question below

What are the three types of environments? Name them.
a. _____ b. _____ c. _____

Explain each type of environment.
a. _____
b. _____
c. _____

I hope you have named the three types of environments. Environment is anything on the world around us. It is looked at under natural, built and social environments.

Natural Environment

Our natural environment is composed of hills, mountains, valleys, rivers, ocean and lakes with millions of life forms in plants, trees, fish, mammals, insect"s spiders, amphibians, crustaceans, birds, and reptiles. The elements or important parts of natural environment are;

- producers
- the consumers
- the decomposers
- the nonliving components

Rest house made from kunai

A natural element of the environment includes, sun, air, water, earth, physical and ecological systems (living things and their relationships).

Parliament House- Port Moresby

Built Environment

People interact with the natural environment and convert it into the human habits by arranging and changing their surroundings to suit their needs and wants. The Parliament of PNG is an example of a built environment.

Humans have totally changed the appearance of the natural environment. The effects are needy seen as roads, houses, drains and rubbish and so forth in towns. The effects are also seen in rural areas as natural landscape transformed by plantations, cattle stations, forestry projects and mines.

Social Elements of the Environment

.

A person does not live in isolation. Human are Social animals and survive in communities that are characterized by friendly companionship and relationship. Evidence of social elements is seen in family groups, wantok system, village, sporting teams, church groups, schools and clans. People in social groups share common interests and meet their needs in similar ways.

A Land owner group

Consequences for the Environement

Consequences are the effects or results of something that has happened previous; there is a cause and effect relationship. Some examples are as follows;

- Heavy rain washes away top soil from gardens.
- A volcanic eruption or tidal wave destroys a town or community.
- A landslide damages a road and people cannot transport goods to market.
- Forestry projects cause a loss of habitats for animals.
- Over-use of chemical sprays and fertilizers can pollute water supplies
- Polluted water and unhygienic conditions cause outbreaks of diarrhea, dysentery or typhoid.
- Overgrazing by animals destroy vegetation cover and productive soils

Landslide

Soil erosion and soil loss are consequences of human activity. Chopping down trees, clearing forests, logging, overgrazing, mining, construction of buildings, transport and building pylons for electricity cables are all examples of human activity that affects the soil in different ways and causes soil loss.

The consequences of mining activities affect natural, built and social environments. Mines destroy natural habitats. Social environments are changed as landowners and mining employees develop. The consequences of environment pollution affect the land, air and water. It is becoming evident that as more and more bush is cleared, there is danger that many species of animals, insects and wildlife will become extinct. The call now is for people to be aware of ways in which we damage our environment and to take the necessary action to protect our resources for the future.

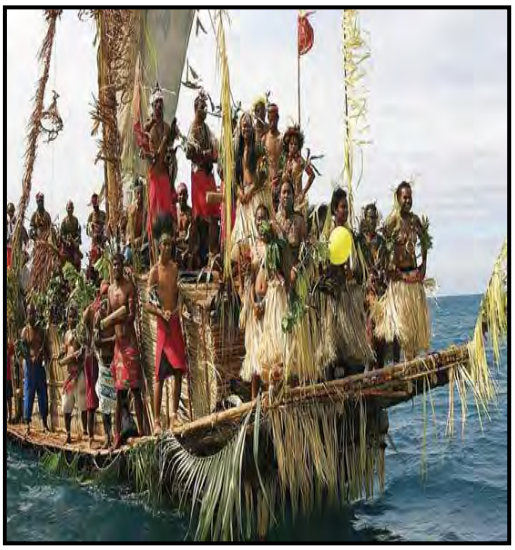
Environment Friendly Waste Managing Practices

A community needs to have environmentally friendly waste managing practices. One approach is following the three R"s – recycle, reduce and reuse. Instead of throwing things away and adding to the problem, we should think of ways to recycle, reduce or reuse products.

To recycle is to change a resource to make another useful product. Example, children"s clothes can be made from an old laplap, bed sheet or wood from a damaged table could be turned into a stool-and rice and flour bags can be made into carry bags.

To reduce means to make something smaller or to use less. Buy and use less of everything. Examples, use bilums instead of plastic bags when shopping, buying a large-sized product instead of two or more smaller products reduces waste and packaging materials,and used cloth nappies for babies instead of disposable nappies.

To reuse means to use a resource for a purpose that is different to its original purpose. Examples, reuse empty glass jars as vases or storage containers reuse plastic bags from stores to hold rubbish and reuse gift paper for wrapping presents or covering books.

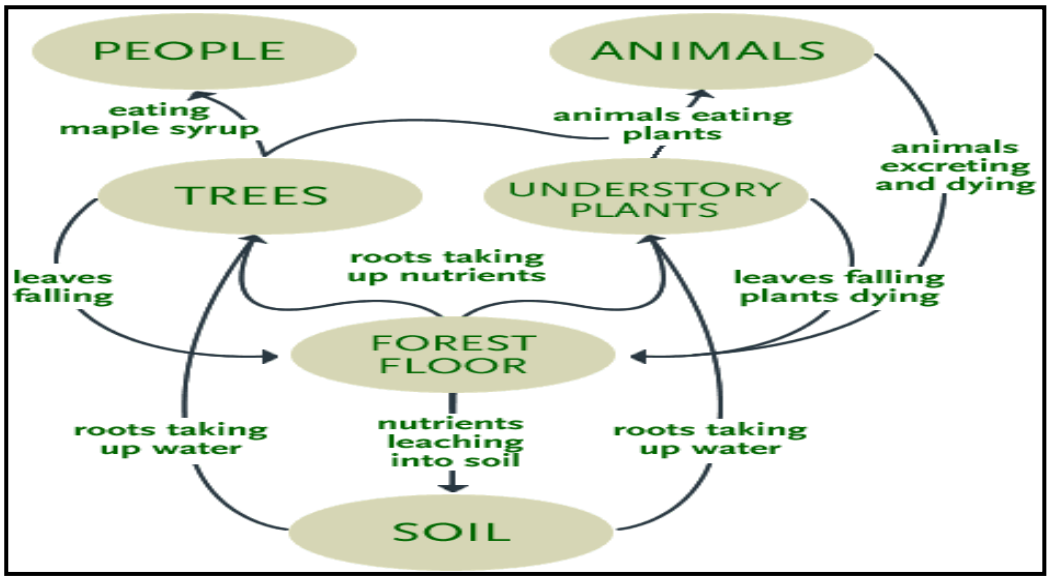


Hiri Moale Festival – use traditionally made canoes

Types of waste and rubbish products

There could be food scraps, vegetables peelings, sugar cane waste which you would find in a rubbish bin. Old stoves, refrigeration vehicles, furniture and many others you would find in a community rubbish dump. Bodily waste includes waste from humans and animals. These need to be disposed of in hygienic, and environmentally friendly ways.

Animal wastes can be used as added fertilizer for soils and mixed with plant cuttings in compost heaps. Human waste should not fall on the ground where people walk as this can lead to hookworm infections.



Cycle of dependency

Economical Systems and Values of Forest and the Coral Reefs

Importance of an ecological system

You may be familiar with the phase ecological system or it might be new to you. Firstly, ecology is the study of plants and animals in relation to their surroundings. Many living things interact because of their need to survive.

1. Plants absorb nutrients from their non-living surroundings, which they use to make food through the process of photosynthesis.
2. Plants may in turn be eaten by herbivores
3. Herbivores can be eaten by carnivores.

Living things also depend on their surroundings. Plants needs water, energy from sunlight, carbon dioxide from the air, nutrients from the soil and shelter from their surroundings. Animals also need water sunlight, oxygen from the air and shelter from their surroundings. The relationship between living things and their surroundings is often complicated and people who study these relationships are called ecologists.

Ecological Values of the Forests

Forests are important because they support and protect the soil, contain many plants and animals, conserve water and provide river, for leisure activities as well as other activities. Number of trees being cut or felled at one time must be controlled

- Young trees should not be felled but left to grow to a certain size
- Soil in logged area must be preserved that it provides the nutrients for re-growth.
- Strict control over commercial logging companies is required

Ecological Value of the Coral Reefs

The seas and coral reefs are an important resource. They contain great numbers of sea creatures. Valuable source of food and income could be lost forever if too many of these sea creatures are caught. Traditional method of catching fish did not remove large numbers of fish at one time. Large commercial fishing boats are now catching huge quantities of fish;

- Regulations need to be introduced to prevent over-fishing
- Number of fish caught needs to be limited
- Young fish should not be caught but left to grow to a certain size
- Number of commercial fishing licenses must be limited
- Young fish should not be caught
- Fish should be restricted at certain times
- Trawling should be banned.

Activity 14

For this activity you are to give examples of environmental pollution affecting the land, air and water. Write down at least eight (8) examples.

_____

_____

Environmental Values

Environmentally friendly ways of managing the environment should reflect the economical, cultural and ecological values that people have for their natural, built and social resources.

People value the things they can obtain from their environments to earn a living. These natural resources include fruits and nuts, fish from the sea, wood sold for firewood and animals that are raised.

People also value the things they can obtain from built environmental resources. These include services such as health, religion, education, transport and electricity and others such as tools, machines, vehicles and processed food.

People value each other in their environment. They enjoy the company they get from families, relatives and work colleagues. Law and order problems spoil the social environment and these are not valued.

The traditional taboos, ceremonies and sacred places are passed from a generation to the next so that people can appreciate in society as true Melanesians. Mt Hagen Show is one way the people of Western Highlands Province connect to their environment and give value to the things they do (traditions) and the way they do it (cultural).

Hagen Cultural Show is Back

The famous MT Hagen Show is on again this weekend at the Rabiamul rugby league oval.

Provincial Events Council Chairman, Sam Angimb, said about 500 tourists from around the world had made arrangements with travel agents in the province to attend the show.

Angimb said the show was sponsored by Coca Cola Amital along with minor sponsors: Western Highlands provincial government, Daewon Trading and Farmset.

Eighty cultural groups from throughout the country registered to take part.

Angimb said this years show will be "pure traditional, unlike the previous shows".

He said preparations are under way to accommodate the singsing groups from outside the province.

"We want to make this show to be a success for the tourists, participants, sponsors and show goers to come and enjoy the weekend" he said

Coca Cola Amital gave K45 000 for the show, with its regional manager, Chris Harker, presenting K35 000, plus K5 000 worth of products and K5 000 worth of merchandised items.

Harker said the company enjoyed a long relationship with the MT Hagen show and was happy to be back as the major sponsor

National, Thursday, August, 9th, 2010
By: James Apa Gumu

Economic Values

We change our environment by farming the land, harvesting the forests, fishing the seas and mining the earth. We do this to satisfy our basic needs and improve our quality of life. If our environment is to continue providing resources for people, and not be destroyed, we must look after on manage it well.

Logs earn a lot of money for PNG

Cultural Values

The natural environment is important for cultural reasons. Many people use materials from the forests and seas to make weapons for use in tribal customs and ceremonial rituals.

Huli dancers at a singsing

Hunters sometimes capture animals alive for ritual purposes, as well as nutrition. As the forests are cleaned and products are developed for export, many traditional resources are becoming scare.

Summary

In this lesson, you have learnt that;

- Our natural environment is composed of hills, mountains, valleys, rivers, oceans and lakes and so forth.
- People interact with the natural environment and convert it into the human habitat to suit their needs and wants.
- The consequences of mining activities affect natural, built and social environments.
- A community needs to have environmentally friendly waste management practices.
  One of the approaches is follow the three R"s – recycle, reduce or reuse products.
- Ecology is the study of plants and animals in relation to their surroundings.
- Forests and coral reefs have their ecological values.
- The natural environment is important for economical and cultural reasons.

END OF LESSON 7. NOW DO PRACTICE EXERCISE 7 ON THE NEXT PAGE

Practice Exercise 7

1.

(a). If our environment is to continue providing resources, what should you do as a citizen?

_____

(b). Law and order problems spoil the social environment. Give at least five of these law and order problems.

a. _____
b. _____
c. _____
d. _____
e. _____

(c). There are many good things and bad things about environment conservation. List three advantages and disadvantages of environment conservation.

.

Advantages	Disadvantages
(a)	
(b)	
(c)	

2. In your own words define the type of environments.

(a) Natural Environment

_____
_____
_____

(b) Built Environment

_____
_____
_____
_____

(c) Social Environment

_____
_____
_____
_____

3. Give one example of environmental pollution affecting the land, air and water. Write down one example for each.

Land	**Air**	**Water**
(a)	(b)	(c)

4. What is the feeding relationship between plants and animals known as?

_____
_____
_____

5. Define herbivores and carnivores

Herbivores:

_____

Carnivores:

_____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 7.

Supplementary Reading 9: Environment Conservation

Our environment is the world around us. It consists of natural elements, things made by humans and human interactions with each other. We can consider our environment as consisting of natural, built and social elements. These elements connect in many ways. These parts are interacting and interdependent. They should not be seen as separate or competing. The quality of the interrelationship defines the health and well-being of the total environment. There are consequences when an element is affected, whether it is by natural or human causes. The condition of the environment finally determines the quality and survival of life.

Consider the elements of healthy and unhealthy environments. A healthy environment has clean air, safe clean water for drinking and cooking, food for the family"s needs, physically fit people, good houses, fertile soil, attractive physical surroundings, sound waste management practices, no obvious signs of pollution and friendly relationships amongst the people.

An unhealthy environment has smoky air, polluted water for drinking and cooking, infertile soil, poor crops, sick or weak people, dirty houses, unattractive physical surroundings, poor waste management practices, litter, graffiti, betel nut spit, and arguments and distrust amongst the people.

Elements of the Natural Environment

Our natural environment is composed of hills, mountains, valleys, rivers, oceans and lakes, with millions of life forms in plants, trees, fish, mammals, insects, spiders, amphibians, crustaceans, birds and reptiles. Important elements of our natural environment are;

- the producers (green plants)
- the consumers (herbivores and carnivores)
- the decomposers(fungi and bacteria)
- the nonliving components (dead organic matter and nutrients in the soil and water)

Ecology is the study of plants and animals in relation to their surroundings. Many interactions between living things are the result of the need for living things to feed. For example, plants absorb nutrients from their non-living surroundings that they then use to make food by the process of photosynthesis. Hence they are known as producers. Plants may then in turn be eaten by herbivores (animals who depend on plants for their own food), which in turn can be eaten by carnivores (animals who depend on plants their own food). These are known as consumers. Humans are omnivores, eating both plants and animals.

The natural elements of the environment include sun, air, water, earth, the physical cycles that support life (oxygen, nitrogen, carbon and water) and biological and ecological systems (living things and their interrelationships). The air is a mixture of gases that living things rely on to survive. Humans and animals breathe in oxygen and breathe out carbon dioxide. Plants do the opposite. Plants take in carbon dioxide and give off oxygen. This relationship between plants, humans and animals is vital for survival. Destruction of vast areas of rain forest reduces the amount of oxygen going into the air.

What are the elements of your local natural environment, How are they used and affected by human activity.

Elements of the Built Environment
People interact with natural environment and convert it into a human habitat by arranging and changing their surroundings to suit their needs and wants. In remote rural areas, we see land being cleared for houses and gardens. There are walking tracks that disturb the natural environment. Natural resources are used for housing, canoes, clothing and tools.

Today, with rapidly advancing technology, humans have greater powers to change the natural environment. Humans have radically changed appearance of the natural environment. The effects are readily seen in towns. There are roads, houses, churches, schools, hospitals, shops, markets, electricity power poles, vehicles, drains and rubbish. The effects are also seen in rural areas where large tracts of natural landscape have been transformed by plantations, cattle stations, forestry projects and mines. Human activity has a huge impact on the natural environment. Often, we have failed to realize the consequences of our actions.

What are the elements of your local built environment, what impact do they have on the natural environment,

Social Elements of the Environmnet
A person does not live in isolation. Humans are social animals and survive in communities that involve friendly companionship and relationships. Evidence of social elements is seen in family groups, wantok system, villages, sporting teams, church groups, schools and clans. People in social groups share common interests and meet their needs in similar ways.

These social groupings are important. From them people obtain a sense of belonging and establish cultural values. These values are reflected in their codes of acceptable behavior, use of technology, the institution they establish, modes of government, economic activities, settlement patterns, religious observances and things they value for visual purposes.

What are the distinctive features of the social environment in your locality, what problems exist and how are these social problems counteracted,

Consequences for the Environment
Consequences are the effects or results of something that has happened previously. There is a cause and effect relationship. Some examples are as follows:

- Heavy rain washes away top soil from gardens.
- A volcanic eruption or tidal wave destroys a town or community.
- A landslide damages a road and people cannot transport goods to market.

- Forestry projects cause a loss of habitat for animals.
- Over-use of chemical sprays and fertilizers can pollute water supplies
- Polluted water and unhygienic conditions cause outbreaks of diarrhea, dysentery or typhoid.
- Overgrazing of animals destroys vegetation cover and productive soils,

In 2004, heavy flooding washed away two bridges on the road from Madang to Lae. A large section of Monia bridge fell into the Homia river making it impassible.

Transport between Lae and Madang was disrupted. Two power pylons collapsed. This disrupted the electricity supply from the Ramu-Yonki power grid to Madang. The old generators in Madang had to be used to supply electricity. They did not have sufficient capacity to supply all the town at once. Many shops and institutions relied on their own back-up generators for power until the problem was fixed. Fuel supplies ran low because of the extra, unexpected demand.

This is an example of the consequences when an element of the environment is affected.

Soil erosion and soil loss are consequences of human activity. Chopping down trees, clearing forests, logging, overgrazing, over-cultivation, mining, construction of buildings, transport and building pylons for electricity cables are all examples of human activity that affects the soil layer in different ways and causes soil loss.
The consequences of mining activities affect natural, built and social environments. Mines directly disturb the land in reshaping its surface with pits and roads. Mines destroy natural habitats. Building and large processing plants are built. Social environment are changed as landowners and mining employees develop relationships.

The consequences of environmental pollution affect the land, air and water. Exhaust fumes from vehicles and air craft, smoke and gases from factories pollute the air we breathe. This can cause bronchitis, pneumonia and associated respiratory complaints. Waste products such as paper, plastic bags and household waste pollute the land.

It is becoming evident that as more and more bush is cleared, there is a danger that many species of animals, insects and wildlife will become extinct. Some introduced species of animals and insects invade local ecosystems and destroy plants and other animal species. The coffee rust, a fungal disease, damages coffee leaves and can destroy young coffee trees. Cattle breeders must be on the lookout for any outbreak of foot and mouth disease. This must be reported to agricultural officers so that the disease does not spread to other parts of the country.

Types of Waste and Rubbish Products

What would you find in a rubbish bin, There could be food scraps, vegetable peelings, sugar cane waste, garden clippings, coconuts, fluorescent light tubes, paper, glass bottles, tins cardboard packaging, rags, plastic bags, plastic wrappers off biscuits or ice blocks, fish and animal bones and prawn shells.

What would you find in a community rubbish dump, There could be old stoves, refrigerators, lamps, washing machines, vehicles, bikes, tyres, furniture, pipes, scrap metal, paint tins, car batteries and all the usual household waste.

Bodily waste includes urine and faeces from humans and animals, these need to be disposed of in hygienic, environmentally friendly ways. Animal wastes can be used as added fertilizer for soils and mixed with plant cuttings in compost heaps. They should not be left on the ground where people may walk. Human waste should not fall on the ground where people walk as this can lead to hookworm infections. Pit, pan and septic toilets are acceptable receptacles for human waste.

An investigation could be conducted into waste products from families, stores and businesses in the locality. Waste management practices can be evaluated and better methods suggested.

Increasingly in modern society, people are buying things from shops. The purpose of packaging is to contain, protect, identify and facilitate the sale and distribution of a consumer product. Virtually all manufactured and processed goods require packaging. The basic materials of packages today include paper, cardboard, cellophane, steel, aluminium, glass, wood, cloth and plastics. Excessive packaging is when too much or unnecessary material is used.

Packaging presents a major problem of environmental pollution. Millions of tones of packaging are discarded as rubbish each year. Some are biodegradable while others are not. Non-degradable material either does not decompose or decomposes very slowly in the natural environment.

In villages we may burn or bury our rubbish. In towns the council has a collection service to take rubbish to landfill areas. Here bulldozers compact the rubbish into layers and cover each layer with clean soil, which is also compacted. Another means of dealing with problem is by recycling packaging materials for use as new products, packages and fuel.

Many of the papers and plastic materials can be reused, recycled and reduced to minimize the pollution. Some recyclable items can be sold for cash. For example, empty drinks cans can be crushed, bagged and sold as scrap metal. Other items can be used to beautify our schools buildings. For example, old tyres can be used as simple borders around classroom buildings. Old newspapers can be sold to garages for spray painting purposes.

Leaves, cut grass and chicken manure can be mixed as compost and later applied as fertilizer. Old paint tins can be reused as pots for ornamental plants and sold in markets of cash. Other waste products from locally produced or imported items can be reused. For example, an old fuel drum or tank can be cut in half for growing vegetables. Broken furniture can be recycled and made into children‟s toys.

Environment Values

Environmentally friendly ways of managing the environment should reflect the economical, cultural and ecological values that people have for their natural, built and social resources.

People value the things they can obtain from their environments that they can use to gain a cash income. These include natural resources such as fruits and nuts that are gathered from the bush, vegetables grown in the garden, animals that are raised, fish from the sea, wood sold for firewood, timber to be carved into artefacts, fibres to be made into bilums and leaves that are woven into baskets.

People value the income they are able to obtain as business enterprises are established such as fishing projects, mining ventures, forestry projects, fish and meat canneries and industrial activities.

People value the things they can obtain from built environmental resources. These include services such as health, religion, education, transport, electricity and

telephone; and goods such as tools, machines, vehicles, processed food, building supplies, books, outboard motors, cooking pots and fabric.

People value each other in their environment. They enjoy the companionship they get from family, relatives, friends and work colleagues. Law and order problems spoil the social environment and these are not valued.

People value the cultural practices that give them identity and self-esteem. The traditional taboos, ceremonies and sacred places are passed from one generation to the next so that people can appreciate and participate in society as true Melanesians.

People value the relationship between plants and animals and their physical and biological environment that sustains life on this planet. The ecosystems need to be protected if life on the planet is to survive for future generations.

World Environment Day

Papua New Guinea celebrates World Environment Day on Friday, June 04, 2010 as debate rages over the newly enacted amendments to the Environment and Conservation Act.

The Department of Environment and Conservation is taking the lead in celebrating this special event. This year"s (2010) theme is "many species, one planet and one future". Environment and Conservation Minister Benny Allen said PNG is blessed with many resources, not only biodiversity but in its cultures and traditions, its many languages, its songs, dances, arts, crafts and its people.

Preserving the rich biodiversity of PNG in all its beauty is a priority for every one of us. Minister Benny Allen said PNG must take care of its environmental issues by itself, not at some point in future, but immediately while bearing in mind that other member countries are left with half of their biodiversity gone, polluted waters and air, vanishing cultures and languages.

Department of Environment and Conservation Secretary, Dr Wari Iamo said PNG was often called the land of 1000 tribes and languages, which was true. He said the people must be proud and protect all these in the face of change because PNG was part of a global community.

„We are a unique people, where our diverse cultures and traditions are built upon the environment," he said. " We have to remind ourselves again and again that we, as human beings, are an integral part of the environment and how we treat the environment affects us.
From the National daily, Friday, June 04, 2010

Class or Community Projects

Choose one project from the list below. Pick one that is appropriate for your local area and available resources. Set clear criteria for a satisfactory completion of tasks.

1. Plan and establish an eco-tourism project. Plan activities that tourists and visitors can do to appreciate the beauty of your environment (the example, bush walks, river rides, guided tours of local plants and land features). Consider fees you could charge and skills needed to be a tour guide.
2. Investigate and undertake practical ways to reduce, reuse and recycle waste from food consumption to benefit and improve the local environment.
3. Plants trees, fruit trees and timber trees around the school and the community.
4. Establish food gardens at the school and demonstrate soil conservation practices such as growing legumes, crop rotation, contouring and mulching.
5. Work closely with community leaders to organize a special community clean-up by cutting long grass, removing weeds, trimming trees, sweeping around the church or other community building and picking up plastic bags and other waste products.

Lesson 8: Government Polices On Forestry

Introduction

In this lesson, you will learn about the sustainability on forestry issues that link with forestry. Firstly identify

Your Aims

- List the government environment policies applicable to the forest industry in Papua New Guinea
- State the importance of government forest policy
- Identify the government and non–government organisations that are responsible for implementing the government forest policies
- Define carbon

What is forest? Forests are large areas of land covered with trees. Why are forests important to people and governments?

Forests are important because they:

- support and protect the soil
- home to many plants and animals
- conserve water and provide river catchments
- provide for leisure activities
- are sources of many products used by people

Forests provide many good things, good virgin forests take many thousands of years to develop, but they can be easily wiped out in a year.

With this, people must preserve, protect and improve and manage natural resources such as forests and others so that they are there for future generations.

Therefore, both combined traditional and modern practices must be looked at to ensure that these resources are fully utilized and benefit all people. In Papua New Guinea people have traditionally managed their environment wisely. The government had also set up laws to protect the forest, to help meet the interests of all its citizens.

Kaukau grown on land

Government's Concern about the Forests of Papua New Guinea

Trees are special homes for animals and insects.

With the government's guidelines on forest it has come up with some good management practices. With this, the government has established National Parks to preserve national animals and plants that are significant to Papuan New Guinean.

The government has declared some animals as 'National Animals' in order to protect them. They can only be caught or collected by Papua New Guineans using traditional methods and they can only be used for traditional purposes

They government has also established wildlife management areas. In these areas local landowners establish their own rules in order to limit damage and protect the natural environment. These rules are based on traditional management.

Activity 15

Read and answer the question below

(a). In this activity you are to find the words in the puzzle then write them down into your exercise book. You can find them spelt downwards, across, backwards or diagonally.

X	Y	Z	O	N	T	E	T	R
W	O	G	H	S	W	A	L	E
F	I	T	E	A	B	C	W	S
D	E	R	F	G	H	I	I	O
W	O	O	D	J	L	K	L	U
F	M	N	O	D	P	Q	R	R
S	T	U	L	V	W	X	Y	C
Z	A	I	M	A	N	A	G	E
B	F	O	R	E	S	T	R	Y
E	C	D	E	Z	Y	X	L	M

(b). Explain why the government laws aim to protect the forests.

_____
_____
_____
_____

Forestry

Forestry is the branch of science that deals with the general care and management of forest land for wood, water, wildlife, food and recreation. There are also hundreds of forest products which are of importance to human beings in a number of ways. These are the main ones,

- food
- raw materials
- medicinal herbs
- employment
- environment benefits

Plantation forestry, also known as **silviculture** involves the planting and care of an artificial or man-made forest of trees in an existing forest or grassland.

- Afforestation – planting of trees on bare land where there has been no forest.
- Deforestation – process of destruction or removal of a forest cover from the land
- Reforestation – planting trees on a piece of land where deforestation had taken place, for example where logging has occur.

Forestry Management Practices in Papua New Guinea

Forestry management practices are not the same for all trees and the landscape

- Seed collection

  The seeds are collected from healthy trees which are either felled in a logging area or climbed to have their seeds picked.

- Nursery preparation

  Seeds are broadcast in seed beds with overhead shade

- Planting in the nursery

  Seeds are usually grown into nursery seedbeds until they are ready to be transplanted to the field. While the seeds are in the nursery they must be cared or looked after.

- Transplanting to the field.

  Planting is done when the plant is ready, soil is damp and in or during the season that is suitable

- Management of the plantation

  To care for the plantation trees these are certain ways to follow;

  - fertilize the plants
  - prune must be done
  - protect the plantation from fire
  - control common insect pests

Harvesting matured trees

- control disease

- Harvesting

  Felling of trees must be carefully done to avoid damaging other trees which are to be felled at a later date

- Processing

  Wood is processed into veneers and other products for export. Others be used as fencing posts, telephone and power poles.

Conservation of PNG Forests

Conservation of the forest means saving the forest environment from destruction. Because of the high demand in developed countries for wood products, several logging companies have moved into Papua New Guinea are signed agreement to harvest timber. The activities of the logging companies destroy the environment in several ways;

- tree cover is removed, exposing it to increased erosion
- landslides become common
- exposed soils rapidly dry out
- firewood and building materials become scare
- natural homes and food of birds are destroyed
- biological life in the soil is destroyed and this leads to an imbalance of soil organisms, resulting in poor soils.

Reserved Area – Mt Bosavi

Number of ways in which Papua New Guinea forests can be conserved and made sustainable;

- trees can be planted where there are none
- new trees can be planted wherever and whenever trees are cut down
- some trees areas have been declared ‘protected areas’ to prevent logging; eg Mt Bosavi,SHP.
- laws made and implemented to limit the use of very heavy equipment in logging
- more forestry staff can be trained to care for forests and implement environmental conservation police

---

Activity 16 Read and answer the question below

(a). Are there any logging companies in your province, If there are any, name three.

_____

_____

_____

(b). Draw a flow chart of how the trees are processed. Start from a young tree to any finished product.

(c) Identify the traditional method of conserving using the forest in you own area. Write in at least few sentences explanation.

_____
_____
_____
_____
_____
_____
_____
_____

Summary

In this lesson, you have learnt that;

- Forestry is the branch of science that deals with the general care and management of forests.
- Forest provide vital resources and are of importance to human beings
- Conservation of the forest means saving the forest environment from destruction and made sustainable
- People need to preserve, protect, improve and manage the forests well far future generations.
- The government had also established laws and guidelines related to forestry.

END OF LESSON 8. NOW DO PRACTICE EXERCISE 8 ON THE NEXT PAGE

Practice Exercise 8

(1). Imagine that you are a landowner and a logging company boss had visited you to exploit your forest. Now, write up a dialogue you have with the company boss.

Drawing

(2). List down at least some of the government and non-government organizations in Papua New Guinea that are concerned with forestry or related issue. Ask or make your research.

Government Organization	**Non-Government Organization**
a.	a.
b.	b.
c.	c.
d.	d.

(3). Complete the table below by filling the necessary information correctly. With disadvantages of logging, what are the effects and causes of activities done by logging, Fill the effects column.

Disadvantages of Logging

Causes	**Effects**
* Tree cover removed	
* Spilled oil from used machine	
* Homes of plants and animals destroyed	
* Small and young trees destroyed	
* Animals migrate to other areas.	

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND 2

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 8.

Supplementary Reading 10: Government Policies on Forestry

Forestry
Forestry is the branch of science that deals with the general care and management of forest lands for wood, water, wildlife, forage and recreation. The part of forestry that deals with timber as a crop is called **silviculture**.

What is a forest?
A forest is vegetation dominated by wood plants. Grasses are almost absent. A forest is also an extensive plant community of trees and shrubs in all stages of growth and decay. Trees are the main types of plants found in forest. Grasses are few because the big tree branches and leaves prevent sunlight from reaching the ground to allow grasses to grow. About 77 per cent of the Papua New Guinea land mass is covered by forests. Various animals and birds are also found in forests.

Types of forests
Different types of forests are found in different parts of the world. Some of the forests are named after locations, for example, tropical forests in the tropics and montane forests on mountains. Generally, the forests of the world may be grouped into the following types:

(1) Evergreen forest
The trees in this forest do not all lose their leaves at the same time. The leaves are lost gradually and are also replaced gradually. There are green leaves on the trees at all times of the year.

(2) Deciduous forest
In a deciduous forest the trees lose all their leaves in the season called autumn or fall.

(3) Tropical forest
This forest is located in the cold temperate zone. The northern temperate forests are found between the Tropic of Cancer in the north and the Tropic of Capricorn to the south. Typically, a tropical forest is an evergreen forest.

(4)Temperate forest
This forest is located in the cold temperature zone. The northern temperate forests are found between the Tropic of Cancer and the Arctic zone. The southern temperate forests are located between the Tropic of Capricorn and the Antarctic zone.

(5) Coniferous forest
The montane zone covers all places with a height of 300-3000 m. The zone has many different types of vegetation.

(6) Montane forest
This forest occurs in high altitude regions such as very high mountains. There are different types of montane forests in PNG. In this forest the dominant tree species are the cone bearing pine trees**.** In the upper montane forest, this type of vegetation is found on Mt Wilhem in Simbu Province and on the roadsides between Wabag town and Mt Hagen, the trees grow to a height of about 25 m. Beech trees are also common in the upper montane forest.

(7) Mangrove swamp forest
This is an evergreen forest found in the low-lying muddy shores of coastal regions Mangrove trees are plentiful in mangrove swamp forests.

(8) Rainforest
This type of forest is usually found in areas of very high rainfall. The trees are very tall and have huge trunks. Animal life is abundant in rainforests. The tropical rainforest in PNG accounts for about 2 per cent of the world's tropical rainforests.

(9) Secondary forest
This type of forest grows along after farming activities have disturbed the typical rainforest. It is a young forest in the process of growing up.

(10) Gallery forest
This forest grows along a water course (for example a river bank). Gallery forests are also known as fringing forests or forest outliers.

(11) Savannah
Savannah is really a grassland vegetation type with a few stunted trees scattered here and there, rather than a forest. It is a grassy type of vegetation with scattered shrubs.

A derived savannah results from the combined effect of destructive gardening methods and bush burning in a forest area. Such destruction of the forest leads to the growth of more grasses and few trees.

It is found in places where the rainfall is lower than in the forest zone (below 2600 mm/year)and there is a long dry season. Savannah vegetation is common in Markham Valley, Oro Bay and around Port Moresby. The most common tree species is Eucalyptus. ('Kamarere')

Savannah vegetation in Markham Valley

Vegetation of Papua New Guinea

Other types of forests include cloud, boreal, monsoon and taiga.

The Vegetation of Papua New Guinea

Vegetation, which is a collective term for all plants, varies according to location. Papua New Guinea's forests have more than 2000 species of trees. About 400 of these are economically useful. The pictures above and below shows the types of vegetation (according to zones) in Papua New Guinea. The Papua New Guinea vegetation is grouped into four zones for convenience. Each zone has several types of vegetation.

Only the major types are named and described.

Lowland zone

The lowland zone is found from sea level to 700 m above sea level. Vegetation types in the lowland zone include:

Mangrove forest

Mangrove forests are found along the coast, especially close to the mouth of big rivers such as the Fly, Strickland, Sepik and Ramu. Mangrove trees (Rhizophora species) are the most common types of trees.

Mangrove trees

Swamp forests

Swamp forests are found close to the coast where there is plenty of rainfall and poor drainage. Sago palms (Metroxylon sagu), known in PNG as saksak are commonly found in mangrove swamp forest. Both mangrove trees and sago palms grow naturally in the swamps. The swamp water may be fresh water or salty (blackish) water. Some swamps may be flooded to a depth of 3 m. Swamp forests are common in Morobe, Madang, Gulf, Western Provinces, Sepik and other coastal provinces.

Sago palms in a swamp forest

Mixed lowland rainforest

This type of forest is found in places where the rainfall is heavy (above 3000 mm per year) and the dry season is very short (about two months). The forest is made up of tall trees with large trunks and buttress roots. Some trees may reach a height of 45 m in this type of forest. Many ferns, orchids and mosses grow on the trunks of these trees. The tree branches and leaves from a close canopy and prevent sunlight from reaching the soil.

Because of this, very few grasses grow on the forest floor which is usually covered by a thick layer of fallen, rotting leaves, and rotting tree trunks. Many trees of economic importance are found in mixed lowland rainforest. Feather palms, creeping

plants (from which ropes are made) and pandanus are commonly found in mixed lowland rainforest.

Monsoon forest
Monsoon forests are found in areas where there is a long period of dry season followed by a wet season. They exist in the hilly areas to the east and north east of Port Moresby. Shrubs grow above the general level of vegetation in a monsoon forest. Important tree species include mangoes, Bombax ('kapok'), Terminalia ('talis') and Albizia ('malmal').

Grassland
Grassland vegetation is also found in the highlands regions where the dominant grasses are **Miscanthus** and I**mperata** species ('kunai grass) which is the roofing materials for traditionl highlands' houses. The rocky hills on both sides of the road from Henganofi to Goroka are also covered with grassland vegetation. Menifo Sheep Research Centre is located in this montane grassland region. Sheep and goats feed on natural grassland in this area. These are also found in the valley floors and slopes of Mt Wilhelm, Mt. Giluwe, Mt Albert Edward and Mt Michael too.

Oak forests
This type of forest is found on Mt Michael near Lufa in the Eastern Highlands Province. Oak trees (Lithocarpus species) and conifers grow in abundance. Leaves of trees in the oak forest are narrow. Buttress roots are not common but the trees are tall like the rainforest trees. In some areas where it is wet, pandanus grows.

Araucaria forest
Araucaria forests are found in the area around Bulolo and Wau (both in Morobe Province) and Jimi Valley (Western Highlands Province). These areas have a height of 550-1500 m. The most common species of pine tree are klinki pine (Araucaria cunnigbamii). Hoop pine is commonly found in Goroka University Campus. Both Klinki and hoop pines is commonly found Goroka, especially at the cemetery and on Goroka University Campus. Both Klinki and hoop pines are temperate trees and their occurrence in PNG suggests that there was a time when there were temperate conditions in Bulolo, Wau and Jimi Valley to support the growth of these trees. Pandanus tree ferns and land orchids are common in Araucaria forest. Other locations of Aaraucaria forest include Mt Missim, Mt Suckling and along the Porgera River.

A typical Araucaria forest is always wet. It has a constant drizzle of rain and there is little or no sunlight reaching the forest oil.

Highlands Grassland Vegetation

Nothofagus forest
This forest is dominated by Nothofagus (beech) trees, as can be readily observed at Daulo Pass (Eastern Highlands Province) and on ridge tops in Western Highlands Province.

Sub-alpine zone
This is also called high mountain forest and occurs on the very high mountains of PNG. The trees grow to a height of about 10m. On Mt Wilhelm, the sub-alpine vegetation has two different types of forests. The lower forest occurs from 60m to 3600 m and has a lot of tree ferns. Above 3600 m, other tree species as well as ferns are common. Mt Giluwe (Southern Highlands Province) and Mt Albert Edward (on the border between Central and Oro Provinces) also have a sub-alpine vegetation.

Bogs and fens
A **bog** is a soft, wet, spongy ground which originated from decayed or decaying plants. It usually has a high acid content because the soils are developed under conditions of stagnant ground water. A bog has shrubs and hummock or hillock plants. A fen is an area of low marshy land. It is less acid than a bog because a fen is developed under conditions of moving ground water. A fen has no shrubs but there are grasses and sedge. Bogs and Fens are found on Mt Wilhelm from 3200-4270 m. Areas of swampy ground with deep mud (mires) also occur on Mt Giluwe.

Alpine zone
Alpine vegetation is the type of vegetation found at the top of Mt Wilhelm, the highest mountain in PNG. The vegetation here includes alpine grasslands, alpine fern meadow, alpine health, wet tundra and alpine bogs.

Importance of Forestry and Forest Products

The forest is important to human beings in a number of ways. These are the main ones:

Food
The forest is the most reliable source of protein – bandicoots, wild pigs, cassowaries – for villagers. Edible forest produce of plant origin includes tubers, roots, leaves and fruits. Forests are a major source of raw materials, which are renewable if they are cared for.

Commercial timber (including sawn timber, plywood and veneers) is used for furniture making, household, utensils, canoes, fences, coffin making, house construction and as electricity and telephone poles. Firewood, the major village fuel is also obtained from the forest.

The hides and skins of forest and swamp animals (for example, snakes, crocodiles and tree kangaroons) are used as articles of clothing and for making string bags (biliums). They are sold for money while the meat is eaten. The skin of the ‘kundu’ (drum) is usually made from a snake or iguana skin.

Other raw materials taken from forest include fibres for making ropes, mats, hats, bags and fishing tools, stakes for growing yams, winged beans and other climbing plant. Some are used for making dyes for colouring fibres and carvings. Some traditional PNG musical instruments, such as bamboo flutes, ‘kundu’ and ‘garamut’, are made from forest products.

Many forest plants are used as medicinal herbs to cure different diseases. These were used many years ago and are still used today.

Employment
Forestry and forest resources provide employment for people in the saw mills, pulp and paper mills and wood chip factories. In these factories, logs are cut and processed into different forms and exported or used locally in house buildings.

Environmental benefits
Forests are places for the preservation and management of wild life in game reserves. Leaves of forest plants purify the air through photosynthesis and so make the forest environment suitable for human habitation.

Types of trees
Trees of economic importance fall into two groups:

a. The flowering plants (angiosperms) which are further divided into two groups:
- Monocotyledonous plants (for example, oil palm, coconut palm, sago palm)
- Dicotyledonous plants. Most of the commercially important hardwood trees (for example, eucalyptus, acacia, oak, ebony, mahogany, wild mango, teak, cedar, baobab) and softwood trees (for example, gmelina, teak, Albizia and dicots.

Ten important forest trees commonly found in PNG

Botanical Name	**Common Name**	**Type of Wood**
1.Rhizophora apiculata	Red mangrove	Hardwood
2.Nothofagus grandis	PNG beech	Hardwood
3.Castanopsis acuminatissima	PNG oak	Hardwood
4. Weinmannia blumei	Mahogany	Hardwood
5. Toona sureni	Red cedar	Softwood
6. Flindersia pimenteliana	Silkwood	Softwood
7. Terminalia complananta	Talis	Softwood
8. Araucaria hunstenii	Klinki pine	Softwood
9. Araucaria cunninghamii	Hoop pine	Softwood
10. Mangifera minor	Wild mango	Hardwood

Gymnosperms
These are the cone-bearing plants such as pine trees. Two important pines are klinki pine and hoop pine.

Forest Ecology
Forest ecology is the study of the interrelationships between all plants and animals that live in a forest. A forest is a natural community which has plants, animals, soil, water and air. All plant and animal life in a forest depends on the sunlight, the source of energy. All forest creatures depend on each other for survival. The sunlight is used by green plants to make food by the process of **photosynthesis**. All forest animals depend on the plants which produce oxygen used by the animals.

Herbivores (animals which feed on plants) depend directly on plant parts (for example, leaves and stems) for their food.

Carnivores (animals which eat other animals) in turn feed on herbivores. If the food supply of herbivores is scarce, the animals may die of starvation. If herbivores die, carnivores have less food and their population in the forest will decline. When forest animals die, their bodies decay and nutrients in them become useful to forest plants which absorb the nutrients and improve their growth.

Soil organisms are also affected by the forest environment. For example, if the soil is unsuitable –too dry, too hot, too wet and lacking oxygen – the organisms could die, Their functions such as decomposing dead bodies of plants and animals may, therefore, not be carried out properly. To maintain this inter-relationship of forest organisms it is important to prevent forest destruction in any form – burning forest, grasslands and fallen trees.

Some animals and birds found in PNG

ANIMALS	BIRDS
1. Possums	Cassowaries
2. Bandicoots	Bird of Paradise
3. Snakes	Cockatoo
4. Wild pigs	Parrots
5. Tree kangaroos	Pigeons
6. Wallabies	Hornbills
7. Crocodile	Wild fowls
8. Iguanas	King fishers
9. Flying foxes	pigeons

Plantation Forestry
Plantation forestry, also known as silviculture, involves the planting and care of an artificial or man-made forest of trees in an existing forest or grassland. The trees in a plantation are regarded as crops.

Afforestation
Afforestation refers to the planting of trees on bare land where there has been no forest. It is often practiced to make soils more stable on grasslands, mountain slopes and deserts.

Afforestation program occurred at Fayantina near Henganofi in which pine trees are planted on mountain slopes.

Plant nursery

Deforestation
This refers to the process of destruction or removal of a forest cover from the land. When logging company cuts down trees, we say that the land is deforested.

Reforestation
Reforestation means planting trees on a pieces of land where deforestation had taken place, for example where logging has occurred. The Araucaria plantation forest in Bulolo is an example of a site where reforestation has been carried out.

Advantages of Developing Tree Plantations

- Tree plantations help to cover the land and so save it from erosion.
- A plantation makes it possible to use a piece of land that cannot be used for growing crops.
- Where plantations are made, some form of development such as access roads, electricity, schools and aid post may reach villages which would otherwise not have had these things.
- Local people employed in the plantation gain some income
- When the plantation trees are mature, they can be harvested and sold for money.
- Branches or dead trunks of plantation trees can be used for firewood.
- Timber from the plantation provides wood for building houses in places where natural forests do not exist.

Disadvantages of Developing Tree Plantations

- Compensation claims over land may disrupt the work and this could lead to waste of money, equipment, time and other valuable resources.
- When local people see the benefits of the plantation, they may start making additional demands on the government or company that owns the plantation.
- Plantation establishment requires a lot of labour which could be used for other work.
- It takes many years for forest trees to mature for harvest. If a farmer invested in a coffee, coconut, cocoa, rubber or oil palm plantation, this would yield income in a shorter time.
- Coffee or oil palm trees give the farmer money for many years before replanting is needed. Forest trees, however, require replanting after they have been felled or harvested.

How to Establish a Forest Plantation

In order to establish a forest plantation, the following steps are required:

- Buy the land or acquire it through donation by the land owners.
- Survey the land and mark out the planting lines.
- Buy seedlings from a government forest nursery and plant according to the directions of the forest officers.
- Maintain the trees according to the advice of the forest officers until the trees are ready for harvest.
- Harvest according to the advice of the forest officers.
- Plant new seedlings after cutting mature trees.

Forestry Management Practices in PNG

Highland species (commonly known as pines) and some leguminous species (mainly Albizia and Leucaena) are the main types of trees recommended for planting in the PNG highlands. About twenty-five species of pines have been introduced to PNG. The common ones are hoop pine, klinki pine and casuarinas ('year' tree). Some of these trees grow well in the highlands and others grow well in lowland areas. Forestry management practices are not the same for all trees. The methods discussed here refer to the specific types of trees named.

Pinus Seed Collection

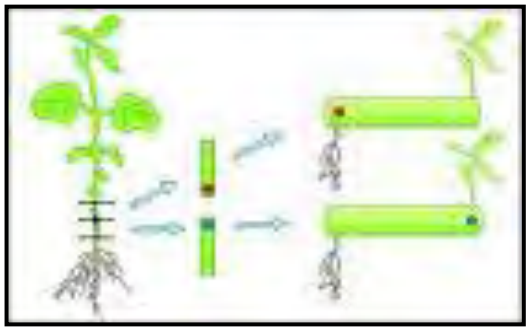
Hoop and klinki pine seeds (cones) are usually collected in October/November every year from seed orchards, for example, the Bulolo seed orchards, First, forest officers use binoculars to look at cones from the ground. The officers then decide on which trees to collect ripe cones from the seeds are collected from healthy trees which are either felled in a logging area or climbed to have their cones picked. Climbers use climbing irons and safety belts. They choose mature cones and knock these down with a long bamboo pole which has a hook at the top. On the ground, the cones are examined, immature or diseased ones are left behind. The good ones are packed in copra bags and carried to the nearest road for a truck to take them to the forest station.

Nursery Preparation

Seeds are broadcast in seed beds (15 m x1.2 m) with an overhead shade (Figure 15.8). When the pine seedlings are 6-8 cm tall, they are inoculated with washed **mycorrhize** (a plant association between a fungus and a pine root) removed from a healthy tree. The seed bed should be rich in organic matter.

A. Tubers prepared for planting

B. Plant cuttings



D. Seedlings with overhead shade.

C. How to grow forest trees

Planting in the Nursery

After two to three months in the seed bed, the pine seedlings are about 8 cm tall. They are dug up and planted into black polythene bags called 'tubes'. The tubes are

filled with topsoil from which stones and other large particles have been removed with a soil sieve. The former practice of planting seedlings of Pinus species in a seed bed before transplanting into tubes has been replaced by the current practice of direct sowing of seeds into tubes. Direct sowing saves time and labour.

Care of Seedlings in the Nursery

The following management's practices are used to care for seedlings:

- Stand out tube seedlings in cyclone netting in each square until they are at least 20 cm tall.
- Apply fertilizer: add 1.8 kg of NPK (11:5:14) per 200 litres of water and apply this solution at the rate of four watering capfuls per bed.
- Use overhead shading for one to three weeks.
- Water to keep the tubes moist
- Remove diseased seedlings.
- Kill pests (rats and crickets)

Transplanting To The Field

When planting:

- Select and clear a good site
- Burn the cleared site
- Dig planting holes at 3 m x 4 m or 3 m x 2.5 m.
- Plant seedlings in the rainy season
- Plant legumes at the same time as you plant the seedlings. These can be used for grazing cattle and to improve the soil.
- Plant new seedlings within two months if any seedlings died. (This replanting is called refilling).

Management Of The Plantation

Look after the trees in the following manner:

- Tend or weed plants about four to six times in the first year.
- Apply fertilizer. The rate depends on soil fertility so seek the advice of a forestry officer
- Remove or prune branches to produce trees which grow without knotty internal parts. Such trees fetch a better price than trees with knots. There are three phases of pruning. The first phase is at three to five years of age; the second at five to eight years, and the third phase after ten years. Prune with a saw and cut close to the stem. Trees on the edge of the plantation should not be pruned.
- Thin plants three times. (First at six to ten years of age; second at ten to twelve and the third after fifteen years.)
- Protect the plantation from firs. Do not allow fires to be lit in the plantation. Fire breaks of 10-20 m in width should be maintained around the plantation especially if there is a public highway or grassland nearby.
- Control insect pests. Spray with Fenthion (trade name Legacy 50% E.C.) at the rate of 1 ml active ingredient to 40 ml of solution. Destroy egg masses and pupae of insects.
- Control rodents by using traps or baits.
- Control diseases. Although diseases are uncommon in PNG, if they occur report the problem to the nearest forest officer who will arrange for a disease specialist to visit the plantation.
- Prevent overgrazing by cattle.

Harvesting
Klinki and hoop pines can be cut down when they are about thirty to forty years of age. Between these years, however, the thinning process makes other trees available for sale. The trees allowed to stand will grow into larger trees for future sale.

Processing
Klinki and hoop pines can be processed into plywood, veneers, furniture and building materials, Other pines can be made into beehive boxes for transporting honey. Pine stems are chemically treated and used as fencing posts, telephone and power poles, PNG Forest Products in Bulolo processes wood into veneers and other wood products for export.

Lowland Species
Among the lowland species planted in PNG are Acacia, Terminalia, Gmelina and **teak**. The establishment and care for a lowland species are similar in some respects to those recommended for the highland trees. The example used here is for teak. Teak is a large deciduous tree which sheds its leaves in the dry season. It can be grown from sea level up to 1200 m but does not grow well in places higher than 1200 m. The Papuan lowlands of PNG are the best places to grow teak as these areas have a prominent dry season.

Seed Collection
The best places from which to collect teak seeds are the teak seed orchards at Kerevat or Brown River Forestry Station near Port Moresby. Although these seeds are available throughout the year, at Keravat, they should be collected from June to September. At Mt Lawes, seed collection time is August to September. In order to collect the seeds, the tree is climbed and the branches which bear mature seeds are vigorously shaken. Fallen seeds are collected in a bag and taken to the seed store where they are sun-dried for about one week. After drying, the seeds are dehusked, that is, their outer coverings are removed.

Nursery Preparation
It is best to make a temporary bush materials nursery at a site close to the proposed plantation. The site should be cleared and all trees felled. Bush burning is carried out to produce mainly ash and little or no unburnt material. Seed beds need to be 15 m x 1.20 m wide, with 30 m cm space between them.
The beds are tilled twice and raked to remove all stones and other unwanted materials. NPK fertilizer (21:14:14) is broadcast and raked into the soil at the rate of 450 kg/ha of nursery bed and the beds watered. All weeds in the nursery must be removed before sowing the seeds. Where weeds are a problem, they can be controlled by spraying 600 ml of White Spirit over a 50 m x 1.2 m area, a few days before sowing.

Planting in the Nursery
Seeds are usually sown into nursery seedbeds in June/July in Kerevant and May/June at Mt Lawes. The seeds are evenly broadcast over the nursery. Workers should not walk over sown seeds. Watering is done after sowing.

Care of Seedlings in The Nursery
Use the following methods to care for seedlings in the nursery:
- Water the soil when it is dry.
- Look for and kill insects, rodents, snails and other pests.
- Look for and remove diseased seedlings.

- Thin seedlings to remove diseased plants.
- Cut back seedlings. If some seedlings are suppressed by stronger ones, the strong seedlings should be cut back to 15 cm above the ground.
- Just before planting, lift the seedlings by loosening the soil with a spade or fork. Care must be taken to avoid damaging roots.
- Prepare the stumps. The seedlings are uprooted and taken to a shed where each stem is cleanly cut 2 cm above the ground level and the taproot about 18 cm below the ground level. This process stumps which are about 20 cm long. The stumps are bagged and stored in a shed for not more than one day before they are planted out in the field.

Transplanting to the Field

Planting is done when the soil is damp, for example, after heavy rains in November through to January. When transplanting:

* plants should be spaced 2.45 m apart along the row and 2.75 m between the rows; this gives 1500 trees/ha
* deep plant the stump; soil should be compacted around the stump after planting.
* carry out refilling within three months of planting.

Management of the Plantation

To care for plantation trees:

Tend the plants by weeding and removing all vines, grasses and trees, especially during the first six months after planting. Slashing should be carried out to control weeds.

* Fertilize the plants. The rate depends on soil fertility. Seek the advice of a forestry officer.
* Prune. Basal shoot pruning is the only type of pruning done in teak. Only the main stem is allowed to develop and all side branches and shoots are removed as close to the main stem as possible.
* Thin out plants to promote good form and to maintain uniform stem diameter increases. Thinning should be done according to the schedule advised by the forestry officer.
* Protect the plantation from fire. Do not allow fires to be lit in the plantation. Maintain fire breaks 10-20 m around the plantation especially if there is a public highway or grassland nearby.
* Control common insect pests in teak plantations such as termites and teak moth. Mist plantations with 0.1% BHC solution.
* Control rodents by laying Rat sack bait around trees where rats damage trees. To control snails, cardboard rings dipped in poison solution should be placed over the stumps on the planting day.
* Control disease. Except for root rots caused by Fomes noxious, teaks in PNG do not suffer many diseases. Infected trees should be removed during thinning and their stumps coated with creosote on the same day.

Harvesting

Teak trees can grow for more than twenty years before they are finally harvested for use as telephone and power poles. At that age, the trees may reach a height of over 25 m. Felling of trees must be carefully done to avoid damaging other trees which are to be felled at a later date.

Processing

Trees grown in the lowlands can be processed into various forms. Gmelina stems and branches can be made into sticks for matches. Teak stems are very useful as decking for building, bridges and wharfs. The stems do not rot for several decades.

Stems of teak are also used for furniture and wood chips which are exported to Japan and further processed into sheets of cardboard for house ceiling.

Some Trees Species Recommended For Planning In PNG

Common Name	Scientific Name	Where to Plant
Gmelina	Gmelina arborea	Lowland areas
Teak	Tectona grandis	Lowland areas
Wattle	Acacia auriculiformis	Lowland areas
Balsa	Ochroma lagopus	Lowland areas
Kamarere	Eucalyptus deglupta	Lowland areas
Hoop pine	Araucaria cunninghamii	Highland areas
Klinki pine	Araucaria hunsteinii	Highland areas
White Albizia	Albizia falcataria	Highland areas
PNG oak	Castanopsis acuminatissima	Highland areas
Yar tree	Casuarina aligodon	Highland areas
Pine	Pinus patula	Highland areas

Example of forest Management in Vanuatu

* Each man or each family is assigned about 0.5 -1.5 ha of land to clear. This plot of land is called a **taunagya** or **shamba**.
* When the cleared land is dry, it is burnt to destroy weeds.
* The land is prepared as required for the different crops.
* The crops (for example, cocoa, corn, pawpaw, banana or sweet potato) are planted.
* Tree seedlings are planted as soon as the planting of the crops is completed. Wider row spacing than in a normal plantation is used in order to delay shading of the food crops by the trees.
* The workers care for the plants (crops and trees) for four to five years until shading makes it uneconomical. The taungya is then abandoned and the workers start a new taungya somewhere else. The trees continue to grow and are harvested when they are mature. In Indonesia and Kenya workers make many taungyas at one time and plant one taungya every year.

Conservation of Papua New Guinea Forests

Conservation of the forest means saving the forest environment from destruction. Papua New Guinea is very rich in natural forest resources. Because of the high demand in developed countries for wood products (for example, plywood, veneers and wood chips), several logging companies have moved into PNG and signed agreements to harvest timber. In Gogol Valley in Madang Province, logging companies fell trees for their chip mill. The activities of the logging companies destroy the environment in several ways:

* The tree cover is removed from the land thus exposing it to increased erosion.
* In mountainous areas, landslides become common.

* Removal of vegetation cover can lead to desert formation.
* The soil immediately under the exposed land becomes hard and difficult to till as hard pans are formed, especially where heavy tractors were used in the logging operations.
* Exposed soils rapidly dry out.
* The microclimate of the area becomes more severe. The environment becomes hot and dry and there is increased force of winds in the area because of the lack of wind breaks.
* Firewood and building materials become scarce and are costly if available.
* More weeds grow on destroyed land and grass vegetation develops causing weed control problems in nearby gardens.
* The natural homes and food of birds and other forest animals are destroyed. This can lead to the eventual death and extinction of rare species such as the Bird of Paradise, tree kangaroos and some butterflies found only in PNG.
* Biological life in the soil is destroyed and this leads to an imbalance of soil organisms, resulting in poor soils. There are a number of ways in which PNG forests can be conserved and made sustainable:
* Trees can be planted where there are none (afforestation).
* New trees can be planted wherever and whenever trees are cut down.
* Trees can be planted on lands which are too poor to grow crops.
* Some forest areas, for example, Mojirau Wildlife Management area along Angoram highway in East Sepik Province, have been declared protected areas to prevent logging.
* Laws are made and implement to limit the use of very heavy equipment in logging. Light equipment does less damage to the land.
* More forestry staff can be trained to care for forests and implement environment and place less emphasis on the immediate financial benefits of logging.
* Government development policies and their implementation can take into consideration the need to preserve forests, destroy less forest land and make forests sustainable.

Major conservation project under way in Madang Province.

A major rainforest conservation and research project in underway in rural Madang to help landowners save their forests and participate in the economy. This project is the biggest in the pacific region, excluding Hawaii.

Located in Middle Ramu's Wanang Conservation area, the Swire PNG Rainforest Study (SPRS) covers 50ha of rainforest and is based on the belief that protecting PNG's rainforest requires a two prong approach of scientific understanding and community empowerment.

One of the leading researcher Dr Stewart Davies said that the project was the vision of the elders of the 12 clans to save their trees and still participates in the economy. He said since 2008, the whole community had been involved in the project and also in helping researchers and scientists to learn ways to save forests.

Davies said with the advent of climate change and global warming, trees were greatly affected and so the study sought to find out what kind of problems could arise. The

island of New Guinea is the third largest tropical forest wilderness in the world.John Swire and Sons (JS&S) and Steamships Trading Co. said the project represented the first long term study of carbon dynamics in PNG forest and would increase scientists' ability to access the response of Pacific forests and global climate change.

Lesson 9: Government Policies on Marine Resources

Introduction
Welcome to lesson 9. In your last lesson you learnt about government policies on forestry. Now in this lesson, you will learn about government's policies on Marine Resources

Your Aims

- Explain sustainability on marine resources and related issues.
- State economic, nutritional and cultural value of marine resources
- Explain traditional fishing methods and its importance
- State government environment policies applicable to the fishing industry in PNG
- List the government and non - government organisations that are responsible for implementing the government marine policies

Sustainability is about maintaining the ecological (natural) balance of exploiting (using) marine resources without destroying the ecological balance of an area. Marine resources taken out of the sea and water must be given time to be restored naturally. So to sustain basically means to replace or give time to be restored back to its original stage. Read on.

Firstly, the government through the National Fisheries Authority, has set laws or guidelines to protect the use of marine resources in the Papua New Guinea. The guidelines are set to help protect and assist with economic, nutritional and the cultural values of marine resources. For example, in one of its laws, it is stated that big fishing vessels are to harvest fish at about 200Km or 300Km away from the shore (ground). Between there, the local people are allowed to look or collect the resources they need for their consumption.

Activity 9.1
(a) Define sustain.

_____
_____
_____

(b) Apart from family consumption, what other reasons do people catch fish for? List two.

(i)_____
(ii)_____

Economical, Nutritional and Cultural Values
The economic value of marine resources is that they may be used for personal purposes such as food which provides a saving in what needs to be bought. They

can also be sold to provide an income for individuals, families and the nation. Papua New Guinea has fish canneries that produce tinned fish.

Inside a fish processing plant- Madang Province

Marine resources especially fish provide the food that enables us to have healthy bodies. Whether they are bought from markets or shops, our diets are comprised of marine foods. All kinds of fish and seafood provide the nutrition's of protein. While they are rich sources of protein, they also contain other nutrients. Tinned fish, for example contains some fat, calcium, iron and vitamin B.

Marine resources are valued for aesthetic (artistic or beautiful) and cultural purposes. They are highly valued for personal adornment, traditional dress and ceremonial occasions. For example, turtle shell and kina shell are some products that form part of headdresses pierced ears, pierced noses and neck bands. Also they have always been important for trade, relationships between clans, bride price, compensation and celebrations.

Catching fish using hand held lines

From the waters of our rivers and seas we get all kinds of food. There are numerous varieties of fish such as tuna, trout, tilapia, carp, red emperor, barramundi, barracuda, eels and shark. Other water animals include octopus, dugong, turtle and the crocodile. A variety of crustaceans includes different shells, oysters, prawns, crabs and crayfish.

Activity 9.2

(a) Name the important and essential nutrient that fish and other marine resources provide humans.

_____

_____

_____

Traditional Fishing

Traditional fishing in Papua New Guinea, most people have traditional fishing grounds where they go to catch fish. The fishing grounds may be close to a lake, river or next to a reef. In coastal areas, local fishermen go out at night to fish using pressure lamps and spears, an underwater torch and fishing guns, or a string line and hooks. Most of the fish caught are either smoked or taken fresh to be sold at the market for cash. Fishermen purchase essential goods from trade stores using the money earned from selling fish. The Koki market in Port Moresby is one place where local fishermen sell their fish for cash.

Using lines to catch tuna

As the population grows, more and more people are using illegal and damaging fishing techniques to increase their fish catch.

- Some coastal fishermen use dynamite to catch fish. This destroys fish breeding grounds,
- Inland fishermen sometimes use poisonous derris roots to catch freshwater fish, prawns and eels. The poison in the water also destroys hundreds of young fingerlings and prawns.
- People fishing in lakes and rivers sometimes use gill nets and these reduce the fish population.

Activity 9.3

(a) Name one traditional method of sustaining marine resources

_____

_____

Fishing is a small industry in Papua New Guinea, though our country has excellent fishing waters. Fisheries estimate that Papua New Guinea's seas could produce 500 000 tones of fish a year without risking the stocks. There is also a sizeable potential market, but despite this, the fishing industry has not grown significantly. Why?

- Fish prices are low compared with the costs and risks involved in catching them.
- Traditional land rights sometimes prevent fishermen from entering the best fishing or bait-gathering areas.
- Harvesting prawns, lobster tails and barramundi, and tuna fishing, are mostly in the hands of foreign companies. Their boats have specialist equipment for large – scale fishing.

Marine resources

Lobsters

Prawns

Tuna

Traditional Fishing is an important activity in Papua New Guinea. One-fourth of rural families' fish. Papua New Guineans consume more than 15 000 tonnes of fresh fish catch each year. Fish is the main source of protein for most coastal and river people. Both men and women fish.

Traditional bamboo fish traps

Some good traditional fishing practices include using;

- Bows and arrows to shoot fish from rocks or canoes.
- Dip and scoop nets with frames of bamboo or wood. These are passed through the water, along the shore or from a canoe.
- Hooks and lines. In many places, metal hooks have replaced the traditional hooks made of turtle shell, bone, wood or other material.
- Fishing nets worked in several ways, plunge baskets, best in muddy water.
- The traditional calendar is followed to hunt certain species of marine life for personal use.
- Fishing practices, such as the use of explosive, are used under strict conditions as coral reefs can be easily destroyed.
- Traditional taboos that limit access to fishing grounds are respected and this makes sure that fish numbers grow.

Fishing at the reef

Coral reefs.
The seas and coral reefs are an important resource. They contain enormous numbers of sea creatures such as prawns, coral and reef fish. If too many of these sea creatures are caught, a valuable source of food and income could be lost forever.

Traditional methods of catching fish did not remove large numbers of fish at one time. However, large commercial fishing boasts are now catching huge quantities of fish using modern fishing equipment. Management must keep strict control over these companies to safeguard the fisheries for the future.

- Regulations need to be introduced to prevent over-fishing.
- The total number of fish caught needs to be limited. (Ecologists can calculate the maximum number of fish that can be caught without risking a decline in the population of that species).
- The number of commercial fishing licenses must be limited.
- Young fish should not be caught as they are breeding stock.
- Fishing could be restricted at certain times of the year, when fish are breeding or migrating.
- Trawling should be banned.

Papua New Guinea takes part in the world trade in buying goods from other countries, it imports good and sells goods to other countries, it exports goods. From the Papua New Guinea exports and imports, marine resources product is also competing with other products in the country.

Activity 9.4

(a) Explain “fishing within 300KM from the shore” by foreign fishing vessels.

_____
_____
_____
_____
_____

(b) Name two government or non- government bodies that look after marine resources.

(i)_____
(ii)_____

Fish farming.
Fish meat is the cheapest animal protein in Papua New Guinea. It is also more easily digested than beef, mutton and poultry. As a result, there is always a high and steady demand for fish. The idea of fish farming in PNG came from foreign companies which recognized the profitability of raising fish in ponds and dammed rivers. Recently, fish farming as a business has become important even in the highlands of PNG because of the need to obtain cheap protein from sources other than pigs.

Selecting a site for a fish pond
The first step in starting a fish pond is selecting a suitable site. A farmer must take into account the following factors when constructing a pond.

- water
- soil type

- land slope
- freedom from pollution
- freedom from floods

Types and construction of fish pond

There are two types of fish ponds: The production pond and the nursery pond. The production pond is used to raise fish to adult size whereas the nursery pond is used to raise very young fish, called **fry**.

Types of fish to keep

The common types of fish that are good for pond water farming are Carp and Tilapia These fish breed well in most PNG conditions and increase in population in very short time.

Carp originates from China and it is an **omnivore**. It feeds on worms, insects, tender plants, decayed organic matter and the mud at the bottom of the pond. Tilapia originates from Africa. This fish feeds on algae, phytoplankton, soft grass, leaves and other decayed organic matter. It is good practice to keep different types of fish in separate ponds to avoid some fish eating others.

Samples of carp fish

Harvesting

Fish are ready to be harvested between six to twelve months. Harvesting should be done every year. Harvesting fish can be done in two ways, by completely draining the pond or with fishing net. Harvested fish are preserved by salting and smoking. Smoking fish is a traditional method of preservation. Sometimes fish are not well preserved and go bad. Harvested fish can be preserved by salting and smoking. Smoking fish is a traditional method of preservation. Fish can be sold smoked, live or cooked.

Summary

In this lesson, you have learnt that;

- The government through the National Fisheries Authority had come up with guidelines protecting the economical, nutritional and cultural values of the marine resources.
- Fishing is a small industry in Papua New Guinea although our country has excellent fishing waters.
- Fish farming had enabled people to become self-reliant and is a growing industry in the country. It must be sustained to help people.
- Pond fish may be infected with disease. Rough handling, poor management and too many fish in the pond lead to diseases.
- Government and non-government organizations in PNG that are concerned with the marine environment are;
    - National Fisheries Authority.
    - Ministry for Agricultural and Livestock
    - National Agricultural Research Institute (NRI)
    - Office of Environment and conservation
    - World Vision.

END OF LESSON 9. NOW DO PRACTICE EXERCISE 9 ON THE NEXT PAGE

Practice Exercise 9

1. What nutrient is contained in the fish and other sea foods?

   _____
   _____

2. Identify and list examples of bad practices by foreign commercial fishing companies of our marine resources.

   _____
   _____

3. Explain a traditional practice of fishing in your area. What are the set rules of fishing. Write them.

   _____
   _____

4. Using the Type of Exports and Import's graph, answer these questions.
   a. How much money did the government receive from the Marine products?

      _____

   b. From the import graph, under which sector do you think marine resources products fall under? How much was spent on this?

      _____

5. Why has the government set up policies on marine resources?

   _____

6. Identify and list some marine resources you know. List them and write down what their uses are. Use the table below.

Marine Resources	What Is It Used For

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 9.

Supplementary Reading 11: Live Reef Food Fish Trade In Papua New Guinea

Introduction: There many different varieties of marine lives that live in the sea and water. All have many uses of them; food, medicine, cosmetics, money, sports, decoration, and tools. For some marines their uses are far more than just one or two, so people sort them much more and this makes them decrease in numbers at an alarming rate. The National Fisheries Authority has to put policies in place to protect these resources before they are wiped out and this will cause other dangers to the sea or water environment. This reading is on **"**Live Reef Food Fish Trade In Papua New Guinea"(LRFFT) for short. It is a policy that protects grouper variety of fish from being over – fished both by locals and foreigners.

Live Reef Food Fish Trade (LRFFT) In Papua New Guinea

What is Live Reef Food Fish Trade In Papua New Guinea?
Live Reef Food Fish Trade In Papua New Guinea is the increasing trade for live groupers, wrasses, and some snappers that caters for rich consumers in South East Asia. These consumers prefer the beauty of live fish from tanks while dinning in very expensive hotels because of the perceived status and prestige.

What are the common species targeted for LRFFT?
The species targeted for LRFFT differs from one region to another depending on the distance and demand by the consumers.

Common Names	Scientific Names
1. Maori Wrasse	Cheillinus undulates
2. Barammundi cod	Cromileptus
3. Camouflage grouper	Epinephelus polyphekadion
4. Giant Grouper	Epinephelus lanceolatus
5. Brownmarbled grouper	Epinephelus polyphekadion
6. Highfin coral grouper	Plectropomus Oligacanhus
7. Squareretail coral grouper	plectropomus
8. Blackmarbled coralgrouper	pietropomus

Where do they live?
Most groupers, cods and trouts are usually found in coral–areas of lagoon and outer reefs. They are abundant around islands and atolls. Some species like squaretail coral grouper, brown marbled cod, camouflaged grouper are usually found in small schools. These fishes usually live on a certain part of the reef to spawn at certain period of times. Groupers during spawning period may become vulnerable to over-exploitation by fishermen. Groupers feed mainly on crustaceans(crabs) fishes ,and sometimes cephalopods and gastropods.

The Maori Wrasse (known as hump head) inhabits steep outer reef slopes channel slopes and lagoon reefs. Usually solitary but may occur in pairs.

Juveniles usually inhabit coral – rich areas of lagoons reefs especially where stoghorn acropora or corals are seen to be abundant. Adults usually rove across the reefs, by day and rest in the reef caves and under coral ledges at night. They feed on mollusc, fishes, sea urchins, crustaceans, and other invertebrates.

Maori wrasse takes five (5) years to become an adult. At this age, it becomes sexually matured or once it reaches fifty (50) cm. Maori wrasse grows to more than two meters and lives at least thirty(30) years.

Barramundi (humpback) cod inhabits lagoon and seaward reefs and are typically found in silty areas, coral reefs and tide pools. Juveniles are commonly caught for aquarium trade.

What is the fuss (worry)?
Most live fish target species are slow growing, have low fecundity, have long life span and usually and usually aggregates during spawning seasons making them vulnerable to over – exploitation. However, if managed properly, this relatively small – volume, high value fishery could contribute to sustainable economic development to the coastal communities and the country as a whole. Therefore, this fishery demands careful consideration in management.

What is the history of LRFFT in Papua New Guinea?
LRFFT was introduced in Papua New Guinea in 1992. The first operation was based on Hermit Island in Manus Province then spread to other provinces.

The fishery presents potential for economic benefits to the coastal communities, but if it managed properly, it can also cause negative environment, economic biological and social impacts.

Potential Problems are:

- Continually moving from one area to another, leaving those who live near the reefs without enough fish for themselves or the community**.** This fishing pattern is called “boom and bust” syndrome.
- Foreign fishers usually use poison like cyanide to stun and capture fish. The poison has severe negative impacts on the coral reefs, other fish, and the surrounding environment.
- Targeting of juveniles and spawning sites
- Introduction of overly efficient fishing practises destructive to the resources, surrounding environment and traditional fishing methods.
- May lead to unsustainable exploitation of the fishery is not properly managed.
- High by catch return
- Social conflicts (eg. Reef ownership rights, fishing rights, royalty distribution)

Potential Benefits:

- A source of income for governments from license fees
- An opportunity to generate income for the coastal population.
- Establishing markets for fishers especially those in the remote coastal areas.
- Providing job opportunities for the youths in the remote area.

The Management Arrangement

- There is nationwide moratorium on the issuance of licences for LRFFT imposed in 1998.
- The National Fisheries Board approved a trial project in Kavieng to obtain the much needed information to formulate and develop a “LRFFT Management Plan”
- At the present the LRFFT in Papua New Guinea is managed under a national management plan known as “ The National Live Reef Food Fish Management Plan”.

Important Reminders

- Fishing for live fish is restricted to handling only.
- Fishing for LRFFT is restricted to local fishers catching and selling fish to the operators.
- The use of sodium cyanide including derris roots for capturing fish illegal.
- Use of hookar gear, SCUBA and traps are prohibited in the LRFFT.
- Fishing on spawning mass sites for the purpose of selling fish is prohibited

Size Limits For Exports

Common Name	Scientific Name	Export Size Limit	Common Name	Scientific Name	Export Size Limit
1.Coral cod	Cephalopholis miniata	No minimum size	13.Red bass	Lutjanus bohar	No minimum size
2.Tomato Rock cod	Cephalopholis sonnerati	No minimum size	14.Stripery sea perch	Lutjanus carponotatus	25cm
3.Hump head Maori Wrasse	Chelinus undulates	65 cm	15.Sandle tailed sea perch	Lutjanus malabraricus	40cm
4.Black spot tusk fish	Choerodon schoenlenii	30 cm	16.Moses perch	Lutjanus russelli	25cm
5.Barramundi cod	Cromileptis Altivelis	40 cm	17.Red emperor	Lutjanus sebae	55cm
6.Flowery cod	Ephinephelus fuscoguttatus	55cm	18.Maori perch	Lutjanus rivulatus	55cm
7. Trout cod	Ephinephelus Maculatus	No minimum size	19.Square tall coral trout	Plectropomus areolatus	36cm
8.Camouflage grouper	Ephinephelus polyhekadion	37cm	20.Chinese football trout	Plectropomus laevis	60cm
9. Potato cod	Ephinephelus tukula	65cm	21.Leopard coral trout	Plectropomus leopardus	36cm
10.Maori Grouper	Ephinephelus undulo striatus	45cm	22.Bar checked coral trout	Plectropomus maculates	36cm
11. Red throat emperor	Lethrinus miniatus	35cm	23.High fin coral	Plectropomus oligocantus	36cm
12. Managrove jack	Lutjanus argentimaculatus	40cm	24.coronation	Variole louti	No minimum size

NB: Minimum=mini Maximum= max

What is the Fisheries Manager – Inshore's plan for LRFFT?

Their duties includes:

- Assess the available stock in the management area.
- Provide awareness materials to educate the fisherman
- Provide training on " live fish handling".

Lesson 10: Government Policies on Mining and Petroleum

Introduction

Welcome to lesson 10. Like lesson 8 and 9, you are going to learn about the mining and petroleum industry in Papua New Guinea. You will ,

Your Aims

- Explain history of mining in Papua New Guinea (PNG)
- state the government‟s policies applicable to the mining and petroleum industry in Papua New Guinea (PNG)
- Explain mining methods and the mines
- Identify benefits and problems of mining
- Explain development of oil and natural gas

History of Mining in Papua New Guinea

Mining in Papua New Guinean (PNG) occurred in three waves. In 1888, gold was discovered on Sudest Island, Milne Bay Province. This touched off 40 years of small-scale alluvial gold exploitation in the Milne Bay islands and on mainland New Guinea. This usually involved a single European miner and a team of 5 to 15 Papua New Guinean helpers. Underground hard rock mining started in the early 1900s at Woodlark Island and later at Laloki near Port Moresby and Sudest and Misima Islands in Milne Bay.

The second phase was marked by the introduction of large-scale dredging in the Bulolo Valley, Morobe, in 1932 and hard-rock mining at Edie Creek and Wau in Morobe. This required large investments and high technology. It created many jobs for Papua New Guineans, but the profits went to overseas companies. Because there were no roads to Bulolo, the dredges were taken apart at Lae and flown to Bulolo. It was the largest air movement operation in the world at that time. The dredging ended in 1965. The current stage of mining opened with the discovery of huge copper/gold deposits on Bougainville by Conzinc Rio Tinto Australia (CRA) in 1963. CRA began mining in 1972 at Panguna. This was followed by the large Ok Tedi copper/gold mine, which commenced production in 1984. Then Misima in 1989, Porgera in 1990, Tolukuma in 1995, and Lihir in 1997.

Wau-1932

Activity 10.1

(a) Name two early mining towns
   (i)
   (ii)

Activity 10.2
(a) Describe early mining activities in PNG.

_____
_____
_____
_____
_____

Historic events in the mines
Critical events in the third phase, renegotiation of the Bougainville Copper agreement after Bougainville Copper Limited posted the highest profits recorded on the Sydney stock exchange in 1973,

- forced closure of the Bougainville mine in 1989,
- the government‟s forced renegotiation of its equity share in the Porgera mine in 1992,
- armed raids and political interference in alluvial mining at Mt Kare, Enga, in 1994,
- environmental lawsuits against Ok Tedi in 1994 and
- 2001, production peak of 4.5 tones of gold in 2000, when PNG ranked as largest producer in the world,
- changes in laws and the tax regime covering mining.

Ok Tedi- Western Province

Ok Tedi-Western Province

Mining and Mining Policies
First of all, mining is the industry that benefits the nation‟s economic development. However, as minerals are exported, there are fewer resources for future use. Mine closures greatly affect the lives of people in those areas. Minerals are non-renewable resources.

Mining is the extraction and processing of valuable metals from the ground. It has been a major industry and source of income in PNG for a century, but particularly since the Bougainville Copper mine at Panguna opened in 1972. Growth in large – scale mining has slowed down, and there has been a drop-off in exploration. By 2003, one of the 5 major mines had dug up most of its mineral resources. However, the government offered new tax incentives in 2003, and several new mining developments were expected to start. The slow-down has not affected alluvial mining as–small scale mining, which is practiced by an estimated 50 000 Papua New Guineans. Companies require licenses to exploit natural resources and activities are monitored by the government. Local people complain when they feel that rewards for themselves and the nation are inadequate.

Under PNG law, the national government owns all the marine resources and minerals in the ground and water.

- It issues permits for exploration and development.
- It organises transfer arrangements for landowner equity share ownership) and royalties from mines.
- Mining companies must offer to sell the government up to 25 percent
- Landowners and affected local government are a party to the project negotiation through a Development Forum.
- The mining company also agrees to compensate affected landowners for use of land and loss of resources, waste rock disposal sites, environmental issues, and village relocations.

Underwater mining Tests were underway in 2004 on what could be the world‟s first undersea mining venture. It would be offshore on the east and west sides of central New Ireland. There are rich beds of copper and zinc in 1.6 km below sea level. Nautilus Minerals Corporation is testing various equipment and techniques used in the offshore oil industry. It needs to use remote operating vehicles (ROVs) to scrape up the minerals, which would be broken up and pumped to the surface. The ore would be moved with very little waste rock – an environmental plus.

Mineral Mining

About 50 000 Papua New Guineans are involved in small-scale mining of numbered and other surface areas in most provinces. They produce over K100 million worth of gold and silver each year, government official‟s estimate. The Wau/Bulolo area of Morobe and East Sepik each have about 15 000 alluvial miners. Most alluvial miners worked with simple tools-shovels, pans and sluice boxes to sort gold from sand and gravel. A few use bigger devices, including bulldozers. An alluvial gold rush at Mt Kare in Enga in 1988 produced an estimated K60 million worth of gold in its first 7 months.

Water mining or panning

In 2002, almost 60 000 ounces of gold and 25 000 ounces of silver from alluvial miners was formally exported. However, observers believe half the alluvial production is sold informally.

Activity 10.3

(a) List two ways in which mining affects landowners.

(i)

(ii)

Activity 10.4

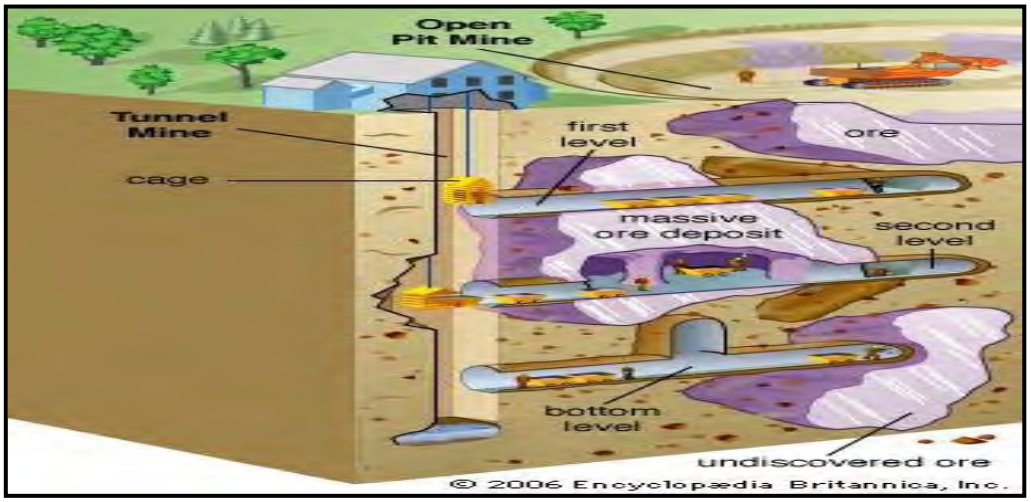
(b) Name two benefits that mining brings to an area.

(i)

(ii)

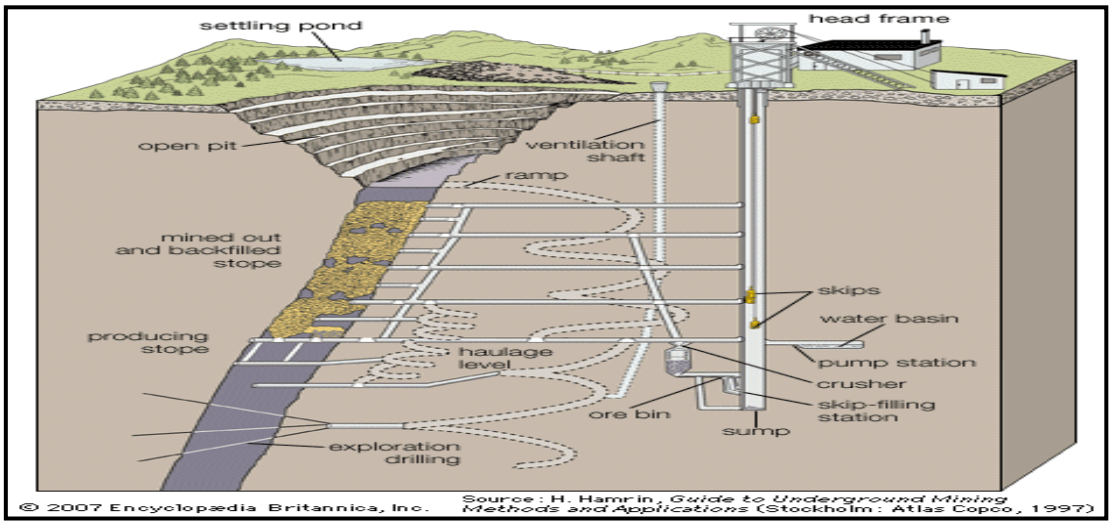
Mining Methods and the Mines

Most of PNG‟s mines are open pits (huge holes in the ground). They are dug deeper and deeper until all the valuable ore (metal-bearing rock) is removed. The rock is blasted apart with explosives. Big trucks carry the ore to a processing plant where it is ground to powder. Then metals are separated from the powder using water and chemicals.



Open pit mine

Some mines take ore from underground tunnels. Alluvial miners use either machines or hand-operated equipment to find gold on surface rocks and river gravels. By law, only Papua New Guinean citizens may hold alluvial mining leases.



Underground mine

Mines in Papua New Guinea

Lihir, located on a volcanic island east of New Ireland, it is one of the world‟s largest gold ore bodies that can be mined from an open pit at the surface. Production began

in 1997. Tailings are disposed of in the deep sea. The mine is owned by Lihir Gold Ltd. It is operated by Lihir Management Company, a subsidiary of Rio Tinto. Mining is expected to continue after 2014.

Misima, Placer Niugini began operating this open-pit gold and silver mine in 1989. It is mining on Misima in the 1930‟s and 40s. The ore is rich in sliver and contains gold too. Tailings are disposed of in the deep sea. Placer Dome owns 80 percent of the mine.

Open-pit mining Ok Tedi, began in 1984 at Mt Fubilan in the Star Mountains of Western Province, It was the world‟s third most productive gold mine in 1987, when output averaged 60 to 70kg a day. Ore was processed into near pure gold at the site. Now copper/gold concentrate is mixed with water and sent thought a 160-km pipeline to Kuinga on the Fly River, where it is dried and shipped overseas. The mine is operated by Ok Tedi Mining Ltd (OTMIL). In 2001, the majority owner, BHP Billiton withdrew and put its 52 percent ownership share into a trust company for the benefits of Western Province 12.5 percent, and local landowners 2.5 percent.

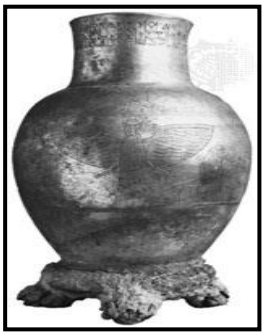
Porgera, Production at this gold and sliver mine began in 1990, just in time to rescue PNG from economic disruption caused by the shutdown at Panguna. Porgera is in mountainous central Enga Province. It was the third largest gold produced in the world in 1992. Both underground and open-pit mines are involved. Development problems included the long distances from supply sources, waste disposal, and mineral forms that are difficult to releases from their ore. An expensive processing scheme is used. The mine is operated by the Porgera Joint Venture: Placer Dome (75 percent), Durban Roodeport Deep (20 percent), and Porgera landowners and Enga provincial government (5 percent). Mining is expected to continue until 2008, milling until 2011.

Tolukuma: Open-pit mining began in 1995, underground production in 1998 at this high grade gold and silver mine near Fane, in the Goilala district of the Central Province. It is owned by Durban Roodeport Deep.

Charactertics of Valuable Metals

Gold is a heavy, soft, yellow precious metal that is used in jewellery, coins, electronics, and in metal alloys. ***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, silverware, and electrical and electronics industries. **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). **Nickel** is a rust-resistant grey metal used in alloys (stainless steel), batteries, plating, and coins. **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 vanishes.



Sample Minerals: Gold, Copper, Diamond, Silver

Benefits and Problems

Large-scale mining has given PNG many benefits:

- tax money for national, provincial, and local governments;
- compensation and royalty for landowners;
- shares of mine ownership for landowners and governments;
- jobs and the chance for workers to gain technical and professional skills,
- contracts for PNG companies,
- and improved education and health are services for the mine communities.

The life expectancy has increased substantially in mining areas.

But large-scale mines have caused some environmental damage and increased social problems such as unwanted immigrants, gambling, and prostitution and disruption of traditional ways. There is concern that younger people in mine areas are not learning subsistence skills that they will need when the mines shut down.

The most controversial effect has been flooding downstream from the Ok Tedi mine in Western Province. It is caused by tailings and waste rock from the mine operation. Tailings are the finely ground matter left over after the mineralized rock (ore) is crushed to power in the mine‟s mill. They also contain trace chemicals from the milling process. Waste rock ore. These sediments raised the riverbed. This has caused problems in the flatlands of the lower Ok Tedi River and lesser problems farther downstream in the Fly River. Problems include increased flooding, destruction of riverbank gardens, sago stands, and other plant life; and a big drop in the number of fish in the Ok Tedi River. Landowners filed lawsuits in 1994 and 2000.

The mine settled with them by agreeing to pay annual compensation and to dredge the lower Ok Tedi to reduce flooding and keep it open for water transportation. The Porgera mine has not had such serious problems because it produces fewer sediments. Island minces typically dispose of their waste deep in the sea.

Heavy flooding due to mining activities

Explorations

Among the best undeveloped prospects are:

(1) Kainautu, Eastern Highlands
A small, high-grade ore body with an estimated 502 000 ounces of recoverable gold. Rights are owned by Highlands Pacific Limited. A mining lease has been granted for an underground operation. First production started in early 2005. Estimated mine life: 4.5 years.

(2) Enga
A larger gold and silver prospect at Mt. Kare. Rights are owned by Madison Enterprises (65 per cent), Matu Mining (25 per cent) and Mt Kare Landowners (10 percent).

(3) Madang
Ramu nickel and cobalt ore body near the Ramu River. An estimated mine life of 40 years. Rights are owned by joint venture between Highlands Pacific (68.5 per cent) and MRDC (31.5 per cent). A special mining lease has been issued and agreement reached on benefit distribution for landowners, provincial, and local-level government.

(4) Morobe
Hidden Valley near Wau. A gold and silver prospect. Rights and owned by Abelle Ltd (100 per cent).

(5) New Ireland
Simberi. Estimated reserves of 750 000 ounces of gold. Rights are owned by Nord Pacific.

(6) Sandaun
Frieda/Nena copper and gold prospect. Rights are owned by Highlands Pacific (88 per cent) OMRD Frieda Ltd (12 per cent).

The consequences of mining activities affect natural, built and social environments. Mining directly disturbs the land in reshaping its surface with pits and roads. Mine also destroy natural habitats.

Very well, so far we have read and talked a lot about mining in Papua New Guinea.

Now we will have a closer look and study into „Oil and Natural Gas".

Oil Ridge

Background

Oil and natural gas are the remains of tiny sea animals which have been changed into liquid by heat and pressure during millions of years of being buried far underground. Occasionally, small amounts reach the surface. The Huli people of Hela have traditionally used oil from such places to beautify their skin and hair and as a treatment for wounds and infections. However, most oil and natural gas is trapped under caps of solid rock. Exploration has been going on in Papua New Guinea since the early 1900s, but commercial development did not happen because the biggest deposits are in remote, mountain areas. The first commercial oil resource was discovered at Iagifu in the Southern Highlands in 1986. Historically, wells were drilled thousands of meters down through the rock. Once oil or natural gas waves found, it took a network of many wells to learn whether the supply was big enough to make its development profitable. The structure of rocks and possible petroleum resources underlying an area is determined by setting off shock waves and then measuring the signals reflected from underground with electronic devices. On land, the shock waves are created by explosives or by vibrators mounted on trucks. At sea, they are created by air guns.

Oil and Natural Gas

PNG has oil and large movements of natural gas deep in the ground – particularly along the southern slopes of the mountain ranges in Southern Highlands, Hela and Gulf Provinces. Commercial development of this natural resource began in the early 1990s after some 80 years of exploration. In July 1992, the first tanker full of „Kutubu light crude oil left the Gulf of Papua. It had passed through a 266-km pipeline to a loading platform called Kumul Terminal, 40 km seashore from the Kikori River. The first oil field of Iagifu/Hedinia, south of Lake Kutubu, SHP,reached its peak production in 1994. Other oil fields have opened in the region since then. In 2002, oil shipments were valued at K431 200 000.

Development

There are three (3) oil projects, Kutubu, Gobe, and Moran and one gas project at Hides. But there are many undeveloped gas fields, with estimated reserves of 15 trillions cubic feet. A proposed Highlands Gas Project would process natural gas so that the liquids are removed for sale and the remaining dry gas is exported through a pipeline to Australia. An oil refinery at Napa Napa, NCD, became fully operational in

2004. It will turn crude oil into petrol, diesel, naphtha, and kerosene – saving PNG huge amounts of money that has been spent to import these products in the past. Any surplus will be exported.

Kutubu oil fields at Agogo, Hedinia, and Kutubu produced 7 800 000 barrels. The Hides gas field southwest of Tari, Hela Province, provides fuel for generators that make electricity for the Porgera mine in neighboring Enga. The natural gas is run through a high-pressure treatment to make it usable as a fuel. The electricity is carried on overhead wires for 70 km.

Activity 10.4 True or False

(a) What do you get,

(i) From ➡ crude oil ➡ fuel _____.

(ii) From ➡ natural gas ➡ liquefied natural gas _____

(b) Describe open pit mining method

_____
_____
_____
_____
_____

Chevron Niugini, as American company, developed PNG‟s oil projects. It sold its share to Oil Search in 2003. Oil Search has been involved in petroleum prospecting in PNG since 1929. In 2001 it merged with Orogen Minerals Ltd, a company that held the government‟s shares in mining and petroleum companies. Oil search now owns half of the gas and oil resources discovered so far. It owns over half of the production. It has 37 per cent ownership of the proposed Highlands Gas Project. There are other, smaller companies in the industry. As of June 2003, the national and local governments had received about K5.24 billion in taxes and royalties from oil production. In addition to this the national government receives customs duties and personal income taxes from employees and returns from part ownership of the projects. The local communities are equity holders in the oil projects and benefit from royalties. Employment, business development, training, and improved social services and infrastructure are the main benefits for the people.

The Chevron Niugini joint venture set up an independent Non-Government Organisation called Community Development Initiatives Foundation (CDI) to promote sustainable Development; support and assist primary health care providers and agricultural development; and manage social services and impacts in the oilfields and other parts of Papua New Guinea.

Polluted river

Exploration

Most exploration has been on the southern slopes of the Highlands from Western to Central, the Gulf of Papua, Sandaun, and East Sepik Provinces. Scientists also believed there could be oil and gas along the coast and offshore in Oro; Cape Vogel to Muyua Island, MBP; New Irelands‟ east coast and water;s and Bougainville‟s west coast waters.

Summary

In this lesson, you have learnt that;

- Mining is the extraction and processing of valuable metals from the ground.
- Companies require licenses to exploit natural resources and activities are monitored by the Government
- Most of PNG‟s mines are open pits (huge hole in the ground).
- Mining in PNG occurred in three waves.

(i) A small-scale alluvial gold exploitation started in 1888 in the Milne Bay islands

(ii) Introduction of large-scale dredging in the Bulolo Valley, Morobe in 1932.

(iii) Discovery of huge given PNG many benefits and problems.

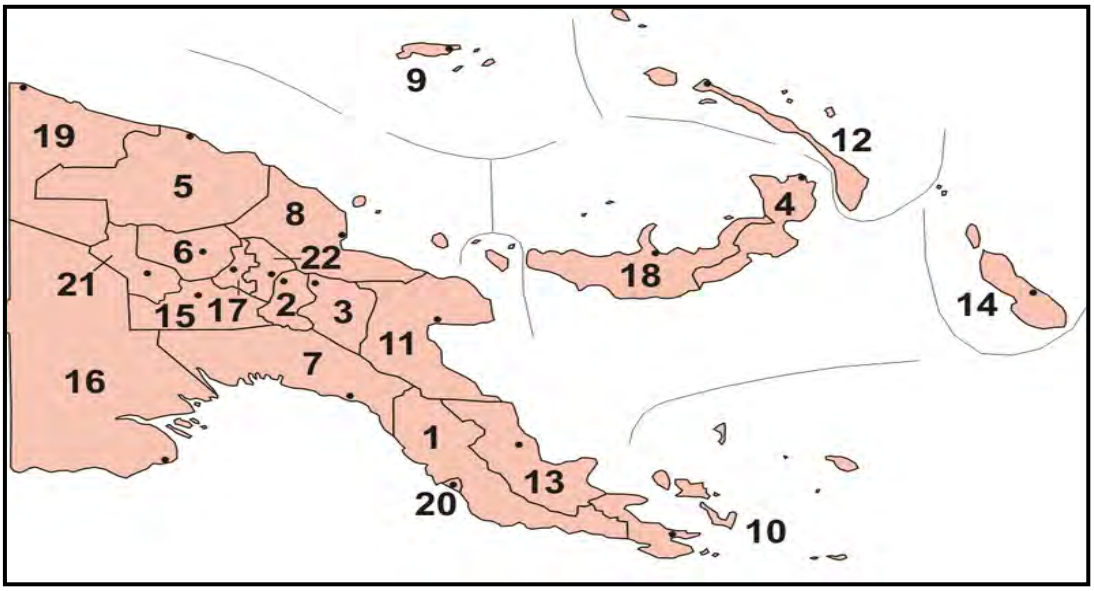
- Oil and natural gas are the remains of tiny sea animals which have been changed into liquid by heat and pressure during millions of years of being buried underground.
- There are 3 oil projects – Kutubu, Gobe, and Moran and there is one gas project at Hides.

END OF LESSON 10. NOW DO PRACTICE EXERCISE 10 ON THE NEXT PAGE

Practice Exercise 10

1. In the map below you are to slot in these mining places in correct provinces by putting an asterisk (*).

   Lihir, Misima, Ok Tedi, Porgera, Tolukuma.



2. Match the metals below to their descriptions by writing the word on the space next to the description.

   Metals: Gold , Silver, Copper Nickel and Cobalt.

(a). _____ is heavy, good conductor of heat and electricity and used in photography.
(b). _____ is hard, grey and used in the production of paints/ink
(c). _____ used in electrical equipment, reddish brown and a good conductor,
(d). _____ heavy, soft and used in jewelry
(e). _____ rust resistant and used in coins.

3. List down two benefits (advantages) and problems 2 (disadvantages) of mining.

   Benefits:

   _____

   _____

   _____

   Problems:

   _____

   _____

   _____

4. Where do you think these new mining exploration sites of undeveloped projects are? Name the province.
   (a). Mt. Kare_____
   (b). Ramu nickel_____
   (c). Simberi_____
   (d). Frieda/Nena_____
   (e). Kainantu _____
   (f). Hidden Valley_____
   (g). Wafi _____

5. Where did the first commercial oil resources open in 1986? Name the place or province.
   _____

6. How many oil fields do the 3 oil projects of Kutubu, Gobe and Moran have?

a. Kutubu _____
b. Gobe _____
c. Moran _____

7. Explain how the oil and natural gas have developed.
_____
_____
_____

8. Use the PNG Imports and Exports table – 2000, and answer the following questions.

PNG Imports and Exports table – 2000

No	Country	Exports	Imports
1	Australia	52%	56.2%
2	Japan	10.6%	4.4%
3	United States	4.4%	15.1%
4	China	5.1%	1.1%
5	South Korea	5.2%	0.5%
6	Singapore	2.5%	5.8%
7	Germany	4.8%	0.2%
8	United Kingdom	4.1%	0.9%
9	Others	11.4%	15.9%

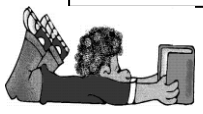
Figures from 2000 - PNG fact Book

a. How much did the country spend on goods and services from Japan?
   _____

b. Which country imported the least from Papua New Guinea ?
   _____

c. What is the difference of the total imports and total exports between Australia and Papua New Guinea?
   _____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND 2



Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 10.

Supplementary Reading 12: Fish and Crocodile Farming

Fish and crocodiles are important in Melanesian cultures. They provide sources of protein and income for people who live along seashores, rivers and lakes. Fishermen and crocodile hunters spend much of their time trying to catch as many fish and crocodiles as possible to meet the protein demand. Such practices can be changed if farmers manage fish and crocodiles in much the same way as they manage chickens and ducks.

Fish Farming

Fish meat is the cheapest animal protein because its production cost is low. It is also more easily digested than beef, mutton and poultry. As a result, there is always a high and steady demand for fish.

The idea of fish farming in PNG came from expatriate companies which recognized the profitability of raising fish in pond and dammed rivers and harvesting them for sale.

Fish that is in excess, or remains unsold, can be salted or dried. Salted fish can be kept or stored for a long time. The unsold fish can also be converted to fish meal. This is done by drying and then grinding the fish. Fish meal has a high protein content and large amount of minerals such as calcium and phosphorus and vitamin B complex. It is an important ingredient in the ration given to young pigs, calves, chickens and ducks. Fish meal is also converted into an emulsion and used as a fertilizer for many horticultural plants as it is a good source of nitrogen and phosphorus.

Fish provide a good source of income when they reach a marketable size. This is usually when they are six to twelve months old. A good fish farm should yield about 3 tonnes per hectare (3 t/ha) per six months.

Selecting a site for a fish pond

The first step in starting a fish pond is selecting a suitable site. Labor and money are required for digging a pond. Therefore care must be taken when selecting the site.

It would be good to consult a local fisheries officer to provide some scientific and managerial information before building a fish pond. A farmer must take into account the following factors when constructing a pond:

* water
* soil type
* land slope
* freedom from pollution
* freedom from floods

Water

Fish take their oxygen and food from water and the pond therefore must be sited near a good water source. This can be a river, creek, stream, an underground spring or a lake which never runs dry.

Soil type
Soil must be able to hold water nutrients.
A clay soil is good because clay particles will expand and not allow water to seep through. A mixture of sandy and clay soil is also good, provided more clay is added to the bottom and the sides of the pond. A sandy soil alone is not suitable because it will not hold a lot of water and the pond may dry up during the dry season.

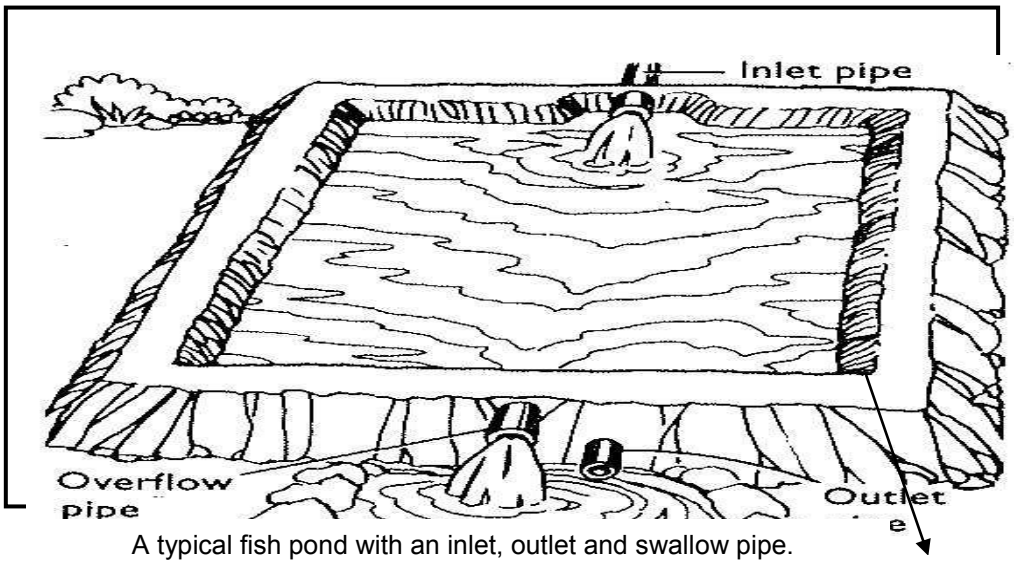
Land slope
The proposed fish pond should be at the lowest points of the slope because this is when all the drainage water will to flow and accumulate. Lowland soil is usually badly drained and waterlogged.

Free from Pollution
The water flowing into the pond must be free of chemicals from factories or areas sprayed with chemicals such as DDT and grammoxone. Ponds polluted with chemicals will poison the fish, use up the oxygen in the pond water and prevent fish from breeding. These chemicals are very toxic to fish when present even in small quantities.

Free from Floods
The Site should be free from floods during the rainy season. Low-lying areas which experience heavy flooding should be avoided. The floods and great rushes of water will damage the bunds of the fish pond and allow the fish to escape.

Types and Contruction of Fish Pond
There are two types of fish pond: the production pond and the nursery pond. The production pond and the nursery pond. The production pond is used to raise fish to adult size whereas the nursery pond is used to raise very young fish, called fry.

The size of the pond will depend on the number of fish a farmer wishes to keep. The shape of the fish pond should be rectangular because such a shape has been found to be more useful and convenient when using fishing nets during harvest. The recommended minimum size of production pond is 12.5 m x 8 x and should be 1.25 m deep, while 11.25 m x 7.2 m with a depth of 50 to 80 cm is recommended for the nursery pond.



A typical fish pond with an inlet, outlet and swallow pipe.

The fish pond should have aninlet pipe line carrying water into the pond and an outlet pipe to drain out the water. The outlet pipe is also used to harvest the fish, to dry the pond and to allow any excess water to flow out of the pond.

The inlet pipe should be placed in a sloped direction, higher than the outlet or overflow pipe. The inlet and overflow pipes should be screened with fine wire-mesh netting such as fly wire or nylon cloth. This will prevent unwanted fish from entering and the farmer"s fish from escaping. The outlet pipe should be plugged with sticky clay to prevent water from draining out. When it is necessary to harvest or check the fish for disease, the clay can be removed.

The slope of the bunds all around the fish pond should be about 45 degrees. This will prevent the bunds from crumbling. If the slope of the bund is too steep, the bunds will be unstable and erosion down the slope will be greater. After some time, such steep bunds will crumble. To make the bunds strong, grass should be planted along the surface of the bunds and on the slopes above the level.

Liming and fertilizing the fish pond.
It is important to lime the soil at the bottom of the pond. Lime decreases the acidity of the soil and pond water. The pH of the water should not be too high or too low. The p H of pond water should be between pH 7 and 8. The “p” stands for potential and the “H” stands for Hydrogen. A scientific explanation is that pH refers to the plant"s ability to attract hydrogen ions. A less scientific explanation says pH is the acid/alkaline balance. This favors the growth of the fish in the pond. A fisheries officer can be called to check the acidity of pond water.

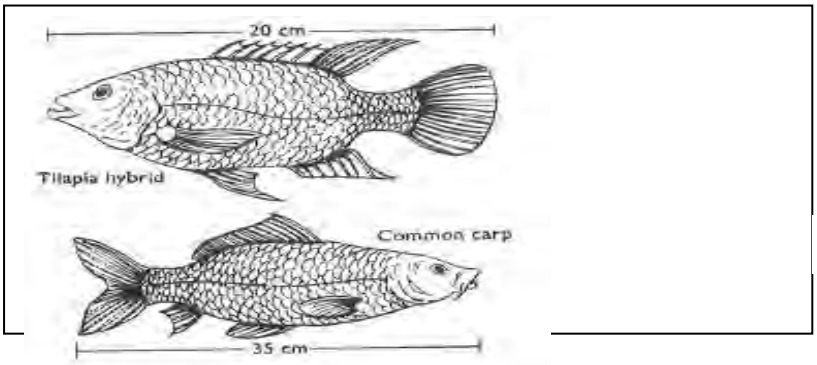
The types of liming materials used in fish farming are:

- limestone, Ca CO3
- slaked lime, Ca (OH)2
- quicklime, CaO

Limestone is applied at 2.5 t/ha, slaked lime at 1.85 t/ha and quicklime at 1.4 t/ha. Limestone is only used when there is fish in the pond. When there is no fish in the pond, quicklime and slaked lime can be used. The liming material can be hand-scattered, and if the pond is big the use of a boat may be necessary.

When the pond is drained and empty, it can be limed with quicklime and slaked lime. These liming materials possess disinfecting properties due to the heat created when they react with water in the wet soil and carbon dioxide in the air. The pond, therefore, should not be stocked with fish for at least two weeks after the application of quicklime or slaked lime.

Two types of fertilizer used in fish ponds are organic and inorganic. Organic fertilizers are of plant and animal origin. Examples of organic fertilizer are cow manure, pig manure, poultry manure and compost. Urea, super phosphate and NPK fertilizers are examples of inorganic fertilizer. These fertilizers are made by man.



Tilapia- a common carp fish.

It is best to use organic fertilizers because these fertilizers are cheaper. Organic fertilizers can be applied to the pond at the rate of 500 to 1500 kg/ha after liming the pond and before filling the pond with water. If inorganic fertilizers are used, apply 100 to 150 kg/ha. These amounts are sufficient to maintain the fertility of the pond for one crop of fish.

Types of fish to keep
The common types of fish that are good for pond water farming are Carp and Tilapia. These fish breed well in most PNG conditions and increase in population in a very short time.

Fresh water fish
A farmer can obtain fresh-water fish from the nearest fisheries section of the DPI in a town or province. The fisheries officer will accept an order for the young fish.

The fisheries officer will provide a bag with correct number of fish in it. The bag of young fish must be immediately taken to the pond. Hang the bag of fish in the pong water for about one hour so that the water in the bag can come to the same temperature as the pond water. After one hour, open the bag of fish in the pond water and allow them to swim out. Do not tip the bag as this might injure the fish.

Feeding Fish
Fish do well on the natural food which is produced in the pond. The best way to make the fish grow quickly is to fertilize the pond so that it can produce enough natural food.

Other food can be given to the fish to make them grow quickly. This food can be cooked sweet potato, soya bean, peanuts, rice bran or chopped trash fish, intestinal parts from other animals and vegetables. Fish food can also be bought in an agricultural store although it is expensive. Ask the fisheries officer to help with the purchasing or ordering of fish food.

The Pond

Always feed the fish at the same time and from the same spot. To prevent food being left over in the pond, give only the amount that the fish can eat. Therefore, measure the feed at about 2 to 5 percent of the body weight of the fish per day. For example, 100 young fish weighing 5 g each, at the total weight of 500 g, should receive 5 per cent of the 500 g, that is 25 g of total feed per day.

Care of pond and fish

Make sure the pond is kept in good condition. This is done by checking out the following at the same time each day (early morning is the best time for checking).

- keep the entrances of the inlet and the overflow pipes covered with fly wire or nylon cloth.
- fertilize the pond if necessary
- check to see that the pond is not leaking; if it is leaking, close the leaking part with sticky clay
- remove unwanted floating materials or plants such as salvinia weed
- feed the fish if necessary
- watch for signs of any disease
- six months after putting the fish in the production pond, collect the young fish (fry) and transfer them to the nursery pond. Collection of fry should be done every three months.

Common disease of fish

Pond fish may be infected by diseases. Some of the factors which may lead to a disease outbreak in the pond are:

- too many fish in the pond, creating conditions suitable for the development of parasites
- rough handling of the fish during their release into the pond which causes injury and infection of wounds.
- poor management of the fish pond causing nutrient deficiency and loss of vigour in the fish; (weakened fish are more susceptible to disease and infection)
- disease brought into the pond by carriers, such as diseased fish
- eating birds flying from one pond to another.

Diseased fish normally have the following symptoms:

- abnormal behaviour such as swimming sluggishly and away from the shoal (a group of fish swimming together)
- they stay at the water surface for a long time , and lie on their sides at the water surface
- they show signs of swelling with sores and reddening of infected parts
    - they may have external parasites such as fish lice and leeches.

COMMON FISH DISEASES

Disease	Description and prevention
Gill- rot	The most serious and widespread fungal disease of pond fish is common during hot seasons and when there is excessive organic matter in the pond. Fish with this disease show red flecks on the gill filaments, which later become white and are destroyed. The fish gasps for air at the surface of the water and dies. To prevent this disease, add cool water to the pond during the hot season as well as limestone (05 t/ha) to settle any suspended organic particles.
White spot	This disease is caused by a protozoon which attacks the fish on the fins, gills and skin and produces white spots. Fish swim sluggishly and lose their appetite which leads to death.
Argulus infection	This is caused by the parasitic fish – louse known as Argulus. The fish-louse sticks to the body of the fish and sucks blood from it. The sores caused by fish-louse are often infected by other fungi. The fish-louse weakens and eventually kills the fish. The infected fish can be treated by placing it in potassium permanganate solution (1 g per 1000 liters of water) for thirty minutes or for one hour in formalin at 250 parts per million (ppm).
Lernaea infection	This infection is caused by an anchor worm called Learnaea. The worm attacks the gills and other parts of the fish body by burrowing into the tissues of the fish for food. It produces red sores on the fish body and causes the fish to lose weight. The infected fish can be treated by placing it in formalin solution (200 ml per 1000 liters of water) for one hour; alternatively, rub a very strong salt solution onto the infected parts.

Harvesting

Fish are ready to be harvested at six to twelve months. Harvesting should be done every year. Harvesting fish can be done in two ways; by completely draining the pond or with a fishing net.

Draining the water is the best way to harvest fish because all of the required sizes can be collected. Unwanted types of fish can also be removed. To do this, make sure the inlet pipe is closed so that no water flows into the pond. Cover the entrance of the outlet pipe. Open the drainage pipe by removing the clay.

(Put a stick through the pipe from the outside opening of the pipe). When all water has drained out, collect the fish by using a scoop net. Young fish must be put into the nursery pond immediately.

Harvesting can also be done by two people using a net. The net is pulled across the pond with one person holding one end and the second person the other. Once it is set in position, pull the net in a straight line from one end of the pond to the other end. Make sure that the lower part of the net when the end of the pond is reached.

Harvesting fish

After harvesting, sort the fish. This means grouping the fish into different sizes. Small fish should be returned to the pond immediately. The big fish can be eaten by the family, sold fresh, or preserved for later use.

Preserving fish

Harvested fish are preserved by salting and smoking. The method of salting fish is carried out using the following steps:

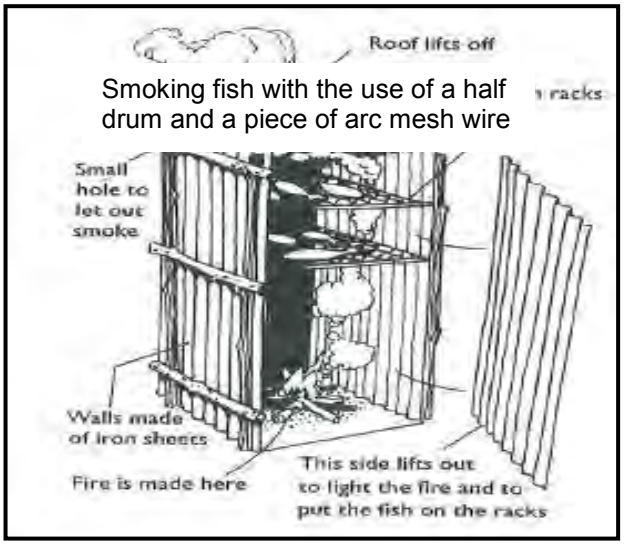
1. Clean the fish by removing the intestines, gills and scales.
2. Split large fish in half from the head to the tail and salt them. Small fish can be salted whole.
3. Make a mixture of salt and water by adding one cup of salt to six cups of water. This mixture is called brine. Soak the fish in brine for ninety minutes. This process will take out blood and other liquid from the fish.
4. Take the fish from the brine and drain the liquid. This can be done by hanging each piece on a rack without the pieces touching.
5. Measure out the proportion of salt to fish to be rubbed onto the fish (1 gram of salt is needed to salt 3 grams of fish).
6. Use a container with holes at the bottom and put the first layer of fish skin down on its side and then put the salt over it. Continue to put salt between each layer of fish. When the last layer is reached, place the skin side-up and put salt over it.
7. Cover the container with a lid and keep it off the ground in a cool dry place where there is good air circulation.
8. After two to seven days take the fish out of the container and wash them in a brine mixture of three cups of salt to 1.5 litres of water.
9. Dry the fish on a flat surface under the direct sunlight for a few days or air dry them by hanging them, head up, on a line for a week. Do not allow the fish to get wet.

10. Keep the dried salted fish in a container in a dry place. When using the salted fish, soak them first in water for about twelve hours. Soaking is done to remove some salt from the fish. Change the water at least once during this twelve-hour period before cooking.

Smoking fish is a traditional method of preservation. Smoking does three things to the fish: it dries it, and allows it to be preserved for a long time.

Smoking fish over the fire

The simplest way of smoking fish is hot smoking. This is done by using a household stove or fire place. Hot smoking requires a tray and half a 200 litre or 44 gallon drum to make a hot oven If a tray is unavailable, use a strong piece of mesh wire or pieces of stick . A small smoke house may also be built.



Smoking fish with the use of a half drum and a piece of arc mesh wire

Smoking House

Sometimes fish are not well preserved.. These fish are not good for human consumption or marketing. They can however, be fed to animals by grinding them into powder and then mixing this powder with other food such as cooked rice, sweet potato, taro or cassava. It can be fed to pigs, chicken, ducks or even fish.

Marketing

Fish can be sold fresh or preserved (salted and smoked). Fish which are to be sold live must be transported in a container of water. The container should be shaded to keep it cool so that the fish are alive until they are sold. Fresh fish can also be frozen in deep coolers for transportation or later use. Fish which have been salted and dried or smoked can be sold directly to buyers.

Lesson 11: Resource Projects in Papua New Guinea

Introduction

Welcome to lesson 11. This time we are going to look at the issue of Resource Projects in Papua New Guinea.

Your Aims

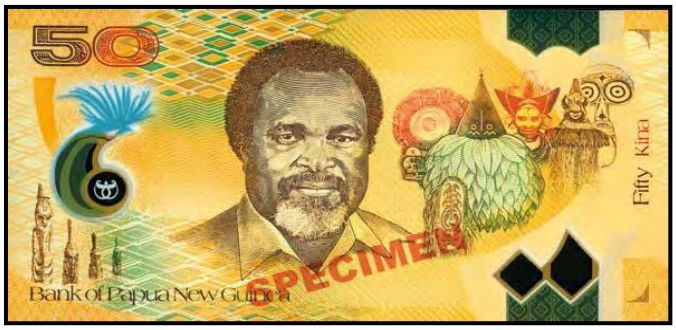
- Identify some resources projects in PNG and where they are
- Tell the impact of each resources project on the local environment.
- Research on a projects compliance to the environmental policies

Resources

Anything that can be used to create wealth or make life better is known as resources. Food crops, cash crops, animals, forest and minerals are all land resources. Water resources come from rain, dams, tanks, wells, oceans, rivers, coral reefs, lakes, and wetlands swamps.

Importance of Resources

Resources are important for physiological, monetary, aesthetic and ecological purposes. Physiology refers to the body. Physiological resources are things that we need for a healthy body:



Money

- Air,
- water,
- food along with the materials we use for clothing's and shelter, are examples of physiological resources.
- Monetary resources are things we can sell, or can make into something to sell in order to get a cash income.
- Aesthetic resources are artistic things we use to beautify the environment, our home,and ourselves.
- Ecology refers to the relationship of plants and animals to their physical and biological environment.

Resource Projects

Having looked at the resources mentioned.
The government has come up with various projects as Resource Projects. Projects refer to a plan of doing something, task or planned program of work that requires a large amount of time, effort, finances and planning to complete.

Therefore, resource projects are projects set to;

- generate income for the country and province
- cater for employment
- help sustain resources

Most of these resource projects are set up and monitored by the government for the good for every individual citizen of Papua New Guinea. Therefore, there are various resources projects supported by the government and resources landowners.

Activity 11.1

(a) Name three resource projects in the country. State where each are located.

(i)
(ii)
(iii)

(b) Logging is a resource project in many parts of PNG. List two disadvantages of logging.

(i)
(ii)

Activity 11.2

(a) How do the landowners benefit from project resources?

_____
_____
_____
_____
_____

(c) If you were a landowner of a large forest just about to be harvested. How can you be different from all the other resource land owners.

_____
_____
_____
_____
_____

Impact of each Resource Projects on the Local Environment

All the resource projects carried out in the country, have advantages and disadvantages. Here, we are going to look at some resource projects and the impacts they have on the local environments.

Logging

As we have looked at in lesson 8, logging activities destroy the environment as well as biological life in the soil is destroyed and this leads to an imbalance of soil organisms. This will result in poor soil and landslides will become common, and occur regularly.

Loggers at work

Government and the landowners are paid royalties, logging site community have an aid post, these are some examples of good things that a company may set.

Mining

Mining is the extraction and processing of valuable metals from the ground. Thought some mining's companies have been issued licenses they still operate in some ways contradictory to the mining guidelines set by the government. Therefore the, influx of unwanted immigrants, gambling, and disruption of traditional ways are some of the mining impacts to the local environment. Compensation and royalty for landowner, jobs offered to people are few good things provided.

Miners at work

Oil and Gas

Government receives tax, landowners compensated and jobs opportunities given are some of the positive impacts of oil and gas industry. Whereas, the clearance of the forest, deposits are in remote mountain areas and lives are at risk. These are examples of consequences faced in such an industry.

Oil and gas setup

Report: Mine affecting refugees

Environmental damage caused by copper mining has affected thousands of refugees from the Indonesian Province of West Papua, according to the UN refugee agency (UNHCR) and non – governmental organisations.

The refugees have not received any support from Papua New Guinea or the mining companies, they said.

Some of the border settlements of West Papua refugees have become severely affected by flooding associated with sediment build up in the rivers due to the Ok Tedi mine, " Ben Farrel, a regional UNHCR spokesperson said,

A recent statement from Ok Tedi Development Foundation said the company was mindful of the health of people living within its area of operation. It said it was fully committed to improving the primary health care and health standards.

The western half of New Guinea, West Papua is an Indonesian province where separatists have fought for independence for decades.

At least 1,500 West Papuans refugees lived along – the second longest river running through the half island nation's Western Province.

They have been affected by ongoing flood damages, according to Wren Chadwick, the former advocacy and information officer for Jesuit Refugees Service based in Port Moresby.

"Flooding has destroyed food gardens and sago palms, the traditional food staple, forcing people into the jungle to wait out the flood so they can access food sources" Chadwick said. ***From: Mon, Nov 12, 2012,***

The National

SUMMARY

In this lesson, you have learnt that;

- Resources are anything useful to make things easier or get cash.
- Forestry, fishing, commercial farming, logging, oil, gas and mining are different resource projects supported by the government and resource landowners.
- Resources provide physiological (body), monetary (money), aesthetic (creative ability) ecological (plants and animals) benefits to the people.
- The National Government manages most resource projects to benefit everyone in the country.
- The development of resources in the country causes a lot of changes – both good and bad.
- The government uses the benefits from the resources to improve the standard of living in the country.

END OF LESSON 11. NOW DO PRACTICE EXERCISE 11 ON THE NEXT PAGE

Practice Exercise 11

1. From all the provinces listed below, list the different types of resources they have;

   Eg; Madang – forestry
   - mining (proposed ones)
   - logging
   - fishing
   - commercial farming

   Morobe –
   New Ireland_
   Southern Highlands-
   Gulf-
   Western Province-

2. What happens to the environment when the following resource projects are in the area? List all the effects they will have. Both the environmentally and not environmentally friendly.

   a). fishing _____
   b). logging _____
   c). mining _____

3. **Case Study**
   Students must do a case study on any Resource Project based in their local area. Use the information below to help with your write up.

   They are to do research and write up about the whole set up of the project,
   - Changes and effects it has on the surrounding environment
   - History of the project
   - Benefit of the project

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND 2

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 11.

Supplementary Reading 13: Glimmer Of Hope

The rain forest of Papua New Guinea is one of the last remaining wilderness areas on the planet, covering over 60% of the country, from the coast to the mountains.

These forests are vital to the livelihood of the mostly rural population, providing them with their food, shelter, medicine and their spiritual and cultural identity.

However, a country–wide proliferation of unsustainable commercial logging (and mining) activity is undermining the environmental fabric on which the cultural, social and economic well–being of the country's rural population depends.

Glimmer of hope

In the Waria Valley, located on the north coast of the Sou of development in th Peninsular in Morobe Province, communities responded to and learnt from recent history.They have rejected logging and opted for an alternative means of development in their area.

The people of the lower Waria Valley have received little benefits where large – scale conventional logging has taken place. The communities have voiced their concerns, and while they are keen to retain control over their resources, they also wanted benefits that these resources could bring.

Local man, Cossey Yosi took on the gauntlet of making this aspiration a reality. While studying in the United Kingdom, he approached a British NGO (Coral Cay Conservation) with a project concept. After much effort and with much support from the Darwin initiative, the Waria Valley people joined forces with a number of partners from PNG and UK. They included development- oriented groups such as Bris Kanda, as well as the University of Technology and the PNG Forest Research Institute in Lae.

The multi- partner collaboration wanted to follow a much less conventional route to development via community – driven forest conservation and alternative livelihood generation.

The first step was to assess the forest biodiversity. Despite the wealth of local knowledge regarding local plant and animal species, virtually nothing has been documented.

The project team undertook the first biodiversity assessment for the area, documenting bats, mammals, birds, butterflies, reptiles and amphibians–within different habitats.

At the same time, vegetation inventories within various forests and non- forest habitats were completed.

While vast areas of primary forest still exist, large areas of floodplain have been lost to 'gardens'.

Patches of forest are cleared for gardens and crops cultivated for a few cycles before being abandoned.

Understanding the impact of land use changes on the forest was priority. Community mapping to document the extent of agricultural conversions was combined with satellite derived date (with the support of the University of PNG).

Forest true value

The habitat maps generated meant local communities could for the first time visualize the spatial value of their forest and see these results of their own impacts at a broader scale.

In addition to a better understanding the forest (and local impacts) communities were keen to improve environmental awareness so that younger generation would not only appreciate the true value of the forests but also have the skills necessary to manage and benefit from them. To this end, a school's educations programme was initiated with additional environmental education materials and teaching aids developed in consultation with local teachers and in conjunction with the existing curricula.

Biodiversity survey training was also undertaken, aimed at developing the skills and ecological knowledge of national students, enhancing their capacity for future research work and employment within the conservation and environment management sector in Papua New Guinea.

Groups of national undergraduate and graduate students receiving field training in biodiversity assessment techniques. In addition, the biodiversity research programme served to build the capacity of local stakeholders through guiding and survey training.

Whilst, preserving the forest trees is important, a key driving force behind the willingness of the local communities to participate in the project was an opportunity for another livelihood.

In conjunction with Bris Kanda, a number of successful sustainable livelihood initiatives were started, including inland aquaculture, poultry and piggery schemes.

These would provide a more regular supply of protein for people and an income for those participating, whilst also lowering the pressure on forest resources (e g, via reduced hunting).

Another major livelihood component of the project was eco – forestry – serving both the ecological and economic goals.

The small-scale use of portable sawmills is seen by many as a way of helping prevent rural communities from turning to commercial logging operations for income from the forest.The establishment of a small–scale saw milling operation was hugely supported by the local communities and seen by many within it as a good source of income.

The project approach Forcert, a PNG based not for profit forest management and certification group, to assist in it's establishment.

Forcert is engaging the communities to make small–scale eco–forestry an economic and ecological reality. All timber would be certified by the forestry Stewardship Council (FSC) and International Trade Fair Association, ensuring the forests are sustain ably managed.

The over–arching goal of the project is to empower local stakeholders to sustain ably benefit from their forest environment. To this end, the communities and partners are in the process of creating a local NGO group.

The NGO will create a body to oversee and assist with the community development project aspects of the project, maintain links with the various project partners and be able to seek funding from within PNG and internationally.

It is hoped the project will strengthen the capacity of local managers, researchers, stewards and other stakeholders in the Waria Valley to protect the forest ecosystem and those who benefit from it.

Whilst the project has achieved successes on many fronts, in research, education, training and livelihoods, the challenge remains–to build on this foundation and ultimately achieve local sustainable development based on benefits derived for local landowners from forest biodiversity.

Lesson 12: Climate Change

Introduction

Welcome to lesson 12. In this lesson, you will learn about climate change and its effects on the physical and cultural environments of the earth. In this lesson;

Your Aims

- Define climate change, carbon emissions and carbon trade
- Identify the causes and effects of climate change
- Identify the roles and responsibilities of the Office of Climate Change and Environmental Sustainability of Papua New Guinea.

Climate Change

The term climate change or *global warming* refers to earth's slowly rising temperature, especially in the last 20 years or so. A major cause of climate change or global warming is air pollution

The changes started hundreds of years ago when people began cutting down forests and burning the wood. The invention of cars and other machines greatly increased the amount of greenhouse gases released into the atmosphere. Such machines burn fuels like wood, coal, oil, and natural gas.

Today, the air contains almost one-third more carbon dioxide than it did in 1750. The amount of methane has doubled.

When these fuels burn, they add carbon dioxide to the atmosphere. Methane comes from coal. This gives off gas in the form of carbon emissions. Papua New Guinea, being a developing country has already encountered problems with pollution.

The Office of Climate Change and Environmental Sustainability (OCCES) is already looking into ways of managing pollution and the related environment effects.

Activity 12.1

In your own words explain climate change.

(a)

_____
_____
_____

(b) Give your opinion. Climate change is only a theory in PNG.

_____
_____
_____
_____

The causes and effects of climate change

Do you like warm weather? Do you wish it could be warmer still? The Earth may be moving in that direction. The trend is called climate change or global warming.

Not all scientists agree that climate change or global warming is happening. Some say it is impossible to know if the climate is changing overall. After all, temperatures vary from day to day and year to year. The warmest days are warmer, the coldest days not as cold. They point out that the ten warmest years of the last century happened after 1980. The three hottest came after 1990. The hottest year on record was 1998.

These scientists say the Earth has warmed up about 1° Fahrenheit (0.6° Celsius) in the last 100 years. The rate of change, they say, is speeding up. A hundred years from now, the Earth may well be as much as ten degrees hotter!

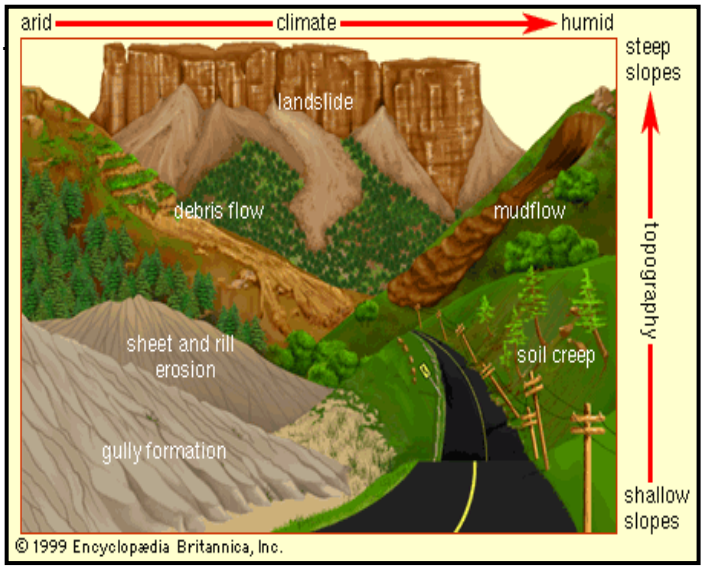
What Causes Climate Change or Global Warming?

Sunlight brings energy to the Earth. This light turns to heat when it hits the ground. The heat in turn leaks away from the Earth, but the atmosphere slows the heat's escape. The atmosphere is a layer of air around the planet. It holds in some of the warmth itself.

The atmosphere is a mixture of many gases. In the last 250 years, this mixture has been changing. The amounts of gases such as methane and carbon dioxide have been rising. These gases trap heat more effectively than other gases. They make the earth's atmosphere act like the glass in a greenhouse. It lets sunlight in, but doesn't let heat out. As a result, heat is building up close to the surface.

What Affects Our Climate

First of all, we look at what climate is. It refers to the conditions of the atmosphere over a longer period of time. When we talk about climate, we are really looking at temperature and rainfall patterns of a place influenced by factors such as distance from the sea and equator, wind patterns and so forth.



Effects of climate change

What is Happening to our Climate

Planet earth's atmosphere is now being affected on a global scale by the addition of gases emitted by industries, power stations and motor vehicles when they burn fossil fuels (oil, gas, coal).

Activity 12.2

(a) Name four significant events that shows that climate change is really happening.

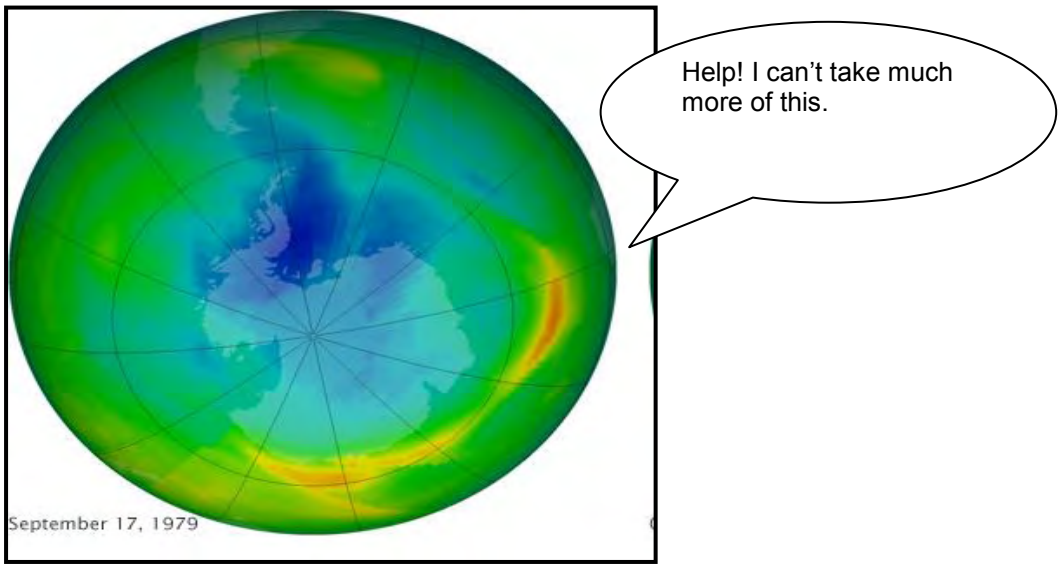
(i)
(ii)
(iii)
(iv)

(b) Is PNG alone in its efforts to manage climate change acitivities.

_____
_____
_____
_____

Climate Change and the Greenhouse Effect

Climate changes are a global geographical issue that has caused great concern since the early 1980's. Climate change happened for thousands of years, with colder periods (interglacial). There has also been variations in rainfall.



Ozone Layer

During the twentieth century, the atmosphere warmed up by about 0.6º Celsius, a trend that is expected to continue. There is growing evidence that the earth's climate is now becoming warmer through the action of humans. Air pollution is producing gases that are trapping the sun's heat in our atmosphere.

The Greenhouse effect is a natural process. The gases in the earth's atmosphere act like the glass of a green house, trapping the sun's warmth. Without the atmosphere, the earth's surface would be about 150º celsius cooler than it is. Water vapor and gases such as carbon dioxide and methane in the atmosphere are responsible for the Greenhouse effect. These Greenhouse gases make up only a small proportion of the atmosphere, so any variation in their amounts could have a critical effect has kept the earth's temperature fairly constant for a very longtime.

Since the Industrial Revolution, and particularly during the second half of the twentieth century, the composition of the earth's atmosphere has changed as a result of global air pollution. Humans have added extra carbon dioxide (CO2) and some

other Greenhouse gases to the air by burning fossils fuels (oil, coal and gas) and by cutting down trees. During the last 200 years or so, the amount of carbon dioxide in the atmosphere has increased by more than 25 percent and the amount of methane by even more. With more gases in the air to trap heat, the earths' temperature is beginning to rise. There is increasing evidence that global warming is taking place even though some scientists still question this.

Effects of Global Warming

Over the next 70 years may changes in the climate would happen that no-one really knows exactly. The changes could include;

- rising sea levels as the polar icecaps melt. This could flood low-lying areas, such as river deltas, coastal cities and low islands. Some scientists believe global warming is responsible for the retreat of glacises in mountain lands and the retreat of Antarctic ice shelves over the past 50 years. When the edge of an ice shelf melts, large pieces of ice break away from the main mass. This accelerates the process.
- More heat waves and droughts, causing more bushfires
- Higher tides and more violent storms
- Wider variation in rainfall and snow
- Increased growth rates of some plants because of higher temperatures and more carbon dioxide for photosynthesis. This may improve crop growth, however, with less rain it may not make a difference.
- The possible extinction of many plants and animals as their habitat changes. For example, animals in mountain lands that rely on cold temperatures may find conditions are too warm for their survival.
- The possibility of bacteria and fungi growing faster in wormer climates increasing the risk of disease
- Increased risk to humans from heat stress and rising pollution levels in cities.

Activity 12.3

Complete the sentence below

(a) Humans give trees carbon dioxide and in return they give us _____.

Responding to Climate Change

Churches to discuss rising sea level

Churches in low–lying Pacific Islands will make plea for assistance at a regional meeting in the Solomon Island next week.

Leaders of Kiribati, Tuvalu, and Marshall Islands Christian groups will ask their counterparts to consider and address the issue of resettlement in the region. At the same time there will be moves to consider resettlement within the threatened atolls.

Maina Talia – Climate Desk Officer of the Ekelesia Kelisiono Tuvalu (Tuvalu Christian Church) – said resettlement must be the second option for island communities threatened by rising sea levels. " As a people we need to pull together and adapt to the changes that are happening around us, he said.

Earlier, New Zealand academic Dr Paul Kench said, climate change affected islands in many different ways. " Islands will disappear in the future but others will grow and others will change profile," Dr Kench said. "People need to know which islands will do what and act accordingly."

Based on this view, some island communities have decided to relocate to areas within their own countries. Kiribati, however, has purchased land in Fiji for planned relocation and agriculture projects when the need arises.

Ekelesia Kelisiano Tuvalu General Secretary, Reverend Semisi Nimo, said regional governments should give people the option to relocate or remain in their home countries.

"Climate change is a priority for the church and people need to be prepared" Rev Nimo said.

A Tuvalu delegation to the PPC General Assembly arrived in Suva Friday en route to Honiara.

The highest point on Tuvalu is five meters above sea level. Meanwhile, the sea is predicted to rise by two meters by the end of the century. Tuvalu and Kiribati are expected to seek support from the general assembly to assist with programs which prepare people for relocation in their communities or to other countries.

What can be done to save Planet Earth

Papua New Guinea is a signatory to International Agreements targeted to reduce carbon emissions. PNG is one of the many South Pacific countries that are facing the effects of human induced climate changes.

The roles and responsibilities of the Office of Climate Change and Environmental Sustainability in Papua New Guinea.

The Office of Climate Change and Environmental Sustainability was established in 2007 to:

- coordinate and lessen the effects of climate change issues,
- achieve environmental sustainability
- help people adapt to climate change
- comply with International Agreements like the Kyoto Protocol

Carbon Trade

The Office of Climate Change and Environmental Sustainability (OCCES) is the government department responsible for all matters related to carbon trading projects. It works closely with PNG National Forest Authority (PNGNFA) and the Department of Environment and Conservation (DEC) as well as other government departments.

Carbon trade falls under the reduction in Emissions by deforest and degradation (REDD) agreed by all nations at the Kyoto Protocol in 1997. It is aimed at reducing the alarming rates of tropical rainforest destruction by paying forest communities not to cut trees and to protect their forests.

In PNG, Carbon Trade may not be able to work too well with landowners because there are no policy framework that may guide benefit sharing and distribution amongst forest owners. It may work well in future when policy frameworks are developed.

Posts of washed away houses- Gabagaba Village

The photograph above shows clearly the climate change and the greenhouse effect. Immersion of coastal areas at high tide is an increasingly common occurrence throughout the Pacific as above in Tagua, Vanuatu.

Summary

In this lesson, you have learnt that;

- Climate change results from emissions of Greenhouse (heat trapping) gases emitted into atmosphere causing global warming.
- Greenhouse gases are carbon dioxide, methane and water vapor.
- Examples of fossil fuels are oil, gas and coal
- The rising global temperature is known as global warming.
- Carbon Trade is a Reducing Emissions by Deforestation and Degradation(REDD). Initiative PNG has taken to address global warming.

END OF LESSON 12. NOW DO PRACTICE EXERCISE 12 ON THE NEXT PAGE

Practice Exercise 12

1. What is the main cause of global warming that is responsible for climate change?

_____

_____

_____

_____

2. List the three Greenhouse gases that causes global warming.

_____

_____

_____

3. Name three effects of global warming PNG and other Pacific Island countries face now.

_____

_____

_____

4. What is the main function of the Office of Climate Changes and Environmental Sustainability in PNG?

_____
_____
_____

5. What is Carbon Trade?

_____
_____
_____
_____
_____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND 2

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 12.

Supplementary Reading 13: The Pacific Islands and the Greenhouse Effect

What is the Greenhouse effect?

There are two meanings of the term "Greenhouse effect". There is a "natural" greenhouse effect that keeps the Earth's climate warm and habitable.

There is also the "man-made" Greenhouse effect, which is the expansion of the earth's natural greenhouse effect by the addition of Greenhouse gases from the burning of fossil fuels.

In order to understand how the Greenhouse effect operates, we need to first understand "i**nfrared radiation"**. Greenhouse gases trap some of the infrared radiation that escapes from the earth, making the earth warmer that it would otherwise be.

You can think of Greenhouse gases as sort of a "blanket" for infrared radiation-- it keeps the lower layers of the atmosphere warmer, and the upper layers colder, than if the greenhouse gases were not there.

About 80-90% of the earth's natural greenhouse effect is due to water vapor, a strong greenhouse gas. The remainder is due to carbon dioxide, methane, and a few other minor gases.

It is the carbon dioxide concentration that is increasing, due to the burning of fossil fuels (as well as from some rainforest burning). This is the man-made portion of the greenhouse effect, and it is responsible for the global warming of the last 150 years.

Also, the concentration of methane, although small, has also increased in recent decades. The reasons for this increase, though, are uncertain.

Interesting facts:
Does the Greenhouse effect even exist?
The Greenhouse warming of the Earth's surface is believed by some people to be physically impossible. They claim it would violate the 2nd Law of Thermodynamics, which basically states that energy must flow from where there is more to where there is less.

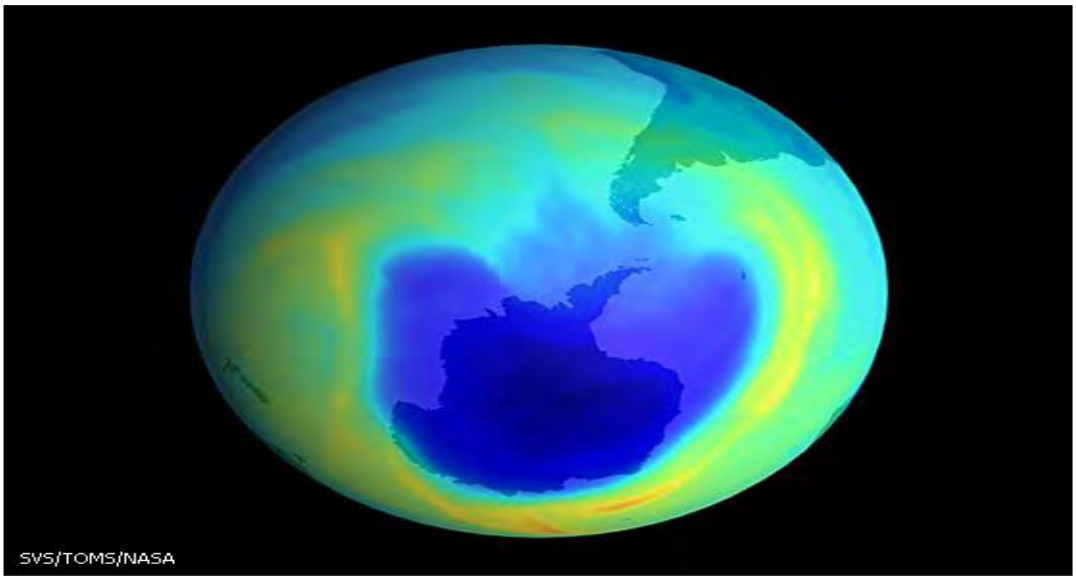
The reason for this apparent violation is that the existence of Greenhouse gases in the colder layers of the atmosphere makes the surface warmer, which would suggest energy flow from colder to warmer areas, which would seem to violate the 2nd Law. But the Greenhouse effect is kind of like adding a lid to cover a pot of water on the stove...even though the lid is colder than the water; its presence actually makes the water warmer.

It's the total (net) flow of energy which must be from warmer to colder, which is indeed the case in both the Greenhouse effect. In New Zealand, warmer temperatures have melted the snow-caps and the winter tourist industry is affected. A further fifteen million people in Bangladesh have fled inland to escape the floods. Drought has once again ruined the wheat crop in the Midwest of the United State. Many are dying in developing countries as the world wheat shortage continues.

Sinking Island -Pacific

Rising sea levels and the increasing number of cyclonic storms have forced people of the low-lying islands in the Pacific Ocean to migrate. The young educated residents of the Pacific Island nations of Kiribati, the Marshall Islands, Tokelau and Tuvalu have migrated to Australia and New Zealand. Unskilled migrants have been relocated to uninhabited high islands in the Pacific.

New Zealand and the United States have agreed to take some of these environmental refugees under their concessionary migration schemes.



The Ozone

3000,000 islanders doomed

As many as 300, 000 people living on South Pacific and Indian Ocean islands may be forced to abandon their homes and seek refuge in countries such as Australia because of rising sea levels caused by the warming of the Earth‟s atmosphere, geographical experts believe.

Speaking in Sydney yesterday at the International Geographical Union Congress, Mr. Peter Roy, a geologist with the NSW Department of Mineral Resources, said: „Then a new class of environmental refugee will be added to the existing class of economic refugee.‟

Giving further support to already serious fears for the region, experts said seas were expected to rise by between 0.2m and 1.4m by the year 2030, dooming hundreds of low-lying islands to erosion by waves or even submersion.

The worst affected of these islands would include the Maldives in the Indian Ocean and the Kiribati, Tuvalu and Marshall islands in the Pacific, some of which have land masses only 2-4m above the low tide level.

The cause of the concern is the Greenhouse effect – the gradual increase in temperature of the Earth‟s atmosphere as a result of a build-up of carbon dioxide and other gases.

Evidence of the Greenhouse Effect

1. Analysis of air bubbles trapped in ice in Antarctica and Greenhouse show that around the start of the Industrial Revolution, in the mid-1800s, the atmosphere contained 270 ppb (parts per billion) CO2. Today it contains 348 ppb. If the present rate of increases continues, by 2040 the concentration of CO2 will be 540 ppb. As CO2 increases, more of the sun's radiation is trapped close to the earth and the atmospheric temperature rise. By 2040 it is expected that the earth's temperature will be 1.5 to 4.5 degrees Celsius hotter.

Seven of the eight hottest years this century occurred in the 1980s. Many scientists say that this is because of the increased concentration of CO2 in the atmosphere.
Sea levels all over the world have been rising.

Why is the Greenhouse Effect Occurring?

Industrial chemicals released into the atmosphere have caused holes in the ozone layer that tend to concentrate at the poles.

Below are names of some of the everyday gas pollutants and the sources where these bad gases originate from.

Pollutant	Origin	Principal Sources
Gases		
1. Carbon monoxide	incomplete combustion of Organic fuels	Motor vehicles
2. Sulphur dioxide	Oxidation of sulphur impurities	Power plants,
3. In fossil fuels	space heating	
4. Nitrogen oxides	High temperature reactions between nitrogen and oxygen	Motor vehicles industry
5. Hydrocarbons	Incomplete combustion of motor vehicle	Organic fuels industry
6. Aldehydes	Atmospheric reactions	various
7. Ozone	Atmospheric reactions	various
Liquid Suspensions		
8. Mist	Particles formed by vapour Condensation	Industry (petroleum)
9. Smog	Complex mixture formed by atmospheric reactions between solid suspensions	Motor vehicles engine exhausts products
10. Fume	Particles formed by condensation of metal vapour	Industry (metals)
11. Smoke	Unburned fuel particles carried a lot by fuel gases	Power plants, incinerators
12. Fly ash	Non-combustible residue carried a lot by fuel gases	Power plants, atmosphere processes
13. dust	Particles produced by wind, erosion or mechanical attrition	Atmosphere processes, construction industry
14. Pollen	Particles released by plants	Plant life

Decreasing rainforests

In the carbon-oxygen cycle, plants absorb CO2 and return oxygen (O2) to the atmosphere. Rainforests are major users of CO2 and generators of O2 – but they are being logged all over the world.

The deforestation of rainforest, especially in the Amazon Basin, contributes to an increase of CO2 in the atmosphere.

Scientists are not sure how much change will occur as a result of the greenhouse effect, or how fast it will happen, but they have made some predictions.

The Pacific Islands and the Greenhouse Effect

Prediction 1: Sea levels will rise one meter in the next 50 years as temperatures increase.

People living on the coast of countries in the Pacific, such as Papua New Guinea, the Solomon Islands, New Caledonia and Fiji, will be forced to move inland to higher ground. If sea levels rise by one meter, many low-lying coral islands (atolls) in the Pacific Ocean will disappear, because atolls are only one to three meter above sea level now. Countries such as Kiribati (65, 000 people) and Tuvalu (9000 people) will disappear. These people will have to move. Even if an atoll is not submerged, increases in sea level may destroy the fresh water supply on the islands, so people will still have to move.

Atolls that are larger than 1.5 hectares and more than 200 meters in diameter have fresh water in the rocks beneath them. People drink this water and it supplies ground water for plants. If the size of the island were to shrink below 1.5 hectares or 200 meters in diameter as the sea level rises, fresh water would disappear.

Some dangers of rising sea levels have been discussed. One of the economic implications for low-lying islands would be the loss of income from tourism.

What are some the other implications of rising sea levels? Can you suggest any way of reducing the danger of rising sea levels, or reducing their effects on the islands?

Some other possible impacts of a rise in sea level:

1. Reefs close to the islands (barrier reefs) will be drowned. Island people use these reefs for fishing. If no light gets to the reef, it will die and the fish will move elsewhere.
2. Land size is reduced. If the population size stays the same, individuals will have few resources.
3. Port facilities will be submerged or .covered by water

Prediction 2: Storm frequency will increase and island coasts will be eroded.

Atolls are formed by rubble accumulating around reefs. The rubble is only loosely cemented together, so the atolls are susceptible to erosion by storm waves. Because of the way they are formed, atolls are flat and usually no more than three meters above sea level. High storm waves may wash completely over the island.

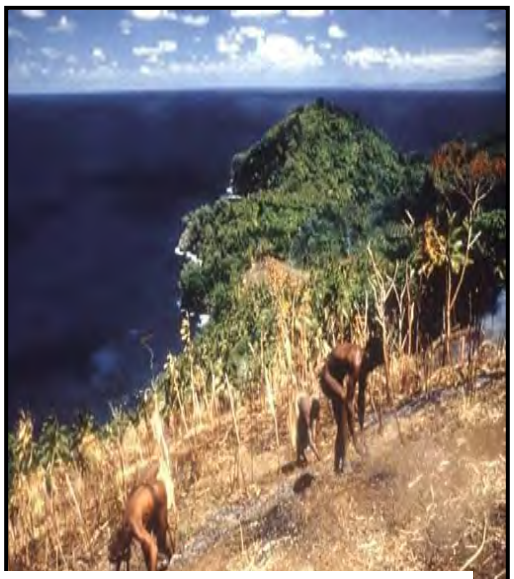
Storm water may pollute the fresh water lens under the island. Salt spray can make agriculture difficult. Some crops, such as coconut palms, are salt-resistant; others, such as taro, do not grow well in salty environments.

The Pacific Island and the Greenhouse Effect. (Vanuatu Case Study)

The allocation of work in subsistence agriculture is largely determined by the suitability of the crops to be planted and harvested in the climatic seasons. Taro and arrowroot may be planted in season and mature in about nine months. Taro bananas and yams, on the other hand, are grown in the second half of the year and harvested a year later. The yam crop may, however, be left in the ground for up to

three years in storage without deterioration. Vegetable crops and kaukau are planted at the beginning of the year and mature in only six months.

The Atiu Island Council (Vanuatu) institutes compulsory planting programmers from time to time to ensure that enough local foods are available for domestic consumption and to feed visiting groups. Those who fail to plant what is stipulated are usually fined small amounts by the Council and also encounter some criticism from their village folk. Few people fail to meet their planting obligations. Recently, with the growing awareness of the need to increase the influence of the younger generation in planting practices a Young Farmers Club has been set up. It is hoped that this will facilitate more up to date farming practices being adopted.



Traditional Agriculture on Vanuatu

As in other Pacific societies, the pattern of subsistence production on Atiu has undergone several major changes since the advent of western administration and organizational ethics. Subsistence production at the period of first European contact was reported to be characterized by the following:

(1). A small range of reliable short-term crops

(2).Little opportunity for individual variation in crop production – as planting was largely directed by chiefs and constrained by social norms; and

(3).Production was based on simple technology, largely reliant upon wooden planting implements.

However, with the introduction of western institutions such as schools and the advent wage labor, there were more opportunities for individual decision making in production. It also seems that the Atiuan people work more intensively today as a result of the increased demands made on their times they come to accept the goals of the consumer society. New labor-saving technology has not only changed work patterns, but has also altered cropping patterns.

The Future for Altoll Islanders

The atolls of the Pacific are isolated and small. Even without the impact of the greenhouse effect, development prospects are poor. Limitations to economic growth include:

1. limited physical and human resources (skills)
2. a small home market in which to sell products
3. high costs of imports and exports
4. limited variety of export goods
5. high administrative costs
6. trade deficit (imports exceed exports)
7. reliance on foreign aid

Some islanders will have no choice but to move to high islands (usually extinct volcanoes), which provide high ground that will be sub merged by rising sea levels. For example the people of Ali will have to move to mainland Papua New Guinea.

As with all solutions, the reduction of one problem could create other. There are a number of problems involved with migration, including these:

1. racial tension against newcomers
2. migrants usually have fewer skills, which makes it difficult for them to find wage employment.
3. there will be a shortage of land, especially as the migrant population grows
4. problems of converting agricultural and fishing skills appropriate to atoll life to a high-island environment
5. breakdown of community

Weather and Climate
Scientists predict that temperatures could rise by between 1.5 °C by the end of the next century. That would be enough to change climates throughout the world. Droughts in the Sudan, Ethiopia and other countries near the Sahara desert could be yearly disasters. As a result, the large numbers of people would be on the move. With a rise of temperature of 3°C, the North Pole would carry on melting and sea level could rise by over half a meter. Low-lying land by the coast would be in danger of flooding. In the next hundred years life in the world's greenhouse could well come in for change. Some scientists are predicting a world disaster.

Agriculture
As temperatures change, vegetation and animals on the islands may die because they are unable to survive in the new conditions. The problem is that climatic change is taking place too quickly for present-day natural systems to adjust to it.

Prediction 3: A change in sea temperatures and sea temperatures affect wind and current patterns. As a consequence, fisheries stocks may decrease and deprive islanders of a food source.

	Laws	Reason
1.	Fishing within the sea marked by the **taunga koperu** (restricted area**)** in the deep and the sea passages on the reef was prohibited to outsiders. Fishermen had to fish from within their families water rights.	The right of ownership continued from the land into the sea. The koperu fish are fed by the owner until they appear under his canoe, then he lets the visitor catch them. Certain fish live in particular areas for particular reasons.
2	Non-owners must obtain permission from owners to fish in their area.	A land-owner accompanies fishermen to check on them. If fish is caught, a portion will be shared with owner.
3.	Octopus must only be caught with the permission of land-owners. The area must be surveyed to find out if there are many available.	Octopus is a sort of domestic creature as it lives in one nest-hole until it is too big to fit in the hole any more.
4.	Fishermen are free to use main landing passages anywhere for access their canoes. Land-owners are not to interfere.	Important for landing. When seas become rough on one side of the island, then fishermen can use other landings.
5.	Fishing for aai (tuna). If the line is cut more than twice, that particular fisherman has to go back ashore	It is believed that it will upset the movement of the fish below as the fish with the hooks in their mouths would cause dispute.

Strategies for cooling the Greenhouse

Reaction to the greenhouse effect can take the form of prevention, compensation and adaptation. Prevention is the best long-term solution.

To decrease the concentration of CO2 in the atmosphere we could convert to alternative, non-polluting energy supplies, such as solar energy and wind power.

Their disadvantage is that they are usually expensive. Also, powerful oil and gas companies have a vested interest in the continued use of fossil fuels.

These problems will take some time to overcome. Meantime natural gas should be used in preference to oil and coal, because it release less CO2 into the air.

Conversion to nuclear energy is not a viable alternative because it is expensive and dangerous, and nuclear waste is an environmental hazard. To convert from fossil fuels to nuclear energy is merely swap one environmental disaster for another.

Conservation of energy could also be achieved by using more efficient electric motors and appliances, insulating buildings, and using solar-powered fuel efficient vehicles, It is also necessary to increase the use of public transport.

There are difficulties in the strategies of conversion and conservation. For example, it will be difficult to reduce to use of private motor cars. We will need to work co-operatively to find solutions.

Greenpeace Flagship Rainbow Warrior

Clearing the Amazon rainforest.

Deforestation and Erosion

After the lush vegetation of a rain forest is removed, an area rarely recovers. This deforested (above) Costa Rican stream valley is eroding away because there is no longer a good root system to anchor thetopsoil or decaying plant matter to replenish its nutrients. If the cycle continues, the area may eventually resemblea desert.

A warmer world

What does carbon dioxide do?

The earth is warmed by heat from the sun, called infra-red radiation. A lot of this radiation is reflected back in to the atmosphere without warming the ground at all. How else could ski slopes keep their snow from melting on sunny days? Without carbon dioxide absorbs some of the radiation and re-radiates back to the earth's surface. As a result, the earth is warmed up. This is called the Greenhouse Effect.

Carbon dioxide from power stations.

Scientists are now discovering how other man-made pollutants can also add to the greenhouse effect. For example, CFC pollution is growing at 6 per cent per year. CFC's are used in some aerosol sprays, refrigerators and air-condition units. They are thought to be far more efficient than carbon dioxide at trapping infra-red radiation.

Smoke pollution

I

Industrial Smokestacks

Carbon dioxide, sulphur dioxide, and other types of contaminants pouring from industrial smokestacks contribute largely to the world's atmospheric pollution. Carbon dioxide contributes significantly to global warming, while sulphur dioxide emissions are the principal cause of acid rain.

Destroying the Forests

- **Cleaning up the Greenhouse**

Coal – fired power stations are one of the biggest producers of carbon dioxide. About 13 per cent of the gas that goes up the chimney is carbon dioxide. If every power station in the world put in equipment to remove carbon dioxide to the atmosphere would be cut by 30 per cent.

So what's the problem? Firstly, there's the cost of putting in the equipment. Secondly, there's the huge problem of disposing safely of the massive amounts of liquid carbon dioxide that would result. This is expensive and adds greatly to the cost. Overall, electricity would cost 50 – 70 per cent more to produce.

A more sensible alternative is to reduce demand for electricity. Energy could be saved by re-using heat in heating systems and industrial processes. Saving electricity in homes, officers and industry makes sense. By the year 2050, saving energy will mean saving money, and in return there will be less, carbon dioxide pumped out into the atmosphere.

ANSWERS TO PRACTICE EXERCISES

SUBSTRAND 2

ANSWERS TO PRACTICE EXERCISE 7

PRACTICE EXERCISE 7

1a. We must look after and mange the environment well.

1b. Law and order problems

- graffiti
- violence against women/children
- litter
- poor management/corruption
- arguments and fights

1c.

Advantages	Disadvantages
(a) land is used wisely	May be used and damaged especially by logging companies
(b) balanced weather pattern	Soil erosion
(c) people help themselves	Land not developed has no value
(d) animals plus others will live peacefully	landslides
(e) land will meet some of the people's needs	Shortage of resources
(f) leave enough land for later use	Soil imbalance

2. (a)Natural Environment is made up of hills, mountains, valleys, rivers, ocean, and lakes
(b) Built Environment is people interacting with the natural environment to suit their needs and wants.
(c) Social Environment is the different groupings (church, work, games, school, singsing, language, area) that human interact where- ever they live.

3.

LAND	AIR	WATER
(a) Over – grazing destroys vegetation	Smoke pollution from vehicles and industries	Flooding
(b) Oil spillage	Noise pollution	Destruction of marine lives
(c) Chemical spillage	Air traffic	Dirty unhygienic water
(d) Material waste plus biodegradables		Factory waste dumped in to river systems
(e) Bad smell from waste		River blockage

4. The feeding relationship between plants and animals is known as the food web.

5. (a) Herbivores are animals that live on vegetarian diet or Somebody who eats vegetables, fruits, grains seeds and usually eggs and dairy products
(b) Carnivores are meat eating animals, including human beings.

ANSWERS TO PRACTICE EXERCISE 8

1. Answers will vary. This is an example.

Hello and good morning Sir

Boss

Good morning, I came to have a talk with you about the forest in that range. To whom does it

You

Good morning. What can I do for you Sir?

Boss

Very good. From here and all the way right to that blue mountain is my land

You

Nice to hear that. I think I'm interested about your forestry. Can we talk more about it

Boss

Well, it's a good idea. But I don't think I'm heading home. Can we meet later?

You

2. Some Organisations

Government Organizations
- Office of the Environment and conservation
- Office of the Petroleum and Energy
- Office of Forestry
- PNG Forest products
- Agricultural colleges

Non-Government
- World Vision
- Green peace
- Land-owner groups

3. CAUSES AND EFFECTS OF LOGGING

Causes	Effects
* Tree cover removed	- erosion and landslide
* Spilled oil from used machine	- spoil soil fertility/pollute water and land
* Homes of plants and animals destroyed	- makes breeding difficult/animals extinction
* Small and young trees destroyed	- losing of species/less building materials left
* Animals migrate to other areas.	- no protein or meat/species extinction

ANSWERS TO PRACTICE EXERCISE 9

1. All fish and seafood contain protein

2. They are over-fished
Have the oil and chemical spilt from the fishing vessels and factories pollute the sea
Disturb the marine life by taking everything from the sea using very big nets etc.

3. Answers may vary
Example: River people from Ramu and Sepik use baskets made from bush leaves to catch fish, prawns and eels. When very small ones are caught they are thrown back into the river.

4. a). From the marine products it received about K18m
b). Marine products come under Food and Live Animals. The government spent around K170m.

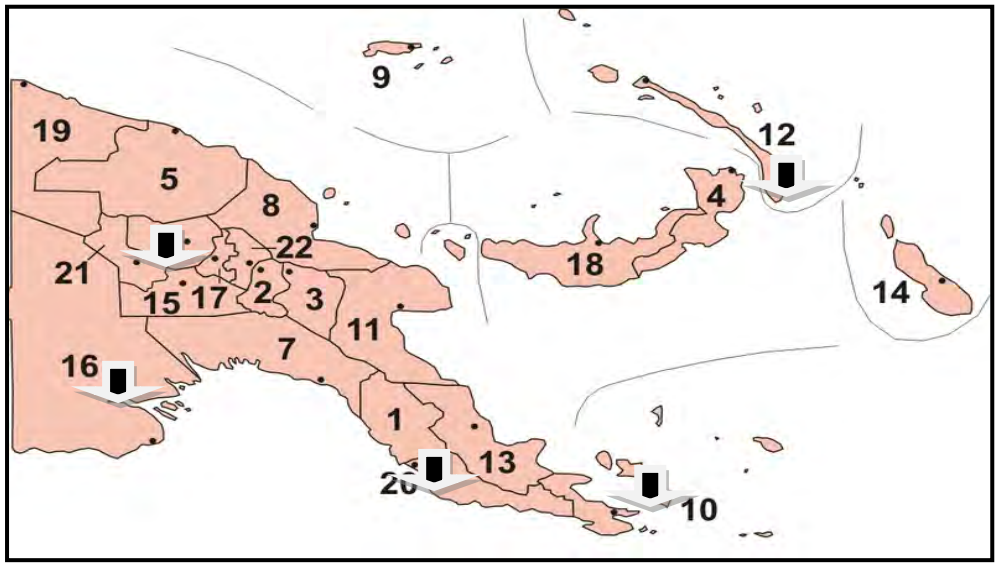
5. Help protect the resources from being exploited
Give opportunity to the people to take part in the economy.

6.

MARINE RESOURCES	USES
- Sea weed	- food for the fish
- Reef	- home for some fish/people use to produce lime
- Fish	- provide protein and a source of income

ANSWERS TO PRACTICE EXERCISE 10

1.



2. a - Silver
b – Cobalt
c – Copper
d - Gold
e – Nickel

3. Advantages
   - tax money for national, provincial and local governments
   - compensation and royalty for landowners
   - Shares of mine ownership
   - contracts for PNG companies
   - Education and health services for mine communities.

   Disadvantages
   - Unwanted immigrants
   - gambling
   - Prostitution
   - disruption of traditional ways
   - loss of biodiversity and ecosystem
   - Soil erosion
   - air, land and water pollution

4. a. Enga
   b. Madang
   c. New Ireland
   d. Sandaun
   e. Eastern Highlands Province
   f. Morobe
   g. Morobe
5. Iagifu/Southern Highlands

6. Kutubu _____ 3
   Gobe _____ 2
   Moran _____ 1

7. Oil and gas developed from the remains of tiny sea animals which have been changed into a liquid by heat and pressure during millions of years of being buried for underground.
8. a. K100 million
   b. Machinery and transport equipment
   c. K100 million

ANSWERS TO PRACTICE EXERCISE 11

1. From all the provinces, list the different types of resources they have;
   Eg; Madang – forestry
   - mining (proposed ones)
   - logging
   - fishing
   - commercial farming

   Morobe – etc……..

2. What happens to the environment when the following resource projects are in the area,
   List all the effects they will have. Both the environmentally and not environmentally friendly.

   (a). fishing: overfishing, damaging of coral, oil spillage, social issues

(b). logging: wastage of trees cut, young trees fallen or damaged by big trees, bulldozers digging soil and falling trees unnecessarily, oil spillage, social issues

(c). mining: tailings, bare land, oil spillage, change of weather pattern, social issues

3. CASE STUDY

NB – Please students must have the case study ona Resource Project in their local area. Use the information below to help with your write up.

They are to do research and write up about the whole set up of the project,

- **Changes and effects it has on the surrounding environment**
- **History of the project**
- **Benefit of the project**

ANSWERS TO PRACTICE EXERCISE 12

1. Burning of fossil fuels (oil, gas, coal)

2. Carbon dioxide, methane, water vapor

3. Sea-level rise, wave surges, heat waves and droughts, flooding of coastal and low-lying islands, etc

4. Deal with the effects of climate change, environmental sustainability and adaptability in PNG

5. Carbon Trade involves forest communities to preserve and protect their forest and in doing so they are being paid.

SUBSTRAND 3

CROP AND ANIMAL MANAGEMENT

In this substrand, you will:

- **Identify and discuss the importance of crops in Papua New Guinea**
- **Identify and discuss the importance of animals in Papua New Guinea**
- **Discuss the importance of planning an agriculture project**
- **Discuss the importance of managing an agricultural project**
- **Discuss the importance of proper management skills**
- **Discuss the importance of generating an income**

SUBSTRAND 3: CROP AND ANIMAL MANAGEMENT

Welcome to Substrand 3. In this substrand, you will learn about crop and animal management. You will learn the importance of using appropriate practices to manage crops and animals. Looking after crops and animals contribute to good production which will make a living for you, too.

This Substrand contains five (5) lessons.

Lesson 13: Importance of Crops in Papua New Guinea
This lesson covers the Importance of crops in Papua New Guinea. You will identify native food crops from the introduced ones. You will also discuss the value of crops and their impact on traditional customs and beliefs in Papua New Guinea.

Lesson 14: Importance of Animals in Papua New Guinea
This lesson covers the importance of animals in Papua New Guinea. You will look at native animals from introduced ones and categories the values of these animals. You will also discuss the impact of animals on traditional customs and beliefs in Papua New Guinea.

Lesson 15: Planning an Agricultural Project
This lesson covers the principles of planning and implementing a small agricultural project. It will also teach you how to carry out a survey on agricultural projects. Furthermore, the lesson will discuss sustainable management and a sustainable project that would apply the sustainable management practices.

Lesson 16: Managing an Agricultural Project
This lesson teaches how to manage an agriculture project. It covers factors to start a garden or an animal farm. It also teaches about the common vegetable pests and diseases and the control measures required.

Lesson 17: Importance of Proper Management Skills
This lesson covers the importance of proper management skills to manage a project. It also teaches the records and documents required.

Lesson 18: Generating an Income
This lesson covers how to generate an income. It also discusses how to find the markets for the produce and how to budget. It also teaches how to evaluate the performance of the project.

SUBSTRAND 3

CROP AND ANIMAL MANAGEMENT

In this sub strand, you will:

- Identify and discuss the importance of crops in PNG
- Identify and discuss the importance of animals in PNG
- Discuss the importance of planning an agricultural project
- Discuss the importance of managing an agricultural project
- Discuss the importance of proper management skills
- Discuss the importance of generating an income

Lesson 13: Importance of Crops in Papua New Guinea

Introduction
Welcome to Lesson 13. Can you still remember what you learnt in Lesson 12. Let us see if you can still remember. The following are the main points you have learnt. (i) definition of Climate Change, Carbon Emission and Carbon trade then we went on to;
(ii) the causes and effects of climate change and finally we
(iii) discuss the roles and responsibilities of the Office of Climate Change and Environment.

Your Aims

- Identify and explain the important crops in Papua New Guinea, especially the native food crops from the introduced ones.
- Secondly, identify and categorise the value of the crops in Papua New Guinea and
- Finally you will discuss the value of crops and explain their impact on traditional customs and beliefs

---

Difference Between the Native Food Crops and Introduced Food Crops
Let us now identify the difference between the native food crops and the introduced ones. First of all, let us explain the two terms “Native food crops and Introduced food crops”.

Native food crops are indigenous, original or locally found in Papua New Guinea while Introduced food crops are those brought in from other countries.

Crops are different types of plants cultivated and produced from the land. Most crops grown in Papua New Guinea are not native to this country. They were brought in and introduced into this country by the early explorers and missionaries. A good example is the coconut tree which grows and adapts very well in the coastal areas. It was first introduced by Queen Emma in East New Britain. Then it spread to other parts of PNG. Other crops including English Potato, cabbage, coffee, oil palm, vanilla and cocoa are a few that were also introduced.

Wing bean, pitpit, tulip, ferns, aupa and aibika are some vegetables believed to be native to Papua New Guinea. Two important tree crops like the hoop pine and klinki are also believed to be native to the Papua New Guinea .

Some local and introduced crops of Papua New Guinea

Native Food Crops. (ferns, kaukau, tapioca, aupa or amaranthus)

Introduced Food and Cash Crops




Cabbage potato, coffee, cocoa

Activity 17 Read and answer the questions below

(1) Make a list of:

(a) five (5) native food crops

_____

(b) five (5) introduced food crops that you know around the community, village or area you live in.

_____

Value of Crops in Papua New Guinea

We will now identify and categorize the value of the crops in Papua New Guinea. To begin with all food crops whether known or unknown have value. Papua New Guinea as we are aware is very rich in natural resources. Many of these resources for this case “Crops” have an economic, nutritional and cultural value which is highly valued in the communities.

Nutritional Value

This lesson taught also in Sub stand 4 of Personal Development. Different crops grown in PNG are categorized according to their nutrition value.

(a) Native Crop	(b) Introduced Crop
	
Cassava is a starchy root vegetable. Its nutritive value mostly resembles that of cereals and is very low in protein. This crop contains cyanide forming compound that makes it toxic unless it is processed correctly. Eg. cassava)	Corn is an introduced crop and most loved by Papua New Guinean. It contains starch, protein, fat etc. and can be grown any time of the year. It can also be cooked as it is or made into soup by chopping the cobs by a knife or as a soup thickener and eaten with other vegetables. Eg: Corn Plant

Fruits: are eaten as fruits and is our main source of vitamins and minerals. Eg. ripe banana, pineapple, pawpaw and watermelon.

Fruits

Vegetables: our main source of vitamins for the body.

Fruits and Vegetables: are eaten as vegetables. Our main source of vitamins and minerals for the body, eg. tomato, avocado, cucumber, egg plant, onion.

Seeds: are eaten as seeds. Eg. corn and beans.

Tubers: a root crop that is our most important source of carbohydrates. Eg sweet potato, yam, cassava, taro, and potato.

Grain legumes: a source of energy for the body. Eg. peanut, various beans (including the wing `bean, snake bean, peas, cowpea and soya bean.

Spices: used mainly for seasoning eg, cardamom, chillie, ginger and pepper.

Tree Crops: These are referred to as permanent, cash crops or perennial crops. They all mean the same thing. The main reason being, they grow and produce for many years, eg, coffee, coconut, cocoa, rubber, oil palm, citrus, mango, orange, apple, grapes, and orange. After sorting and explaining each, you can see the value and importance of all the crops.




Tropical / Temperate Fruits

Activity 18 Read and answer the question below

(a) Identify and list ten (10) different types of crops eaten daily and how they are used in your local community, village or the place you live. One example is done for you to follow.

Important Crops

No	Crops	How It Is Used
1.	Eg: Cooking banana	A high energy food, a common family food.
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
11		
12		
13		
14		
15		

Impact on Traditional Customs and Beliefs in Papua New Guinea

You will now state and explain the value of crops and their influence on traditional customs and beliefs in Papua New Guinea. People are seen as one of the most important and valuable resources in a country. Add more from your local area.

Food Classification

(A) Fruits

(i) Pineapple

B. Vegetables / Fruit Vegetable

(i)lettuce

(ii) Cabbage (round)

(iii) Cucumber

iv) Avocado

(v) Capsicum

(C) Root Vegetables or Tubers

(i) Taro (ii) Sweet Potato

(iii) Potato

(**D)** Spices

(**E)** Grain Legumes

F) Tree Crops

(i) Cocoa plant

(ii) galip nut

(G) Seeds

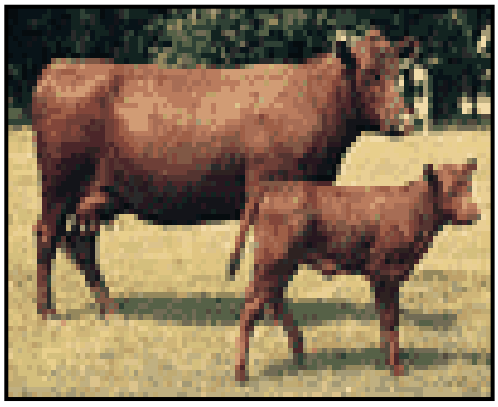
(i) Wing bean (ii) Corn Plant

In PNG there are, different traditions, customs and beliefs. The skills, knowledge and the respect for the land on how it is used have enabled us to live and develop it over these so many thousands of years. These things are partof our traditions.

Agriculture: is simply defined as cultivation or digging of soil. It is as many people say is a way of life. About 70 percent of our population live in rural areas and depends on farming for a living. Most farmers in PNG are subsistence farmers.

Subsistence agriculture.

Subsistence farming and gardening is mainly carried out by women and children, while clearing of the land the felling of trees are mainly done by men. Girls are taught and encouraged to maintain gardens and cooking. Much of the social festive and daily living activities revolve around subsistence agriculture. The traditional village calendar highlights this. Festivals are still common or practiced at times of planting and harvesting crops. These festivals involves dancing and singing for more than a day depending on the type of crop and traditional beliefs associated with it.



Cattle with its young

Animal rearing: This is mainly raising or keeping animals for food and ceremonial rituals. This is sometimes called animal husbandry in agriculture.

Hunting and gathering: Long, ago there was no agriculture. The people did not know how to grow plants and keep animals to use as their food. The first people were food-gatherers and they walked over the land gathering the food they could, eat when they wanted it. Hunting is mostly done by men and boys while women and children hunt small animals and gather fruits and nuts from the forest. Traditional weapons like bows and arrows, spears and nets were used.

Arts and crafts: There is a great variety of art and craft including paintings, sculpture, carvings, masks, bark cloth, baskets and string bags. Decorated objects included clay bows, jars, shields and weapons and musical instruments. Families pass on skills to their children. All children learn the spiritual values of their clan. Boys are taught different skills of hunting, fishing and house building while girls are taught cooking, gardening, crafts and child care skills. Only selected or favourable children are taught the magic,

Sepik carving

medicine and land rights of the clan.



Activity 19 Read and answer the question below

List five (5) customs and beliefs still practiced in your local community or village.

_____

_____

_____

_____

_____


Hunters and gatherers

_____

Summary

In this lesson, you have learnt the following:

- Native food crops are indigenous, originally or locally found in Papua New Guinea and introduced food crops are those that are brought in from other countries and now are grown in the local gardens.

- Native food crops are food such as; yam,; wing bean, pitpit, tulip, ferns, aupa, cassava and aibika and introduced food crops are crops like; English potato, cabbage, coffee, oil palm, vanilla, and cocoa.
- The value of food crops in PNG is highly regarded as each food contains nutritional values that are needed by the body to continue to survive. Each meal an individual must eat food from the three food groups that will give him or her the nutrients the body needs.

Each person big or small must get the right amount for their individual needs.

Traditionally, people value the crops they plant in their gardens and as such some observe some beliefs, associated with some traditionally grown crops as well as some introduced food.

END OF LESSON 13. NOW DO PRACTICE EXERCISE 13 ON THE NEXT PAGE

Practice Exercise 13

1. Name two (2) Native and Introduced crops that can grow well in the highlands and along the coastal areas.

Native Crops

No	Coastal	Highlands
1.		
2.		

Introduced Crops

No	Coastal	Highlands
1.		
2.		

2. Is ginger a spice?

_____

3. Mango is classified as a Tree crop,

   i) Which part of the tree is eaten?

   _____

   ii) State the nutritional value

   _____

4. What is the difference between subsistence farming and commercial farming? Briefly explain in your own words or understanding

   (i) Subsistence farming

   _____

   (ii) Commercial farming

   _____

5. Name two animals that have been domesticated for festivals and ceremonial rituals.

   (i) _____

   (ii) _____

6. What happens to the skin of a crocodile when killed?

_____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND

Now turn to your Supplementary Book and read all the Additional Readings for Lesson 13.

Supplementary Reading 14: Food Crops in PNG

Crops are one of the very important sources in our lives whether it is termed as food or cash crops. People use crops for food and feed, clothing, beverages and drugs, shelter, oil, spices, pasture and food crops.

People living in the communities depend heavily on crops to meet their needs whether for consumption or sale to generate income for the family.

Most food or cash crops seen today are not native to the place. They were brought into the country and introduced by the early explorers and missionaries, e.g. coconut. However, some are native to our communities because they have existed and survived in our environment for so many thousands of years, e.g. Wing bean and tulip.

People back in the Stone Age did know agriculture and how to cultivate the soil for gardening. Whatever ways used, has greatly influenced the way of cultivating crops up the present time.

Below are the different categories of crops

1. Annual crops – These are the crops that live and produce seed within one year. Examples, tomato, corn, yam and rice

2. Biennial crops – These crops grow for more than one year but not more than two years. During the first year, they store up food in their leaves; in the second year, the stored material is used to produce flowers and seeds, and then the plant dies. Example, cabbage (a vegetable) and turnip (a root crop grown for forage).

3. Perennial crops – These grow for several years. Example, oil palm, coconut, rubber, coffee, cocoa, citrus and mango.

Different types of crops

Agriculture was the main form of activity that we see a lot of crops grown, processed, manufactured and consumed.

What is Agriculture?
Agriculture is the cultivation of land, including raising crops and animals which are of direct value to man. It is a way of life. In Papua New Guinea about 70-80% of people in rural communities depend on farming.

It is important to note that food crops forms the basis of the subsistence agriculture in the communities. In traditional land cultivation, simple tools were used. However, on large commercial farms, modern farm machinery and implements are used.

Growing field crops
Field crops or dry-land crops are usually grown on a large scale in big fields without irrigation. They rely on natural rainfall. These are corn, english potatoes, sweet potatoes (kaukau), peanuts, cabbages, pineapple, copra, coffee, cocoa, and oil palm. They can be grown on small scale in the communities quite easily.

A number of gardens are cultivated for specialized purposes. Vegetable gardens produce edible vegetables.

Crops are grown in rows

Plants used for nutrition are classed into two groups.

They are classified as follows;

1. **Above ground food**

   The first category is fruits, which is further divided into fruits eaten as fruits and fruits eaten as vegetables.

   Fruit -

   a) Fruit eaten as fruit, e.g. banana, pineapple and pawpaw.

   b) Fruits eaten as Vegetables, e.g. Tomato, cucumber and wing bean.

   Seeds – seeds, e.g. corn and peanuts.

   Flower – e.g. cauliflower.

   Leaves – e.g. greens (aibika, pumpkin tips, cabbage,aupa).

   Stems – e.g. Sugar cane

2. **Below ground food**

   The first category of below ground plant parts we eat is roots and root tubers.

   Rhizomes - e.g. ginger.

   Corms - e.g. base of the taro and banana plant. Suckers grow from the corm of bananas.

Underground nuts - Peanut plant flowers above ground and the flower stalk, called the peg grows into the ground and forms the nuts in shells. For this reason peanuts are also called groundnut.

3. **Underground Leaves and bulbs**,

The third category includes underground leaves and bulbs, e.g. onion and shallots.

Fruits

Plants that produce fruit that can be eaten as fruits in the garden are banana, oranges, mangoes, pineapples and paw paws. Other plants that produce fruits that can be eaten as vegetables are pumpkin, tomato, capsicum, eggplant and cucumber.

Seeds and Seedpods

Seeds are a plants' way of reproducing. Many seeds are also consumed as food. They contain starch, vitamins, protein and oil. Seeds in pods belong to the plant family called **legumes**. Peanut and all types of beans are legumes. The roots of the legumes are the home of a type of bacteria that produces nitrates from nitrogen from the air in the soil.
Some seeds are called cereals. Cereals are plants that produce flower heads full of seed or grains. E.g. corn and rice.

Leaves

Leaves have vitamins and proteins. Some of the leaves are commonly called greens, e.g. Aibika, kangkong, pumpkin tips, tulip and amaranthus (aupa).

Stems

Sugar cane is the stem we use most. Sugar is stored in the stem.

Roots, stem tubers, rhizomes and corms

Tubers form in the roots and in the stem under the ground. They store food in the form starch in their roots and underground stems. Tubers, rhizomes and corms are planted to produce more plants.

Bulbs

Bulbs are parts of plants below the ground. Plants with bulbs store food in swollen leaves at the base of their stem under the ground. They are used to grow new plants. Onions, shallots and garlic are bulbs.

Different classes of garden food.

Cash Cropping

This means growing crops with the intention of selling them all. These are perennial crops such as cocoa, copra, coffee, vanilla and tea that have a long life span. Cash crop account for about one-sixth of PNG's export earnings. Palm oil, coffee, cocoa, copra, tea and vanilla are the leaders.

Small holders grow significant amounts of cash crops except tea and sugarcane.Some cash cropping is essential for an economy to develop and to provide exports to other parts of the world which cannot produce the particular commodity. However, export crops compete with food crop production. Emphasis on profits can lead to exploitation (abuse) of both soil and farm workers. Dependence on a single cash crop is risky, because its real economic value may fluctuate badly.

Nevertheless, agricultural exports are needed and their production can help to provide permanent rural settlement and employment, as well as being a source of funds for other needs.

PNG is not a major supplier of any crops. It has little influence on prices, which depend on world supplies and charge a lot from one year to the next.

Palm oil

Palm oil is PNG's most valuable cash crop. It is pressed from the clusters of small fruit of the oil palm. It is made into soap, cooking oil and margarine. It grows well from sea level to 500 m in areas with plenty of sunshine and rain year round.

Coffee

Coffee is PNG's second most valuable cash crop. Forty-five percent of rural families depend on it for most of their cash income. Beans of the coffee cherries are fermented dried roasted and then ground into the coarse powder which is used to make the hot drink. Most roasting is done overseas. Instant coffee powder is made by drying liquid coffee.

Almost all of PNG's coffee is Arabica, a premium variety that grows between 1000 m and 2000 m above sea level. Arabica needs cool temperature, high rainfall and well drained soils. Robusta coffee grows from sea level to 600 m. It is less valuable than Arabica and is used for instant coffee.

Ninety one percent of PNG's coffee is produced by smallholders. Plantations and 20 ha blocks account for the rest. For years, coffee was a leading crop. It has been affected by low world prices and the deterioration of roads needed to transport it.

Cocoa

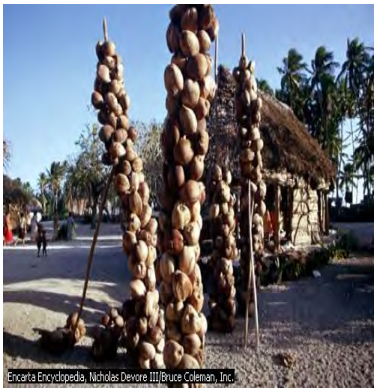
Cocoa is PNG's third most valuable cash crop. It is made from fermented and dried beans of the cocoa tree. The seeds are roasted and ground to produce cocoa butter for sweets and medicines and cocoa powder for chocolate flavouring. Cocoa has high food value. Cacao trees grow best in hot, wet climate from sea level to 600 m. They need shade usually coconut palm, leucaena and glyricidia and a rich, deep soil without a hard layer.

Examples of different types of cash crops

coffee

cocoa

banana



cotton

coconut

tobacco

Lesson 14: Importance of Animals in PNG

Introduction

Welcome to lesson 14. Before we begin, let us test to see if you can still remember what you learnt in lesson 13. Firstly, you identified the native food crops from the introduced ones. Secondly, you identified and categorised the value of crops in PNG. Finally, you discussed and explained the value of crops and their impact on traditional customs and beliefs in PNG. In this lesson, you will study the importance of animals.

Your Aims

- Identify and explain the importance of animals in PNG, especially the native animals from the introduced ones
- Categorise the value of animals in PNG.
- discuss and explain the value of animals and their impact on traditional customs and benefits in PNG.

Native and Introduced Animals

Let us now identify the native animals from the introduced ones.

Explanation of the words native and introduced has already been given in Lesson 13. The main concern here is Lesson 13 talks about the importance of crops while Lesson 14 talks about the importance of animals.

Animals covers all types and kinds of animals, smallest to the biggest, weakest to the strongest, their habitat, and type of food depended upon. We will identify the native animals from the introduced ones.

Animal Husbandry

In the most simple definition, it is the agricultural practice of breeding and raising livestock. Many types of animals are kept for two main reasons; (1) personal use (2) to generate an income. This includes pigs, ducks, chickens, cattle, sheep, rabbits, cassowaries, goats and horses.

Long ago, people were nomads, that is, they were moving from place to place. They may be called the food-gatherers and hunters. They only realized the importance of domestication or looking after animals after learning how and plant crops. Then there was no need to go and hunt for animals. People also learned to keep animals for the purpose of meat, milk or clothing.

1. **Native animals** – are indigenous or locally found in Papua New Guinea. Some of these animals will include.
    (i) The bush pig – found wild in the jungles of PNG
    (ii) Crocodile – is a reptile, manly found in the warm coastal areas
    (iii) Cassowary
    (iv) Bird of Paradise

2. **Introduced Animals** – Are animals brought into the country from other countries. Some of these animals will include;
   (i) chicken eg, Australorp
   (ii) Pigs eg. landrace pig
   (iii) Cattle eg. Braford cattle
   (iv) Goat eg. Anglo-nubian goat
   (v) Sheep
   (vi) Horse

Native Animal	Introduced Animal
	
Pig	A hereford bull

Activity 1

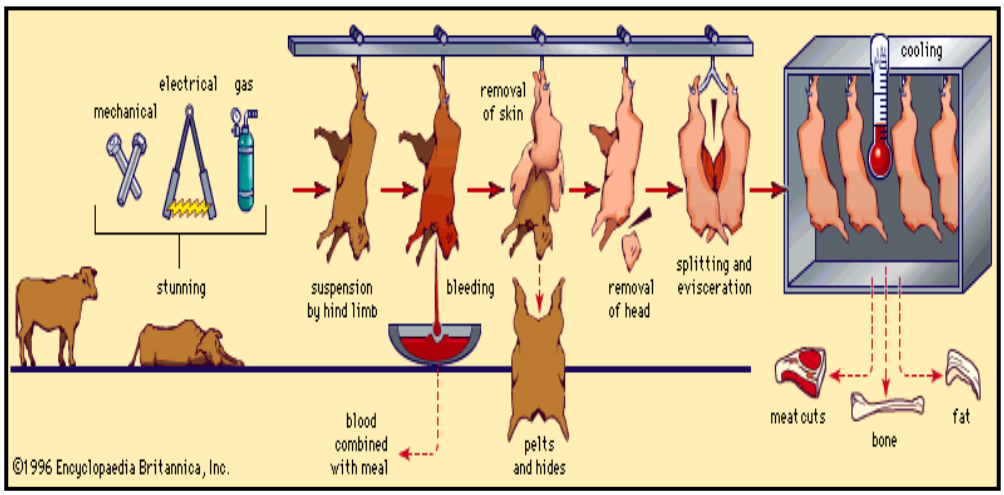
Read and answer the question below and make a list of;

(i) two (2) native animals
(ii) two (2) introduced animals that you know around the community,village or area you live in.

Value of Animals in Papua New Guinea

Animals are raised or looked after for a number of reasons. The most important and obvious one is as a source of animal protein for daily meals. That is the very reason people see animals very valuable in Papua New Guinea.

Animals are categorised in the following manner.
(i) Pigs
(ii) Beef cattle
(iii) Dairy cattle
(iv) Water Buffalo
(iv) Goats
(v) Sheep



Process of killing and storing cattle

Chickens, ducks, geese, guinea fowl, pigeons and turkeys are all categorized as Poultry. In the past, people did not actually see the value and the potential in animals. However, in these present times pigs especially are very valuable where people contribute towards bride price, feasts, deaths and is also for a money making.

Activity 2
Read and answer the question below

Write 2 – 3 sentences explaining one animal in your community, village or local area where it was used in a ceremony; eg, death, and bride price.

_____
_____
_____
_____
_____
_____
_____
_____

Summary

You have come to the end of lesson 14. What have you learnt?
In this lesson, you have learnt the following:

- Native animals are animals that are original or locally raised using local food, adapt well to the climate and the environment. Examples of native animals are; pig, fowl, cassowary, birds, crocodile, wild ducks and bird of paradise.
- Introduced animals are animals that have been brought in from other countries. Examples of introduced animals are; cattle, sheep, goat, duck, chicken, water buffalo,and horse.
- Native or introduced animals in the Papua New Guinean societies, play an important role such as; feasts, singsings, celebrations, bride price exchanges, ending of death rituals, etc.
- The value of animals and crops and their impact on traditional customs and beliefs in PNG is highly regarded. Food and animals are a very big and important part of our cultural traditions because without them there won't be any feasting, singing, celebrating, bride price exchanges and ending of death rituals.
- The killing of a boa signifies bravery, hunting skills, meat (protein), singing and feasting for the family and even the clan(hausline)
- Traditionally in Papua New Guinea a lot of animals especially pigs, goats, sheep, and land bring status (bigman or meri) however, from a modern perspective, today it means wealth (money) for an individual or family.

END OF LESSON 14. NOW DO PRACTICE EXERCISE 14 ON THE NEXT PAGE

Practice Exercise 14

1. Name two (2) native and introduced animals that you see or know of in the community, village or local area you live in.

No	Native Animals	Introduced Animals
1		
2		

2. Explain Animal Husbandry

_____

_____

_____

3. List two (2) main reasons for looking after animals.

(i) _____

(ii) _____

4. Name two animals used for traditional ceremonies.

(i) _____

(ii) _____

CHECK YOUR WORK. ANSWERS ARE AT THE END OF STRAND 1

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 14.

Supplementary Reading 15: Animals in PNG

Animals are living things that can feel and move about.

Importance and uses of animals

Animals are important in PNG, because they provide protein (meat and eggs), cash income, milk (cattle and goats), Wool (sheep), pets and Traditional ceremonies, especially for decorations (chicken) and rituals, e.g. bride price (pigs).

Examples of animals

a. rooster

b. cattle

c. dog

d. goat

e. cat

f. pig

Man and his animals

Hunting

Early man used to hunt animals to eat their meat and use their skins for clothing. Hunting takes skills and patience. They were never sure of catching the animal they wanted, and also found themselves being hunted by an animal bigger and fiercer animals. The life of a hunter was not easy.

Herding

Later people began to follow herds of grazing animals. These were the nomadic herders. Their way of life was not settled. Every time the animals moved, the people move with them, carrying their possessions. Animals move, or migrate, over long distances, so it was hard to keep up, but the herds provided the nomads with a steady supply of meat, milk and skins. The dangers of hunting were avoided.

Domestication

At an even later stage people realized that some animals could be tamed. They would stay near human beings if they were given food and protection. Some animals began to be domesticated, or looked after at home. Looking after animals has become part of our

agriculture, and we now have a great variety of domesticated livestock. This arrangement worked well for the animals and better still for us. No more hunting, No more following herds. The animals stay at home, and provide us with many food products as well as materials for clothing.

Animals are workers
Animals can also provide a labour force. Oxen, horses and donkeys are very strong, and can be trained to work. They pull carts, ploughs and agricultural implements. They carry heavy loads. This is another way in which man gains from keeping livestock on the farm.

Looking after animals
Animal Husbandry is the term used for the techniques and skills involved in looking after animals. If we want the animals to do well for us, we have to learn how to take good care of them. They have their needs, as we do, for food and shelter, for protection from heat and cold, from natural enemies and diseases.

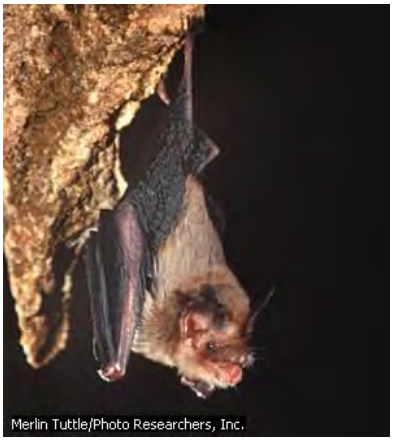
Many domesticated animals are mammals. We ourselves have a lot in common with them, because we are mammals. We all belong to the homoeothermic (constant body temperature) animals that bear their young alive and suckle them with milk.

Birds and fish are not so like ourselves, but they still need similar things. We can learn how to give them what they need, and make them produce food for us.

Pictures of animals hunted in the past.

a. possum

b. wild pig



c. flying fox

Breeds of some domesticated Animals
There are many breeds of animals. These range from wild breeds to domesticated breeds looked after by human beings for food, textile, cash income and for the fun of looking after animals (game animals or pets).

Characteristics of animal breeds
The different breeds of livestock can be identified by various features such as colour, shape, size, height, weight, use, and origin. Some breeds of animals are **purebreds** while others are **crossbreds**.

Purebreeds means the breeding of animals using the same breed while **crossbred** means the breeding of animals of different breeds. No one breed of animal is good for all types of condition and purposes. There are a number of important factors to consider in raising.

These factors are:

i. Climatic conditions and topography.
ii. Personal preference.
iii. Market requirements in an area.
iv. The type of enterprise (e.g. raising animals for eggs, meat, cash, etc.).
v. Cost of operation.
vi. Availability of breeds.
vii. Quantity and quality of product.
viii. Quantity and quality of feed or feedstuff.

Selecting and breeding animals to produce high quality livestock with the right characteristics is the ultimate goal for farmers. This will ensure high productivity in any enterprise. The type of breed is therefore, the most important consideration followed by proper selection, care and management of animals.

Factors used in selecting breeds of animals

The task of selecting suitable types and breeds for any location is done by animal breeders. They do this by experimenting, selecting and combining two or more desirable features like rapid growth rate and high level of production. Some of the following features are used in the selection process by animal breeders:

i. Rapid growth rate – Growth rate means amount of weight put on by an animal over a given period of time.

ii. Food conversion ratio (Efficiency) – Good breeds have the ability to quickly change feed to meat. Food conversion ratio or efficiency refers to the amount or weight of feed needed to make one kilogram of meat over a given period of time.

iii. High resistance to diseases and parasites – Resistance means the ability to withstand some diseases and parasites.

iv. High fertility (Productive ability) – This refers to the number of offsprings per producing female.

v. Increased livability (Mortality rate) – This is the ability to live to full age.

vi. Meat or carcass quality – This refers to improved taste and tenderness or soft meat quality.

vii. Adaptability and condition of management – Some breeds especially those improved modern breeds respond well to good care and management.

Important animal breeds in Papua New Guinea

1. Breeds of chickens
2. Dual –Purpose breeds

In Papua New Guinea, it is good to encourage rural farmers to raise dual-purpose breeds of chickens for the following reasons:

They will get both meat and eggs from the same source which ensures a constant supply of protein

There is continuity in the supply of protein from the meat and eggs.

Hardy breeds (such as the Australorp chicken) are adaptable to a broad range of local conditions such as:

a. Poor management, usually an extensive and or free range system which is inefficient.

b. Nutritional feed quality (feed other than commercial feed which has less protein, vitamins and minerals, i.e. unbalanced diet).

c. Varying climatic conditions of rain, wind and heat or cold.

d. Tolerance of diseases and parasites.

The Austra-lop chicken is a dual-purpose breed developed to lay eggs and produce good meat. It performs very well under rural conditions and is suitable for villages, communities, schools, and backyard farming in towns.

Austra-lop hens can produce 160 -180 eggs per year. They can be used for breeding when they reach the age of 7 months. They are not good mothers and do not brood eggs or hatch them, but a village hen or a Muscovy duck can be used to assist in brooding and hatching the eggs.

Pictures of some domesticated breeds of animals

a. hen

b. cow

c. goat

d. sheep

Lesson 15: Planning an Agriculture Project

Introduction

Welcome to lesson 15. Can you remember what you learnt in Lesson 14? Let us revise together. Firstly, you identified native animals from the introduced ones. Secondly, you learnt to identify and categorize the of animals in Papua New Guinea. Lastly, you learnt about the value of animals their impact on traditional customs and beliefs in Papua New Guinea. In this lesson you will learn how to plan Agriculture Projects.

Your Aims

- Plan an Agriculture Project, having in mind the principles required in planning and implementing a small Agriculture project.
- Carry out a survey on the existing agricultural projects in the community.
- List sustainable management practices and try to apply them in practical situations.

The principles required to plan and implement a small agriculture project

Let us now identify, list and explain the principles required in the planning and implementing of a small agriculture project. Before we start with the lesson we have to know the following

(i) Planning is a detailed proposal for doing or achieving something in advance (what has to be done, when it should be done, how it should be done and what is needed to do it)

(ii) Implementing – Is to put something into effect.

In order for an agriculture project to be successfully implemented, planning must be properly done in advance. Before we begin any sort of project we usually think about what we are going to do, when we are going to do it and how. We make a quick plan and then follow it up with more serious preparation later. Planning involves two areas:

Physical Planning And Financial Planning.

(1) Physical Planning means thinking about what physical resource (people, facilities, equipment, tools, materials, markets) are needed for the project. Physical planning must come first, before financial planning. You must identify the resources before you can say what they will cost or how much money you may make.

(2) Financial Planning – means thinking about how much money will be needed for the project and how much you might make or save. Then you can decide if the project is financially worthwhile. Initial financial planning should be done as soon as physical planning is completed.

The above mentioned points on physical and financial planning are good, however, you can still follow these step which will be listed below to come up with a good plan.

(1) Investigate: in the form of questionnaire, seeking opinion or conduct a survey on the possible existing projects.

(2) Plan and Design: Once a project is decided, work on an action plan

(3) Implement the plan: Put the plan in action and work on a project.

(4) Evaluate: Once the project has been completed, it is important to evaluate it.

When selecting and planning a project you have to take into consideration the resources needed.

Resources: This factor covers time, cost, money, materials, tools and facilities. You can select a project that suit the community depending on the availability of materials.

Before you do that here are some questions you must ask yourself.

- How many people are willing and available to do the work?
- How soon will the project start?
- What are the costs involved?
- Where will the money come from?
- What materials are needed? Are they available?.
- What equipment and tools are needed? Are they available? What facilities (water, power, transport) are available?

Activity 22 Read and answer the question below

Visit your community and identify resources available for under taking the project.

Location (site selection) This needs to be considered in selecting your project. Choosing a good garden site is a very important skill. It is a very important skill that Papua New Guinea farmers have developed over thousands of years. Modern science usually proves that the farmers' judgment has been correct. Again it is good to have your project near a source of water, especially during the driest part of the year.

An area that has a well-drained soil is best for food gardens. The project whether crop or animal must be close to your house easy reach and protection from people (thieves) and animals. However, if your project is far from where you live you must work build good public relations with the community. Time and transport become issues when the project sit is some distance from where you live. When planning

your project, discuss the time required to get to and from the project and how you will transport tools, materials, equipment and people.

Activity23 Read and answer the question below

Visit your local community and check about the risks involved in setting up a project of your choice.

Viability: Before implementing the project, you need to do a feasibility study to determine whether or not a project is viable, practical, possible, feasible and within your capacity. There is no point in planning to repair or improve something if you do not have skills (ability) or resources to achieve your desired outcome. Therefore, it is always analysis, see the strengths, weakness, opportunities and threat before starting.

Below is an example of how you could do a feasibility study on some projects you have in mind.

Project Options	**Viable (Can Do)**	**Not Viable (Can't Do)**
Pig Farming		
Cattle farm		
Vegetable gardening (eg. Cabbage,lettuce, aibika		
Corn gardening		
Chicken farming		
Vanila farming		
Cocoa & Coconut farm		

Activity 24 Read and answer the question below

(1) List three project that are viable (successful) and three not viable(unsuccessful)

_____

_____

(2) Identify the activities that are involved in doing a task as part of the planning process. You will put the activities in order and allocate time for each task. This will help you to plan and coordinate the people and resources required at each stage of the project and anticipate the overall time required to complete the project

An example is given below.

Task: **To create a food garden**	**Week 1**	**Week 2**	**Week 3**	**Week 4**
1. Clearing the site/land	*Start digging the ground at the chosen site.*	*Water the young plants*	*Water the young plants*	*Water the young plants*
2. Prepare nursery and plant seeds	*Break up the soil and make lines for the seeds and drop them inside*	*Water the young plants*	*Water the young plants*	*Water the young plants*
3. Prepare and shape the garden beds	*Put a small shelter over the nursery*	*Water the young plants*	*Water the young plants*	*Water the young plants*
4. Transplant seedlings	*Water the young plants*	*Water the young plants*	*Water the young plants*	*Water the young plants*
5. Planting seeds eg: corn or cabbage (pak choi)	*Carefully make holes and plants the seedlings*	*Water the young plants*	*Water the young plants*	*Water the young plants* ***NB: Week 5- harvest***

(i) Visit your local community and list activities involved in a project already existing.

(ii) List resources involved and time taken for each activity to be completed.

Following are the processes and principles that one has to take into consideration when implementing a project.

Labour

Labour is the physical work a farmer and his family do to produce the food and materials they require to support themselves. In Papua New Guinea, men and women leading a subsistence life often do separate tasks. The men generally hunt and do the heaviest clearing and cultivation; women do the lighter but no less difficult tasks. Group work is common for heavy clearing, while ownership and the day–to–day work in a garden is nearly always an individual or small family task.

Changes to the traditional roles of men and women, and to the nature of work in modern society, have had an impact on the lives of people in Papua New Guinea, especially in rural areas.

Materials and management practices

Modern agricultural systems create highly artificial environments. Farmers plant vast populations of specific crops and in the process kill other species. Thus, both the natural vegetation and a high population of the animals, including useful insects and mammals, are destroyed. Commercial agricultural systems have little diversity and it is very hard to maintain environmental stability, even for a short time. The soil is

quickly depleted of nutrients and pest numbers often increase dramatically and have to be controlled.

Eventually some of these management processes will damage the environment. For example: fertilizers that are not organic replace nutrients, but they do not replace the humus that is necessary for soil structure and continue to use it, eventually some pests become resistant to this method of control. Humus improves the water-retaining properties of soil, adds nutrients, and makes it more workable.

Increasing the diversity of agriculture systems and using management methods that are less damaging can overcome these problems. In gardens there are many easy rules to follow that assist in sustainable management practices.

Two Different Agriculture Projects

Vegetable farming-Carrot

Chicken farming

Activity 25 Read and answer the question below

Visit local gardens in your area and record the kinds of physical work families do in the garden.

In the second part of this lesson you will check the community to try and identify the existing agricultural projects. You will conduct a survey and find out for yourself. We will now go further and explain the meaning of sustainable management. Sustainable management is basically cultivation practices one has to follow to maintain soil fertility. Following are the main practices one needs to follow.

Sustainable management practices.

.

Do not burn the ground: Cut the grass under wood and trees and allow it to dry on the ground. This will mulch and protect the soil until you are ready to plant

Because of this, we should change the place where we plant our crops after each harvest. For example: if we grow a crop of corn, we should next plant a crop that can put plant food back into the soil, such as beans.

Three main groups of crop used in rotation are:
Heavy feeders for example, corn, and lettuce.
Light feeders for example kaukau, and taro.
Nutrient givers for example winged beans, peanuts, and makuna beans

Mixed cropping: Planting many different kinds of crops in one area at the same time is called mix cropping. This method is practiced in traditional gardens. There are many advantages to this method: Crops help each other. For example, when corn and beans are grown together, the corn shades the beans from the hot sun. The beans in return, put nitrogen into the soil and this helps the corn to grow well. This is known as **companion planting.**

Pest and disease control: when there is variety of crops, it is harder for pests and diseases to spread into the whole crop.

Trees: Trees provide food, clothing and shelter. Now many people live far away from trees and lose the benefits.

Composting: Natural plants and animals die or rot. This gives the soil the organic substances it needs to feed other plants. The better the compost, the higher the crop yield and the better the soil structure.

Mulch: Dry grass (or other dry materials) placed on top of garden beds or mounds prevents the soil from dying out. Mulch protects the soil from heavy rain and slows the growth of weeds. It also helps the ground to stay cool and wet during the dry season, and provide plant nutrients for the growing crops.

Seeds for sale

Seed selection and planting materials: To have healthy and productive crops, quality planting materials need to be used. People should save the best of their harvest of seeds for the future.

Work the soil: When soil is turned over, air, water and nutrients are mixed within the soil. This often loosens the soil and allows crop roots grow deep into the soil.

Use fallow times: As fallow time becomes shorter, due to the pressures of providing more food, it is important to plant desirable fallow crops to ensure soil conditions remain constant and do not deteriorate.

Different types of cultivation practices

Contour planting

Hill side planting

Rice paddy

Check with people in the community about the common type of agricultural practices done in the past.

For this part of the lesson we will choose a project where sustainable management practices will be applied.

Enterprising projects
To make a living, people need to be enterprising. They need to be creative, and imaginative in planning products or services that people need or want. Different types of projects could include:

- Agricultural
- Handicraft
- Hospitality and tourism
- Eco-tourism
- Walkabout sawmill
- Construction and maintenance projects.

The above are the different enterprising projects. Let us look at why the agricultural projects are important.

Agricultural Projects
Agriculture is the main way people earn money in Papua New Guinea. We can sell food crops such as pumpkins, potatoes, cabbages, sugar cane, carrots, spring onions, and fruit such as bananas, pawpaw, lemons, tomatoes, and pineapples. We can sell cash crops such as cocoa, coffee, tea, spices, and vanilla. We can sell eggs and other animals such as pigs, chickens, goats and ducks. We can sell seafood such as fish, crabs, crayfish and prawns. These items can be sold locally or in town markets or shops.

To be successful, we need to think creatively about ways of marketing your produce. Perhaps you can try growing different crops or keeping different animals. You could make an agreement to supply a hotel or guesthouse. You need to be imaginative in filling a need that is not being met by others.

Corn project

Activity 26 Read and answer the question below

By looking at the picture of a corn project above, explain why the people planted the crop in neat straight rows.

Summary

You have come to the end of lesson 15.

The following are what you have learnt.

- The principle requirements in starting a small agricultural project are firstly;

(i) Planning, how to go about the project, in detail state what has to do, how much money is needed, when, type, when it is due and Implementation, carry out the plan made and start working

(ii) Monitoring, checking to make sure that everything is running smoothly as planned.

(iii) Evaluate, to see that the outcome of the project is good and if not, what are the things that did not get done well and how it can be corrected

- Closing; the project must come to an end on the time estimated.
- A survey will show the need for the project to go ahead or otherwise. Details of the type, number of existing project, location, and length of time, will be covered in the survey.
- A sustainable agricultural project is one that starts and concludes on time.
- Sustainable management practices vary but should follow this basic order; planning, implementation, monitoring, evaluation and closing.
- When an agricultural project is selected and planned the following factors must be taken onboard; resources, location, viability and labour. A well planned project will produce good results for the owners.

END OF LESSON 15. NOW DO PRACTICE EXERCISE 15 ON THE NEXT PAGE

Practice Exercise 15

1. Name the six (6) physical resources when dealing with physical planning.

   i) _____
   ii) _____
   iii) _____
   iv) _____
   v) _____
   vi) _____

2. What is financial planning?

   _____

   _____

3. List the processes of implementing a project.

   i) _____
   ii) _____
   iii) _____
   iv) _____

4. List two sustainable management practices.

   i) _____
   ii) _____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 15.

Supplementary Reading 16: Project or Business

Farming is a business

A farmer is concerned with growing crops and looking after animals. Another important part of his/her work is concerned with buying and selling, and running a business. Following are some points to consider when planning a project.

1. You must know how financial records of farming projects are kept in order to tell if you are making a profit or loss.
2. Consider why some enterprises might be chosen by farmers instead of others.
3. Learn and know how to make the decisions that will make a whole project run successfully.

Planning and Budgeting

The basic questions a farmer asks himself are:

1. What can I produce?
2. How can I produce it?
3. Can I sell it?
4. Will it pay?

Depending on how he/she answers these questions, the farmer will make decisions, make plans and put the plans into effect. Every project is different, so the answers to the questions can vary. The important thing is to understand the factors that have to be taken into account before sensible decisions can be made.

Study the four basic questions listed below in turns. Note how each one leads to an investigation.

1. **What can I produce?**

   There are many possibilities, but they will be limited by the resources available, such as:

   - The climate and rainfall.
   - The amount of land available, the type of soil and altitude.
   - The building available.
   - Whether there is water for irrigation.
   - The money available.
   - The labour required.
   - Pest and disease control.
   - The type of garden tools.

2. **How can I produce it?**

   Here you have to consider:

   - Whether you have the knowledge and skills needed to carry through any project you might choose.
   - The availability of inputs required.
   - The expected yield of produce.

3. Can I sell it?

This is important. Before starting you have to be sure there will be a market for the produce. You have to think about:

- ❖ Who will buy the produce?
- ❖ The distance from the market.
- ❖ The price expected for the produce.
- ❖ The competition from other people (producers).

4. Will it pay?

The project must be able to pay. So you will think of:

- ❖ The expected returns.
- ❖ Whether these will exceed the costs, and
- ❖ By how much.

Practical work

Planning an agricultural Project.

- ➢ Choose any farming project that you could do (like putting or growing cabbages).
- ➢ Pretend you are really intending to put this project into effect in your community.
- ➢ Using the questions above as a check list, go through all the factors you need to consider when planning the project.
- ➢ Write down your answers to the questions as accurately as you can, taking into account the true conditions in your own area or community.
- ➢ Do you still think you can carry out the plan? If so, you could be a farmer.

From this exercise you can see how much thought and planning goes into the work a farmer does. He has to be a skilled craftsman, an applied scientist and a business manager, all at the same time.

Note that money is always a factor in farm planning. It is always necessary to estimate as accurately as possible how much the inputs will cost, how much yield of produce there will be and how much it will be worth. Guessing is not enough. We have to be sure.

Lesson 16: Managing an Agriculture Project

Introduction

Welcome to lesson 16. Can you remember what you learnt in Lesson 15? Firstly, you learnt about Agriculture projects.Secondly,you learnt about the existing Agricultural projects in the community by conducting a survey. You went on to define sustainable management practices and identified a sustainable project. Finally, you learnt about applying sustainable management practices. In this lesson, you will about Managing an Agriculture Project

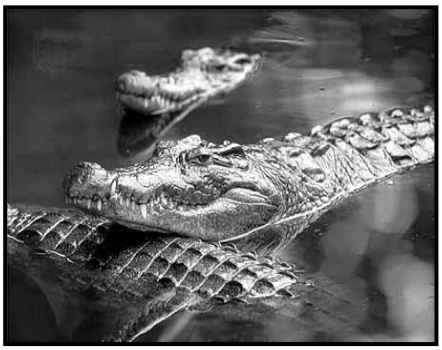
Your Aims

- List the factors to take into consideration when you are trying to start a garden or an animal farm.
- Identify the common vegetable pests and diseases and the necessary measures to control them.

Factors to start a garden or an animal farm

Different agricultural projects (crops and animals)

Meat chickens, ready for sale



Crocodiles feeding

Sun-drying coffee beans

Combine harvesting of rice

Papua New Guinea consists of four (4) regions, each with a differing topography and climate. Because of this, agriculture projects will vary according to the needs and topography of the community you live in.

The photos above are 4 out of the so many projects to consider, depending on the availability of resources as well as the amount of time and effort you are willing to commit. Included in the table are projects you can start in your region.

Regions	**Type of crops**	**Type of animals**
Highlands	Growing coffee, mushrooms, vegetable farming and landscaping	Pig, sheep, chicken, cattle, honeybees and fish farming
Momase	Growing vanilla, cocoa, rice, coffee, copra, vegetable farming and landscaping	Cattle, chicken, pig and fish farming.
New Guinea Islands	Growing cocoa, copra, oil palm, rice, vanilla, balsa, vegetable farming and landscaping	Chicken, pig, cattle, fish farming.
Southern	Growing oil palm, cocoa, copra, rice, vanilla, rubber, vegetable farming and landscaping	Cattle, fish, chicken, pig and butterfly farming

Now that we have identified the possible projects in each region we can proceed on by start planning and designing a vegetable garden.

Vegetable gardening should be a selected agricultural project for the following reasons: low costs, quick harvest depending on the type of crop/variety, the demand and the produce can be sold at markets and the community for cash.

Factors to Consider Before Commencing a Garden Project

Rainfall

The rainfall pattern in Papua New Guinea varies from province to province. Both Gulf and Western Provinces receives a lot of rainfall throughout the year, Port Moresby is dry while the Highlands, Momase and New Guinea Islands have a similar rainfall pattern throughout the year. In some parts of Papua New Guinea the rainy season lasts from November to April. It is important to study rainfall seasons so that vegetables can be planted just before the rain comes. The rain will keep plants grow and can then be harvested quickly.

Soil type

Good soil is essential to vegetable growth. If the soil cannot supply specific nutrient, vegetable production will decline. However, if you use chicken manure and compost, these nutrients will improve the richness of the soild and crops will grow well and produce a good yield.

Crops that add nutrients to the soil are peanuts, winged bean, soya been and snake bean. It is a good idea to plant some of these crops in the school garden just before the long school holiday at the end of the year. These will stop weeds from spoiling the garden site and when school begins the following year, the garden can be prepared by chopping up and digging these beans back into the soil. Legume plants are important because they produce nitrogen and this improves soil quality.

Humidity
In a humid climate it is usually wet; people feel sticky and uncomfortable. Some plants are suited to this type of climate, especially trees. Vegetables that grow well in humid conditions are sweet potato, pumpkin and kangkong (creeping plant).

Altitude
The higher you go in the mountains, the colder it gets and this affects the types of plants that can survive and grow in this climate. For example, in Enga (2345 metres above sea level), coconuts, mangoes, sago and even pawpaw cannot survive. This is because it is very cold, the altitude is too high and humidity is too low for these types of plants. It is important to consider altitude when you choose the type of crops to plant in your garden. Talk to local people because they are the experts and will provide excellent advice.

Where to make your garden
The following points should be considered when selecting your garden site:

- The vegetable garden needs to be near your home or community
- The land should be flat and have deep topsoil.
- There should be water near the garden.
- Ensure the soil is soft when you dig for planting.
- Fence around the garden to keep out animals and intruders.

Garden tools
A tool is something that makes work easier. In a vegetable garden there are many different jobs to be done.

Pests and disease control

The most common **vegetable pests** are:

- Caterpillars.
- Cut worms.
- Grasshoppers.
- Aphis (white patches of insects found under Chinese cabbage leaves).

Control measure
- Hand pick and kill them.
- Use derris dust (sprinkle on leaves).
- Apply wood ash (sprinkle on leaves).

The most common **diseases** are:
Nematodes (small worms that live in plants sharing their foods and causing disease).
Root rots (small worms that destroy root systems in cabbage and aibika).

Smut (small worms that produce large amounts of black powdery materials on the plant parts – corn fruit and sugar cane).

Control measure

- Nematodes: remove affected plants and burn them. Plant another type of crop in the same area.
- Root rots: remove affected plants and burn them. Allow the area to rest for some months before using it again. There could be too much water in your soil.
- Smut: remove affected plants and burn them. Practise crop rotation.

Implementation

- Select a suitable garden site.
- Decide on the type of vegetables that are to be grown. Consider demand at the local market and the costs involved in running the project.
- Commence a vegetable garden diary. The diary is a reminder of all that has been achieved and what still has to be done, and when.

Sample: A simple vegetable diary

Date	What we did	What we saw
15th February	We cleared the area where we are going to position our plots. We moved the grass and shrubs and heaped them for mulch. We dug up the soil and mixed in some chicken manure.	There were a lot of weeds and grasshoppers in the garden.
22nd February	Our teacher showed us how to make a seedbed. We planted cabbage and tomato seeds and watered them to keep the nursery soil moist.	The soil looked healthier than it did on Tuesday last week. It had a better texture

In your garden you will probably plant one crop of vegetables, although it would be quite easy to undertake mixed cropping which would generate income all year around. Good farmers aim to produce vegetables throughout the year. To do this, they need to plan ahead. Seedlings should be planted every three to six weeks depending on the vegetable, the variety and the climate.

How to make a seedbed

1. Prepare the seedbed in a sunny place using good soil.
2. The seedbed should not be more than one metre wide.
3. Mix a little fertilizer and manure with the soil
4. Dig the soil well until it is smooth.
5. Make the seedbed a bit higher than the ground so that extra water can drain away.
6. Make sure that the seedbed can be shaded.

Managing your plot

When the seedbed is ready, sow (plant) the seeds:

1. Put the seeds in rows across the seedbed.
2. Cover them with fine soil.
3. Water the seedbed carefully.
4. Put mulch over the seeds until they germinate.
   Make sure the seeds don't dry out

To get the best yields from your plot, you need to manage it well from the time you plant to the time you harvest. To manage your plot well, you will need to do the following:

- Replace seedlings that died when transplanted.
- If too crowded, thin out the seedlings.
- Water the seedlings.
- Weed the plot to keep it clean.

Harvesting and storing vegetables

You must not harvest your vegetables until they are ready. If you do, they will not be fully grown and they will not taste as they should. If you harvest too late, the vegetables will be old and tough and will not fetch good prices.

Activity 27 Recording the harvest

You must keep good records so that you can calculate the total production and work out the income.

a. Visit the community you live in and identify good soil where you can collect to make nursery.
b. Look around your community and choose materials suitable to build a temporary nursery house.

Summary

You have come to the end of your lesson 16. The following are what you have learnt.

- When managing an agricultural project the following factors must be considered;
  (i) weather
  (ii) soil
  (iii) humility
  (iv) altitude
  (v) location
  (vi) resources
- Correct and proper methods for growing, caring and harvesting must be followed in each selected project.
- Seedlings are to be planted in a nursery bed, watered and when ready transplanted on to prepared soil in order to grow and sold for cash.
- Records of transactions must be kept correctly so that profit can be calculated as well as activity records of the project.
- Fresh vegetable and fruits can be sold in the market as soon as they are harvested.

END OF LESSON 16. NOW DO PRACTICE EXERCISE 16 ON THE NEXT PAGE

Practice Exercise 16

1. List the four (4) factors of production

   (i)_____

   (ii)_____

   (iii)_____

   (vi)_____

2. Name (i) two (2) plant pests (ii) two (2) plant diseases

   (i) (a) _____(b)_____

   (ii) (a) _____ (b)_____

3. How long does it take for the seedlings to be ready for transplanting?

   _____

4. What is financial record?

   _____

5. What are the steps involved on how to manage your garden?

   (i)_____

   (ii)_____

   (iii)_____

   (iv)_____

   (v)_____

   (vi)_____

   (vii)_____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 16.

Supplementary Reading 17: Agricultural Project

Managing an agriculture project is not as easy as one may think. It requires time, promise, dedication, experiences and know-how, money and even resources for something to be successful. Manage means to be in-charge or control over something.

For best results you need to manage the project well, that is from the beginning (planting) up to harvesting time or slaughtering time in the case of livestock.

For example, a Leafy vegetable (Chinese cabbage) was selected. In order for you to manage the project well, you need to consider the following:

1. Site Selection – Choose a good piece of land in the community you come from or probably close to your house near a water source. Chinese cabbage grows well on flat, well-drained, and sandy land. Cabbage will grow up to an altitude of 2400m above sea level.

Land preparation

2. Gardening methods:
Land Preparation – If the project location is close to a source of water that will be an advantage because the plants can be watered in the dry season.

(i) The garden soil should be well dug and pig manure, chicken manure or compost mixed with the soil when digging. The cabbages are usually raised in nurseries before transplanted out in the garden.

(ii).Transplanting –When the seedlings have grown in the nursery for about thirty to thirty-five days, they are ready for transplanting. Only healthy, strong seedlings can be transplanted. Transplanting of seedlings to the garden can be done at any time of the day but evening is better because it is cooler and plants will not lose too much water. It is recommended to water seedlings straight after transplanting.

Transplanting rice

(iii). Planting materials – In the nursery, the planting materials are the seeds. In the main garden, the planting materials are the seedlings from the nursery.

(iv). Spacing – In a nursery, the seeds are drilled, that is, sown very closely together in lines which should be about 4-5 cm apart. In the garden, seedlings are transplanted at a spacing of 30 x30 cm apart.

(v). Weeding – Weeds should be removed as soon they start to appear. If they are not removed early, there will be competition in food nutrients, cabbages will be choked resulting in poor plant growth and low crop yield.

(vi) Fertilizer application – Compost can be applied, otherwise, if you can afford fertilizer, then NPK can be applied at a rate of 500-600 kg per hectare.

Weeding

Harvesting – It takes eight to twelve weeks for cabbages to mature. That is when you harvest them and sell them at the market.

Harvesting cabbage

1. Expected yield – In the lowlands of PNG where it is warm most of the year, the yield of cabbage is low but in the highlands, cabbage yield comes in the range of 20-25 tonnes per hectare under good management.

2. Diseases and pests – Diseases are mostly caused by fungi on the plants and pests are mostly insects or their larvae, which eat or suck the juices from the leaves and fruits.

Harvested crop

Diseased leaves and Pests of Plants

Samples of diseased leaves and pests

Apart from the list mentioned to guide you, do remember these also:

3. Cost involved – Planting materials, tools and many other things bought before, during and probably after the project are expenses. Proper records must be kept..

4. Labour – is physical work a famer and his family do to produce food required to support them. In Papua New Guinea, work is centered on the immediate family members and at times extended family members are called in if work is still plenty. The labour used may be paid for or on a free basis. However, today everyone wants to receive some payment in exchange for labour.

Lesson 17: Importance of Proper Management Skills

Introduction:

Welcome to Lesson 17. Let us highlight the main points discussed in Lesson16.They were; identifying a suitable vegetable Agriculture Project that suit your community plus all the factors to consider when starting a vegetable garden. In this lesson you will

Your Aims

- List and explain the importance of having proper knowledge and skills to manage a project and
- Identify and explain the records and documents required.

Crop management skills

For the plants to grow and produce higher yield, the following must be done.

Land preparation

It is important that land is well prepared before planting. Healthy soil is necessary for good crop yield. Plants get water, oxygen and essential nutrients from the soil. Not all soils have enough nutrients. For this reason we should add green weeds, manure, compost and other fertilizers to the soil. Organic matter improves drainage and helps to aerate the soil. Air and water can then more easily pass into the soil. Both air and water are needed for healthy growth of roots and soil organisms. Water in soil contains dissolved plant nutrients that the roots absorb.

Before planting crops, land should be prepared as follows:

Cut down weeds with bush knives and put them in a compost heap.

- Dig out big stumps, dead logs, shrubs and wild ferns.
- Turn over the topsoil with hoes and garden forks.
- Spread manure or compost evenly over the soil.
- Bury the manure or compost in the soil using hoes or spades.
- Green weeds can also be dug into the soil to add humus.
- Smooth the surface soil with a rake or spade.

Activity 1 Read and answer the question below

In your community, find out and list the land preparation methods used in gardening or planting tree crops.

_____

_____

Planting methods: nursery and direct planting

Two planting methods are to:

- plant seeds in a box-tray in a nursery or
- plant seeds or cutting directly into the soil.

A nursery is a shelter under which seed trays are placed on benches. A nursery allows seeds to germinate and become young seedlings in an area that is protected from heavy rain, wind, insects and weeds. Tiny seeds for cabbages, lettuces, carrots, rice and tomatoes can be started in seed boxes, houses or in the paddies.

(a) Seedlings in seed box

(b) Seedlings in seed bed called rice paddies

Activity 2 Read and answer the question below

1. Visit gardens in your local community, find out and list the steps involved in planting directly and in the nursery.

_____
_____
_____
_____
_____
_____

Seeds are sown on or close to the soil surface. They develop into tiny plants or seedlings and can then be transplanted into the prepared garden soil.

Crops such as corn, pumpkin, beans, peas and peanuts have bigger seeds and these can be planted directly into the prepared garden soil. They are sown 3 – 4 cm below the soil surface. A small hole is made and the seed dropped in. It is gently covered with soil to keep the seed moist. It can then germinate and develop its root system.

Crops such as taro, yam, sweet potato, sugar cane, cassava, aibika and pitpit can be grown from cutting that are planted directly into the soil. A small hole is made; one end of the cutting is placed in the hole and gently surrounded by soil. Roots form on the part of the plant that is covered in soil. Sterns and leaves form on the section of the cutting that sits above the soil. In this way a new plant is generated.

Weeding

Another way to control weeds is to use chemical weed killers. However, weed killers can pollute the water and soil, and kill crop plants, so they need to be used with great care.

Tractor weeding

Activity 3 Read and answer the question below

1. (a) Visit gardens in your local community, list and explain the different methods of weeding used.

_____

(b) List the common ones and explain reasons of weeding.

_____

_____

Mulching

Mulching is a good crop management practice. Mulch may be straw, sawdust, shredded tree bark, leaves, coconut waste, grass or manure. It is placed in a thick layer over the soil. Mulching prevents weeds from growing and water from evaporating from the soil. It keeps the soil cool for seeds to grow. As soon as the seeds have germinated, the mulch must be moved away from the stems to give the young plants light and air.

As well as protecting plants, mulch delays in time and enriches the soil. This is important when crops are grown one after another. Digging in the decayed mulch feeds the soil and this creates a better environment for growing new crops.

Activity 4 Read and answer the question below

1. (i) Visit gardens in your local community and find out if mulching is practiced/used.

(ii) List reasons for:

(a) applying mulch

(b) not applying mulch

(iii) List the type of materials used in mulching.

_____

Irrigation

Irrigation means to supply water to land by artificial means. In Papua New Guinea, crops are most often irrigated using buckets or water hoses. This takes a lot of time and human energy. All countries of the world irrigate when rain does not fall regularly enough, or in sufficient quantity, to grow crops. Irrigation ensures plant growth and crop yields. Four methods of irrigation are flood, channel, sprinkler and drip.

Flood irrigation is suitable for growing rice where the ground is level and water is plentiful. Water is allowed to flood the ground for a given time, depending on the crop, the type of soil and its drainage. Paddy rice, grown in flooded fields, is common in Asian countries.

Channel irrigation involves making water channels between crops that are grown in rows. There could be a dam or river beside a field and when necessary, a barrier is removed to allow water to flow along the channels between the rows of plants. When enough water has reached the crops, the barrier is replaced.

Sprinkler irrigation places sprinklers at regular intervals along pipe. Water droplets spray out of each sprinkler in a circle. When water has reached the roots of the plants, the sprinkler system can be turned off. Sprinkler irrigation uses less water and has finer control than channel or flood irrigation methods.

Drip irrigation: long lengths of narrow plastic tubing, with holes at regular intervals, are laid over the ground where tree crops are planted. Usually attached to a timing device, small but frequent amounts of water trickle on to the ground close to the roots of each plant. This method also uses less water and has better control than channel or flood irrigation methods.

Activity 5 Read and answer the question below

(i) Visit your local community and find out the type of irrigation used.

(ii) Identify the common or the one type of irrigation used and state reasons.

_____
_____
_____
_____

Staking prevents plant from lodging, that is, falling over when they bear a lot of fruit or when there is a strong wind. Staking prevents fruits from damage by soil organisms, wind and rain. Staking also helps plants grow upright and expose more.

Plants such as tomatoes, climbing beans, cucumbers and yams that have weak stems or are climbers, must be staked for better fruiting. To stake climbing plants, sticks about 2m long are firmly stuck in ridges next to each other, between plants, slanting towards each other. Where the sticks meet, tie more sticks horizontally. The horizontal sticks give the structure strength to bear the weight and the pulling force of the vines. Tie plants stems to the stake, using strings or vines, as the plant grows.

Staking yam vines

Staked tomato plants

Activity 6 Read and answer the question below

(i) Visit gardens in your local community and see if weak stems or climbers are staked to support them.

_____
_____
_____

(ii) List the different methods and materials used

_____
_____
_____

Earthing up

Earthing up is gathering soil around the base of the stem. Weeding and earthing up with tools such as hoes and spades also help to loosen the soil for better airing.

Activity 6 Read and answer the question below

1(i) Visit gardens in your local community and see the earthing up on food crops/vegetables.

(ii) If it is done, how and when?

Pruning

Vegetables such as tomatoes and eggplants produce a lot of shoots or branches. Excess shoots use up nutrients that are needed for flowering and fruiting. When there are too many fruits, their size and quality are poor. The branches also get heavy and break. Removing excess growth on a plant is called **pruning**. In tomatoes, prune everything except the main branches. Secondary branches should be pruned with a sharp clean knife or secateurs.

Activity 7 Read and answer the question below

(i) Visit gardens in your local community and find out if this management practiced is used.

_____
_____

(ii) Check how the food crops/vegetable pruning was done and the type of tools used.

_____
_____

Harvesting

Harvesting is the time when crops are gathered. If you harvest many good quality crops, you have used appropriate crop management practices. To growers, quantity and quality are equally important. They both determine how much a crop is worth. You need to harvest crops when the time is right, not too early and not too late. Farmers also try to harvest crops at a time when prices are high. Traditionally, special festivals are held at harvest time.

Crops such as tomato, pawpaw and bananas are harvested when the fruit is ripe. Crops like aibika, lettuce, cabbage and spinach are harvested when the leaves are mature and tender.

Corn and beans are harvested when they mature. Root crops, like carrots, are harvested when the root is a good size but before it becomes woody and loses its sweetness. Potatoes, yam, cassava and taro are harvested when the tubers are needed and they are a good size.

Cash crops such as coffee, rubber, cocoa, coconut and vanilla are also harvested in particular ways. Rubber is harvested by collecting latex from v-cuts in the trunks of the rubber trees. Vanilla pods, coffee beans and cocoa pods are picked from trees when they are ready. Dry mature coconuts for making copra are gathered from the ground after they fall from trees.

Activity 8 Read and answer the question below

(i) Visit gardens in your local community and list the different cash and food crops.

_____

_____

(ii) List the methods techniques used in harvesting.

_____

_____

Processing

Food processing describes all the stages that food goes through from the time it is harvested to the time it is sold.

Processing may simply involve picking, sorting and washing fruit and vegetables before they are taken to market.

Other processing methods convert raw materials into a different form or change the nature of the product. For example, sugar is made from sugar cane, jam from fruit, flour from cereal or root vegetables and sago is made from sago palms.

Cash crops such as coffee, rubber, cocoa, coconut and vanilla require complex processing before they are sold.

Activity 9 Read and answer the question below

(i) Visit your local community and find out if food is processed

_____

_____

(ii) If yes, state the food crop and methods used.

_____

_____

Storage

Most often food crops are not stored; they are eaten or taken to market as soon as they are ready. This means that when produce is plentiful, prices drop. When produce is scarce, prices go up. One way to make fruit and vegetables last longer is to store them at low temperatures.

Some crops can be successfully stored for a long time before they are used. Leaf bundles and clay pots are used to store sago. Pandanus and cane baskets are used to store potatoes and onions. Hessian sacks are useful for storing sweet potatoes and pumpkins. In the Trobriand Islands, yam huts are built to store yams. Crops should be dry before they are stored. Mould and rot will quickly spoil food.

Insects, rats, mice and mould are enemies of stored produce. All food crops should be stored in clean dry places and checked regularly for damage. Damaged food should be removed to stop the disease or rot from spreading to other food.

Activity 10 Read and answer the question below

1. (i) Visit people in your local community and talk about how food is stored.

   (ii) List the common ones the methods used and which food and cash crops in particular.

_____

_____

Pest and disease control

Fungi and bacteria attach to plants cause disease. When you first see the signs of diseased leaves, look for ways to get rid of them very quickly.

In Papua New Guinea, common pests are insects, beetles, locusts, snails, weevils, rats and mice. Insecticides and poisons can be used to control pests but these are poisonous and can affect humans.

For this reason, food should be washed before being cooked or eaten.

- As you walk around the garden, pick off and destroy any insects that you see.
- Destroy all rubbish and places where insects could hide, feed and breed.
- Change crops so that the same plants are not always grown in the same place.
- Digging your garden sometimes exposes larvae to the sun and they die.
- Plant your crops at the right time of the year when there are fewer insects.
- If you feed and water plants, they will be more resistant to insects.

Remember you can earn a lot of money if you manage your finance well and by following and practicing the skills mentioned already.

We have now completed touching on all the common management skills one has to follow to get a good harvest and good return in term of money.

For this part of the lesson, we will touch on Animal Husbandry. If you can still remember in Lesson 14, we defined this term by stating the native and introduced animals. Here we will carry on from where we left off in Lesson 14.

Appropriate animal husbandry practices

In Papua New Guinea animals (farm) are important because of their uses. Most animals are kept for meat. In many rural communities, meat which is a good source or protein, is quite often, in short supply. Farm animals are mainly kept to enable protein supplement in the diets of rural people.

We will now look at some of the animal husbandry practices one has to follow.

Housing

No one design of housing fills all types of livestock, under all climatic conditions. The design of housing should always take into consideration the climate and other environmental conditions of the area. The animal house must also be suitable for the person to carry out daily duties of cleaning the house, and feeding the animals.

The type of animal that is kept by the farmer, also determine the type of house to build. Below are some reasons for building animal houses:

- Provide shelter from rain, wind, heat and cold.
- Be well ventilated.
- Let in enough light.
- Be easy to clean.
- Provide protection from thieves.
- Provide protection from other animals.
- Provide enough room for each animal.

Provide access to food and water

Animal housing can be varied in shape and size. It can be made from different materials. The type of housing provided will depend on the livestock being kept, resources available, and the climate. Bush materials, such as thatch roofs, bush timber walls and packed earthen floors, may be used in some areas. Iron roofs, milled timber or chain wire walls and concrete floors may be used in other areas. Walls for pig houses need to be stronger than walls for chickens. In the highlands, closed-in walls protect animals from cold. Coastal animal housing can be more open.

A deep layer of straw or sawdust covers the floor of some animal enclosures. This collects animal waste and can be used later as compost for gardens. Special feeders and water containers can be purchased for chicken houses. A flow of air is necessary to minimize bad smells help keep the area dry.

Activity 11 Read and answer the question below

(i) Visit your community and observe for yourself the type of animal housing.

_____
_____
_____

(ii) Check the cost involved and the materials used.

_____
_____
_____

To be healthy, farm animals need food and water. Water should be available at all times. If left to roam freely, animals forage for the water and food they need. If you watch chickens, ducks, pigs or goats feeding around villages, you will see them eating leaves on plants, digging for worms, scratching for seeds and seeking other food.

Feeding

Animals kept in captivity cannot find their own food, so the food they are given must provide a balanced diet. The amount of feed depends on the age and type of animal, the quality of the feed and the weather.

Some animals like goats, sheep and cattle, graze on plants. Special grasses are sometimes planted to provide rich pasture of grazing animals. In captivity they are fed stalks and grain from crops such as corn, barley, oats and sorghum.

In addition, to food from foraging, pigs can be fed vegetable from the garden, cooked rice and food scraps from the house.

Chickens and ducks can forage freely or be fed food scraps. Also, commercially produced mash can be purchased. It is a prepared mix of grain crops such as corn, barley, oats and sorghum. „Chicken Starter", „Growers" Mach" and „Layers" Mash" are different types of feed for chickens.

With desirable characteristics, we promote the survival of selected breeds and the possible extinction of other breeds.

Activity 12 Read and answer the question below

Visit the community and see the different types of breeds of animals raised. Eg. pig, chicken, cattle.

Health and hygiene

Appropriate animal husbandry practices protect the health and hygiene of animals and prevent animal diseases. Farmers are concerned about disease for several reasons:

- Disease can reduce the productivity of animals that are raised for slaughter.
- Sick animals can affect others.
- Some animal diseases can be passed on to humans and control of these types of diseases is vital.

Mad Cow Disease and Asian Bird Flu are two animal diseases that caused a major international health crisis. In a number of Asian countries, millions of chickens were slaughtered in response to an outbreak of Avian Influenza – commonly known as Bird Flu. This was very bad for Asian farmers. In Britain, thousands of cattle were slaughtered as a result of Mad Cow Disease. This seriously hurt cattle producers and the beef industry. Strict quarantine regulations aim to prevent animal diseases from other countries spreading to Papua New Guinea.

Animal diseases may be infectious or non-infectious. Parasites, bacteria and virus cause infectious disease when they enter animal"s body. Non-infectious disease can be inherited or caused by diet, environment or injury. Veterinarians are doctors who treat animal health problems.

People often say that prevention is better than cure. But what can a farmer do to prevent diseases infecting his animals? Any farmer can take the following action:

- Provide quality housing that protects animals from harsh weather conditions. It must have good ventilation.
- Make sure animal housing is clean and disinfected before bringing in new stock.
- Keep food and water supplies clean. It is important to regularly clean and maintain containers.
- Manage floor litter to prevent the building of disease organisms.

Activity 13 Read and answer the question below

(i) Visit and check others in the community if they have noticed some unusual behaviour or signs in the animals.

(ii) Get an expert in Department of Primary officer (DPI) to help you out. If he/she cannot help, then see an animal doctor

- Wear protective clothing when handling animals. Long trousers and footwear help guard against injury.
- Wear rubber gloves when handling sick or injured animals.
- Wash your hands thoroughly after handling animals.
- Keep animal areas clean and free of rubbish and sharp objects.
- Remove anything that could make you (or the animal) trip or slip.

Handling

- Animals respond to the way they are treated. Be quiet and calm. Avoid loud, abrupt noises that distress livestock.
- Pens should be equipped with a gate.
- Animals areas should be evenly lit as animals can panic when moved from a light area to a darker area.
  - Moving or flapping objects can cause problems and make animals hesitant to move.
  - All livestock tend to refuse to walk over any change in ground texture or surface, for example a drain, grate, hose, puddle or shadow.
  - Livestock with young are usually more defensive and difficult to handle. When possible, let the young stay as close to the adult as possible. All these factors need to be considered when planning

---

Activity 14 Read and answer the question below

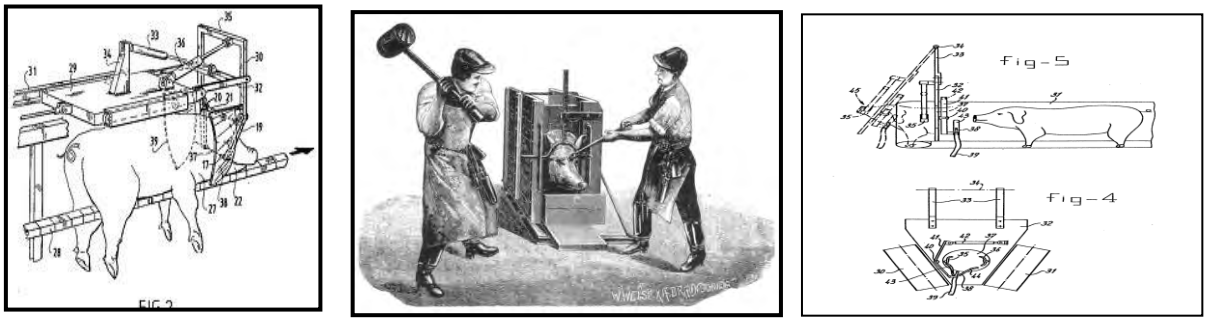
Visit a farm and observe how animals are handled eg. loading pigs or chickens onto trucks for marketing.

Slaughter and processing

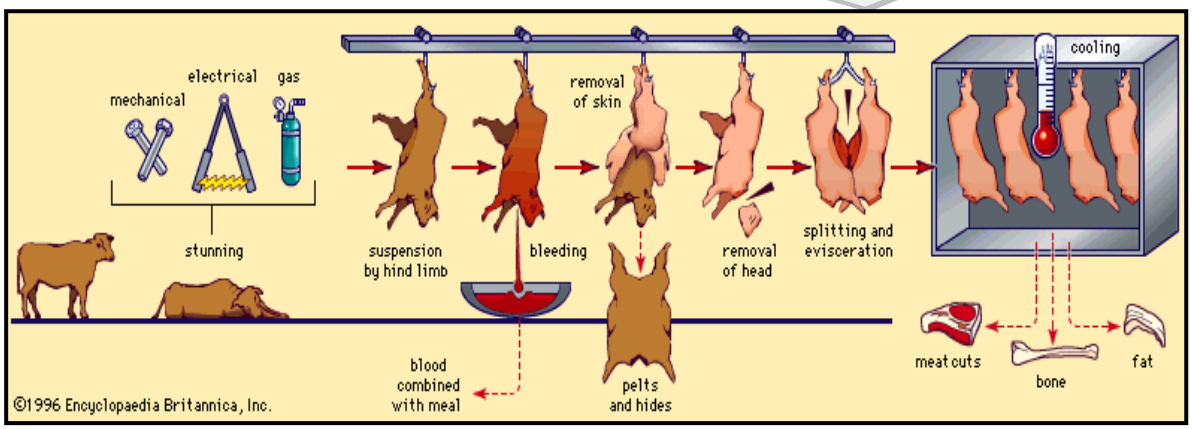
To slaughter means to kill an animal and „procœssing‟ refers to the steps required to prepare animal meat. All slaughtering should be done quickly to avoid undue suffering by the animal.

Killing chickens or ducks can be done quickly by breaking the neck. Hold the bird by its legs. Place your other hand behind the head. Pull down, twisting to the right. This breaks the neck. The bird will flap its wings for a few seconds, but it will soon be still. Straight after killing, hang the bird by its feet and pluck out the feathers. Plucking is easier when the body is still warm. If the bird is left for a while, dip it in hot water to make the plucking easier. After plucking, cut the head off. Cut around the vent taking care not to cut into the rectum. Remove the intestines, liver, heart and lungs. Rinse the bird out with cold water. After these processes, the bird is ready for cooking. The bird can be stored in a freezer if you do not want to cook it straightaway.

Stunning is a technique used to kill pigs in Papua New Guinea. Animals are bled after stunning and they die from loss of blood before they regain consciousness. Use a sharp knife to slit the pig‟s throat on clean ground. Slit the throat while the heart is still beating so that all the blood gets pumped out. Make sure you severe the main veins and arteries. Wash the pig down.



Methods of stunning pigs



Modern methods of preparing and storing of pork, lamb, and beef

Written below is an example of how a chicken is slaughtered. Steps involved in from slaughtering to processing.

1. Starving

Starve the chicken for at least a day before slaughtering to empty the crop. It‟s easier during slaughtering.

2. Heating water

Heat some water to about 100°C and pour into a bucket.

3. Slaughtering

Hand the chicken by the legs, or put it inside a cone to stop it flapping its wings. Hold the head and make a clean cut through the veins on the left side of the neck, about 2cm below the eyes. Use a sharp knife. Hold the head and allow the blood to drain out into a container. Wait until all the blood is drained out.

4. Plucking

Immerse the body in hot water to relax its muscles and make them soft. When the muscles are relaxed, the feathers can be plucked easily. Do not leave the chicken in hot water for too long, or the meat will start to cook. Test by plucking the wing feathers and tail feathers. It is ready when the feathers come out easily. If not, dip the chicken into hot water again. Gently pluck the feathers, pulling them out in the direction they are growing. This will not damage the skin. Pull all feathers from the skin without leaving stubs of feathers. Put the feathers into bags, for disposal or later use.

5. Removing head and legs

Wash the bird in cold water. Cut the feet off at the first joint. Cut the head off at the neck, about 2cm from the eyes.

6. Removing internal organs

Open the chicken by cutting around the vent or anus area to remove the internal organs. Remove the gut by pushing the crop through the abdominal cavity. Separate edible parts like the gizzard, heart and liver from the rest. Cut open the gizzard and remove the waste and the layer enclosing the undigested feed. Discard the contents of the gizzard. Pack the heart, liver and gizzard for sale or for home consumption.

7. Cleaning and inspection

Wash the chicken thoroughly, and check the intestine and internal parts for internal parasites. Contact the agriculture officer and seek advice if you see parasites.

8. Packaging

Hang the chicken up for five to ten minutes, to drain excess water. Then wrap it in a plastic bag ready for sale.

9. Weighing or grading

Weigh and record the weight of the chicken. Grade it according to weight, based on market requirements. Put it in a carbon or on a tray for sale.

10. Preservation

If you have a freezer, the chicken can be stored in it awaiting delivery or sale.

11. Cleaning

Feathers and offal (non-edible parts) can be buried. Clean the equipment with hot soapy water, dry and store away neatly. Wash the clothing and clean yourself.

Packaged chicken- ready for sale

Activity 15 Read and answer the question below

(a) Visit a farm and observe how slaughtering and processing to packaging is done.

_____

_____

_____

b) Identify and explain the records and documents required for proper management skills.

_____

_____

_____

_____

Summary

In this lesson, you have learnt the following:

- A suitable Agricultural project (vegetable eg, cabbage or animal) is one that can be developed, established and suit the community"s needs.
- Project management skills such as land preparation, planting methods, weeding, mulching, irrigation, pruning, harvesting, processing, storage, pest and disease control are needed to see that project concludes successfully.
- For animal projects, management skills such as housing, feeding, health, hygiene, handling, slaughtering and processing of the animal.
- Below are the steps and methods to slaughtering, processing, packaging and storing of chicken.
  - (i). Starving
  - (ii). Heating water
  - (iii). Slaughtering
  - (iv). Plucking
  - (v). Removing head and legs
  - (vi). Removing internal organs
  - (vii). Cleaning and inspection
  - (viii). Packaging
  - (ix). Weighing or grading
  - (x) Preservation
  - (xi) Cleaning

END OF LESSON 17. NOW DO PRACTICE EXERCISE 17 ON THE NEXT PAGE

Practice Exercise 17

1. List all the management skills or practices involved in a Agriculture vegetable (crop) project.

(a) _____ (g) _____
(b) _____ (h) _____
(c) _____ (i) _____
(c) _____ (j) _____
(e) _____ (k) _____
(f) _____ (l) _____

2. List all the management skills/practices involved in a animal project.

(a) _____ (d) _____
(b) _____ (e) _____
(c) _____ (f) _____

3. List all the steps involved in slaughtering and processing a chicken.

(a) _____ (d) _____
(b) _____ (e) _____
(c) _____ (f) _____
(g) _____ (j) _____
(h) _____ (k) _____
(i) _____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 17.

\

Supplementary Reading 19: Farming Practices in Papua New Guinea

---

1. **Land Preparation** –

Before you plant a crop, it is necessary to prepare the land, so the seeds can readily grow, when planted. Land preparation may involve some of the following operations:

Land Clearing, bush burning, stumping, drainage and tillage.

i Land clearing

Land clearing methods vary from one locality to another. In PNG farmers do not usually carry out full clearing and stumping. Simple tools such as knives, axes, bush knives, grass knives, spades and forks are used for land clearing. Undergrowth with small plants is cut down as well as felling of bigger trees.

ii Bush Burning

After the vegetation on cleared land had sufficiently dried, it is usual to burn the entire area, or patches of it. This is the normal practice in subsistence farming. In subsistence agriculture, bush burning is a necessity, but in modern, and commercial farming, it can be dispensed with.

iii Stumping

Stumping is the digging out, or removal of the stems and roots of trees. In traditional agriculture, because of the unavailability of suitable equipment, little or no stumping is done. When some stumping is done on local farms, hoes, axes and machetes are the tools used, in commercial farming, machines are used in felling trees. The tree roots often come out of the soil when the trees are pushed over. Thus, felling of trees and stumping become one operation in mechanized agriculture.

iv Drainage

Drainage is the removal of excess soil and water from a piece of land. In school and village gardens, drainage is readily achieved by digging trenches or ditches on the land.

Methods of drainage: there are two general types of drainage: open drainage, and closed drainage.

Open drainage: this is the common type of drainage in subsistence farming. Ditches are made through the land. The depth, width, and direction of the open ditch, depend on the slope of the land, the type of the soil, and the amount of water that the ditch is expected to carry.

Closed drainage: the closed drainage system is not commonly used on peasant farms because of the high capital requirement involved and because of the farmer"s lack of technical knowledge and unavailability of suitable materials and equipment.

v Tillage:
Tillage refers to any of the methods used for preparing the soil in readiness for planting. Tillage is described as primary tillage (e.g. ploughing) when it is the first soil cultivation method which breaks up the land. Secondary tillage includes harrowing, bed-making and ridging, which are done after primary tillage.

2. Diagram of how land is prepared.

Modern method of land preparation.

2. **Planting methods: nursery and direct planting**
There are two planting methods:

i. Using Nurseries – That is planting seeds in seed boxes or nursery seed beds.
ii. Plant seeds or cuttings directly into the soil.

A nursery – is a place where small seedlings are raised and cared for, until they are ready for transplanting into the gardens. Following are reasons for using a nursery;

a. The shade of the nursery reduces soil temperature. This reduces the loss of water through evaporation and transpiration.

b. It is easy to water seeds or seedlings because they are in one place.

c. Seeds or seedlings can easily be protected from pests because they are all in one place.

d. Soil can be carefully prepared in advance.

e. The healthiest seedlings can be selected.

- Small seeds dry out very easily because they have limited stored food resources.
- Large seeds do not dry out quickly. This is because they can absorb more water. They have large stored food resources.

A cabbage nursery

Cabbage Seedlings
These young cabbage plants have just begun to sprout leaves. The plants were sown in the controlled environment of a greenhouse, where grid like dividers in the soil separates each plant. It is easier for scientists to study plant growth in a greenhouse or laboratory, where they can control temperature, soil humidity, and other environmental factors.

Direct planting - Crops such as taro, kaukau, aibika, sugar cane, cassava and yam can be grown from cuttings that are planted directly into the soil. Shoots and leave form on the section of cutting that is above the ground. In this way a new plant is generated. Seeds of crops such as peanut, pumpkin, water melon and corn are bigger seeds and can be planted directly into the prepared garden soil.

3. Shading the seedling straight after transplanting – Seedlings should be shaded straight after transplanting to protect the young delicate plants from the direct heat from the sun and heavy raindrops. The plants should be shaded for about a week and keep watering. After a week when you realized that the plants are growing, showing no signs of dying then remove the leaves and reduce watering.

4. Replace the dead seedlings – Make sure to check the garden regularly for any dead seedlings. Replace the dead ones for high economic returns.

5. Spacing and Plant Population – Over-crowding is not good for most crop plants. It is very important to ensure that the correct spacing is used when a crop is planted. All crops are not planted at the same spacing. When too close a spacing is used in planting, the number of plants per unit space (plant population) becomes too high. Plants in such a situation will compete for nutrients, light and water.

6. Add manure to enrich the soil–Well-decomposed compost or manure can be Compost should be applied two or three months before planting. Green manure is best worked into the soil four to six months before planting to allow time for it to decompose. Inorganic fertilizers are best applied at different periods of plant growth, rather than all at once in the beginning. Part can be applied during land preparation. For vegetables, apply again two to four weeks after planting. For cereals, apply again about four weeks after planting and at flowering time. For tree crops apply at planting and then once a year.

7. Irrigation or Watering – Plants are largely made up of water. The cytoplasm of their cell is 90% water.
   - The nutrients (plant foods) dissolve in the water and are able to move from the soil into the plant roots and up to the leaves.
   - Water is needed to make carbohydrate food in the leaves.
   - Water in the plant carries food made by the leaves to other parts of the plant.
   - Plants are mostly made up of water. It helps them to stand up straight. If plants do not get enough water they will droop or wilt.
   - Water is important for many important processes in the plant.

Transplanting

Rather than planting seeds directly in the garden, gardeners in cooler climates may start their seeds indoors and transplant the young plants outside when the danger of frost has passed. Using tranplants, which are also available for purchase in nurseries, enables gardeners to maximize the growing season. While it may be months before seedlings are ready to flower, transplanted plants often flower sooner.

8. Mulching – Mulching materials are any dry grass and weeds, coffee husks, sawdust and dry materials which are called mulch. Mulch stops weeds from growing, reduces soil temperature during the day and prevents water loss, keeps soil warm during the night, adds nutrients and organic matter to the soil when it rots and reduces soil erosion. Mulch applied at an early stage will control weeds.

9. Weeding the garden and earthing up – A weed is any plant growing where it is not wanted. It has to be removed, because it competes with crop plants for food, light, water and space on the ground. Any plant growing where It was not planted, is also a weed. So if you see a weed kill it, cut it down, dig it up, poison it and exterminate it. Whatever you do, get rid of it. It is your enemy. Earthing up is gathering soil around the base of the stem. Weeding and earthling up with tools such as hoes and spades also help to loosen the soil for better aeration.

   Methods of weeding – Hand weeding, using tools such as knives or hoes, shading the soil by using mulch, shading the soil by correctly spacing the crops and using herbicides (weedicides).

Effects of Weeds

Good effects of weeds:

i. Weeds help to control erosion.
ii. Weeds provide nutrients to the soil, when they are ploughed under.
iii. Some weeds are used as food for man and feed for livestock.
iv. Some weeds are used by “witch doctors” and the pharmaceutical industry, for medicinal purposes.
v. Weeds are cut, and used for compost preparation, and for mulching.

Harmful effects of weeds:

i. Weeds competes with crops for water, nutrients and sunlight, and cause low yield of crops.
ii. Weeds contaminate seed harvest, and so reduce the quality of such seeds.
iii. Some weeds are poisonous to man and livestock.
iv. Weeds cause an increase in operational cost of a farm.
v. Weed seeds stick to animal skin, so the quality of hides, skins and wool is reduce

vi. Weeds harbor disease organisms which later attack crops, which are grown or near the weed infected area.
vii. Where noxious or bad weeds occupy a piece of land, the value of such land is reduced.

10. Pruning – Vegetables such as tomatoes and eggplants produce a lot of shoots or branches. Excess shoots use up nutrients that are needed for flowering and fruiting. When there are too many fruits, their size and quality are poor. The branches also get too heavy and break. Removing excess growth on a plant is called Pruning.

11. Staking – This is done to the plants such as tomatoes, climbing beans, cucumbers and yams that have weak stems. Staking is done for a number of reasons:

- Gives support to the plants
- Allows climbing plants to get more sunlight
- Stops climbing plants from shading each other
- Makes it easier for better fruiting and harvesting
- Reduces damage by some pests
- Reduces decay of the fruit by lifting it off the ground.

Small branches or wire can be used for staking.

12. Pest and Disease control – Weeds are not the only problem the farmer has to face. Pests and disease can also attack his plants. The pests are mostly insects or their larvae. The diseases are mostly caused by parasitic fungi that live on the plants. Some diseases are also caused by bacteria and viruses. Vegetables which are most susceptible to pests and diseases are leafy vegetables, fruit vegetables, legumes and common root crops. Other vegetables like carrots, onions, peppers and radishes are not often attacked by pests and diseases. Good and regular care of crops will reduce the incidence of pest and disease damage.

Practice Exercise. Use this natural pest killer or controller

Ingredients:
1bleach container (1 litre)
20 ripe chillies
Method:

1. Fill the 1 litre container with water.
2. Put all the ripe chillies in a plastic bag and crush with a stone or wood.
3. Pour into the 1 litre container and shake it well.
4. Spray the crops

***P.S Must be used within twenty four hours*.**

Disease organisms

A crop disease is defined as any abnormality or deviation from normal growth or structure of a crop.

Types of disease organisms Fungi

Fungi are small plants which cannot carry out food manufacture by photosynthesis because they do not have any chlorophyll. Fungal diseases are often recognized by the appearance of dead or necrotic spots, mycelia, as well as fungal fruiting bodies of the affected parts of the plant.

Bacteria
Bacteria are microscopic organisms capable of living in poor environments where other diseases causing organisms may not survive. They usually enter the plant through wounds, fruits or through the flower.

Nematodes
Nematodes are small microscopic, parasitic worms which may attack plants. They are also known as; “Nema” or ill worms”. They usually attack plants through the roots.

Viruses
They are smaller than bacteria and are described as submicroscopic organisms which multiply only in host living tissue. The viruses are usually transmitted by insect vectors and Insect pests:

Based on the feeding habits of these insects‟ pests, they can be classified into two groups:

a. Biting and chewing insects
The biting and chewing insect pests have sharp mouth-parts adapted for biting and chewing. Examples of biting and chewing insects includes; grasshoppers, locusts, crickets, termites, caterpillars and stem borers.

b. Piecing and sucking insects: The piecing and sucking insect pests have needle-like mouth-parts with which they pierce the plant and then suck up the plant sap or liquid. Examples are aphids, leaf hoppers.

13. Harvesting – Harvest refers to the cutting or gathering in of grains or other food crops. The sole purpose of agriculture is to obtain a good harvest. All agricultural activities should be carried out in time. Harvest is no exception. Timely harvest is very important as a delay in harvest could spell disaster if rain sets in to wet a good crop. Harvest should not be done too early as this will result in less than the maximum yield from the farm. Harvest wounds on the crops should be avoided because such wounds are channels through which disease organisms (particularly fungi and bacteria) enter the crop and cause rots in storage.

    Maturity:
    Different crops have different time intervals from planting before they are ready to be harvested. The maturity period depends on the use to which the crop will be put after harvest.

14. Processing – Processing is a general term for all operations which are carried out on a farm product and alter its shape, appearance or chemical composition before sale or consumption.

15. Storage – Refers to the preservation of the farm product in its raw or processed form with the aim of prolonging the utility period of the product. Processing equipment is generally called processors.

Lesson 18: Generating an Income

Introduction

Welcome to Lesson 18, the last lesson of the sub strand 3. Let us recap on what you learnt in Lesson 17. Firstly, you learnt to identify a suitable Agriculture project like a vegetable for example, cabbage. A project of your choice that would be suitable in the community you live in. Secondly, you learnt about the proper skills of managing a crop or animal project. Lastly, you learnt the steps and methods involved to slaughter, process and pack a chicken. In this lesson,

Your Aims

- list income generating activities and records required.
- Identifying suitable markets for the product whether food crops or animals and budgeting for them.
- Lastly, you will evaluate the performance of a project

Importance of Keeping Records of Income

Records and documents required for proper financial records

At this stage the crops or animals are becoming ready for harvest or sale. The method and timing of the harvest should depend on where the crops or animals are going to be sold, that is, they depend on the market outlet. Thus, it is important to know how and where the crops or animals are going to be sold.

Under this heading, we will be studying two types of records; **Production** records and **Financial** records.

Production records

You will have to write down or keep a record of what was harvested, especially the quantity and the quality per crop or animal. Complete these records carefully, especially as you are learning agriculture at home.

Production records can be written in table form. On a clean page in your diary, draw a table like the one shown below on the next page. Make it cover the whole page to be sure you have enough room. Every time you harvest something from your vegetable plot, record the weight in the appropriate column together with the date. When the harvesting season is finished, add up the total weight of vegetables produced. This is now a complete production record.

Study the completed production record on the next page.

Sample record

Date	Tomatoes	Carrots	Corn	Cabbages	Cucumbers
12th June	1.5 kg			2 kg	
16th June		2 kg			
19th June	2.5 kg	4 kg			1kg
21st June		3 kg			
23rd June		4.5 kg	1.5 kg		
16th July	3 kg		2.5 kg	5 kg	
20th July	1.5 kg	2.5 kg	4 kg	2 kg	2 kg
25th July				1 kg	3 kg
Totals	**8.5 kg**	**16.0 kg**	**8.0 kg**	**10.0 kg**	**6.0 kg**

Financial records

Financial records show the monetary value of all that you produce. This will tell you whether the vegetable growing enterprise made a profit or a loss. Financial records need to be filled in at the beginning of the season. A sample financial sheet is shown below. Find out the market value of the vegetables you have harvested, that is, see what it costs to buy them in the market. Enter the value of your vegetables in the **Returns** column. Now you can complete the financial record by adding up all the costs and all the returns. See which is the greatest then subtract one from the other to find the profit or loss.

You can see that every time a farmer buys something he or she enters it under **Costs**. Whenever a farmer sells something, he or she enters it under **Returns**.

At the end, when the enterprise has run for a complete year, you can add up both columns of figures. By subtracting returns from the cost you can find out how much extra money you made. This is the profit. The outcome depends on the balance between costs and returns.

Sample financial record table

Name of enterprise: Vegetable Growing							
Costs				**Returns**			
Date	**Items**	**Amount**		**Date**	**Item**	**Amount**	
Feb 10th	4 kg lime	K30					
Feb 20th	0.8 fertiliser	K16					
Feb 21st	65g of bean seeds	K2.70					
Feb 21st	6g cucumber seeds	K2					
	Total costs	**K50.70**					

The financial record

Total returns **Total costs**		
Profit (or loss)		

Profit Formula: Profit = Returns - Cost

We have finished looking at the two different production records and their importance. Now we are going to look at where these goods are going to be sold and the prices to be charged. The table below is a crop or planting calendar showing the different crops planting as well as showing the costs involved in a vegetable project.

Estimating a time frame and costs involved in a vegetable project
Suggested vegetable project information and time schedule for a community.

Types of vegetable	Maturity period	Seeds/cuttings per hole	Estimate of expenses	Estimate of returns
1. Aibika	2 months	1 cutting/hole	20.00	200.00
2. Banana	18 months	1 sucker/hole	20.00	300.00
3. Broccoli	4 – 5 months	1 seedling/hole	100.00	400.00
4.Chinese cabbages	3 – 4 months	1 seedling/hole	50.00	400.00
5. Corn	3 – 4 months	2 seeds/hole	40.00	400.00
6. Cucumber	3 – 4 months	2 seeds/hole	40.00	400.00
7. Egg plants	3 – 4 months	1 seedling/hole	40.00	80.00
8. Lettuce	4 months	1 seedling/hole	40.00	200.00
9. Peanut	4 months	2 seeds/hole	30.00	200.00
10. Pumpkin	4.5 months	2 seeds/hole	30.00	100.00
11. Snake bean	3 months	2 seeds/hole	40.00	100.00
12. Sweet potatoes	5 – 6 months	3 cuttings/hole	50.00	400.00
13.Taro	8 – 12 months	1 tuber/hole	20.00	300.00
14.Tomatoes	3 months	1 seedling/hole	50.00	100.00
15.Winged bean	3 months	2 seeds/hole	60.00	100.00
16.Yams	9 – 12 months	1 tuber/hole	40.00	100.00

Note: All prices obtained from the Madang market

From experience we know, markets are the recommended place, for generating income, however, nowadays, evidence are very clear where we see a lot of self created markets along the road sides or in front of people's yards (street vending)

Generating income

Selling your vegetables at the market
Village markets are interesting places. They are often very lively with people arguing, buying and selling all at the same time.

In every market goods are on sale. There are sellers who offer the goods for sale. There are buyers who want to purchase goods with money. The effects of supply and demand determine price. The higher the demand, the higher the price.

To sell produce at the market
- Bundle your produce (beans, pitpit, taro, aibika and pumpkin tops).
- Only the best quality produce should be taken to the market.
- Put price tags on your produce for the buyer to see.
- Carry some coins for change.

The money earned from the market can be saved at the bank. If you do not have an account with any bank, you have to seriously look into it. Open an Agriculture Account at the bank, savings account, having three people to sign. This is mainly for security reasons, either yourself, your father and a leader in the community. Any two of these people can endorse withdrawals for things you may need to buy from the stores. As you deposit money into the account, over time the bank will pay you interest on the money saved. That money is safe and will not be lost or stolen. The main reason for opening the account is to deposit money from sales.

At this stage, lets assume that the project is about to be completed. The crops or animals have been harvested and sold, money is banked and the cash book record nearing completion. This is the time to close all the records of the project and evaluate. Evaluating the project is important so that improvements can be made to generate more income.

Included below is a sample evaluation form for you to follow. Add more if needed..

Sample evaluation form

	Things to be improved	**Future (local conditions)**
1	Imported seeds were expensive	Use local seeds (beans,pumpkin,cucumber,corn)
2	Tools – not enough for all students	Parents are to help
3	Nursery seed boxes were not ready	Community should help in making boxes
4	Timing of vegetable picking was a bit too early	Tomatoes to be harvested when yellow
5	Proper fencing to be constructed	Local pigs to be fenced in
6	Flooding is a problem	Relocate the garden site
7	Cabbages sold very fast	Increase the price of cabbages

Activity 1 Read and answer the question below

(1) Visit your local community and check to find out projects that are successful and unsuccessful.

(a) State reasons of successful and unsuccessful

_____

_____

(b) How evaluation is done

_____

_____

Summary

You have come to the end of your lesson 18. In this lesson, you have learnt the following:

- Record keeping is the process by which production and records of money of a project are recorded. These records can be done in a simple exercise book. All projects are required to keep these two records. The owners of the project need information (production/financial) to make decisions about the future running of the project.
- **Production records** are activities such as name of crop, date of nursery or transplanting, disease attacks, height of plants, weights, quantity of crop or animals, and feeding habits of animals. It also includes all the activities that help the plants and animals to grow.
- **Financial records** are the records of money spent on the project. Money spent to purchase seeds or young animals, animals feed, fertilizer, freight etc is a cost to the project. It must be recorded under **costs.** Money obtained from the sale of animal or crop is an income and must be recorded under **returns.**
- When a project ends, evaluate it, find out why it has been successful or why it has been unsuccessful.

END OF LESSON 12. NOW DO PRACTICE EXERCISE 18 ON THE NEXT PAGE

Practice Exercise 18

1. (i) Explain Production records

_____

_____

(ii) Explain Financial records

_____

_____

2. Which column do you enter the value of the vegetables?
-

_____

3. Which column do you enter the things you buy?
-

_____

4. Name three (3) places where you can sell to make money.

i)
_____

ii)
_____

iii)
_____

5. What is the main reason for opening a savings account?
-

_____

6. Do you think evaluating a project is good?
_____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND

Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 18.

Supplementary Reading 20: Generating an Income

Income – is the most general word used for money we receive from work, sale of goods and services and investment.

There are different agricultural projects or enterprises in Papua New Guinea which people can select to generate income.

Some examples are as follows:

1. Pig Production – Pigs are looked after for two basic reasons ;
   i. As a commercial business
   ii. Because of its high value in the PNG society.

2. Poultry – Birds raised by the farmers for meat and eggs are called Poultry. These include chicken, ducks, turkeys and geese.

Poultry Farming
At this chicken farm, the building belongs to the farmer, while the chickens and feed are purchased from the supplier company. The farmer is paid according to a ratio of the weight gained.

Chicken farming

3. Fish and crocodile farming – They provide sources of protein and income for people who live along seashores, rivers and lakes, e.g. East Sepik, West Sepik and Western Province.

Fish and Crocodile farming

4. Cattle Production – Cattle industry is an important agriculture enterprise for tropical countries. In Papua New Guinea it is a common farming practice for Provinces such as the Highlands, Morobe and Madang.

Cattle and Pig farming

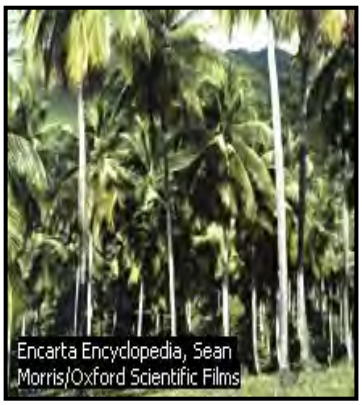
5. Food Crops
   i. Tubers – Root crops, e.g. Kaukau, Yam, Taro and Cassava.
   ii. Cereals – e.g. Corn, Rice and Wheat.
   iii. Vegetables – e.g. Cabbage and Aibika.
   iv. Fruits – Ripe banana, Citrus, Pineapple and Pawpaw etc.

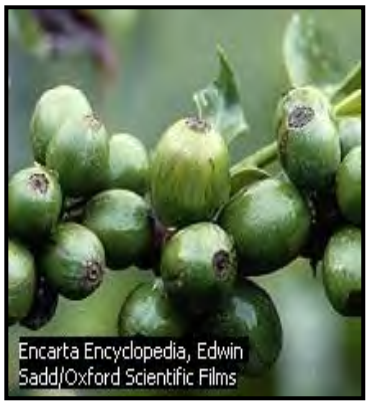
   Organic farmers grow a wide variety of fruits and vegetables. Organic farming in the United States has increased rapidly since 1990, and organic foods are projected to make up 10 percent of the agricultural market by the year 2000.

Different food crops

6. Tree Crops (cash crops)
   i. Coconut.
   ii. Oil Palm
   iii. Coffee
   iv. Cocoa

v. Example of different cash crops





Cash crops of PNG

Again it's up to people's choice on the project they wish to start.

People actually start generating income as soon as goods or produce (e.g. cabbages, tomato, capsicum, Kaukau, etc) are sold at the market place. Village markets are interesting places because this is a common place where people meet every day. You find this place interesting also because people are talking everywhere, buying and selling and at some instance arguing about some issues.
In every market goods are on sale at different prices depending on the demand and supply. The higher the demand the higher the prices. Sellers determine the prices of their goods themselves.

Marketing food crops
Buyers will pay or buy your food crops if they look good and healthy. Any food crops that show poor quality or damage by insect or disease may bring only lower prices or not being bought at all. The appearance and quality of food crops can be improved and higher prices can be obtained if the following methods are used.

1. Shading and Ventilation – The moment the crops are harvested, they should be shaded from the sun and kept well ventilated. Under a cool shade house built from bush materials is recommended or under shady trees.

2. Washing – Food crops like Kaukau, yam, taro etc requires washing to remove soil. It is important to dry them properly to avoid rotting when stored or transported over long distance.
3. Trimming – Remove dry parts, diseased or areas full of holes to improve appearance of food crops.

4. Grading – As harvesting is taking place, sort out the crops, damaged ones should be separated from the good quality ones and graded accordingly according to their size, shape, colour and ripeness. Then price them in that manner.
5. Bunching – Leafy vegetables and stem tubers like yams can be tied together to look neat and be priced by quantity.

6. Packing – Pack the succulent food crops like tomatoes, pawpaw etc neatly in small, strong basket, empty boxes or for tougher root crops in bags.

7. Transporting to the market – Food crops have to be carefully loaded on to the vehicles. Careless loading can cause much damage, which will affect the quality. Soft food crops must be filed on top of the harder ones. Getting the food crops to the market quickly is very important to minimize losses in quality and profit.

Evaluation of the project
Evaluating the project is important so that further improvements to generate more income.

Practical Exercise

Draw up a simple evaluation form.

No	Things to be improved	Future Planting
1	Wrong tools	Buy the right kind for the right use, e.g. Spade and fork for digging and Bush knife for chopping down things.
2	Imported seeds were expensive	Use local healthy seeds
3	Seedlings not growing properly in the nursery	Select a good site for the nursery, dig up the soil, break it up into smaller pieces and sterilize the soil before sowing the seeds.
4	Watering of plants needs improvement	Put an empty drum close to the garden site and fill up with water
5	Proper fencing to be constructed	Local pigs to be fenced in
6	Flooding is a problem	Relocate the garden site or make proper drainage
7	Some food crops sold very fast	Increase the prices of the affected ones

Answers to Practice Exercise 13

1.

NO	COASTAL	NO	HIGHLANDS
	NATIVE CROPS		**NATIVE CROPS**
1	Sago, Aibika	1.	Pitpit, (moi), Rungia, Rorippa
2	Amarathus / Aupa, Karakap	2.	Oenan, winged bean
NO	**INTRODUCED CROPS**		**INTRODUCED CROPS**
1.	Vanilla, Chinese cabbage	1.	Coffee, cauliflower, Chinese cabbage
2.	Mango, Five corner	2.	Round/English cabbage, English Potato

- You can also accept answers if students have similar to what I stated in the lesson.

2. Yes, ginger is a spice.

3. (i) Fruits from the mango tree is eaten.
   (ii) Mango contains vitamins and minerals which are of high nutritional value.

4. (i) Subsistence Farming: This is when people grow just enough food to feed their families. The spare ones are for exchange for clothing and other needs.

   (ii) Commercial farming: This is when farmers only grow crops or animals to sell for money.

5. (i) pigs
   (ii) cassowary, birds

6. When a crocodile is hunted and killed its skin are sold for money

Answers to practice exercise 14

1. Name two (2) native and two (2) Introduced Animals that you see and know of in the community, village or local area you live in.

No	Native Animals	Introduced Animals
1	Pig	Cow
2	Dog	sheep

2. Explain Animal Husbandry

   It is the agricultural practice of breeding and raising livestock.

3. List two (2) main reasons for looking after animals.

   (i) For personal use
   (ii) to generate an income.

4. Name two animals use for customs and traditional ceremonies.

   (i) Pigs
   (ii) Cassowary

Answers to Practice Exercise 15

1. Name the six (6) physical resources when dealing with physical planning.

   (i) People
   (ii) Road, wharf, bridges, airport,(any one)
   (iii) Equipment (dump truck, dozer,truck,(+ any suitable ones)
   (iv) Tools (spades,chainsaws, brush cutters,(+ any suitable ones)
   (v) Materials (timber,cement powder, nails,(+ any suitable ones)
   (vi) Markets

2. What is financial planning ?
   It is referring to the planning for money.

3. List the processes of implementing a project.

   (i) plan
   (ii) implement
   (iii) Monitor
   (iv) evaluate
   (v) Close

4. List two (2) sustainable management practices.

   (i) Mixed cropping

   (ii) Crop rotation

Answers to Practice Exercise 16

1. List the four (4) factors of production

   (i) Rainfall
   (ii) Soil type
   (iii) Humidity
   (iv) Altitude

2. Name (i) two (2) pests (ii) two (2) diseases

   (i) (a) Caterpillars (b) Grasshoppers

   (ii) (a) Nematodes (b) Root rots

3. How long does it take for the seedlings to be ready for transplanting?

   Three to six weeks depending on the vegetable.

4. What is financial record?

   Record of money spent and received.

5. What are the steps involved in managing your garden?

   (i) Replace seedlings that died when transplanting.
   (ii) If too crowded, thin out the seedlings
   (iii) Water the seedlings
   (iv) Weed the plot to keep it clean.
   (iv) Apply mulch to conserve water in the soil.
   (v) Apply manure to enrich the soil.
   (vi) Control pests and diseases.

Answers to Practice Exercise 17

1. List all the management skills or practices involved in a Agriculture vegetable (crop) project.

(a)	Land preparation	(g)	Earthing up
(b)	Planting methods:		
	nursery and direct planting	(h)	Prunning
(c)	Weeding	(i)	Harvesting
(d)	Mulching	(j)	Processing
(e)	Irrigation	(k)	Storage
(f)	Stalking	(l)	Pests and Diseases control

2. List all the management skills and practices involved in a animal project.

(a)	Housing	(d)	Health and hygiene
(b)	Feeding	(e)	Handling
(c)	Choosing breeding stock	(f)	Slaughter and processing

3. List all the steps involved in slaughtering and processing a chicken.

(a) starving
(b) Heating water
(c) slaughtering
(f) removing head and legs
(i) plucking
(e) removing internal organs
(d) checking and inspection
(i) weighing or grading
(h) packaging
(j) preservation

Answers to Practice Exercise 18

1. (i) Explain Production records.

   They are records of the harvest particularly that of quantity and quality.

   (ii) Financial records

   Records telling you about the monetary value of all you produce.

2. Which column do you enter the value of the vegetables?

   Returns Column

3. Which column do you enter the things you buy?

   Costs Column

4. Name there (3) places where you can sell to make money.

   (i) Public markets

   (ii) Back and Front yards

   (iii) Along the roadside or streets

5. What is the main reason for opening a Savings Account?

   For security reasons, that is to avoid unwise spending and also to save money in the bank to earn interest.

6. Do you think evaluating a project is good?

   Yes, so that further improvements can be made to generate more income.

Answers to Lesson Activities in Substrand 1

Lesson 1

Activity 1.1

(a). Yes. It was passed to them by their parents or grandparents.

(b). Yes. The law does recognize customary land ownership.

Activity 2.2

(a) They are called Land Surveyors.

(b) Land Valuer

Activity 3.3

(a) The similarities are people live, grow crops, extract natural resources, built houses, and business on the land and the differences are that free hold or state land, the government zones the land for various activities (business, residential, leisure. commercial and industrial)

Lesson 2

Activity 2.1

(a) The government should build enough schools, health centres, and improve roads in the rural area so people will stop drifting to urban areas.

Lesson 3

Activity 3.1

(a) Yes. All that was needed was taken from the land.

Activity 3.2

(a) cash crops

(b) animals

(c) Lend land to others to use in return for cash

Activity 3.3

(a) Student Choice

(b) Student Answer

Lesson 4

Activity 4.1

(a) i. Drinking ii.Cooking

(b) i. Sirinumu dam ii.Yonki dam

(c) To provide safe drinking water and make it readily available where people can have easy access to it.

(d) In coastal, island or atols.

(e) i. fish ii. salt

(f) i. food ii. Marine Life habitat / etc

(g) i. Fly river ii. Purari river iii. Ramu/Markam/Kikori

(h) i. Lake Kopiago ii. Murik Lakes

(i) i. Food (shells, crabs) ii. Timber / Firewood

(j) i. Habitat for animals, ii. The earths cooling systems, iii. Provides food for animals and people.

Activity 4.2

1. one quarter (1/4)

2. 15,130 tonnes

The new imported materials such as outboat motor, nylon nets, and fishing guns .

Lesson 5

Activity 5.1

(a) Porgera / Lihir

(b) Ramu Nickel Mining

(c) i. coffee, ii cocoa, iii. copra

Activity 5.2

1. Department of Environment and Conservation

2. i. Conservation Melanesia, ii. Green Peace, iii. Nature Conservation, vi. Peace Foundation

Lesson 6

Activity 6.1

(i)

(a) drinking,

(b) laundry

(c) bathing,

(d) gardening

(e) irrigation

(f) fishing

(g) (in towns – toilet flushing, electricity, washing cars)

Activity 6.2

(i)

(a) Rouna Hydro – Central Province

(b) Ramu Hydro - Madang Province

(c) Warangoi - ENB Province

(d) **plus any new and local ones**

(ii)

(a) Water is in abundance in in PNG

(b) Water is free in most rural places in PNG

(c) Our water is clean and ready to use

Activity 6.3

(i)

(a) over-fishing

(b) stealing of its resources

(c) pollution (dynamite , oil/fuel human and animal waste)

(ii)

(a) make strong laws that will protect its resources

(b) make regular patrols on its seas and waters

(c) do awareness and educate people on how best they can use the water resources

Lesson 7

Activity 7.1

1. a. Natural, b. built, c. social

2. a Natural environment is the nature as God has made, hills, rivers, and trees, animals

b. Built environment is using the resources in ways to suit man likings.

c. Social environment is interaction of humans where- ever they are.

Activity 7.2

exhaust fumes, smoke/gases from factories, factory wastes/chemicals dumped into rivers, over – grazing of animals destroys vegetation.

Lesson 8

Activity 8.1.

1. (a)

X	Y	Z	O	N	T	E	T	**R**
W	O	G	H	**S**	**W**	**A**	**L**	**E**
F	I	T	E	A	B	C	W	**S**
D	E	R	F	G	H	I	I	**O**
W	**O**	**O**	**D**	J	L	K	L	**U**
F	M	N	O	D	P	Q	R	**R**
S	T	U	L	V	W	**X**	Y	**C**
Z	A	I	**M**	**A**	**N**	**A**	**G**	**E**
B	**F**	**O**	**R**	**E**	**S**	**T**	R	Y
E	C	D	E	Z	Y	X	L	M

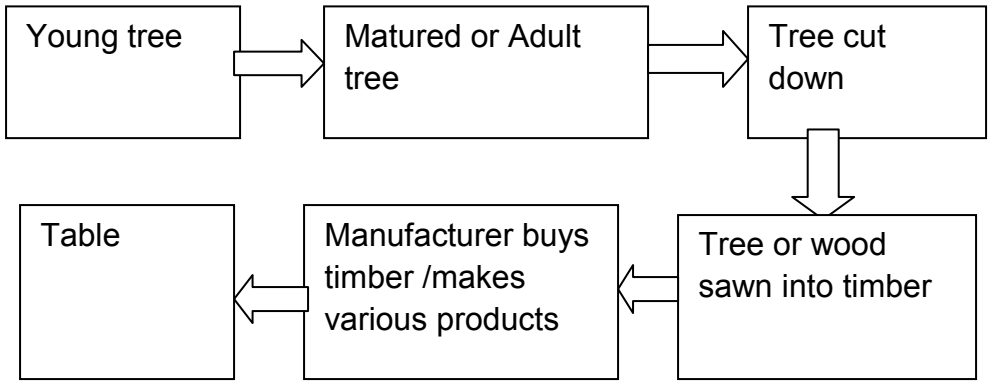
Words: resource, law, manage, tax, wood, forest

(b) Government laws are very concerned about forests fast disappearing and leading into bigger issues such as soil erosion, landslides, destruction of natural habitat for animals/ birds, and imbalance in soil make up.

Activity 8.1

(a) **Students own answer**

(b)



(b) In my area resources are harvested selectively from one area and when more is needed than another is chosen. When trees are cut down, time has to be allowed for the regrowth process to take place.

Lesson 9

Activity 9.1

(a) Sustain means to use a resource and replace or give time to be restored back to its origin

(b) Apart from family consumption, what other reasons do people catch fish ? List two.
(i) Selling for cash
(ii) feasts
(iii) entertainment (game fish)
(iv) export for overseas market (any two)

Activity 9.2

(i) protein

Activity 9.3

(a) Name one traditional method of sustaining marine resources

(i) stop fishing in certain areas or for certain species for a fixed period of time

(ii) use traditional methods of fishing or catching marine resources

(iii) use traditional taboos (death, feasts) to restrict access to fishing grounds

(iv) use traditional calendar to catch certain marine resources

(v) encourage people to start small fish farms

(Any one)

Activity 9.4

(a)
(i) Foreign fishing vessels catching marine resources in restricted areas meant only for coastal villages.

(b)
(i) National Fisheries Authority

(ii) Department of Agriculture and Livestock

(iii) NGOs

Lesson 10

Activity 10.1

(a)
(i) Wau/Bulolo

(ii) Sudest

(iii) Laloki

Activity 10.2

(a)
Mining in early years was very simple – using scale dredging and panning only

Activity 10.3
(a)
(i) destroys their gardening, fishing, and hunting grounds

(ii) kills animals habitation

(iii) destroys natural environment

(iv) pollutes their environment (smoke, dirty water, chemical)

(any two)

Activity 10.4

(a)

(i) improved infrastructure (roads, bridges, wharves)

(i) improved schools, hospitals, aid ports

(iii) improved standard of living

(iv) employment (**any two)**

Activity 10.5 True or False

(a) What do you get,

(i) From ➡ crude oil ➡ fuel **_ true.**

(ii) From ➡ natural gas ➡ liquefied natural gas ____ **true**

(b)
Open Pit Mining is one that the developer or miner extracts the resources mainly copper, gold, silver, and diamond by cutting a big hole into the ground from the side and continue to do so until all the minerals are exhausted.

Lesson 11

Activity 11.1

(a) Name three resource projects in the country. State where each one is located.
(i) Natural gas - Hela Province

(ii) Copper- Western Province

(iii) Oil – Southern Highlands Province

(iv) Gold/ copper mine- new Ireland Province

(v) Fish canning - Madang Province

(vi) Morobe Province

(Any three)

(b)
(i) destroys environment

(ii) kills animals

(iii) Soil is exposed and may erode away

(iv) Young trees are destroyed by bigger ones

(v) Landslides occur regularly

(Any two)

Activity 11.2

(a)

(i) by way of employment

(ii) companies build better roads, proper water supplies ,schools

(iii) improved standard of living

(iv) schools, hospitals, stores at built

(any of the above)

(c) If you were a landowner of a large forest just about to be harvested. How can you be different from all the other resource landowners.

Sample answer only

I would be different from all the other landowners by making sure that the developer has all the development plans in place and any initial developments must be done before harvesting starts. Roads and bridges must be in place before any activity of harvesting begins. All my clan members will have permanent houses to live in. All the money earned will be shared among all the clan members. If there is any surplus funds, it will be invested in my clans name and help any community activities that needs attention like water supply and awareness of social issues in my area. After the harvest is over, new plants are planted for the future generation.

Lesson 12

Activity 12.1
In your own words explain climate change.

(a)

Climate change is the earth's slowly rising temperature especially in the last 20 years.

(b) Climate change is not a theory because there is evidence of activities associated with climate change like the climate is much more warmer, landslides, flooding, crops never grown in Highlands like cocoa and water melon are now grown there and along the coast beaches have been eroded away. The evidence is substantial and cannot be denied.

Activity 12.2

(a) Name four significant events that shows that climate change is really happening.

(i) climate much more warmer

(ii) landslides

(iii) flooding

(v) beaches eroded away

(vi) el nino and la nina

(any four)

(b) No. PNG is not alone in its efforts to manage climate change activities. It has joined other international organization in its bid to control or manage climate change.

Activity 12.3

Complete the sentence below

(a) Humans give trees carbon dioxide and in return they give us oxygen.

Lesson 13

Activity 13.1

(a) Taro, yam, sugarcane, banana, Singapore

(b) cabbage, beans, aibika, peanuts, kaukau, potatoe, carrots, corn

Activity 13. 2

(a) Important Crops

No	Crops	How it is Used
1.	banana	a high energy food, a common family food.
2.	kaukau	high energy, staple food
3.	aibika	protective food
4.	cassava	starch energy
5.	coconut	high energy
6.	sugarcane	energy
7.	taro	energy
8.	cabbage	protective
9.	armarranthus (aupa)	protective
10.	corn	protein

(b) Students use the boxes to write their answers.
(Students answers depends on where they come from.)

(c) You will now state and explain the value of crops and their impact on traditional customs and beliefs in Papua New Guinea. People are seen as one of the most important and valuable resources in a country.

<table>
<tr><td rowspan="3">(A) Fruits

(i)pineapple</td><td colspan="2">(B). Vegetables / Fruit Vegetable</td></tr>
<tr><td>(i) lettuce</td><td>(ii)Cabbage (round)</td></tr>
<tr><td>(iii)Cucumber</td><td>(iv)avocado</td></tr>
<tr><td>(C) Root Vegetable or Tubers
(i)taro (ii)sweet potato

(iii) potato</td><td colspan="2">(v)capsicum
(D) Spices

(E) Grain Legumes</td></tr>
<tr><td>(F) Tree Crops
(i) Cocoa plant
(II) Galip Nut</td><td colspan="2">(G) Seeds
(i) Wing bean
(ii) Corn Plant</td></tr>
</table>

Activity 13.1.

Pregnant mothers eating aibika helps deliver their babies without problems

(a) - a child less than two years is forbidden to eat fish
- when planting taro, children are forbidden from making noise in the garden.
- giving names of ancestors to pigs especially for a healthy growth

Lesson 14

Activity 14.1.

(a) pig, cat, dog

(b) goat, cow, sheep, chicken, and rabbit.

Activity 14. 2.

Pig is the main animal usually used in ceremonies, (deaths, bride price, births, feasts)

Lesson 15

Activity 15.1.

(Resources Identification visitation)

Activity 15.2.

(Risks Identification visitation)

Activity 15.3.

(Students Choice depending on their observation)

Activity 15.4.

1. (a) (Students Choice depending on their observation)

(b) Sample Work Plan

Task: To create a food garden	**WEEK 1**	**WEEK 2**	**WEEK 3**	**WEEK 4**
Clearing the site/land				
Prepare nursery and plant seeds				
Prepare and shape the garden beds				
Transplant seedlings				
Planting seeds eg: pak choy				

(c) (Students answer depending on their observation)

(d) (Students answer depending on their observation)

Activity 15. 5.

(Students answer depending on their observation)

Who does the cutting of trees or logs, clearing, digging, planting, weeding harvesting , and cleaning

---

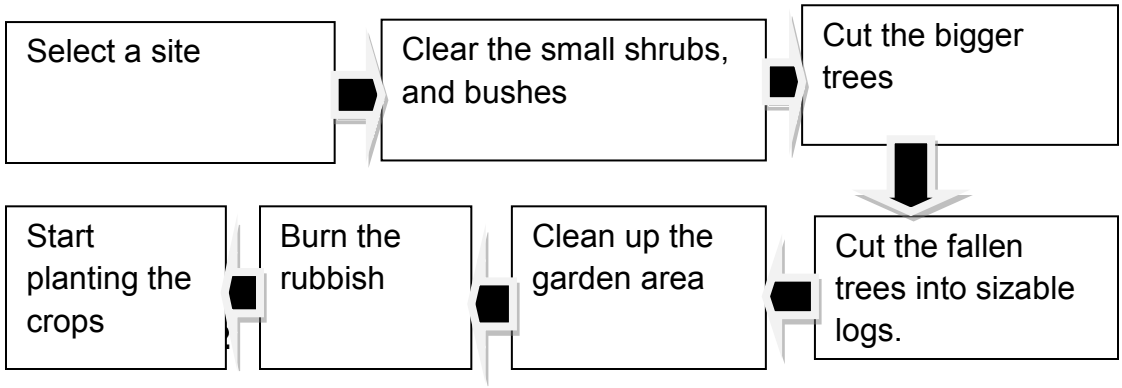
Lesson 16

Activity 16. 1.

Bean stacks are done to enable the bean vine to climb on to, so the fruits can grow well and be harvested easily.

Lesson 17

Activity 17.1.1



(Students answer depending on their observation)

Activity 17.1.3

(Students answer depending on their findings)

Sample

(a) The main methods of weeding are physically pulling out the unwanted weeds or use chemicals to spray them.

(b) The reason why weeds are removed is because;

- the plants can grow well
- stop disease carrying pests or organisms from destroying the crop
- allow the main crop to get all the soil nutrients to grow

Activity 17.1.4

(a) (Students answer depending on their findings/ Different methods of weeding)

Mulching is done in most areas of Papua New Guinea.

(b) **Reasons for mulching**

The reason for mulching are many but the main ones are;

- Support the plants while they are growing up
- Stops weeds from growing
- Stops moist from evaporating
- Keeps the soil cooler for the seed or plant to grow.
- Enriches the soil

(c) **Leaves, Grass**

Activity 17.1.5

(a) (Students answer depending on their findings - irrigation)

Type of irrigation used

(b) rain fall, dew , and drains

Activity 17.1.6

(a) (Students answer depending on their findings)

(b) standing dry tree, platform style, rope or cane hanging from one end to another**.**

Activity 17.1.7

(a) (Students answer depending on their locality)

(c) dig around the plant and pile the soil up, get soil else - where and put at the base of plants. This is done after weeding or any time the plants base is noticed and exposed. After the rain is a good time to do earthing too.

Activity 17.1.8

management

(a) Student answer

(b) The fruits trees, cash crops plus vegetables like tomatoes, egg- plant, aibika, and pumpkim using bush knife, curved saw, pruning shears and secateurs.

Activity 17.1.9

1. Harvesting

(a/b) Student answer

Activity 17: 2.0

Food processing

(a) (Students answer depending on their area)

Sample

Sago - dried in the sun, over the fire place, or put into pots of water

Tapioca – grated, water removed and dried in the sun for two weeks.

Breadfruit – boiled and smoked at the fire place in a similar way fish is smoked.

Galip nut – remove the fleshy covering and dry in the sun or over the fire place.

Cash and Food Crops

No	Highlands	Coastal
1	coffee	Coconut, watermelon
2	tea	cocoa
3	kaukau	corn
4	potatoe	banana
5	cabbage	yam
6	carrot	taro
7	broccoli	kaukau
8	sugarcane	sugarcane
9	tomatoe	aibika
10	pineapple	beans

(b) Normal hand picking is the method used to harvest them.

Activity 17.2. 1

(a) (Students answer depending on their area- food processing)

(b) Most Papua New Guinea have their food fresh from the garden. Some food such as peanuts, and sago are dried and stored for later use.
(c) coffee is dried in the sun and exported later

Activity 17.2.2

(a) (Students answer depending on their area)

Chicken house, cattle house, pig house

(b) Bush materials, semi-permanent

Activity 17. 2.3

(a) (Students answer depending on their area)

Activity 17.2.4

(a) (Students answer depending on their area)

Unusual signs of sick diseases, loss weight, pale colour of skin or eyes, foaming from the mouth, and deaths.

Activity 17.2. 5

(a) (Students answer depending on their area)

Pigs, goats, sheep and cattle are usually loaded into trucks and taken away to be prepared and consumed.

Activity 17.2. 6.

(a) (Students answer depending on their area)

Lesson 18

Activity 18.1.1

(a) (Students answer depending on their area)

(b) Successful businesses or unsuccessful businesses

- not enough market
- too many wantoks getting things free or little money
- stealing from the business

(c) Evaluation

References / Resources / Link

1. Robertson Brian, Tindall Trever, Swallow Villacort Josie, 2008, Making a Living Outcomes Grade 7 / 8 Student's Book, Pearson Education, Australia

2. Norman Pam, Potek Stephen, Hagunama Eron, Deruge Joe, 2005, Making A Living Outcomes, Book 2 ,OXFORD.

3. Getty Images from Google.

4. Nagalingam Ethirveerasingam , Micheal Kapari, Arnold Parapi, Ekpo Ossom, 1993, Agriculture for Melanesia – Grade 7 / 8, Longman, Australia.

4. Liklik Buk, South Pacific Appropriate Technology, Pages 74, 81

5. Animal Science for Advance Diploma

6. Introduction to Tropical Agriculture

7. Brian Robertson, Kerapuke Hivu Toben, Organising School Agriculture, 1998, Longman, Australia