

Department of Education

GRADE 7

MAKING A LIVING

STRAND 1: MANAGING RESOURCES



COURSE BOOK 1

Name: _____

Address: _____

District or Province: _____



**PUBLISHED BY FLEXIBLE OPEN AND DISTANCE EDUCATION
FOR
DEPARTMENT OF EDUCATION**

COMPILED BY: Lucy Joseph
Doris Payok
Diana Akis

DEPARTMENT EDITORS: Ursula miria
Doris Payok

SUBJECT CONTENT EDITORS: Silas Umaropi
Bessie Kilavanua

SUBJECT EDITORS: Late Andala Ipata
Loreta Mekesi
Armstrong Rupa
Celina vavetaovi
Bessie Kilavanua

GRADE 7

MAKING A LIVING

STRAND 1

MANAGING RESOURCES

COURSE BOOK 1

SUB - STRAND 1: LAND AND WATER MANAGEMENT

SUB - STRAND 2: ENVIRONMENT

SUB - STRAND 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 Making A Living (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 members of the Primary School 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: Diana Akis and Lucy Joseph
Formatted by: Ursula Miria

Published in 2017 by the Flexible, Open and Distance Education
© Copyright 2017, Department of Education, Papua New Guinea

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means electronic, mechanical, photocopying, recording or otherwise without prior permission of the publisher.

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

TABLE OF CONTENTS

| | |
|--|----------------|
| Contents | 3 |
| Message | 4 |
| Course Introduction | 5 |
| Strand 1 Introduction | 7 |
| Study Guide | 8 |
| Substrand 1: Land and Water Management | 11 |
| Land and Water Management: Introduction | 12 |
|  Lesson 1: Importance of Land Resources | 13 |
|  Lesson 2: Importance of Water Resources | 19 |
|  Lesson 3: Causes and Effects of Mismanaging Land Resources | 25 |
|  Lesson 4: Causes and Effects of Mismanaging Water Resources | 31 |
|  Lesson 5: Appropriate Management Practices | 37 |
|  Lesson 6: Case Study on Reefs and Islands in Papua New Guinea | 43 |
| Answers to Practice Exercises 1- 6 | 51-58 |
| Substrand 2: Environment | 59 |
| Environment: Introduction | 60 |
|  Lesson 7: Importance of the Environment | 61 |
|  Lesson 8: Household and Community Waste | 67 |
|  Lesson 9: Disposal of waste | 73 |
|  Lesson 10: Practical and Appropriate Waste Management | 77 |
|  Answers to Practice Exercises 7- 10 | 87-92 |
| Substrand 3: Crop and Animal Management | 93 |
| Crop and Animal Management: Introduction | 94 |
|  Lesson 11: Importance of Managing Crop and Animal production | 95 |
|  Lesson 12: Appropriate Crop Management Practices | 101 |
|  Lesson 13: Appropriate Animal Husbandry Practices | 109 |
|  Lesson 14: Case Study on Crop and Animal Farming in Papua New Guinea | 117 |
|  Answers to Practice Exercises 11-14 | 125-130 |
| Answers to Strand 1 Lesson Activities | 131-145 |
| Reference | |

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 Guineans 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. UKE KOMBRA PhD
Secretary for Education

COURSE INTRODUCTION



Dear Student,

Welcome to Grade 7 Making A Living Course. The course will teach you practical knowledge, skills, attitudes and values required for you to be 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. The Grade 7 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 compare the consequences of the mismanagement of land and water resources.
- Investigate and implement practical changes to reduce, reuse and recycle waste to benefit the local environment and community
- Apply and demonstrate knowledge of crop management and animal husbandry practices by undertaking practical projects.

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:

- Discuss and analyse aspects of a nutritious diet and identify different ways of obtaining, processing and preserving food.
- Identify and assess required maintenance of home and school buildings and take appropriate action.
- Investigate consumer rights and responsibilities, and develop skills to become a wise consumer.
- Initiate plans and apply techniques and processes to design items that will benefit you as an individual and your community as well.

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:

- Reflect upon individual strengths and capabilities and how to use them within a community in a positive way.
- Identify and establish networks within a wider community to promote effective access to information to benefit the wider community.
- Plan cooperative projects that require community and individual participation.

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 three Supplementary Books. They are as follows:

- Strand 1: Managing Resources –Supplementary Book 1
- Strand 2: Better Living- Supplementary Book 2
- Strand 3: Community Development - Supplementary Book 3

3. Assessment Books

There are two types of assessment books. They are as follows:

- **Assignment Books:** There are three (3) assignment books. They are labelled 1, 2 and 3. The assignment books contain Substrands Tests and a Strand Examination.
- **Project Books:** There are three (3) project books. They are labelled 1, 2 and 3. The project books 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 when 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 Strand 1 of Grade 7 Making A Living Course.

In this strand, you will learn about the effects of mismanagement of land and water resources. You will also learn the practical ways to reduce reuse and recycle waste to benefit and improve the local environment in which you live in. Furthermore, you will learn about appropriate crop management and animal husbandry practices. Finally, the course will teach you how to plan, design and undertake a small project using appropriate land, water, crop and animal husbandry management practices.

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 land and water resources. You will develop the understanding to appreciate the many land and water resources we have in Papua New Guinea. Land resources refer to all resources on the land such as plants, animals and soil. Water resources refer to resources found in the ocean, creeks, rivers and lakes. You will learn the causes and effects of mismanagement of these resources. You will also learn the importance of using appropriate management practices to sustain these resources.

Substrand 2: Environment

In this Substrand, you will learn about the environment in which you live in and how you can apply appropriate practices to conserve and protect the environment.





Substrand 3: Crop and Animal Management

In this Substrand, you will learn about the importance of farming crops and animals for consumption and for sale. Crops include vegetables and tree crops. Animals includes both land and water animals. You will learn appropriate crop and husbandry practices to improve production.

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 the end of the Substrand and Strand Book to correct your answers. The answers for your Practice Exercises are at the end of the Substrand. 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, when you are satisfied, then go ahead and do Project Book 1

Icons

| | | | |
|---|---|---|--|
|  Introduction |  Lesson Activity Practice Exercise |  Supplementary 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 examination. The second one is the Project Book. Both Assessment Books are out of 100 marks.

Your Assignment and Project Book 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 7-10 | Substrand 2 Test | |
| 7- 8 | Substrand 3 Lessons 11-14 | 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 keep a record of your study progress.

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

SUBSTRAND 1

LAND AND WATER MANAGEMENT

In this Substrand, you will :

- **Identify the importance of managing land resources**
- **Identify the importance of managing water resources**
- **Discuss the causes and effects of mismanagement of land resources**
- **Discuss the causes and effects of mismanagement of water resources**
- **Identify appropriate management practices**
- **Complete a case study or a project**

SUBSTRAND 1 INTRODUCTION



Welcome to Substrand 1: Land and Water Management. You will look at various ways to manage these two very important resources that are essential to human life.

This Substrand contains six (6) lessons.

Lesson 1: Importance of Land Resources

This lesson covers the Importance of land resources. You will identify and discuss the importance of land resources and explain the consequences of not looking after them.

Lesson 2: Importance of Water Resources

This lesson covers the Importance of water resources. You will identify and discuss the importance of water resources and explain the consequences of not looking after them.

Lesson 3: Causes and Effects of Mismanaging Land Resources

This lesson covers the causes and effects of mismanaging land resources. You will identify and discuss various issues that are contributing to land resource problems and suggest ways to solve them.

Lesson 4: Causes and Effects of Mismanaging Water Resources

This lesson covers the causes and effects of mismanaging water resources. You will identify and discuss various issues that are contributing to water resource problems and suggest ways to solve them.

Lesson 5: Appropriate Management Practices

This lesson will help you to investigate and explore appropriate management practices to sustain and preserve land and water resources.

Lesson 6: Case Study on Reefs and Islands in Papua New Guinea

This lesson will provide case studies of land and water resources in particular places in Papua New Guinea. The case studies will give you information about how the resources are managed, sustained and preserved.



Land and water are very important resources. Good management practices will sustain and preserve them.

Source: Google Images

Lesson 1: Importance of Land Resources



Welcome to Lesson 1 of Sub Strand 1. In this lesson you will learn about the importance of land resources.



Your Aims:

- Explain why land is important
 - Identify land resources
 - Discuss effects of not taking good care of land resources
-

Resources

Can you remember the meaning of resources? Yes or No, Resources are things that we use to make other things.



Activity 1: What are some things we use in order to survive? Identify three things we need to survive.

1. _____ 2. _____ 3. _____

There are many, many things we use such as tools, water, clothes, transport, money, food, books, radio, wood, telephone, road, utensils like plates and cups, comb, pen, bag, classroom, playing field, store, market, firewood and timber, plants, leaves and so on. These are all resources. We can continue to list so many things that we use.

There are things we use every day and those that we use when we need to and those that we use sometimes. We can classify them as needs and wants.



Activity 2: Food, water, shelter and clothes are things we need to survive. What are some examples of wants? List three

1. _____ 2. _____ 3. _____

Wants are those things that you don't need to survive but they make life more comfortable and interesting. They include ice cream, sweets and lollies, mobile phone, television set, computer, travel to other places, car, ear rings, perfumes, newspaper, carvings, household items like rice cooker, toaster and microwave oven and so on.



Wildlife- A bird in PNG

Land Resources

Why is land such a valuable resource? Because land produces most of the people's needs. It also provides the habitat and food for animals and plants as well. Human beings, animals and plants all survive on the land. Land provides a place for all to live.

Land includes plants, soil, domestic animals, wildlife, minerals, forest, swamps and wetlands. Land is farmed, grazed, mined, built on or used for leisure. People use land in different ways.

As the population of Papua New Guinea and the World continues to grow, more land will be used. Therefore, there is a great need to protect this resource so that it is used wisely.

However, not all land is suitable for farming. Only a small percentage of the world's surface is suitable for cultivation.

If the land is not used carefully it can be completely destroyed. So, we need to use the land in ways that will not destroy it but save some for future generation. Sustainable Land Development is to use land resources properly and wisely.

Minerals are significant land resources. They provide valuable income for the government, landowners and employees. The income is used to meet human needs in the services the government can provide and for personal use by individuals.

Crops, animals and forests meet physical needs for food, clothing and building material. They can be sold in different forms and provide us monetary income.

Feathers, animal skins, flowers and leaves are used in traditional dress and for other decorative purposes. The relationship between plants, animals and the natural environment can be maintained by good management practices.



Road built through the forest



Activity 3:

Complete the table below with examples of the different food resources we use in Papua New Guinea. Make your list under the headings given. The first one is done for you.

| | Plant Resources | Legumes | Edible Greens | Fruits and Nuts | Beverages and Stimulants | Spice |
|----|------------------------|---------------------|----------------------|------------------------------|---------------------------------|----------------------------|
| 1. | <i>cassava</i> | <i>winged beans</i> | <i>aibika,</i> | <i>soursop pineapple</i> | <i>tea</i> | <i>Mustard vanilla</i> |
| 2. | | | | | | |
| 3. | | | | | | |
| 4. | | | | | | |



Corns and Beans

Plants

Plants are land resources. They include the food crops we eat and cash crops we grow to earn money. Food crops include the staple foods, legumes, greens, fruits, nuts, beverages and spices.

Plant resources include food crops like banana, corn, cassava, taro, rice, yam and sweet potato. They are plant resources that we eat. Legumes include varieties of beans like winged and soya beans, peas, snake beans and mung beans and peanut is also a legume. Other edible greens include; greens like aibika, pumpkin tops, ferns and cabbage.

We have a wide variety of fruits and nuts in Papua New Guinea. We can also include fruits like pawpaw and mango, nuts like coconuts and okari. They play an important role in our diet and give our bodies the vitamins and minerals needed to function well.

There are also plants that we use as beverages and stimulants in Papua New Guinea like betel nut, tea, sugarcane, coffee and tobacco.

We also use many kinds of spices in our diet like ginger, garlic, spring onion and chillies.

Other plants that many Papua New Guineans also use include vines, grass like kunai, bamboo, tree barks, leaves and flowers.

Cash Crops

Many people make a living from growing cash crops. In Papua New Guinea cash crops are grown by individuals and companies. Growers sell their products to factories or exporters in return for cash.

The important cash crops are coffee, oil palm, cocoa, tea, rubber and sugar.

All food crops and cash crops need soil to grow. Soil and land are important resources because they supply us with food and many good things that we need.



Drying Coffee Beans

Land and Soil

The amount of land and quality of soil are important factors that help to decide how well land resources can be used to meet human needs. When a family has limited area of land, the same soil is used repeatedly. This makes the land less fertile and less food is harvested. The family needs to know ways of improving the quality of the soil.

Can you suggest two ways to maintain soil fertility?

(1) _____
(2) _____

Adding organic matter such as mulch, compost and manure to the soil helps to maintain soil fertility. It is important to know the following;

- That all plants take food and water from the soil. The important foods are minerals such as nitrogen, phosphorous, potassium, lime or calcium, magnesium and sulphur.
- Different plants need different amounts of minerals and the soil must suit the plant for it to grow well.
- Fertile soil has plenty of nutrients.
- Rotating the types of crops grown in the same area helps the soil remain fertile as different crops require different nutrients.

Forests, swamps and Wetlands

Forests, swamps and wetlands are other resources. Many forests are rain forest. Why are rainforests important? Why are swamps and wetlands useful to us?



Activity 4:

Give a reason why rain forests, swamps and wetlands are important in the spaces provided below.

- Rain forests: _____
 - Swamps: _____
 - Wetlands: _____
-

Forests are important because;

- Roots of trees protect the forest soil from rain.
- Falling leaves and fruit turn into plant food to keep the soil fertile.
- Fertile soil helps trees to grow big and strong.
- Forest products are used by people for personal needs and to generate an income.
- Trees provide firewood, timber for building houses, building boats and carved items.

- Tree barks, grass, fibres, vines and leaves can be used for clothes, roofing and wrapping food for cooking. Some are also used as medicine to cure various kinds of ailments.

Swamps and wetlands are land that are usually flat and waterlogged. They are important because;

- They are good homes for birds, fish and crocodiles.
- They provide excellent land for sago palms which are important source of both food and building materials for people in that area.
- Rice growing is possible in many wetland areas.

Minerals

Minerals are an important resource in Papua New Guinea. In some areas of Papua New Guinea, there are mineral resources such as gold, copper, nickel, oil and gas. Mineral resources are non-renewable.

Why are minerals non-renewable resources? Minerals are non renewable resources because they cannot be replaced once used or removed. Fossil fuels are non renewable resources. Coal, oil, and natural gas are fossil fuels. Fossil fuels come from plants and animals that died millions of years ago. We are using up fossil fuels much faster than Earth can replace them.

Ores come from rocks that were formed millions of years ago. We use ores to make metals. Ores cannot be replaced, therefore is a non-renewable resource.

What are renewable resources? Renewable resources can be replaced. Plants are renewable resources. Plants might get chopped down, but they can grow again. Animals are renewable resources. They can reproduce.

Solar energy is a renewable resource which comes from the Sun. No matter how much solar energy you use, there will always be more. Wind, water, and soil are also renewable resources.

Animals

Can we classify animals as land resources? Yes, animals are kept by families for personal use, for food, for sale, or kept as pets.



Activity 5: Identify domestic and wild animals you have in your area. In the table below write examples for each class of animal.

| DOMESTIC ANIMALS | WILD ANIMALS | |
|------------------|--------------|------------|
| 1. Poultry | 1. Birds | 4. Insects |
| 2. Livestock | 2. Mammals | |
| 3. Insects | 3. Reptiles | |

Some examples of poultry are; chickens and ducks

Livestock include pigs, cattle, goats and sheep. Insects that human beings use are butterflies, bees, sago grubs and some species of beetles are edible.

Wild animals can be a source of food, decoration or bilas for traditional singsings, clothing and income for the family. Wild birds include doves, cassowaries, parrots, hornbills, and cockatoos.

Mammals like cuscus, tree kangaroos, flying foxes and bandicoots are hunted for food too.

The numbers of many wild animals are decreasing today. Can you explain why?

1. Because the population in many parts of Papua New Guinea is increasing very quickly. More animals are being hunted to provide food for the increasing population.
2. Large forest areas are being cleared to plant cash crops. Many Papua New Guineans are growing cash crops to earn money. A lot more land is being used to plant the cash crops taking the habitat away from the animals.
3. In other areas of the country, virgin forests are being cleared including trees that have taken many years to grow. The trees are being logged for timber by foreign timber companies. Good fertile land is being destroyed and the environment belonging to the wild animals is being destroyed as well.

Importance of Land Resources

The use of land resources must be managed wisely if we are to provide for the needs of people now and in the future. If these resources are mismanaged, human life is in danger.

Plants grow on the land and need soil. What do plants produce that we all need? Remember your science lessons on plants? Yes, plants give off oxygen and take in carbondioxide. For that reason, we need to think about conservation. What does conservation mean?

Conservation means preserving, protecting, saving, managing, maintaining and not destroying the environment.

Why do we need conservation? Long ago, people did not even have to think about conservation because there were very few people. Then, people learned to use natural resources. They learned that using wood, ore, and other natural resources could make their lives easier. People began to live longer. The number of people living on earth grew and grew.

Today, billions of people live on Earth. All these people continue to use natural resources. People are using up fossil fuels and other natural resources faster than the planet can replace them. People cut down forests and destroy the homes and lives of many plants and animals.

People need to use renewable resources wisely. It's important to plant a tree to replace every tree cut down.

Summary



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

- resources are things that we use. They refer to things we take from the land including the land itself.
- land is a valuable resource because it produces most of the food people need.
- land resources include plants, soil, domestic animals, wildlife, minerals, forest, swamps and wetlands.
- land resources are very important in our lives because they provide food, shelter, clothes and money.

NOW DO PRACTICE EXERCISE 1 ON THE NEXT PAGE



Practice Exercise 1

1. Land resources provide for the physical needs of people. State the four (4) basic needs.

2. List some foods that are taken from the forest.

3. What are the main cash crops in your community? (Answer will depend on where the student comes from)

4. Mana is from an island and she has problems producing enough food for her family because of land shortage. She has no more new land area to cultivate. Suggest some methods she can use to continue producing food on the same piece of land.

5. Minerals are non-renewable resources. Explain what the word non-renewable means.

6. Explain the main differences between the need for land resources in traditional times and today.

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

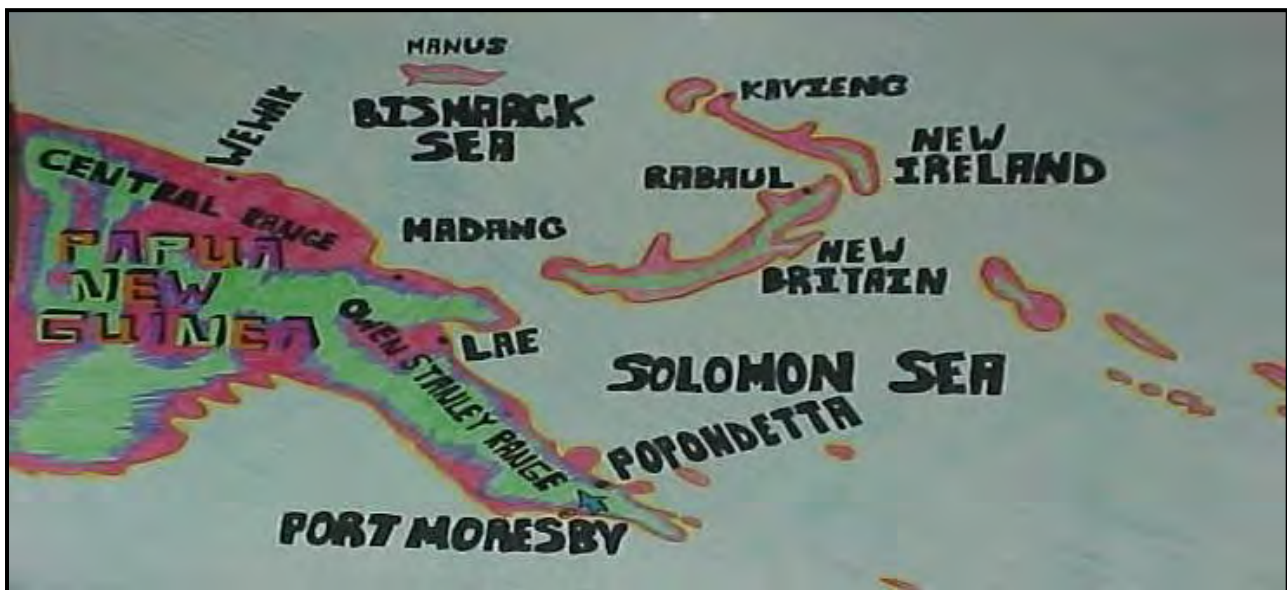
NOW CHECK YOUR WORK. ANSWERS AT THE END OF TOPIC 1 ON PAGES 44 - 46

Supplementary Reading 1: Know Your Country – Papua New Guinea

This is your first supplementary reading on Managing Resources. It will help you get to know your country a little bit more. Where ever you live, who your neighbours are, where and the kinds of food they grow and eat, rivers flowing close by, etc. can generally appreciate our land and the environment live in. Therefore, in this lesson you will learn about your country, its people, plants and animals that grow and live in different parts of Papua New Guinea.

The information you learn will assist you to get around easily any in Papua New Guinea. Every time you visit a province, district or village, you will not real like be a stranger. You can adjust and behave accordingly and communicate freely with the people from that area.

“Papua New Guinea is a land of the unexpected.” However, is very rich in natural resources and has beautiful sites along the beaches, of swaying palms and rugged mountain tops. Let’s go and explore the country.



Map of Papua New Guinea

Where are you in Papua New Guinea?

The coastline of mainland Papua New Guinea is mostly low-lying. In the south it is deeply indented and curved by river mouths and by a number of bays, including, at the furthest point, Milne Bay. The River Fly forms a vast low-lying, swampy delta plain in the south-west. From here the land rises to the rugged mountains of the inland, which include the Bismarck and Owen Stanley ranges. The highest point is Mount Wilhelm 4,509 m². The Mainland Rivers include the Fly, also in the south-west; the Purari, in the south; the Sepik and Ramu, in the north; and the Markham, in the east. The Fly is navigable (deep or wide enough for ships) in its lower course. Some of Papua New Guinea’s major islands, such as New Britain, New Ireland, and Bougainville, are mountainous and volcanic in origin. Many of the small islands are low-lying coral atolls.

1. What local area do you belong to?
2. Are you from the Highlands or a Coastal village of Papua New Guinea?

3. What language do you speak?
4. What kinds of development are taking place on your land?
5. How are you as an individual, land owner or province going to benefit from this developmental project?
6. Are there any logging companies or individuals cutting timber in your local area? If so, go closer and have a look at the fallen trees. What is covering the branches and the tree trunks? Orchids. These are the rarest plants that take many, many years to grow on the tree branch tops and trunks in our jungles.



Palm trees at Lae Botanical Garden

Let's have a look at land first. Our people live on their land, grow food, raise and hunt animals, and finally will go back to the land. We must value and care for our land because it is our livelihood.

Land as a Resource

Land provides all the natural resources, the one that satisfies needs and wants for everyone's survival. Natural resources are of two main types, renewable and non-renewable. Renewable resources include wildlife and natural vegetation of all kinds. The soil or land itself can be considered a renewable resource, although severe damage is difficult to repair because of the slow rate of soil-forming processes. The natural drainage of waters from the watershed of a region can be preserved forever by careful management of vegetation and soils. This also means that the quantity of water can be controlled through pollution control.



Tropical Forest

Papua New Guinea is rich in flora (plants) and fauna (wildlife). It is home to a number of animal species found only here and in the neighbouring West Papua, Province of Indonesian. About 82 per cent of Papua New Guinea's total land area is under forest cover, including some of the least disturbed tropical forests in the world. However, some destruction of forest areas rich in biodiversity has occurred. From 1990 to 1995 deforestation resulted in a loss of 666,000 hectares of forestland. In some parts loss of forest habitat, one hundred and twenty two (122) species of Papua New Guinean are threatened with extinction. Forest conservation programmes in place and the government encouraged eco - tourism as a source of revenue.

While we use the land for our daily nourishment and enjoyment we must do so in the best possible manner so that it can continue to provide our daily needs and wants

Plant and Animal Resources

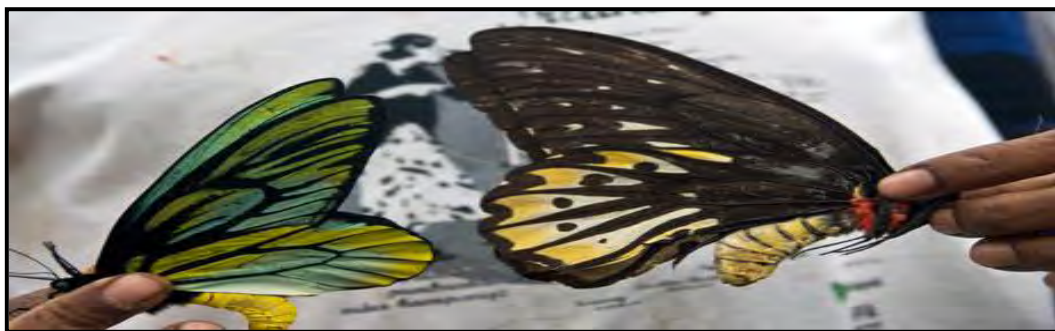
We will now have a look at plants and animals. Nearly three quarters of Papua New Guinea is covered by thick tropical rainforest. Sago and mangrove swamps are found along parts of the coast of the mainland. Scattered stands of pine trees are found on the mountains, as are deciduous (wood) forest and some alpine flora.

Papua New Guinea's wild animal life is plentiful and wide-ranging. The majority of animals are similar to those found in Australia, but there are many species of both animals and plants that exist only in Papua New Guinea and West Papua. Monotremes (egg-laying mammals) such as echidnas (spiny anteaters) are among the mammals commonly found on the island, as are marsupials, including tree kangaroos, wallabies, and phalanges. Wild pigs, rats, bats, and mice are also common mammals, some of which were introduced by early human immigrants. It also has hundreds of species of tropical birds, among them many unique and protected birds of paradise. Reptile species, including snakes, lizards, and the crocodile, are plentiful.



Echidna and tree kangaroo are both mammals

A number of crocodile farms like Mainland Farming in Lae export skins and sell the meat. Insects include large and colourful butterfly species and malaria-carrying *Anopheles* mosquitoes. The coastal waters support many species of fish shellfish, and turtles. So you can see that there is so much that this country has which makes up the biodiversity and compliments it population.



Butterflies: birdwing /Alexandra

Samples of Orchids



1



2



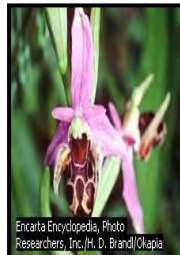
3



7



4



5



6

- | | | | | | | |
|------------------|-----------|-------------|-------------------|--------|---------------|--------------|
| 1. Black Vanilla | 2. Orchid | 3. tropical | 4. lady's slipper | 5. Bee | 6. pink/white | 7. Brazilian |
|------------------|-----------|-------------|-------------------|--------|---------------|--------------|

Languages

There are more than 800 local languages existing in Papua New Guinea – about a third of the world's local tongues. This gives us the bigger picture of the diverse culture and tradition in the country. Pidgin is common to most Papua New Guineans, and learning a few words can be handy, especially when travelling in more remote areas and towns too when you need treatment, use bank facilities and shops too. Below are some basic words and phrases in Pidgin, asking for things and directions.

Some common **English** words in **Pidgin**

| English | Pidgin | English | Pidgin |
|-------------------|---------------|------------------------|-------------------------|
| 1. Yes | 1. Yes | 6. What is your name? | 6. Wanem nem bilong yu? |
| 2. No | 2. Nogat | 7. Where are you from? | 7. Yu bilong weh? |
| 3. Good morning | 3. Monin | 8. Hospital | 8. Haus sik |
| 4. Good afternoon | 4. Apinun | 9. May I take a photo? | 9. Inap mi kisim piksa? |
| 5. Good night | 5. Gut nait | 10. I don't like it | 10. Mi no laikim |

Supplementary Activity - Orchid Nursery

Here is a sample of a project that you can do in your backyard, at home or school. The orchid plants can be grown to beautify the school grounds, sell to hotels, churches, offices and even used in the homes

Materials needed

Ten (10) strong and short logs about two meters long of any size.

A roll of tie wires about 20 meters long

A small shelter [4mx4m] and 2 meters high

Equipment needed

20 different varieties of orchid plants

Spades for digging holes

A green nursery cloth or green fly wire(shade cloth)

Steps

1. Select good flat land in the yard to build the nursery
2. Mark the holes for the orchid posts with equal distances and height [five on each sides]
3. Carefully place an orchid plant upright on each post and tie with a wire.
4. Support the orchid plant with coconut husks or banana fibres around the base and tie with a piece of wire firmly
5. Build a strong fence around the nursery Water your plants in the afternoons and watch out for pests
6. Plants should produce flowers within twelve to thirty six months.
7. Harvest the flowers and cuttings with a sharp knife and bring them to the market for sale

Note: Repair the nursery with strong timber from the bush.

Supplementary Reading 2: Soil

Soil is a resource that our life depends on for food and many other essentials for living. It is the loose material that covers the land surfaces of Earth and supports the growth of plants.

Have you ever run barefoot through the grass or muddy footpath? Have you ever looked at a field of corn? Have you ever planted a flower seed? Grass, corn flowers, and all other plants need soil in order to grow. Without soil there would be no crops for food, forest, flowers, or grasslands. You could say that life on earth depends on soil.

Soil is everywhere around you. It covers much of the earth's surface. The soil in the Wabag Valley is black. The soil in some Southern Region Provinces - Central Province, Sogeri, is a reddish colour. Near well watered lakes, and oceans, the soil

can be gritty and sandy. What a soil looks and feels like depends on how it is formed. Pick up some soil from your yard or a park. Look at its colour. Try and feel if it is gritty or smooth when you pick it with your fingers.

What is Soil Made Of ?

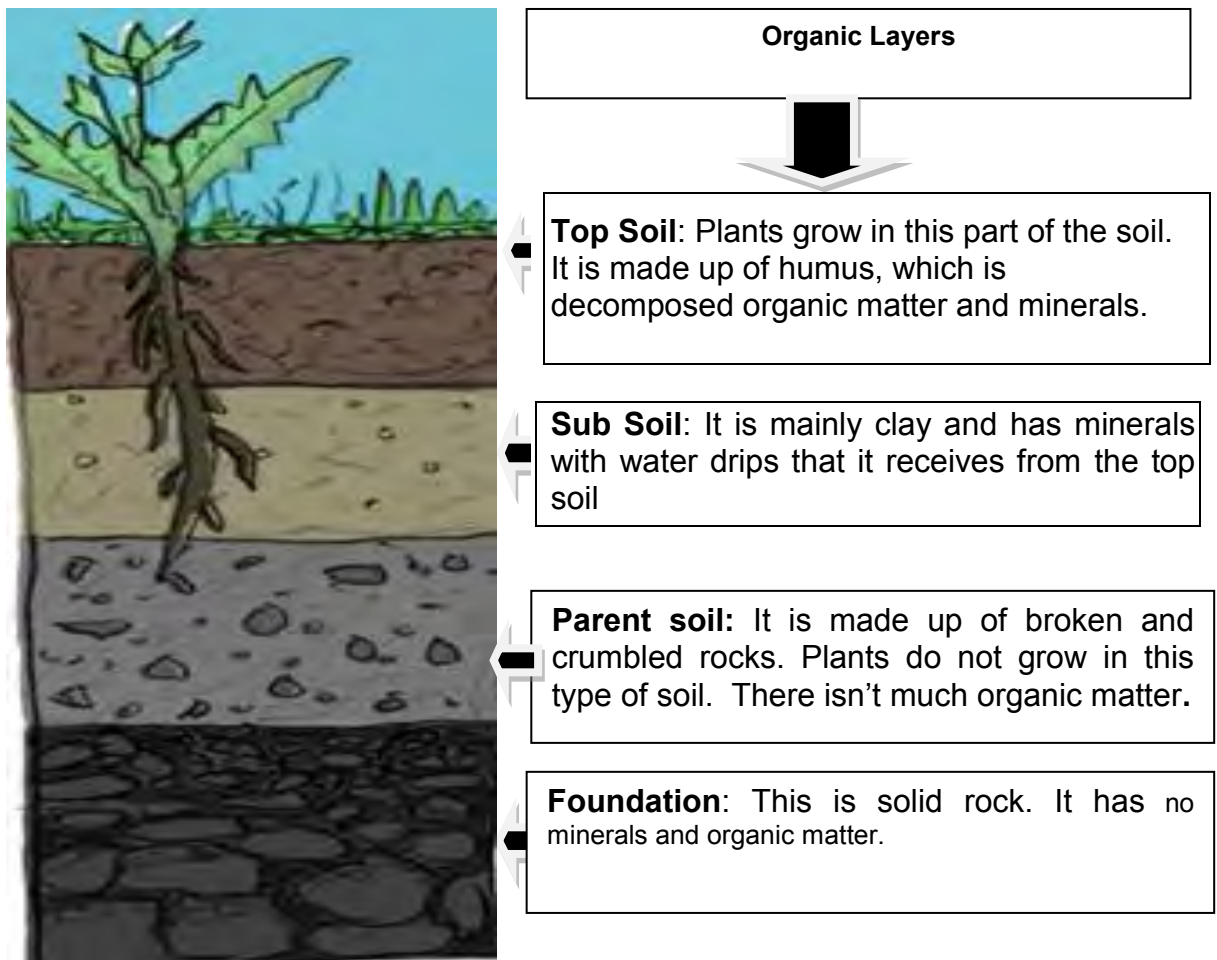
Soil is the thin surface that covers the foundation of most of the land area of the Earth. It is a resource, along with water and air. It provides the basis of human existence. Soil develops when rock is broken down by weathering and material is exchanged through relations with the environment. Organic (living) matter becomes incorporated (combined) into the soil as the result of the activity of living organisms. Soil also contains water, minerals, and gases. The soil system is full of life and it develops a distinct structure, often with recognised layers or soil horizons arranged vertically through the soil profile.

Soil is important for the growth of most plants, providing physical support and nutrients. Plants are anchored in the soil by their roots. Nutrients, dissolved in soil water, are necessary for the plants' growth. Soil contains various organic matters, including dead material from plants and animals as well as other living things animals that live in the soil.

The soil is therefore a store of major nutrients such as carbon and nitrogen. It plays an important role in global nutrient cycles and in regulating hydrological (water) cycles and atmospheric (wind pressure) systems.



Earthworm



Different layers of soil

Types of Soil

Soils vary from place to place due to various conditions such as climate, rock type, topography, and the local soil-forming processes. Over time soils develop characteristics specific to their location, which relate closely to the climate and vegetation of the area. The major world **biomes** reflect a clear link between vegetation and soil that has developed in response to the general climate. Each soil type has a separate combination of soil horizons and associated soil properties.

Biomes is a division of the world's vegetation that links to a distinct climate and is grouped by specific types of plants and animals, e.g. tropical rain forest or desert. Soils form continuously as the result of natural processes, and can therefore be regarded as a renewable resource

However, the soil-forming processes operate very slowly and the misuse or mismanagement of the soil may lead to damage or erosion, or can disrupt the processes by which the soil forms. If this happens the resource can be degraded or even lost. Many human activities cause damage to soils. These include bad farming methods, overgrazing, deforestation, urbanization, construction, mining, wars, contamination, pollution, and fires.

The result of these is that soil erosion. With growing populations, the need for productive soils is increasing. Soil loss in many developing countries is a major cause for concern and will become a major issue in the future.

The process of soil loss can have a disadvantageous effect on other systems as it produces sediment that can cause siltation (Siltation is the process of becoming blocked with fine sediments) of river systems and reservoirs, set off flooding downstream, and contribute to pollution and damage to estuaries, wetlands, and coral reefs. Soils need to be managed carefully in order to remain in good condition.

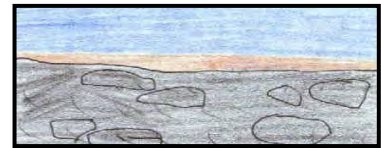


Sandy and loam soil

Stages in Soil Formation

The formation of soil happens over a very long period of time, like thousands of years or more. Soil is formed from the weathering of rocks and minerals.

(1) The surface rocks break down into smaller pieces through a process of weathering (Stage 1)



(2) It is then mixed with moss and organic matter. (Stage 2)



(3) Over time this creates a thin layer of soil. Plants help the development of the soil. How? (Stage 3)



(4) The plants attract animals, and when the animals die, their bodies decay. Decaying matter makes the soil thick and rich. This continues until the soil is fully formed. The soil then supports many different plants. (Stage 4)



Stages in the formation of soil

Weathering is the process of the breaking down rocks. There are two different types of weathering, physical weathering and chemical weathering. In physical weathering it breaks down the rocks, but what it's made of stays the same. For example, In chemical weathering it still breaks down the rocks, but it may change what it's made of. For instance, a hard material may change to a soft material after chemical weathering.

What Kinds of Things Live in the Soil?

Look closely at a pile of soil. It is full of living creatures mainly small organisms. You may see earthworms, mites, millipedes, centipedes, grubs, termites, and other animals. Soil is also full of things you can only see under a microscope.

In this small world of soil, a lot is going on. Worms and other fairly large creatures eat decaying parts of plants. Bigger animals eat smaller ones. They expel waste into the soil. Minute life forms called bacteria and fungi feed on the bodies of dead animals and reduce them to simpler materials that plants can use for food. Decayed plant and animal parts create a rich, dark-coloured soil called humus.

Lesson 2: Importance of Water Resources



Welcome to lesson 2 of Sub Strand 1. In the last lesson you learnt about the importance of land, the effects and results of not taking good care of it. You also identified the land resources. In this lesson you will learn about the importance of water resources.



Your Aims:

- Identify important water resources
- Discuss the effects of not taking good care of water
- Discuss the importance of water resources

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

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

What Is Water?

Water is a combination of oxygen and hydrogen atoms. It can be a liquid, a solid, or a gas. Liquid water flows. Solid water is ice. Water in the form of a gas is called water vapour.

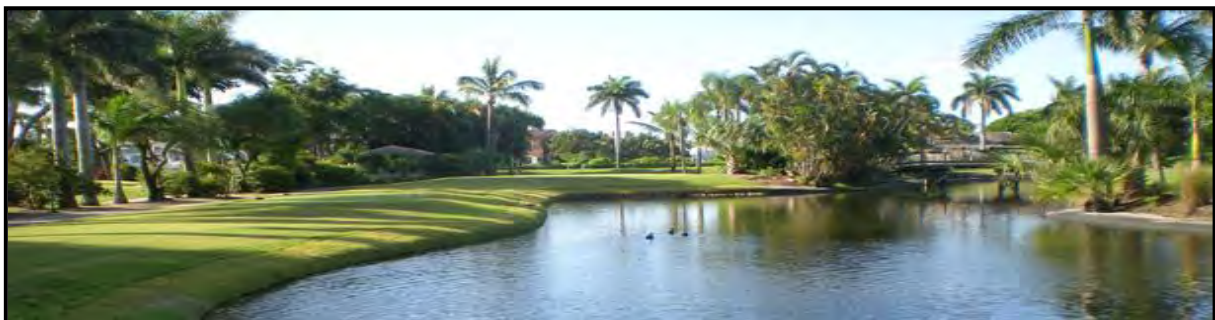


A drop of water (H₂O)

Where Is Water Found on Earth?

Water is found in many things. A huge amount of water is found in the ocean, lakes, ponds, rivers, and swamps. Water droplets form rain clouds. Water makes beads of dew on the grass. It seeps down into the ground and fills underground lakes and streams. Ice falls as hail or crystals of snow. Ice forms on ponds and frosty windowpanes. Huge sheets of ice make glaciers and icecaps at the North and South Poles. Water vapour is always present in the air. It makes clouds in the sky. and fog that hangs close to the ground, like the steam that comes out of a boiling kettle.

People who live near big lakes or rivers have more fresh water than people who live in the desert. Places where a lot of rain falls also have more fresh water.



A part of the main river branching into the land

Places that usually have enough fresh water sometimes have drought. Very little rain falls during a drought and people run short of water. It is very important for people everywhere to be careful not to waste water.

Nature recycles water all the time. Water in oceans, lakes, and rivers evaporates, or turns into a gas and rises into the air. The water vapour eventually turns back into a liquid and falls as rain. The water cycle keeps the total amount of water on Earth the same. But most of this water is salt water in the ocean.

Where is Water Found in Papua New Guinea?

Water resource come from rain, dams, tanks, wells, oceans, rivers, coral reefs, lakes, mangroves, wetlands, and swamps. People need a water supply for drinking, cooking, washing and flushing the toilets. Although Papua New Guinea has an abundance of water resources, 70 percent of the population have no access to safe, water and sanitation is a major problem. Furthermore, many people travel long distances to collect water.



Mother and child fetching from the water tap

What are the names of the big rivers in Papua New Guinea?

1. Fly River is in the Western Province and is the longest river and carries the most water. Ships travel up the river to Kiunga Port to deliver cargo to Ok Tedi and also to load copper and gold for export.
2. Sepik River is the second biggest river in Papua New Guinea. It is best known for the Sepik masks, carvings, artefacts, crocodiles and fish.
3. Purari River in the Gulf Province of Papua New Guinea is the third biggest river and
4. Kikori River, also in the Gulf Province is the fourth biggest river.

All these rivers are important water ways and means of transporting goods into and out of the area. They provide food for people, plants and animals living along the rivers. Rivers also carry a large quantity of soil and other matter down into the sea.



Activity 1:

1. What is the name of the nearest river to your village _____
2. How does the river help you and your people?

Where Do You Get Drinking Water?

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

One method of making water safe for human consumption is by boiling it for five minutes, before removing it from the heat source and letting it to cool. Another method which kills harmful bacteria is by adding chlorine to water supplies.

Dirty water can be made less dirty by sedimentation and filtration. In the sedimentation method, water is let to stand for the coarser particles to settle to the bottom. In the filtration method, water runs through sand or a fine cloth that catches the coarser particles. In both these cases, the water should still be boiled or chlorinated to be made safe to drink.

A good quality, conveniently located source of water is important for people's health. Diseases such as diarrhoea, typhoid and dysentery are caused by poor quality drinking water.

**Activity 2:**

In the place that you are living, where do you get water from?

The Importance of Water and Water Resources

Water is one of the basic human needs including food, shelter, clothes, love, protection and safety. Water is important for human health and survival. It is a physiological resource. Physiological means relating to the way that living things function, rather than to their shape or structure

Water resources such as wells, streams and rivers must be looked after. It is important to make sure rivers and the coastal areas are not over fished and that pollution is prevented. Pit toilets built close to wells can pollute the ground water and eventually the well. River pollution can be caused by too much fertiliser run - off from plantations and from too many people and their animals using the river as the toilet place. Smaller rivers and streams with much less water are more at risk to this pollution.

People need fresh water for drinking and for growing food on farms. Ocean water is too salty to drink. It is too salty to use for watering plants too.

What other resources do you get from water? You get food from water sources including fish, trout, tuna, sharks, crabs, crayfish, shell-food, oysters, octopus and turtles. Sea-shells may be sold, used as money or used to make necklaces, armbands and other decorative purposes.

Much of the fish in fresh water and seas is for self-consumption but there are some commercial fishing, especially for prawns, crayfish and tuna. Fishing licences sold to foreign fishing fleets are also an important revenue source.

Sustainable practices are currently being carried out to ensure seafood supplies for future generations.

**Activity 3:**

How do your people in the village protect their rivers, swamps and the water resources that live there?

Summary

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

- Water can be in the form of liquid, solid, or gas.
- Water sources come from rain, dams, tanks, wells, oceans, rivers, coral reefs, lakes, wetlands, and swamps.
- People need water for drinking, cooking, washing, flushing the toilets and many other things.
- Not all water is safe to drink. Water in lakes and rivers can be polluted. It can have harmful chemicals or germs that cause disease.
- One method of making water safe for human consumption is by boiling it.
- Dirty water can be made less dirty by filtration and sedimentation.
- A good quality, conveniently located source of water is important for people's health.
- Water is one of the basic human needs. It is important for human health and survival. It is a physiological resource.
- Water sources such as wells, creeks, streams and rivers must also be looked after.

NOW DO PRACTICE EXERCISE 2 ON THE NEXT PAGE



Practice Exercise 2

1. Why are waterways seeing important for everyone?

2. Name two sources of pollution affecting streams and rivers.

3. Why are smaller streams and rivers more likely to be polluted than larger rivers?

4. Read the passage below about Rivers in PNG then answer the questions that follow.

Papua New Guinea has 10 940 km of rivers. This is the twelfth (12th) largest river system in the world. Most of the rivers are short, running directly from mountains into the sea. A few rivers, such as the Sepik and Purari, collect water from many rivers before reaching the sea. PNG's rivers carry unusually large amounts of water because of heavy rainfall and steep mountainous terrain and valleys. Some, for example, the Sepik and Fly, lose much water in flood plains.

(a) The Sepik and the Fly rivers lose plenty of water in the flood plains. What do you find in the flood plains of the Sepik and Fly rivers?

(b) PNG's rivers carry unusually large amounts of water, why?

(c) PNG is rated as having the twelfth largest river system in the world. Find out which country has the largest river system in the world.

5. Now read this passage about turtles in PNG

Turtles are slow-moving reptiles with heavy shells to protect their soft bodies. PNG has 6 kinds of sea turtle and 7 kinds of fresh-water turtle. Most turtles eat both plants and animals like fish frogs and insects. Turtles do not have teeth, instead, they have hard, sharp beaks that they use to catch and cut food. Turtles bury their eggs in sand or mud. New-born turtles must look after themselves. Villagers eat turtle eggs and meat. People carve combs and ornaments from the scutes of sea turtles.

Sea turtles are very big and have flat swimming flippers instead of feet. They swim with the flying motion of a bird. Sea turtles travel long distances during their life but they return to PNG beaches to lay their eggs. Several kinds of sea turtle are becoming scarce in PNG and environmentalists have urged villagers to limit eating their eggs. Green turtles are the main turtles hunted in PNG. Which eat sea plants. Their meat is green but tastes good.

(a) List some uses of turtles.

(b) How can we ensure that the green turtle does not become extinct in PNG?

(c) How many kinds of turtles are there in PNG?

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 3: Water

Introduction

It takes a very, long time for soil to form. Everything in this world grows, flows and sits on soil. Water is another essential resource that you and I cannot live without. It is one of the basic human needs too.

Use of water

Water resources are sources of water that are useful to humans. The uses of water include agriculture, industrial, household, recreation and environmental activities. Ninety seven percentage [97%] of water on the earth is salt, leaving only three percentage (3%) as fresh water. Two thirds of fresh water is frozen in glaciers and ice caps. The remaining unfrozen is found as groundwater with a small part above ground or in the air.

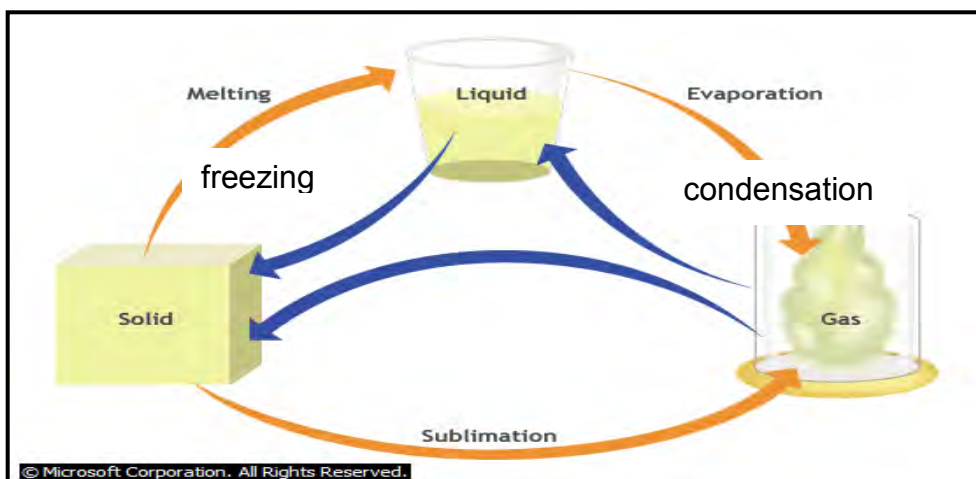
Fresh water is a renewable resource; however, it is sad to note that clean, fresh water is steadily decreasing. Our population is increasing so as the demand for water. Awareness in conserving wetland just started in the 20th century when half of the wetland with its valuable resources have been lost.

Food and water are two basic human needs. However, worldwide coverage figures from 2002 indicate that, of every 10 people:

- 5 out of 10 have a connection to piped water supply at home.
- 3 out of 10 have some sort of water supply.
- 2 out of 10 are without water.
- In addition, 4 out of 10 people live without improved sanitation.

Stages of Water

Water can take the shape of a solid, liquid, or gas. When water changes to a liquid, it is called melting. When a liquid changes to a gas, it is called evaporation. Sublimation occurs when a solid changes to a gas. These changes are reversible. Gas can turn into a solid or a liquid, and a liquid can turn into a solid.



Stages of Water

Water is the only substance that occurs at ordinary temperatures in all three states of matter, that is, as a solid, a liquid, and a gas. As a solid, or ice, it is found as glaciers and ice caps, on water surfaces in winter, as snow, hail, and frost, and as clouds formed of ice crystals. It occurs in the liquid state as rain clouds formed of water droplets, and on vegetation as dew; in addition, it covers three-quarters of the surface of the Earth in

the form of swamps, lakes, rivers, and oceans. As gas, or water vapour, it occurs as fog, steam, and clouds. Atmospheric vapour is measured in terms of moisture

Climate Change

Climate change will have big effects on water resources because of close connections between the climate and hydrological (water) cycle. There will be increase evaporation due to high temperature and may lead to increases in rainfall. Droughts and floods will be more regular in some regions at various times. Higher temperatures will be experienced and affect water quality in unexplainable ways.

Water pollution is one of the main concerns of the world today. The governments of many countries are determined to find solutions to reduce this problem. Many developing countries face the problem of dumping sewage into the natural waters.

Lesson 3: Causes and Effects of Mismanaging Land Resource



Welcome to Lesson 3 of Sub Strand 1. In the last two lessons, you learnt about the importance of land and water. You learnt that land and water are essential for life. You also learnt that these two very important resources are under greater threat today than they were in the past. In this lesson, you will learn about the causes and effects of mismanaging land resources.



Your Aims:

- Discuss the causes of mismanagement of land resources
 - Discuss the effects of mismanagement of land resources
-

Land and water are becoming very important as developments continue to take place. The population of Papua New Guinea is also growing very quickly.

When developments take place, it always requires the use of resources. Development is good for our communities and country but we must know how to manage the changes that development is bringing.

Mismanagement of Land Resources

What does the word management mean? According to the Encarta Dictionary, it defines management as the skillful handling or using of something such as resources.

To manage means to organize, run, administer or supervise and control the running of an activity. In our case, we will be looking at how land resources are managed, organized, administered, supervised and used.

Mismanagement is the opposite of management. It means not managing, not organizing, not carrying out the activities properly or not using resources properly. This can become a big problem. The activities we will be concentrating on here are to do with land.

What are the Causes of Land Problems?

There are some reasons causing land problems. Overcrowding is one. Why is there overcrowding in some areas of Papua New Guinea? Well, the population has increased so that in the last three decades. This means that there are more people on the same land area. Therefore the land available for people to farm is not enough. When such a situation is not managed properly, what is likely to happen? Disputes among people, or between neighbours, families, clans and tribes are likely to occur.



Activity 1: In Papua New Guinea, overcrowding is not the only reason why there are land disputes and problems. Identify two other reasons and write them down.

Rapid increase in population is one factor causing shortage of food and money, infrastructural and resource developments, including mining, forestry and agricultural developments.

What does infrastructure mean? The government provides services to the people such as roads, airports, schools, hospitals, telecommunication services and towns. All of these are government infrastructural developments and they all require the use of land.

We now have many forestry companies logging timber in various parts of the country. We also have a number of mining companies. There are also big agricultural companies running plantations like coffee, coconut, cocoa, oil palm and tea. So, you can now see why our land resource is becoming smaller.

Imagine what it will be like if all the land is used up by the government and the big businesses and foreign companies. Where will we live and where will we make gardens for our food? Will our future generations have land to build their homes?

We must now learn to manage land by learning and using new and improved technologies.

Effects of Land Mismanagement

All development activities have their advantages and disadvantages. What are the advantages of allowing a company to cut timber in your area?

People in the community will have more money because some will be employed by the company. Some will be able to sell their garden produce to the company and its employees and earn an income. Others will get into some other businesses like running a PMV or bus service. Can you see how the community will benefit?

What are the disadvantages? Rainforest will be cut down. Good trees which took a long time to grow will disappear. The ecosystem will be disturbed or even destroyed. Land may not be suitable for gardening anymore. Birds and animals will disappear. There will be no more hunting grounds. Some food resources will be lost and so on. Some medicinal plants may also disappear. Remember that when we allow our land and the resources to be exploited, we must be prepared to face the consequences and effects.

Look at the picture on the next page which shows the development taking place in the new Ramu Nickel Mine. What are the effects of this development to the environment, the ecosystem and the land?



The Kurumbukari Mine Site

Developments like this mine can reduce the availability of resources if they are mismanaged. Logging areas without a reforestation program causes loss of plant diversity, animal habitat and soil.

Continuous cropping on the same piece of land reduces the fertility of the soil, which then requires longer time to recover and the use of fertilizers. Low production of food also occurs over time.

Resource developers must follow environmental laws and regulations to ensure that pollution and waste disposal are properly managed.



Activity 2: The picture below shows the effect of some activities. A landslide occurred here. What do you think is the cause of this landslide?



By Paul Maolai, Post courier Friday June 26, 2009.

Summary



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

- Management is defined as the skillful handling or using of something such as resources.
- To manage means to organize, run, administer or supervise and control the running of an activity.
- Mismanagement is the opposite of management. It means not managing, not organizing, not carrying out the activities properly or not using resources properly.
- Population, infrastructural developments, resource developments, include mining, forestry and agricultural developments can contribute to mismanagement of land resources.
- Developments like mining and logging projects can reduce the availability of land resources.

NOW DO PRACTICE EXERCISE 3 ON THE NEXT PAGE



Practice Exercise 3

1. Read the article below then answer the questions that follow.

FLOODS HIT MILNE BAY

Two thousand people have been affected with their houses, properties and gardens washed away in flash flooding at the weekend due to heavy rain.

Milne Bay provincial disaster co-ordinator Eric Balaria, after his rapid assessment of the disaster affected areas like Porotona, Huhuna, Nigila and Sagarai said the flood was caused when 1040mm of rain fell over the Milne Bay mainland at the weekend. This was the highest rainfall recorded in the province since January to June.

The heavy rain caused several rivers in the East Cape area to burst their banks, sweeping away gardens, pit toilets, domestic animals like pigs and causing major landslips on the North Coast Highway. Mr Balaria said there were 25 landslips recorded on the North Coast road making it impassable by vehicles. The highway is the only road link for the people to travel from Maramatana to Alotau. Two thousand people in these areas have been affected however many more will be affected because the only road link is badly damaged, he said. Mr Balaria said because of the road, badly affected people were resorting to travel by dingy from Maramatana to East Cape and from there by road to Alotau which is very costly while others resorted to walking.

After the weather improves, he will engage the Department of Works and Milne Bay Technical services to firstly remove the debris from the landslips before trying to repair as best as possible the road. He said he has not received any reports from the Oro-Milne Bay border villages in the Gegerawa to Biniguni were not badly affected. These areas were badly affected during cyclone Guba previously and villagers have moved away from the rivers. He has written a report and sent it to the Culture and Tourism an Alotau Open MP Charles Abel, briefing him on the areas affected. His report included an urgent request for food supplies, tents and tools for the people affected. He was also concerned about the many pit toilets that had been washed away and said there was an urgent need to repair them quickly to prevent water-borne sicknesses. Mr Balaria said there was no problems with drinking water however many food gardens had been washed away and there was too much water, causing damages to food crops. He warned people not to make gardens near rivers or on hills in these area to prevent more damages during heavy rain in the future. He said there had been no reports of flooding in the Milne Bay islands however there was a strong wind warning with no reports of damage or accidents. Meanwhile, Maramatana local level government president James Rubeni said he had walked across from Garuahi to Watunou and confirmed the people were badly affected by the floods. "In my view this is the worst flooding I have seen in many years and the highway has huge gaping holes. "Several sections have been completely swept away and this has been compounded by many landslips." Mr Rubeni said.

1. Complete this table of Cause and Effect. The first two have been done for you as examples,

| NO | CAUSE | EFFECT |
|----|------------|--|
| 1. | Heavy Rain | Flood |
| 2. | Flood | Houses, properties and food gardens are washed away. |
| 3 | | |
| 4 | | |
| 5 | | |
| 6 | | |
| 7 | | |

2. Explain how land in this area has been affected.

3. Explain how people in the area have been affected.

4. Can you suggest two solutions to the problems faced by the people affected by the floods and landslides?

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 4: Return to Hunstein Forest (Case Study)

Part one

Introduction

The article below will also help you to understand and appreciate land and water resources in your environment such as how someone from another far away society values them. It is divided into three parts (Part one, Part two, and Part three) for easy reading.

Modernization is bringing a lot of changes to our society and this is deceiving our population especially those that dwell in the rural areas. This group of people have needs and because of that it is easy to convince them with money in return for their land resources. This money means school fees, clothes, utensils, axes and knives useful things in life. However, not too far down the track in development, they soon realize their mistake, accepting money in exchange for natural resources.

The loss of trees, land, animals, rivers and fish. This is the price for development. There is in fact a dilemma in development.

It is important to pass this knowledge to your friends, family members and people in the community. They need to know the importance of protecting and preserving our natural resources as well as their environment.

The daughter of American missionaries, Edie Bakker grew up among the people of the Hunstein Forest in northwestern Papua New Guinea. Bakker eventually settled in Duncanville, Texas, but after learning that the rain forest was threatened by logging, she returned to visit her old friends and her childhood home. In this February 1994 *National Geographic* article, Bakker describes the rain forest and a way of life that are both shadowed by an uncertain future.

Return to Hunstein Forest: BY EDIE BAKKER

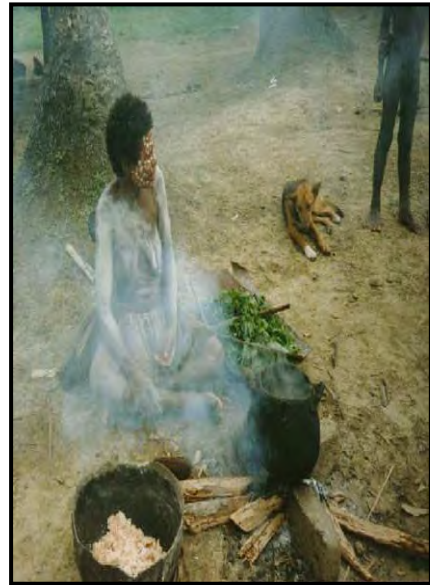
THE SEPIK RIVER meanders through the vast wetlands of northwestern Papua New Guinea, its swirling brown water spilling over banks as much as a mile apart. But sunrise turned its currents pink as we watched from our motorized dugout for a gap in the towering grasses that marks a seasonally flooded channels—a *baret*—leading to the Bahinemo village of Wagu.

I was raised in this remote village in the Hunstein forest, the daughter of American anthropologist-missionaries. The surprisingly named Hunstein (a legacy of 19th-century German colonialism) is one of the country's most undisturbed rain forests, rising from swampy lowlands into a mist-covered mountain range that peaks at 5,069 feet.



Making a new Canoe

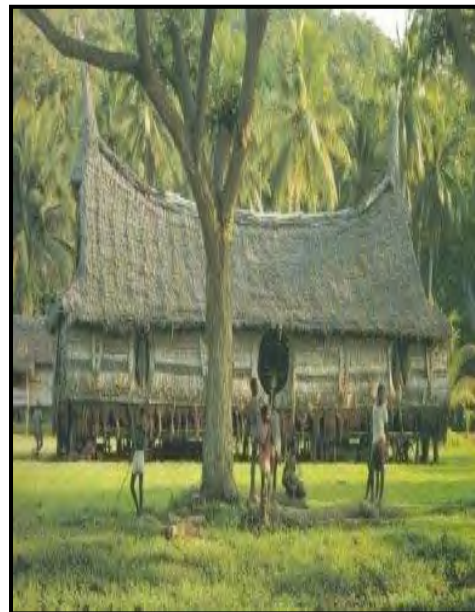
I was four years old when we moved here in 1964. My family became members of a Bahinemo clan. I grew up speaking Bahinemo and playing barefoot in a shredded palm-frond skirt. My memories are of watching men carve cedar canoes and of breathing the aromatic showering of soft red chips. Of gathering firewood with my Bahinemo girlfriends and securing it in a strap up of carrot-scented vines that twisted around my forehead and hung down my back.



An adult cooking a meal

A year after I graduated from the boarding school I attended in Papua New Guinea's highlands, I moved to the United States. Now I was coming back, with my husband, Rob, an aircraft mechanic, and our seven-year-old son, Gabriel, and five-year-old daughter, Sarah. After 11 years of living in the U. S., I was coming home.

The dark green foothills of the Hunstein Range rose at the horizon of the winding baret. Herons, cormorants, egrets, and hawks watched us intently. Parrots screamed and raced away. We crossed the wake of a crocodile and cut into the hills. The view of four-mile-long Lake Wagu opened like a slowly drawn curtain. Mount Hunstein towered blue in the distance, and sweet jasmine drenched the air.



Traditional Bush Material House

As we beached on the rough, pebbled shore of Wagu village, people rushed toward us hugging, clinging, laughing, and crying. With each pair of eyes I met flowed thousands of silent thoughts. There is no Bahinemo word for 'hello,' and only an extended absence requires a greeting. 'You're here,' they said. 'I'm here,' I replied.

WHAT BROUGHT ME BACK TO WAGU was a crisis—the Hunstein is on the verge of being logged. Some of the world's last major rain forests are in Papua New Guinea. I had heard about clear-cutting in the coastal province of Madang, and the thought of such destruction in the Hunstein was painful.

The Papua New Guinea government has left land-use questions with local owners. But I am worried that foreign logging companies would not tell the Bahinemos the truth about what logging would do to their forest, still vital to their livelihood and culture. And did the remote Bahinemos understand what their treasure means to the world?

Feeling angry, feeling helpless, I had written letters. One found its way to botanist S. H. Sohmer of the Bishop Museum, who organized the Hunstein River Expedition, supported by the Wau Ecology Institute of Papua New Guinea and the Bishop Museum of Honolulu, with funding from the National Geographic Society. There was a need for a comprehensive study of the Hunstein; if we were going to lose it, at least

we would know what we were losing. And this knowledge might encourage international conservation efforts.

The Papua New Guinea government receives a percentage of log sales and, therefore, views logging as a profitable source of economic development for the region.

'The government has attempted to identify the landowners and follow their wishes,' said Harry Sakulas, who grew up in the Sepik River region. He is the director of the Wau Ecology Institute and was one of the field leaders of the expedition. 'But there are two serious dangers. First, even if the people speak English, they won't know the legal terms needed to secure their desires. You can't imagine how clever these multinational companies can get at reinterpreting contracts.

'Second, the logging companies will go to incredible lengths to convince people. Promises of a lifetime salary or even a weekend in a hotel on the coast can go a long way when the landowner has never seen a paved road.

When I arrived in Wagu, the research team had already set up camps in the forest. I would join them, but first I wanted to get reacquainted with the village and with the joy of walking the forest barefoot. This doesn't require tough feet, only an intimate knowledge of the terrain. There are dangers—nests of stinging ants and hornets, death adders, thorny vines—but once you know how to avoid them, you are free to concentrate on the unexpected patterns and colors in this world that at first glance seems only green. Plate-size leaves of mottled orange and yellow drift from the canopy like jumbo confetti, clouds of butterflies flash glittering purples and blues, liana vines dangle clusters of scarlet flowers 10, even 15 feet long. The stillness is tangible—holy. To walk here is to feel the very pulse of creation. This, I believe, is one of the rain forest's great gifts to us.

When I first met the Bahinemos in 1964, they lived in eight villages scattered throughout their 600-square - mile territory. They were recent settlements, each consisting of palm shelters and a men's cult house. Traditionally, groups of three or four families had moved through the Hunstein from camp to camp, hunting wild pigs and flightless cassowaries with bows strung with bamboo fibers and gathering fruits, nuts, and the staple of their diet—starchy pulp of the sago palm.

(To be continued)

Lesson 4: Causes and Effects of Mismanaging Water Resources



Welcome to Lesson 4 of Substrand 1. In the last lesson, you looked at the causes and effects of mismanaging land resources. In this lesson, you will discuss the effects of its managing water resources. Later in lesson 5, you will discuss how these problems can be solved.



Your Aims:

- Identify and discuss issues affecting water resources and discuss them

Water Pollution

Water pollution is about streams, underground water, oceans being made dirty with substances that are harmful to the living things that are living in the water.



Activity 1:

List two substances that can cause water pollution.

Pollution can come from waste from the human body, waste from animals, fuel and oil spills, dead animals, household waste such as plastic bags, tins and tyres, chemical waste from industry.

Thoughtful management is needed to maintain clean water supplies. Clean water is essential to support life on this planet.

Water resources such as wells, streams and rivers must be looked after. It is important to make sure rivers and the coastal areas are not over fished and that pollution is prevented. Pit toilets built close to wells can pollute the ground water and eventually the well. Polluted water is unpleasant to drink, look at, smell and also to swim in.

River pollution can be caused by too much fertilizer run-off from plantations and from too many people and their animals using the river as a toilet place. Smaller rivers and streams with much less water are more susceptible to this pollution.



Boats over turning with oil drums causing pollution of the sea

Logging can also be the cause of river and stream pollution. Cutting down trees near the riverbanks usually causes this. There is a law against cutting trees near streams and rivers but it is sometimes ignored. When trees are removed from banks the roots die and no longer hold the soil together. The soil is then washed down the river as soon as there is a heavy rain. Trees and forest undergrowth further away from the banks also tend to hold the rainwater on the place where it lands. This allows it time to soak into the ground. However, if the whole area has been logged, there will be much more than just the usual rainwater run-off landing in the river. Mismanagement practices can cause water pollution and this can damage or kill living things.

Places that usually have enough fresh water sometimes experience drought. Very little rain falls during a drought. People run short of water. People everywhere should be careful not to waste water.

Rivers

Rivers have always been important to people. The first civilizations formed between the Tigris and Euphrates rivers in the Middle East and along the Nile River in Egypt. People built near rivers because rivers provided water for drinking, fish for food and transportation routes. People used water from rivers to grow crops and sailed boats down the rivers for transportation.

Today people still use rivers for their survival and transport. They also learned how to control rivers. They build walls called levees along rivers to keep them from overflowing. They build dams to harness the power of water for making electricity. They build reservoirs to collect water for drinking and for industries to use. They have even straightened out bends in rivers called meanders. Some things that people did have harmed rivers. Some factories built along rivers polluted river water.



A village built near the river

Some of the dams prevent rivers from carrying sediment to the sea. Some dams have changed the way animals live in the rivers. For example, dams can prevent salmon from swimming upstream to spawn.

People have now taken steps to protect rivers. Laws have been passed to prevent factories from polluting rivers. Some dams are being taken down to let the water flow freely. People now know that rivers are important and must be protected. Clean water is essential to support life on this planet.

**Activity 2:**

What are rivers used for?

Reefs

Scientists fear that many coral reefs are in danger. Many reefs have had a problem called bleaching. This occurs when the zooxanthellae, the algae that live in polyps, die off and the reef changes colour. Then the coral polyps die.

A starfish called the Crown of Thorns starfish is also a threat to reefs. Sometimes too many of these starfish suddenly show up on a reef. The starfish kill the coral.

Pollution is also a threat to coral reefs. Conservationists and governments are working to protect the Great Barrier Reef and other coral reefs.

Ocean

Oceanographers are scientists who study the ocean and its marine life. They worry about ocean pollution that can harm and destroy ocean marine life.

Large ships and boats use the ocean and usually pollute these oceans with oil spills. Large factories also dump their wastes in the rivers that find their way into the oceans. Chemicals used in large firms also find their way into the oceans.

People get many things from the seas and oceans including fish. It is important to keep an ocean clean and safe from these pollutants.

How to solve the problem of mismanagement of water resources will be looked at in the next lesson.

**Activity 3:**

What are some other things that pollute the sea and its shores?

Summary



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

- Pollution can come from waste from the human body, waste from animals, fuel and oil spills, dead animals, household waste such as plastic bags, tins and tyres, chemical waste from industry.
- Thoughtful management is needed to maintain clean water supplies.
- Clean water is essential to support life on this planet.
- Water resources such as wells, streams and rivers must be looked after. It is important to make sure rivers and the coastal areas are not over fished and that pollution is prevented.
- Mismanagement practices can cause water pollution and this can damage or kill living things.
- Polluted water is unpleasant to drink, use, smell and swim in and even look at.
- Rivers have always been important to people.
- People built houses near rivers because rivers provided water for drinking, fish for food, and transportation routes
- Some things that people did have harmed rivers.
- People now know that rivers are important and must be protected. Clean water is essential to support life on this planet.
- Pollution is also a threat to coral reefs.
- Oceanographers are scientists who study the ocean.

NOW DO PRACTICE EXERCISE 4 ON THE NEXT PAGE



Practice Exercise: 4

Read the paragraphs below and answer the questions that follow.

1. Fish

PNG has more than 2300 different kinds of fish including 200 freshwater varieties. They are an important source of protein (body-building food) in coastal and river villages. Most of PNG's fish live around reefs and coastal waters. One medium-sized reef may host 200 different kinds.

Source: Unknown

(a) How many kinds of fish are there in the waters of Papua New Guinea?

(b) Where are most of the fish found?

(c) How many kinds of fish can be found in one reef?

2. Fresh Water Fish

Most of the saltwater fish in PNG are of the same species found in other warm tropical seas too. However, most of this country's freshwater fish are unique to PNG. PNG's land rose from the sea and originally had no fish adapted to fresh water. Over millions of years since then, certain saltwater have changed so they spend part of their lives in rivers and lakes. For example, barramundi and freshwater. The main families of saltwater fish which have developed freshwater cousins here are archerfish, cardinal fish, catfish, chanda-perch, eels, flatfish (sole), gobies, grunters, gudgeon, herrings, lontoms, pipefish, rainbow runner fish, sawfish and scats.

Source: Unknown

(a) What is the difference between the saltwater and fresh water fish in Papua New Guinea?

(b) Describe how Barramundi and eels breed?

3. Prawns

Prawns also called shrimps, they are small shellfish which live in PNG's seas, rivers and lakes. They are an important food for fish and other water animals as well as villagers. Prawns are crustaceans. They have thin shells, 5 pairs of walking legs and 14 pairs of smaller limbs that they use for swimming, feeling or grabbing and eating food. PNG has more than 40 kinds of prawn. Many kinds eat dead plants and animals in mud and sand. Others rise to the sea's surface to eat plankton each night, when they will be safe from predators. Commercial fishermen take about 1200 metric tonnes of prawns from the Gulf of Papua and Orangerie Bay, Central Province each year. Half the total catch is banana prawns from the adjoining Kerema freshwater bays. About 10 percent is higher-valued tiger prawns. Prawns are caught by trawlers, which are boats which drag nets through the water. Most of the catch is processed on the ships and made into frozen packs for export. Japan is the major buyer. To avoid over-fishing, the government licences only 15 PNG-owned trawlers. It restricts where they may operate and closed the fishing season from December to April.

Source: Unknown

(a) How many kinds of prawns are there in PNG?

(b) How many kilograms of prawns was caught each year and where are they caught?

(c) Who is the major buyer of PNG prawns?

(d) What has the government done to sustain the supply of prawns in PNG?

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 5: Lakes

Introduction:

Water is a valuable resource that all cannot live without and for some they simply enjoy it. It means life for everyone today. This reading is on lakes. Lakes, again another source of water that you may enjoy and for some, their lives depend on it for food as well as water for washing, drinking and doing other household activities.

Lakes

You can have a lot of fun at a lake. Many people take holidays near lakes. You can go swimming, jump off a raft, go out on a boat or catch fish. Some lakes are huge and look like big oceans. You cannot see across the largest lakes.

What is a Lake?

Big lakes and small lakes are like bowls in the ground filled with water. Lakes are not part of the ocean. Lakes are called inland bodies of water. Most lakes are filled with fresh water, but a few are filled with salty water. The Great Salt Lake, Utah, USA, is filled with water that is much saltier than ocean water. The salt comes from streams flowing in to the Great Salt Lake. When water in this lake evaporates, the salt is left behind.

How are Lakes Formed?

The bowls in the ground that lakes fill sometimes formed because of sliding or moving rock and mud. Most lakes are formed because of huge fields of ice called glaciers. Glaciers carve out most lakes when the ice moves, crushing rock below.



Lake Luloru – Buin, Bougainville

The ground up rock freezes in the ice. The glacier carried the rocks away. This leaves a bowl like shape in the ground, later filled up by rain.

Glaciers have carved some of the great lakes in the world. Big ships can travel on the lakes. Lake Superior, USA, is one of the greatest lakes in the world.

Where does Lake Water Come From?

Lake water comes from rain and snow. Sometimes the rain or snow make streams and flow right into the lake. How much water a lake holds changes all the time. A lot of rain or snow can fill a lake until it overflows. Too little rain or snow can cause a lake to dry up.

Great Lakes

Huge glaciers moving over the land dug out the Great Lakes. The glaciers melted away about 10,000 years ago. Before the glaciers came, the area now covered by the lakes was made up of plains, broad valleys, and rivers.

How Big are They?

The five lakes Lake Superior, Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario cover an area 244,100 square kilometres. All together, the lakes hold about 20 percent of all the fresh water on the Earth's surface.

Lake Superior is the biggest of the Great Lakes. In fact, it's the world's largest body of fresh water. It is 560 kilometres long and it reaches a depth of 406 meters. Lake Ontario is the smallest of the Great Lakes.

Lake Murray is the largest lake in Papua New Guinea. It is located in the Middle Fly District, Western Province and in the wet season increases to five times the size. It has a highly complex shoreline of more than 2000 km long. The lake has been a source of food for many of the local peoples. Freshwater sawfish have been caught in its shallow waters to feed the crocodiles in a freshwater crocodile farming operation.



Lake Murray –Western Province, PNG

Where are the Great Lakes?

The Great Lakes are so large, you could easily see them if you stood on the Moon. They're the world's largest group of freshwater lakes, and they're found in North America.

A total of five lakes make up the Great Lakes. They are Lake Superior, Lake Michigan, Lake Huron, Lake Erie, and Lake Ontario.

The Great Lakes are located in the eastern half of North America along the United States-Canadian border.

The lakes are a part of both countries and are shared by both. Only Lake Michigan lies entirely within the United States.

Eight American states border the lakes to the south. They are New York, Pennsylvania, Ohio, Indiana, Michigan, Illinois, Minnesota, and Wisconsin. The big Canadian province of Ontario is on the north side of the lakes.

Four of North America's largest cities are located on the edge of the Great Lakes. They are Chicago, Detroit, Toronto, and Cleveland.

Papua New Guinean lakes to name a few are; Lake Kutubu / Lake Kopyago both in Southern Highlands, Chambri Lakes - East Sepik, Lake Murray – Western Province, Wisdom Lake –Madang, and Loloru Lake – Bougainville.



Lake Kutubu, Southern Highlands

Lakesides are great places to build homes, resorts, study or research, holiday places or just getaway destinations for relaxation or business.

Shipping and Recreation on the Great Lakes

The five Great Lakes are linked by rivers and canals. These allow ships to sail from lake to lake. The St. Lawrence River provides an outlet for large vessels to the Atlantic Ocean. The Great Lakes, together with the St. Lawrence River, form one of the most important inland waterway systems in the world.

Today, the Lakes are among the world's busiest shipping routes. Farms, factories, and businesses ship iron ore, coal, grain, steel, automobiles, and other goods are carried across the lakes and beyond.

They are also popular for recreation. There are thousands of homes and cabins on the shores. Millions of people flock to the lakes in the summer to water-ski, sail, fish, and swim.



Niagara Falls- USA

Read the second part of Return to Hunstein Forest below.

Supplementary Reading 6: Return to Hunstein Forest (Case Study)

Part Two

When the first commercial traders came into the region in the 1930s, a desire for contact with the outside world drew the Bahinemos closer to Lake Wagu and the rivers. Families still lived in the forest for months at a time (and do so today for weeks at a time), but traders came regularly and received carvings and crocodile skins for kerosene lamps, matches, metal axes, knives, spoons, and Western clothing.

Papua New Guinea was then a territory of Australia, and after World War II the government encouraged all the country's tribal people—sometimes by force—to settle near the river or highways of this nearly roadless land. There they would be closer to outside influences that might persuade them to give up revenge warfare, sorcery, and cannibalism.

The Bahinemos had already begun to abandon these practices, informally agreeing on an area of the Hunstein where there would be no fighting. Too many lives—and too many traditions—were being lost in violent cycles of attack and revenge.



Villagers in their daily attire

Little more than 300 Bahinemos remained in the early 1960s. Any population gains expected by the advent of peace were offset by disease, especially malaria—rarely a concern when people lived in the higher forest away from swampy areas. In the eight years before we arrived, not one of 23 children born in the village had survived infancy, and many adults had died also.

Medical care offered by my parents, Wayne and Sally Dye, helped stop malaria and other illnesses and infections. As they learned the Bahinemo language, they began to compile a dictionary and translate the New Testament.



A mother and child returning home.

Bahinemo was not a written language, nor did its speakers have a name for it or for themselves as a people. My parents helped villagers decide upon a name to give their language an identity. They called it Bahinemo, meaning 'our talk.' Ask a Hunstein forest resident today if he speaks Bahinemo, and he will say yes. Ask if he is a Bahinemo, and he might say no. But they indulge our Western need for organization and do not object to being called by this name.

Nondenominational Christians from the Summer Institute of Linguistics, my parents tried to present the teachings of Jesus in a way that would assure the Bahinemos that their lives and culture have value. In early 1968 many chose to become Christians, calling themselves 'kinsmen of Jesus.'

Soon after, plans to move the village to nearby Wagu were under way. The people had long wanted to move to higher ground, but the risk from unknown spirits there had seemed too great: Non indigenous pottery and piles of smooth stones littered the site. But whatever the nature of these spirits, the villagers now believed that God would protect them, and so they moved.

AS I WALKED ABOUT WAGU, it seemed that little had changed. It was uncanny to follow the same mud path edged with hibiscus and mango trees, to touch the palm-wood-walls of our old house, and to pour a cup of water from the same kerosene refrigerator. In other ways much had changed. Most people were wearing western clothing, and many had adopted western names. Members of my peer group looked too old to be in their early 30s. The men I grew up with had worn faces and serious eyes. Some of the women were grandmothers.

When I asked my friend Bawi Balki how many children she had, she paused. Then she began naming them, concluding, 'Oh, and Wida. Is that six? No, wait, seven.' She beamed: 'I have seven children.' Her initial uncertainty reminded me how unrelated counting is to the Bahinemos. Bawi's world is not governed by numbers or schedules. Some things are constant: the sun, the rain, the continuous spread of vegetation. Others happen unpredictably, children, wild game, thunderstorms, malaria, love, death. People do not plan, cause, or control any of it.

By chance, my parents were also visiting Wagu. They now live in Kenya, teaching missionaries the importance of adapting to the culture in which they work. Returning to update my father's study of the Bahinemos, they began by taking a census. They knew that they would quickly readapt to Bahinemo culture, and, as my dad joked, 'If you adapt, you don't count.' The eight initial Bahinemo settlements have united into four villages: Wagu, Yigai, Gahom, and Inalu.



Making Saqo

The region's population has risen to nearly 400, with 135 people in Wagu. Young men still move from village to village—'making the long walk'—for marriage or economic alliances. People marry for love. It is permissible for a man to take a second wife, but it's considered selfish. There is also intermarriage with speakers of other languages who live adjacent to the Hunstein on land that the government of East Sepik Province is also recommending for logging. Logging is what I quickly began hearing about.

'Don't be concerned about your rain forest,' visiting forestry officials had told the Bahinemos. 'We can always replant whatever is cut down. Our lawyers can help you write your contract so you will gain as much money as possible.'

A woman named Moyali Yalfei, about 45 years old and the widow of the head of the largest landholding clan, told me she thought she *had* to agree to logging. 'The forestry department said they wanted it, so I'll have to give it to them, won't I?'

It's not naive of her to think that. A Bahinemo thinks of wealth in terms of personal alliances, not profits. While Westerners base business decisions around profit and expect to cultivate some friends in the process, Bahinemos aim for friendships and hope to earn some money in the process. Some 15 clans control various-size holdings in the Hunstein, and it is an honor to give permission for other people to use your land.

Compounding the confusion of Moyali and other Bahinemos is the overwhelming modern need for cash. As it is, the Bahinemos must struggle for years to obtain an outboard motor, clothes, cassette players, Western camping gear. And if they want to send their children away to high school, they must save hundreds of Kina for tuition and board.

'Trees are our only real source of income,' Moyali said.

Tourism could provide an alternative income to logging in the Hunstein, but it too has drawbacks. 'Tourism is evil,' an important village man told me. 'Tourists bring beer. We have enough problems with alcohol as it is. It has made our teenagers stop listening to us and is tearing up families. The last thing we need is a steady stream of beer. But if we made a law that no beer would be sold at our lodge, no tourists would come.'



Cutting a tree with chainsaw

Tour outfitters encourage villages to attract visitors by performing traditional ceremonies and selling carvings, many of which are associated with spirit worship. People who no longer fear these spirits because of education or Christianity see this as forced decay. Those who are animists feel the performances are a mockery. Watching a dance in a village south of here in the highlands, I asked a man what they were singing. He hesitated before translating. 'They are telling the spirits, 'We shouldn't be doing this. We shouldn't be doing this. We only do it for the tourists, to make a lot of money.'"

ALONG THE HUNSTEIN RIVER and the north slope of Mount Hunstein, the ten scientists of the Hunstein River Expedition had pitched four camps reaching up to 3,300 feet. Each was three to six walking hours apart. The month-long study was just under way

when I joined the scientists at Camp Two, a site the Bahinemos call Gipa. Rich with catfish, the crystal river here drops into a deep pool beside a rocky bar.

It rained that night, as it does most nights in the Hunstein Range. But what struck as we were falling asleep was an overflow, and people rushed to bail sagging tent roofs. The river was nearing the top of its bank, and the researchers worried that the camp would flood. The Bahinemos working as carriers—camped only a few feet from the churning current—laughed. 'This is just an ordinary rain! If it rained like this for three days in a row, then we would worry.'

The rushing water gave good news to expedition leader S. H. Sohmer. 'The water is clear; this is a healthy, well-balanced rain forest.' He explained that the slightest disturbance of a rain forest can set off soil erosion.

'The soil here is thin. Without the roots of forest trees to hold it in place, it will quickly wash away, leaving bare rock. Then, with nothing to hold moisture, the area dries out and rain rushes off the barren land, creating floods. The watershed is one of the most important reasons for preserving this type of forest.'

Hiking with me up to Camp Three—called '20-mile camp' by the carriers, who felt as if they had walked that far—were two Wagu men, Gogomo Wiyawi and Solomon Magofa. Ma Gogomo is the village pastor. ('Ma' shows respect in addressing a man, as does 'San' for a woman.) Ma Solomon treats me like a daughter because long ago he adopted my father into his clan as his brother. He and I call each other Leikim, which means 'tied vines.'

Scattered on our path were flower petals that looked like pink brushes or long yellow bells, and nuts that seemed to be wrapped with red string. We crossed the scat of wild pigs and cassowaries. Ma Gogomo peeled bark from a cinnamon tree, and we inhaled its perfume. To stretch our water supply, we cut a thick vine and drank its sweet liquid. We collected the foot-long nest of a giant moth that is used for making cloth; the larvae are roasted and eaten.

Ma Solomon told me about the hunting and gathering routes that crisscross the forest along ridges and creeks. Trails slashed along these routes grow over within weeks, so knowledge of them has been passed down from generation to generation. 'Now, San Leikim, I am passing it to you.'

Approaching Camp Three at 2,000 feet, we hit cool air and mist blowing from the summit. At this altitude the soil is even thinner. Dripping with water, tangled roots, mosses, and plants cling together over bare rock. The trees are smaller here, reaching at most 65 feet, but they could be logged for pulp. If they were, none could ever be replanted.



A cinnamon tree,

Lesson 5: Appropriate Management Practices



Welcome to Lesson 5 of Sub Strand 1. In lessons 3 and 4, you looked at the consequences of mismanaging land and water resources. You learned that there is a need for Papua New Guineans to take more responsibility in the exploitation of resources. Exploitation means how the resources are treated, harvested and used. In this lesson, you will explore management practices that can help stop mismanagement of resources and pollution.



Your Aims:

- Identify new technologies and methods to improve and sustain important resources such as land, forest, reefs, mangroves, rivers and water supplies
-

Need for Conservation

Why do we need conservation? Well, long ago people did not even have to think about conservation because there were very few people. Then, people learned to use natural resources. They learned that using wood, ores and other natural resources could make their lives easier. People began to live longer. The number of people living on Earth has increased.

Today, billions of people live on Earth. All these people use more and more natural resources. People are using up fossil fuels and other natural resources faster than the planet can replace them. People cut down forests and destroy the homes of many plants and animals.

Conservationists are people who look for ways to protect wild life habitat and save natural resources. They try to manage natural resources so that people will have enough trees, fossil fuels, water, and food. They look for ways to save endangered plants and animals.

Conserving Resources

Conserving resources is important for sustainability. Conservation refers to the sustainable use and protection of natural resources including plants, animals, mineral deposits, soils, clean water, clean air and fossil fuels such as coal petroleum and natural gas.

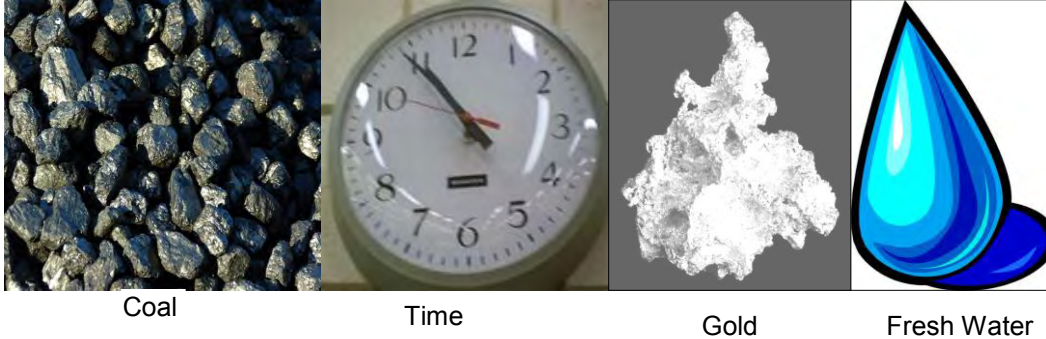
Natural resources are grouped into two categories, renewable and non renewable. A renewable resource is one that may be replaced over time by natural processes such as fish populations or natural vegetation or cannot be used-up such as solar



Locals are being taught about good management practices.

energy. The goal of conserving renewable resources is to ensure that such resources are not consumed faster than they are replaced. Non-renewable resources are those in limited supply that cannot be replaced or can be replaced only over extremely long periods of time. Those include mineral deposits, soils, coal, iron, aluminium, petroleum and natural gas.

PICTURES OF NON RENEWABLE RESOURCES



Coal

Time

Gold

Fresh Water

Sharing resources avoids wastage. For example, if two people travelled in one boat or vehicle instead of each person travelling alone, the effort and fuel use would be halved. If several families made one big mumu instead of each making their own, again the effort and fuel use would be lessened. If a village had one set of tools or equipment that could be shared, this could lessen the resources needed to equip each family. Where applicable, sharing resources is an example of a sustainable practice.



Activity 1: Name five renewable resources

Sustainable Resource Management

Sustainable resource management is the planned practice of using things in a way that will keep them going for the future generations. Sustainable is maintaining environmental balance while exploiting natural resources without destroying the natural balance of an area



A group of students promoting Sustainable Natural Resource Management In their garden project

Sustainable resource management practices include permaculture, mixed cropping, reusing resources, conserving resources, sharing resources, protecting marine areas and organic farming.

Ecologists are working with companies and governments to find better ways of catching fish, cutting down trees and building dams. They are looking for ways to get food, lumber, and other products for people without causing harm to ecosystems. They are looking for ways to sustain the resources or sustainable development of resources.

Sustainable management and development of resources will ensure that the resources are not used up quickly or are used wisely to last longer. For example, if the LNG (Liquified Natural Gas) Project drills the identified gas wells one at a time, then it will take a longer period of time for the natural gas to be taken out of the field. However, if all of them are drilled at the same time, it would not be sustainable. It will take a very short time for all the gas to be taken out from the ground. It is sustainable to drill one well at a time. Do you understand what sustainable means now? I hope so.

Permaculture

Permaculture is short for permanent agriculture. It is a system of agriculture that does not involve yearly crops but uses crops that are self-sustaining like, sweet potato, taro, yam, sugarcane, banana, coconut, corn and so on. Another definition of permaculture is the harmonious integration of landscape and people, providing their food, fuel, shelter and other material needs in a sustainable way. Traditional subsistence farming methods in Papua New Guinea could be considered examples of permaculture. Cuttings, seeds or suckers from plants ensured that varieties of crops are sustained from one generation to the next.

Mixed Cropping

Mixed cropping is where varieties of crops are grown in the food garden, plantations and forests. The benefit is that different crops take and replace different nutrients in the soil. Some with shallow roots and others with deeper roots take and replace nutrients at different levels in the soils. Some crops also minimize damage by pests to other plants.

PICTURES OF MIX CROPPING





One of PNG's Organic Products –
The PNG GARAINA TEA

Organic farming

Organic farming promotes the use of natural materials and farming methods. Traditional subsistence farming reflects organic farming methods and is sustainable. Organic farming does not use chemicals and fertilizers.

For example: The *PNG GARAINA TEA*; It is grown in the clean valley air without artificial fertilizers, pesticides or weedicides. The tea is picked by hand and processed on the estate. The result is an invigorating, delightfully low-acid tea with a strong, fresh flavour. Certified Organic "A" by the National Association for Sustainable Agriculture Australia (NASAA), a member of the International Federation of Organic Agriculture Movements

There are many appropriate ways of managing resources for sustainability. Protecting wildlife areas and coral reefs ensures the survival of endangered species. Using sustainable fishing, gathering and hunting practices avoids waste of life and ensures survival for the future.



Activity 2:

State 2 ways in which you would fish or hunt in order to avoid wastage.

Reusing and recycling resources reduces the energy and materials needed for further production. Tyres, glass, scrap metal, timber off-cuts, old furniture, clothes that have been outgrown, paper, aluminium and motor oil can be recycled. Drainage and contour gardening helps to prevent soil erosion. Rotating crops, mulching and composting improve soil quality. Controlling numbers of grazing animals and the area where they graze can protect vegetation. Elimination of pollution in waterways maintains the cleanliness and safe use of water. Re-vegetation and reforestation



Tyres can be recycled

ensures growth of plants and trees for future use. Repairing leaking taps and tanks promptly saves water wastage.

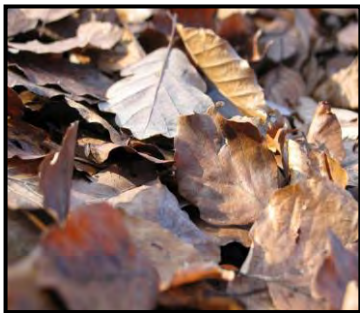
For example, let us take waste tires. Waste tires can be used to make many useful objects such as doormats, water hoses, shoe soles, door stoppers, playground and athletic surfaces, non-slip products, sheet rubber for manufacturing products, and artificial reefs for marine life habitats.

Re-using Resources

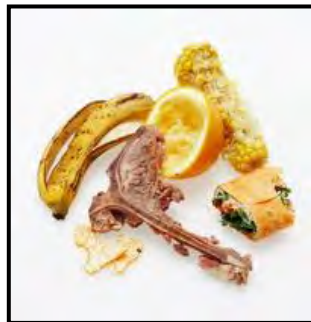
An example of reusing resources is the use of mulch and compost. A thick layer of mulch on the soil surface stops weeds from growing and helps to retain the moisture content of the soil. After the material breaks down, it can be mixed into the soil. Compost is made from a mixture of plant matter and animal manure. This is dug into the soil when garden beds are being prepared to enrich the soil nutrient content.



Activity 3: Explain how you would either recycle or reuse the following that are shown in the pictures below.



(a) Dry leaves



(b) Food scraps



(c) Empty tin cans and aluminum

(a) _____

(b) _____

((c) _____

Summary



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

- Conservation and using resources in a sustainable way is necessary because some resources are non renewable.
- Non-renewable resources are those that are limited in supply and cannot be replaced or can be replaced only over long period of time.
- Renewable resources are those that may be replaced over time by natural processes.
- Sustainable resource management is a planned practice of using things in a way that will keep them going for the future generations.
- Sustainable resource management practices include permaculture, mixed cropping, reusing resources, conserving resources, sharing resources, protecting marine areas and organic farming.
- Permaculture is short for permanent agriculture. It is a system of agriculture that uses crops that are self-sustaining like, sweet potato, taro and so on.
- Mixed cropping is where varieties of crops are grown in the food garden, plantations and forests.
- Organic farming promotes the use of natural materials and farming methods, it does not include chemicals and fertilizers
- Traditional subsistence farming reflects organic farming methods and is sustainable, resource are used to make mulch and compost.

NOW DO PRACTICE EXERCISE 5 ON THE NEXT PAGE



Practice Exercise 5

1. Why do we need to conserve and manage our resources?

2. What do we call people who are concerned about saving natural resources? Explain the kind of work they do..

3. What is the goal of conserving renewable resources?

4. Explain what non-renewable resources are and give an examples each.

- (a) _____ (b) _____
(c) _____ (d) _____

5. Explain what sustainable development means and give an example.

6. Explain how fishing can be managed in Papua New Guinea to sustain the fish supply. _-

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 7: Rivers

Rivers

Have you ever taken a ride on a river? Some rivers flow slowly and gently. You can hop into a tube that looks like a big rubber doughnut or raft and take a relaxing float down this kind of river.

Before you continue your reading, complete this exercise.

In the table below by putting the correct province these rivers are found. State also how long they are. The places are: Western Province, East Sepik Province, Western Highlands Province, Gulf Province, Eastern Highlands Province, Madang Province, Oro Province, Morobe Province, East New Britain Province. (Check your answers at the end if you score seven (7) and above, you are well informed)

Rivers in Papua New Guinea

| Name of Rivers | Location | Kilometers |
|---------------------|----------|------------|
| 1. Kikori River | | |
| 2. Strickland River | | |
| 3. Ramu River | | |
| 4. Purari River | | |
| 5. Markham River | | |
| 6. Kumusi River | | |
| 7. Fly River | | |
| 8. Warongoi River | | |
| 9. Sepik River | | |
| 10. Wahgi River | | |

The World's Longest Rivers

| River | Location | Miles | Kilometers |
|-------------------------|---------------|-------|------------|
| Nile | Africa | 4,160 | 6,700 |
| Amazon | South America | 3,980 | 6,400 |
| Yangtze | Asia | 3,910 | 6,300 |
| Mississippi-Missouri | North America | 3,710 | 5,970 |
| Yenisey-Angara | Asia | 3,450 | 5,550 |
| Huang He (Yellow River) | Asia | 3,400 | 5,460 |
| Ob-Irtysh | Asia | 3,360 | 5,410 |

Some rivers rush over rocks making foaming white water rapids. You can have a wild ride in a rubber or banana raft on this kind of river. The kind of river you ride on depends on many things, including where the river is, what the water flows over, and how wide the river is.

Rivers that flow through flat plains are usually wider and deeper than rivers higher up. These rivers usually flow lazily and are good for floating down. Rivers in mountains often flow through narrow channels. Water moves swiftly through these channels. Rivers on high hills or mountains usually flow over rocky river beds. Fast-flowing water rushing over a rock-filled riverbed makes rapids. Shallow, rocky rivers are the best rivers for white water rafting.

What Makes a River?

All rivers are made of fresh water. The water usually comes from rain or melted snow. Sometimes the water comes from underground springs.

The water that eventually forms a river collects in an area called the watershed. You would probably need gum boots to walk in a watershed during the wet season. The ground would be soggy with rain. Watersheds are usually high up on hills or mountains. Rain and melting snow trickles through the watershed and form tiny streams. As the streams flow downhill, they join together. The place where a river starts is called its headwaters.

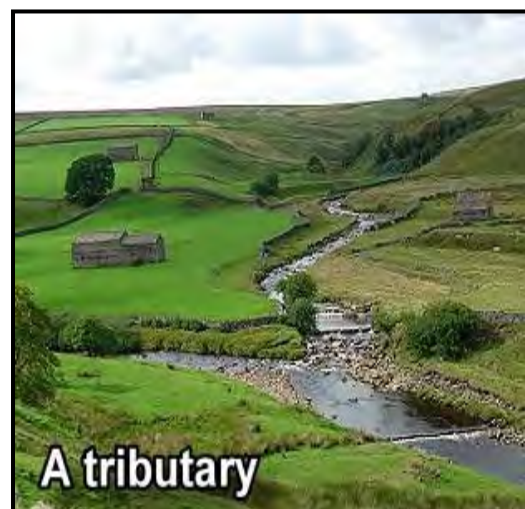


A River

Why are Some Rivers Big?

Rivers get bigger when streams flow into them. These streams are called tributaries. A smaller river also can be a tributary of a larger river. A big river and its tributaries form a river system.

The area that the river system flows through is called the drainage bowl. The drainage bowl can cover thousands of square kilometres. The size of a river depends on the size of its bowl and the amount of rain that falls in the bowl. The Mississippi River has the largest drainage bowl in North America. The Missouri, which drains into the Mississippi, is the longest river on the continent.



A tributary

A river system drains into a lake or ocean, where the big river ends. The end of a river is called its mouth. Some rivers flow right into a lake or sea. The fresh water of a river that meets the sea mixes with the salt water of the sea. The part of the river with a mixture of salt water and fresh water is called an estuary.

What Do Rivers Do?

As water flows through a river channel, it *erodes* (washes away) the riverbanks. The water wears away rock and soil and carries the material downstream. Heavier pieces of rock and soil fall to the riverbed. These pieces on the riverbed are called sediment. Tiny pieces of eroded material float in the water and sometimes make the water look muddy and dark.

The Colorado River created the Grand Canyon in Arizona by erosion. It took millions of years, but that river cut through layers of rock to make a canyon about 1.5 kilometres deep and about 446 kilometres long.

Sometimes a delta forms at the mouth of a river. Deltas are made of sediments—the sand, soil, and other materials carried by the river water. Deltas are like big, wide islands with small streams running through them. River sediments make the soil on deltas good for farmland. The Mississippi River has created a vast delta in south eastern Louisiana, where it empties into the Gulf of Mexico.

Why do Rivers Flood?

Have you ever seen a flood? Maybe you have seen pictures of floods in the newspaper or on television. A flood happens when a river overflows its banks. Too much rain or melted snow can cause flooding.

When rivers overflow, they deposit sediments on the flat land alongside the riverbanks. The flat land can be in a valley or on a plain. It is called the floodplain. All rivers have floodplains. These plains can spread out hundreds of miles from a river. People build farms and towns on floodplains because the sediments deposited on the plains are fertile and make great farmland. If the river overflows its banks, however, the farms and towns get flooded.



A Sepik River Village

Why are Rivers Important?

Rivers have always been important to people. The first civilizations formed between the Tigris and Euphrates rivers in the Middle East and along the Nile River in Egypt. People built near rivers because rivers provided water for drinking, fish for food, and transportation routes. People used water from rivers to grow crops and sail boats down the rivers for transportation.

Today people still use rivers for water and transportation. They also learned how to control rivers. They build walls called levees (walls) along river banks to keep them from overflowing.

They build dams to control the power of water for making electricity. They build reservoirs to collect water for drinking and for industries to use. They have even straightened out bends in rivers called meanders.

Some things that people did have harmed rivers. Some factories built along rivers polluted river water. Some of the dams prevent rivers from carrying sediment to the sea. Some dams have changed the way animals live in the rivers. For example, dams can prevent salmon from swimming upstream to spawn (lay eggs).

People have taken steps to protect rivers. They passed laws to prevent factories from polluting rivers. Some dams are being taken down to let the water flow freely. People now know that rivers are important and must be protected.



Is this the top of the mountain?, Or?

Supplementary Reading 8: Return to Hunstein Forest (Case Study)

Part Three

Our climb to Camp Four took us beyond the routes of the bravest hunters. Cold has prevented the Bahinemos from venturing onto the upper shoulders of Mount Hunstein; they have no clothing for coping with nightly temperatures of 55°F. The small camp overlooked a valley of unbroken green; lower peaks occasionally shed their clouds. Constant drizzle here strengthens into rain at night, accounting for the thick mantle of moss worn by everything that doesn't move. Tiny crimson orchids clung to it. As if to make up for the lack of stars, constellations of bioluminescent fungi glowed on the trees.



Is this the top of the mountain? Or?

A unmelodiousness of frogs solicited relentlessly for mates. Zoologist Allen Allison of the Bishop Museum told me he had already discovered five new frog species here and spent evenings recording their songs.

Focusing on birds—the most numerous vertebrates in the Hunstein—graduate students Debbie Wright and Andy Mack found several rare species, such as shovel-billed kingfishers, harpy eagles, and vulturine parrots. 'Birds that seasonally migrate from one altitude to another may find all their ranges right here on this mountain,' said Debbie.

After weeks of battling leeches ('but practically no mosquitoes!' one optimistic researcher noted in a report), the expedition gathered nearly 4,500 plant specimens—at least 10 percent of them new to science. It also collected 472 animal specimens representing 115 species.

'Our findings seem to show that the Hunstein Range has many rare plants and animals because it is isolated from other mountains by lowland alluvial forests and wetlands,' said S. H. Sohmer. 'If logging has to happen, perhaps at least Mount Hunstein itself could be put aside.'

Few people have reached the top of Mount Hunstein. My family thought we did in 1978, but Ma Gogomo now corrected me. 'We never had the heart to tell you the truth. Your guides told you it was the top because if you didn't stop then, you couldn't have returned to your camp before dark. It was so cloudy you didn't doubt them.'



A scientist at work

On a later trip I pushed Ma Gogomo to find the summit with me. When I heard his joyful yodeling, I rushed to catch up. 'San Edie, we're here. We have conquered the mountain.'

I pointed out a mound higher than we were. Gogomo shook his head in fatherly exasperation: 'You know what's wrong with you white people? You're never satisfied with getting on the forehead of a mountain—you think you have to get to the tip of the crown! You tell your boss that in our country it makes no difference whether something sits on your forehead or on your crown—it is still the top of your head. We've made it to the top; that spot over there is nothing. Let's go back. It will be a miracle if we get to camp by dark. And we have no flashlights.'

WHEN GOGOMO QUESTIONS the thinking of 'white people,' he means Westerners of any color. He means someone who isn't thinking like a Bahinemo. Sadly cultural miscommunication has now clouded the fate of the Hunstein.

As I was leaving Wagu, the widow Moyali, whose clan land covers the area surveyed by the expedition, told me she was 'determined not to sell to logging' now that she knew 'it would destroy our forest.' But later events have swayed her.

With fresh ideas and the best of intentions, educators from the Wau Ecology Institute, members of the Australian Foundation for the Peoples of the South Pacific, and other conservation groups such as Greenpeace, Friends of the Sepik, and the East Sepik Council of Women have been trying to help the Bahinemos find alternatives to mass logging that will bring the development so desperately desired.

They also want local owners to be paid more for their lumber. 'Currently they'll make \$40 for an average tree, which would sell for \$2,750 on the international market,' said American conservationist Glen Barry. 'That's unreasonable. The price of tropical hardwood should reflect its scarcity.'

Unfortunately when some conservation group members visited Wagu after my parents and I left, they dealt mainly with a resident government worker, an outsider, because he spoke English, and this insulted the village elders. Taking advantage of the mix-up, forestry officials were again able to persuade Moyali and others to allow logging.



No man's land? ?

The conservationists have not surrendered. As an alternative to clear-cutting they are promoting portable sawmills. Local people can then selectively harvest trees and rotate the mills through the forest to allow regrowth. There is no need to cut a wide road and no damage from heavy machinery.

The village of Yigai has been using such a sawmill, but Moyali, for one, has not been impressed: 'It looks like the forest is still being ruined, only for less money for

us.' Logging companies—who promise to 'replant every tree'—would give her clan a larger bulk payment for clearing the land 'only one time.'
 Could a logged Hunstein be regenerated?

Renowned for his work in Papua New Guinea, German agriculturalist Reimund Kube told me: 'If everything was done just right, if the foresters left the largest trees, built as few roads as possible, and replanted what they took out, in 30 years you might get a sort of artificial forest, if the sell was good. Otherwise you'd get grass and shrubs. But no matter how carefully it was exploited, certain species would be lost. The large birds would be the first to go.

'No one has ever replaced a rain forest,' he said. 'No one knows if full recuperation (recovery) would take a hundred years or a thousand years.'

THOUGH THE BAHINEMOS have abandoned some traditions they no longer consider important, I was reminded of how entwined they remain with the Hunstein by a story my father recently told me. He was traveling through the forest with a group from Wagu. In usual style two men went ahead to hunt. The others cleared the trail for the women and children, who, far behind, were carrying camping supplies and gathering food. One of the trailblazers noticed a speck of blood on a fallen leaf, then on another. He conferred with one of his companions, and then turned the leaves over. When my father asked why, he said with a smile: 'The men ahead must have speared a pig. We want it to be a surprise for the women that we will have fresh meat tonight.'

The stability of the rain forest makes it difficult for the Bahinemos to imagine the consequences of logging. Their physical world has not taught them to think in terms of cause and effect. If the Hunstein is destroyed, Bahinemo culture will die also. Not just their outer culture—what they eat, what they wear—but more devastatingly their inner culture. Who they are as a people, how they approach life, will lose its sustaining environment.

I still hear the old music pounding and sailing into the night and feel the mystery of legends whispered to my young ears about the origins of those songs. I still recall the dance of people who believed their ways were the only ways.

If you were the leader of the Bahinemo people, what decision would you make on behalf of your people concerning their Hunstein resources?

As things now stand, logging is still a serious threat to the Hunstein. How much will be cut is uncertain. But it can be hoped that enough of the forest will be saved so that Solomon and anyone who chooses to follow him can still walk the routes of the ancestors.



Plantation at Galley Reach –Central Province

On our last trip to the crystal water hole at Gipa, he and I watched a side creek cascade from tiers of rocks into the river. Golden spillways of light broke through the canopy. He turned and said quietly, 'It is beautiful, isn't it?'

Source: Bakker, Edie. 'Return to Hunstein Forest.' *National Geographic*, February

Lesson 6: Case Study on Reefs and Islands in Papua New Guinea



Welcome to lesson 6 of Sub Strand 1. In the last lesson, you learnt about management practices that can help stop mismanagement of resources and pollution. In this lesson, you will learn about reefs and islands of Papua New Guinea

CORAL

Your Aims:

- Identify different types of reefs
- Discuss the formation of reefs and their importance
- Identify different kinds of islands in PNG and explain them



It is important that you pass on the knowledge to your friends, relatives and people in the villages, especially in the coastal areas. Despite the locations in PNG people need to know the importance of protecting reefs to save the islands from sinking.

This is a case study about reefs and the islands of Papua New Guinea. What does that mean and what is a case study? It means that you will read information about reefs and islands in Papua New Guinea and use it as a basis to do your own research.

Do you understand what research means? It means that you will investigate study, read, explore and look into this particular subject on reefs and islands in Papua New Guinea.

Before we study about reefs, we need to know what makes up the reefs. What do you see on the reef? You will always see corals.

Coral reefs play an important role in ocean life. Many kinds of plants, fish and other animals live on and around a coral reef. Even the reef itself is made mostly of tiny coral animals, both living and dead.

Coral

How do Coral reefs form?

Corals build our coastal reefs and are the most visible animals on them. The reef-building polyp makes a hard outer shell for itself from materials found in seawater. When the polyp dies, the shell is left behind. The shells from colonies of polyps build up over time to form a rock called limestone. This limestone becomes the inner part of the reef. The living coral animals form the top part of the reef. As each layer of polyp dies, their stony skeletons get added to the reef. A new layer then grows on top of the old. This is how a reef grows. Tiny single-celled algae called zooxanthellae live in coral polyps. The polyp and the algae make food for one another. The polyps could not live without the algae.



Shallow Water Corals



Activity 1:

Define *coral*

Why are Coral Reefs important?

Reefs in Danger

Scientists fear that many coral reefs are in danger. Many reefs have had a problem called bleaching. This occurs when the zooxanthellae, the algae that live in polyps, die off and the reef changes colour. Then the coral polyps die. No one knows what causes bleaching.

A starfish called the Crown of Thorns is also a threat to reefs. Sometimes too many of these starfish suddenly show up on a reef. The starfish kill the coral. No one knows why there are so many starfish.

Pollution is also a threat to coral reefs. Conservationists and governments are working to protect the Great Barrier Reef and other coral reefs.

Why are reefs important in Papua New Guinea?

PNG is a nation of islands. The mainland itself is the eastern half of the second largest island on earth, New Guinea. More than 1400 other islands are scattered among 15 coastal and island provinces. Close to one-third of these islands are in one province, Milne Bay.

Kinds of Coral

Scientists have found more than 300 kinds of corals in Papua New Guinea. Hard or stony coral is the kind of coral that builds reefs. These corals have hard outer skeletons. Other corals do not have hard outer skeletons and look like fans and flowers. Some kinds of coral look like branches of a tree. Other kinds can sting you if you touch them. The shape of the colony is determined by the type of coral, its depth below sea level, the amount of wave action and other factors.

Corals are coelenterata. This means that they do not move around. They usually attach themselves to the reef and grow in one place. One single coral is called a polyp. It has a body shaped like a tube. Its mouth is on the top of the tube. Each individual coral polyp has a number of tentacles or fingers with poison stingers. The tentacles paralyse and catch tiny reef fish, shrimps, bacteria and other plankton. Little tentacles around the mouth help the coral polyp catch food that floats by. Coral



Reefs are homes for fish

animals eat microscopic sea creatures called zooplankton. When not feeding, the polyps are closed like tight fists.

Reefs

PNG has more than 40 000 square km of limestone reefs lying less than 30 m below sea level. These shallow reefs surround most islands and much of the mainland. They are the home of hundreds of kinds of fish and other sea animals, an important source of food and shells for villagers. Reefs protect coastal villages from large ocean waves but they are also a hazard for ships.



Activity 2:

Define *reef*

Reef Formation

The stony reefs have been built over thousands of years by tiny corals and other sea animals which make limestone skeletons or shells from the chemicals in sea water. When these animals die, plants called red algae cement the limestone together into hard rock. Other algae and animals support the reef builders by making food or by eating decaying matter and keeping its energy in the reef community.

Reef building can occur only in clear, warm sea water. Water temperatures of at least 20 degrees celcius are needed to cause the right chemical reactions. Clear water is required by algae, which need sunlight to grow. Muddy water keep reefs from developing near the mouths of rivers. Corals have difficulty attaching themselves to the muddy sea bottom and algae cannot get enough sunlight. Pollution from sewerage and off-shore developments also slows down reef building. Scientists say reefs grow outward only 2 to 5 cm a year. They oppose the use of destructive explosives to kill reef fish because it takes so many years for the reef to restore itself.



A coral reef

Types of Reefs

Fringing Reefs

Fringing reefs are the most common. They run parallel to the coastline in shallow water. This means that they are close to shore. There is no lagoon or other bodies of water between a fringing reef and the shore.

Barrier Reefs

Barrier reefs are further out in the ocean. There is usually a lagoon between a barrier reef and the shore. Barrier reefs can be huge. The largest group of reefs in the world is Australia's Great Barrier Reef. It covers thousands of square kilometers. Often they are at the edge of a land mass and drop off steeply on the seaward side. There is often deep water between them and the fringing reefs. A 48 km barrier reef runs parallel to Tagula Island in Milne Bay Province.

Atolls

Atolls are ringed-shaped reefs in the open ocean. They surround quiet, shallow lagoons. There are many atolls in PNG. They start as fringing reefs around a volcano or island which later sinks beneath the sea. Atolls are the tops of volcanoes that sank below the sea. The reef grows on the rim of the volcano. Inside the reef is a lagoon.



Atolls are rings of reefs

Platform Reefs

Platform reefs are big, oval, nearly flat-topped reefs. The interior is protected from heavy seas and mangrove trees may grow there. Land movements have uplifted old platform reefs and created islands. The Trobriand Islands in Milne Bay Province and Buka on the northern Bougainville islands are examples.

Ribbon Reefs

Ribbon reefs are long, side-by-side reefs. High speed water currents have cut channels between them. Ribbon reefs occur in Torres Strait. Some are 25 km long and 500 m wide with 1000-m passages between them.

Future Changes

Scientists estimate that today's reefs are 6000 years old. That is how long the seas have been at their current level. But sea levels change eventually and when that happens, these reefs will die. If the water level drops, exposed coral and algae will dry up and die. If the water level rises, algae will not get the sunlight they need to keep the reef community going.

There is dramatic evidence of this process over a period of 1 800 000 years, on the Huon Peninsula west of Finschhafen. Limestone terraces rest one above the other like stairs for 200 m above sea level. Each terrace is an old reef, marking the sea level for thousands of years

Island Groups

The major island provinces and their island groups are shown in the following table, in order of the number of islands.

ISLAND GROUPS

| ISLAND PROVINCE | NUMBER OF ISLANDS | ISLAND GROUP | NUMBER OF ISLANDS |
|------------------|-------------------|-----------------|-------------------|
| Milne Bay | 438 | D'Entrecasteaux | 49 |
| | | Calvados | 33 |
| | | Trobriands | 28 |
| | | Conflict | 20 |
| | | Lusancay | 16 |
| Manus | 208 | Admiralty | 57 |
| | | Ninigo | 46 |
| | | Hermit | 16 |
| Bougainville | 168 | Nukumanu | 33 |
| | | Tauu | 14 |
| | | Nuguria | 12 |
| New Ireland | 149 | Mussau-Emirau | |
| | | Tanga | |
| West New Britain | 125 | Arawe | 10 |
| Morobe | 57 | - | - |
| Western | 52 | - | - |
| Gulf | 48 | - | - |
| East New Britain | 46 | - | - |
| Madang | 45 | - | - |
| Central | 33 | - | - |
| East Sepik | 15 | - | - |
| Oro | 8 | - | - |
| NCD | 8 | - | - |
| West Sepik | 6 | - | - |



Activity 3:

What is an island?

Kinds of Islands

Alluvial Islands

Alluvial Islands are made of sand and gravel which have been built near the mouth of a river. Examples are Kiwai Island at the mouth of the Fly river and Goaribari Island at the Kikori. The rivers that create alluvial islands also carry seeds and nutrients that help life get established quickly.

Continental Islands

Continental Islands are extensions of a mainland. They are mountain tops which have been isolated by the sea. They have most of the plants and animals of their mainland. Examples are the D'Entrecasteaux islands and the Louisiade Archipelago of Milne Bay, both extensions of New Guinea Island.

Coral Islands

Coral Islands are low, flat islands that have built up from reefs. Their soil is low in nutrients and they usually have only limited range of plants and animals. Atolls are ridged-shaped coral islands or chains of islands.



Coral Islands

Raised Coral Islands

Raised Coral Islands are old reefs which have been lifted above sea level by earth movements. Examples are the Trobriand Islands, Milne Bay Province and Buka, in Bougainville.

Volcanic Islands

Volcanic islands push above sea level after eruptions from the ocean floor. Their soils are rich but it still takes time for life to get established. Examples are Karkar, Long and Manam Islands all in Madang Province.

Small Islands in Peril

Many small islands are facing problems of overpopulation and destruction of natural resources. Scientists from Australia and the University of PNG are conducting research on 50 so-called Small-Islands in Peril (SMIPs) in Milne Bay. They define a SMIP as an island with less than 100 km² of land for food growing and a population density of more than 100 people per 100 km² that is totally dependent on local resources for survival. SMIPs tend to have high population growth rates and to overuse natural resources. The Milne Bay program will study the island communities and their resources, recommend ways to restore and conserve fishing and other food-supply areas and provide information on birth control methods. If successful, the SMIP program will be used in other areas of PNG and the South Pacific.

Summary



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

- Corals build our coastal reefs and are the most visible animals on reefs.
- There are more than 300 kinds of corals in Papua New Guinea. Corals grow in colonies that cover the reef and look like colourful rocks, bushes, whips, fans or plates. Corals are coelenterate which means that they attach themselves to the reef and grow in one place.
- There are different kinds of corals. Hard and soft corals, gorgonians, mushroom corals and sea anemones.
- PNG has more than 40 000 square km of limestone reefs lying less than 30 m below sea level. Shallow reefs surround most islands and much of the mainland and they are home to hundreds of kinds of fish and other sea animals.
- Reefs provide an important source of food and shells for Papua New Guinean villagers.
- Reefs protect coastal villages from large ocean waves but they are also a hazard for ships.
- Stony reefs have been built by tiny corals and other sea animals over thousands of years. Corals and sea animals make limestone skeletons or shells from the chemicals in sea water.
- Reef building can occur only in clear, warm sea water. Scientists say that reefs grow outward only 2 to 5 cm a year.
- Destructive explosives should not be used on reefs to kill fish because it takes many years for the reef to restore itself. Other things such as oil spillage also cause reefs to die.
- There are five types of reefs. They are fringing, barrier, atolls, plat form and ribbon reefs.
- Scientists estimate that today's reefs are 6000 years old.
- There are six (6) kinds of islands in PNG, which are Alluvial, Continental, Coral, Raised Coral, Volcanic and the small islands in Peril.(SMIPS)

NOW DO PRACTICE EXERCISE 6 ON THE NEXT PAGE



Practice Exercise 6

1. Why are Coral reefs important?

2. Why can't corals grow near the mouths of rivers?

3. How many kinds of corals are there?

4. Why is it important for people living in coastal villages and islands to protect reefs?

5. What is the difference between a Fringing reef and a Barrier reef?

6. Papua New Guinea is a nation of islands. What is likely to happen to the islands if coral reefs are not protected?

7. What can you do to help protect the reefs from dying and islands from sinking?

(a) _____

(b) _____

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 9: Eco- Tourism

Introduction

Mankind is not really taking care of these natural resources under the sea, and in the forest. In this supplementary reading, you will study a project which is applying appropriate sustainable management practices to preserve land resources in a rural village in Morobe Province. Read how this rural village is trying its best to make use of the resources they have available in their area to help themselves.

People of Gabensis village. Morobe Province, Papua New Guinea are trying to use natural and essential skills, knowledge and resources to be self-reliant and improve their standard of living. Resources can only be useful if one can put them into good use.

Eco- lodge opens in Gabensis: Senior Anzu

Gabensis village, in the Huon District of Morobe Province is the first in the Pacific to try out a new village movement concept, focusing on agriculture and eco- tourism development, courtesy of the Korean Government.

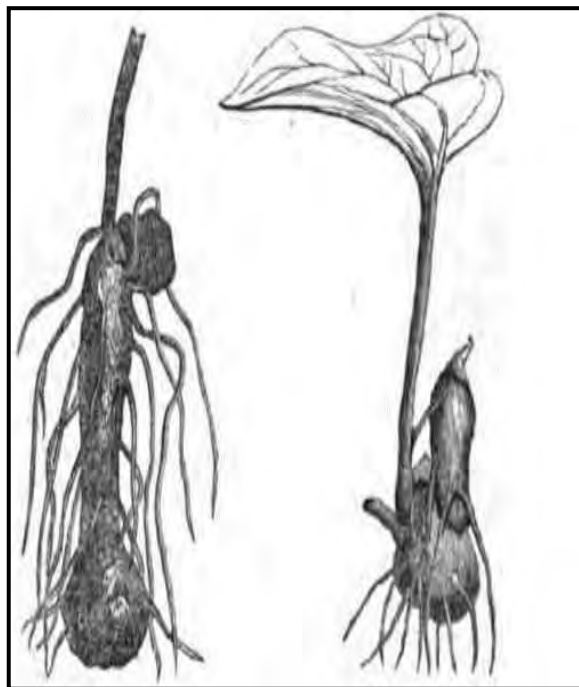
The pilot project includes the construction of a yam-based tourist facility known as “Saemaul Eco- lodge” and the production and processing of yam.

This is a cooperation project for rural development between Korea and Papua New Guinea, facilitated by Korea’s Kangwon National University and PNG’s National Agricultural Research Institute [NARI].

The project is titled “Production and Processing of Yam and Preparation of Yam- based “Saemaul Eco- tour Village for Rural Poverty Reduction”.

The Korean Government, through the Ministry for Food, Agriculture, Forestry and Fisheries, has invested US\$58,900 in this new initiative which is expected to bring positive development in eco-tourism to the district and the country.

The eco- lodge will be used by the community to accommodate tourist visiting Gabensis village to adventure the attractive Wanam Lake and enjoy activities like diving, canoeing, fishing, bush tracking and bird watching. In doing so, tourist will also spend their money on yams produced and processed at the lodge site by the local community.



The project comprises of three major aspects – lod Yam Nursery Yam agronomy and yam processing- all to be facilitated at the project site with the Gabensis community. Under agronomy, interested local farmers will participate in training by NARI on the best production practices by going through stage- by- stage of the vital practices so as to impact appropriate and relevant skills for improved production.

This training will be provided through the „farmer field school model“.

With food processing, NARI will also demonstrate yam processing techniques for value added products for income generation by the local community. Last Tuesday, the Eco-Lodge was officially launched after the completion of the first component.

A delegation from Korea was in Gabensis to be part of the launching. Team leader Dr Chang Jin- Kwang cut the ribbon to officially open the Eco- Lodge, witnessed by the delegation, NARI representatives, local leaders and the Gabensis community.



African Yam

It is anticipated that once the project is completed, the community will take ownership and promote it to attract tourists and visitors.

Papua New Guinean foods are perishable and the project will look at food processing preservation which will address value- addition and food security needs.

Similar projects were under-taken in Cambodia, Laos, Vietnam and Tanzania with the mission to alleviate poverty through eco- tourism.

Source: National Newspaper

ANSWERS TO SUBSTRAND 1
PRACTICE EXERCISES

ANSWERS TO PRACTICE EXERCISES 1 - 6

Practice Exercise 1

- 1 Land resources provide for the physical needs of people. State the four basic needs.

Food, Shelter, Water, Air, Clothing

2. List some foods that are taken from the forest.

Fruits, Meat from wild animals, Nuts, Roots

Eggs, Roots, edible leaves, etc

3. What are the main cash crops in your community? (Answer will depend on where the student comes from)

Coffee, cocoa, Copra, timber, oil palm

4. Mana is from an island and she has problems producing enough food for her family because of land shortage. She has no more new land area to cultivate. Suggest some methods she can use to continue producing food on the same piece of land.

Advice her to use mulching, compost, manure and to rotate the type of crops she grows. Suggest to her the kinds of vegetables she can grow.

5. Minerals are non renewable resources. Explain what the word non renewable means.

Non - renewable means that minerals cannot be replaced once they are removed from the ground.

6. Explain the main difference between the need for land resources in traditional times and today.

Should mention some or all of these. Population, Tools and equipment, money, use of machines, growth of towns and cities.

NOW GO BACK AND STUDY LESSON 2

Practice Exercise 2

1. Why are waterways so important for everyone?

Waterways are important because they provide a means for people to travel out and into their villages. They also are the means of getting food and other resources needed for livelihood.

2. Name two sources of pollution affecting streams and rivers.

People and animal waste being thrown into the streams. Using streams to throw household rubbish. Using the rivers and streams to dump chemicals

3. Why are smaller streams and rivers more likely to be polluted than larger rivers?

Smaller streams can dry up and do not flow fast enough to carry chemicals and other dangerous materials away quickly.

4.

- (A) The Sepik and the Fly rivers lose plenty of water in the flood plains. What do you find in the flood plains of Sepik and Fly rivers?

Swamps and wetlands

- (B) PNG's rivers carry unusually large amounts of water, Why?

Because of heavy rainfall and steep terrain that does not allow rain to soak in and also because most of the rivers are short, running directly from mountains into the sea.

- (C) PNG is rated as having the twelfth largest river system in the world. Find out which country has the largest river system in the world.

South America has the largest river in the world. The river is called Amazon River. It carries the largest amount of water into the sea.

- 5 (a) List some uses of turtles.

Food from turtle meat and eggs, ornaments from turtle shell, money from selling the meat and eggs.

- (b) How can we ensure that green turtle does not become extinct in PNG?

By allowing them to breed and not eating too many eggs and not killing too many of them for meat.

- (c) How many kinds of turtles are there in PNG?

Six kinds of sea turtle and 7 kinds of fresh water turtles.

NOW GO BACK AND STUDY LESSON 3

Practice Exercise 3

1. Complete the table of Cause and Effect on the next page. The first two have been done for you as example.

| NO | CAUSE | EFFECT |
|----|--|--|
| 1. | Heavy Rain | Flooding |
| 2. | Flood | Houses, properties and food gardens were washed away. |
| 3. | <i>Damaged roads</i> | <i>People travel by dingy which is very costly and others resort to walking - which can wear out the strength of the body.</i> |
| 4. | <i>Damaged pit toilets</i> | <i>The spread of water borne sicknesses</i> |
| 5. | <i>Properties and food gardens washed away</i> | <i>Food shortage and lacking essential tools to work, no clothes to wear</i> |
| 6. | <i>Damaged houses</i> | <i>Homeless, sleep in tents, having mosquitoes bites</i> |

2. Explain how land in this area has been affected.

Land in this area has been affected by flood. There is too much water, causing damage to food crops

3. Explain how people in the area have been affected.

Homeless, no clothes and food, travelling has become very costly and difficult for them

4. Can you suggest some solutions to the problems faced by the people affected by the floods and landsides?

- *plant more trees alongside the hills and rivers*
- *build their home away from the rivers and hillsides*

NOW GO BACK AND STUDY LESSON 4

Practice Exercise 4

1. (a) How many kinds of fish are there in the waters of Papua New Guinea?
More than 2300 kinds of fish
- (b) Where are most of the fish found?
Most of the fish are found in reefs in coastal waters.
- (c) How many kinds of fish can be found in one medium - sized reef?
More than 200 different kinds of fish can be found.
2. (a) What is the difference between a saltwater and freshwater fish in PNG?
A saltwater fish spends its life in the sea
- (b) Describe a fresh water fish
A freshwater fish spends its live in the fresh water
- (c) Describe how Barramundi and eels breed?
Eels and barramundi lay their eggs in the sea and after they are borne they go inland through rivers to grow.
3. (a) How many kinds of prawns are there in PNG?
More than 40 kinds of prawns
- (b) How much prawns are caught each year and where are they caught?
1,200metric tonnes each year mainly from the Gulf of Papua and Orangerie Bay in Central Province
- (c) Describe how Barramundi and eels breed?
Eels and barramundi lay their eggs in the sea and after they are borne they go inland through rivers to grow.
- (d) Who is the major buyer of PNG prawns?
Japan
- (e) What has the government done to sustain the supply of prawns in PNG?
The government has allowed only 15 PNG-owned trawlers to harvest prawns. It also restricted the fishing season and where they may operate.

NOW GO BACK AND STUDY LESSON 5

Practice Exercise 5

1. Why do we need to conserve and manage our resources?

We need to conserve and manage resources because the world's population is very big. People are using up fossil fuels and natural resources faster than the planet can replace them.

2. What do we call people who are concerned about saving natural resources? Explain what their work involves.

Conservationists look for ways to save natural resources. They try to manage natural resources so that people will have enough lumber, fossil fuels, water, and food. They look for ways to save endangered plants and animals. Conservationists are a group of people who look for ways to protect wild life habitat.

3. What is the goal of conserving renewable resources?

The goal of conserving renewable resources is to ensure that such resources are not consumed faster than they are replaced.

4. Explain what non renewable resources are and give four (4) examples.

Non-renewable resources are those in limited supply that cannot be replaced or can be replaced only over long periods of time. They include mineral deposits, soils, coal, petroleum and natural gas.

5. Explain what sustainable development means and give an example.

Sustainable resource management is the planned practice of using things in a way that will keep them going for the future generations. Sustainable resource management practices include permaculture, mixed cropping, reusing resources, conserving resources, sharing resources, protecting marine areas and organic farming.

6. Explain how fishing can be managed in Papua New Guinea to sustain the fish supply.

Traditional fishing methods and equipment should be encouraged. Continue to discourage fisherman from using dynamite in fishing. Don't catch little/baby fish.

Use of fishing nets to be regulated so that fisherman catch only good/certain size fish. Carry out awareness on the effects of over fishing in coastal areas. Government regulations on fishing especially by foreign owned fishing companies that are already in place should be strengthened.

NOW GO BACK AND STUDY LESSON 6

Practice Exercise 6

1. Why are Coral reefs important?

Coral reefs are important in ocean life because many kinds of plants, fish and other animals live on and around a coral reef. Reefs are also a source of food.

1. Why can't corals grow near the mouths of rivers?

Corals cannot attach themselves to muddy sea bottom and algae cannot get enough sunlight to grow.

2. How many kinds of corals are there?

There are five kinds of corals.

3. Why is it important for people living in coastal villages and islands to protect reefs?

Reefs are an important source of food for them and they protect the island villages from large ocean waves.

4. What is the difference between a Fringing reef and a Barrier reef?

Fringing reefs are close to the shore but the barrier reefs are further out in the ocean.

5. Papua New Guinea is a nation of islands. What is likely to happen to the islands if coral reefs are not protected?

If coral reefs are not protected they will die and as a result the islands will sink

7. What can you do to help protect the reefs from dying and islands from sinking?

*- We should not use destructive explosives to kill fish.
-We should not throw rubbish in the sea and pollute the sea.*

REVISE SUBSTRAND 1 AND DO SUBSTRAND 1 TEST IN YOUR ASSIGNMENT 1 BOOK

SUBSTRAND 2

THE ENVIRONMENT

In this sub strand, you will:

- **identify and describe the processes of reducing, recycling and reusing**
- **describe how waste is generated in the community**
- **identify the methods of reducing, reusing and recycling a range of waste items**
- **predict possible causes and effects of applying recycling processes to everyday life**
- **initiate and undertake recycling, reusing or reducing to benefit or improve the local environment**
- **complete a case study or a project**

SUBSTRAND 2: THE ENVIRONMENT



Welcome to Substrand 2. In this Substrand, you will look closely at your environment. You will look at things you need in order to live and what happens to these things after you have used them. You will see that there are things that will build up in your environment as a result of your living. If you are not careful, those things can very quickly destroy your environment.

This Substrand contains four (4) lessons.

Lesson 7: Importance of the Environment

This lesson will help you to revise what you learnt in Grade 6 about the meaning and importance of the environment by discussing briefly the elements of the environment.

Lesson 8: Household and Community Waste

This lesson will help you to look at the different types of wastes in the home and the community. The lesson will guide you to identify the sources and nature of the waste products in the home and the community. You will consider how the wastes are created and become a problem in our homes and communities. You will also consider biodegradable and non biodegradable products and wastes.

Lesson 9: Disposal of Waste

This lesson covers the disposal of wastes. This lesson will help you to look at ways to dispose of wastes appropriately. After identifying biodegradable and non biodegradable products or wastes, you will understand why it is important to dispose of wastes properly.

Lesson 10: Practical and Appropriate Waste Management

This lesson will require you to apply appropriate waste management practices in your home and in the community. You will find ways to reduce, reuse and recycle wastes and consider how you can put them into practice in the rural villages and also in towns. You will also be required to identify a major community waste problem for which you will suggest solutions to control or to stop it completely.



Our Environment is very important. Appropriate waste management practices will keep the environment of our homes and communities clean and healthy to live in.

Lesson 7: Importance of the Environment



Welcome to lesson 7 of Sub Strand 2. This is a continuation from Sub Strand 1 where you looked at management of land and water resources. In this lesson, you will learn about the importance of the environment.



Your Aims:

- Define environment
 - Identify elements of the local environment
 - Discuss the elements of the local environment
-

Environment

What does environment mean? Underline the correct definition from the alternatives a, b, c and d given below.

- (a) Things that surround us
- (b) The heavens and the earth
- (c) All living things around us
- (d) Environment is the world around us

If you underlined one, then you are correct because all are collect about the environment. Environment means the world around us. It can be described as all the things that surround us including the heavens and the earth and everything God created for us to enjoy.

Our environment is where we live, work, study and play. It is all around us.



People and their natural environment

Some parts of the environment are natural; some are influenced by the people while other parts are made by people. People influence the environment and the environment influences people. We call this interdependence where people and the environment influence each other. The environment affects all people wherever they live. Things that happen in one place may affect things in other places, even in faraway places.

The Elements of the Environment

You learnt that there are three elements to any local environments. They are natural, built and social elements.

- What are the natural elements of the environment? Does it include the trees?
- What else? List them here. _____

The natural environment includes the hills, mountains, valleys, rivers, ocean and lakes with millions of life forms in plants, trees, fish, mammals, insects, spiders, amphibians, crustaceans, birds and reptiles. Are you able to remember some things you learnt in Grade 6 now? Good.

What are the elements of the built environment?

Human activity has a huge impact on the natural environment. People interact with the natural environment and convert it into a human habitat by arranging and changing their surroundings to suit their needs and wants.

What are some examples of these?

We see land being cleared for houses and gardens in rural areas. There are walking tracks that disturb the natural environment. Natural resources are used for housing, canoes, clothing and tools. Humans have changed the appearance of the natural environment.

In rural areas, landscape has been transformed by cash crop plantations, farms like cattle paddocks, forestry projects and mines.

With rapidly changing technology, humans have greater powers to change the natural environment. The effects are more evident in towns.



Activity 1: (a) Give three examples of built environment in towns.

Built Environment includes roads, houses, churches, schools, hospitals, markets, shops, electricity power poles, vehicles, drains and rubbish.

(b) What would be the situation if there was no human inhabiting the land? Would there be any changes to the environment? _____

There is also the social element of the environment.

(c) Can you explain what social element of the environment means?



Gateway Hotel in Port Moresby

Humans are social beings and survive in communities which are characterized by friendly companionship and relationships. A person cannot live in isolation of their culture and community.

(d) List two specific social elements?

Social groupings are very important like, family groups, wantok groups, villages, sporting teams, church groups, schools and clans, provincial groups and so on.

People in these social groups share common interests and meet their needs in similar ways. Why is it necessary to belong to a social group such as those mentioned above?

(e) _____

Remember, a person does not live in isolation. Social groupings are important because from them, people obtain a sense of belonging and establish cultural values.

We briefly discussed the elements of the environment. Now, let us consider why the environment is important.

Importance of the Environment

We have seen that our environment consists of natural, built and social elements. These elements connect in many ways. These parts are interacting and interdependent. They cannot be seen as separate or competing against one another.



Members of a Golf Team

The quality of the interrelationships defines the health and well-being of the total environment. There are consequences when an element is affected either by natural or human causes. The condition of the environment determines the quality and survival of life.

Today, we recognize the need to be aware of the impact of our actions on the environment. We need to be aware of positive actions we can take to preserve and manage the environment for the future. Changes to the world's natural systems are occurring rapidly. The changes in weather patterns, climate and sea level are very complicated.

Human survival will depend on environmental awareness at a global level and appropriate action to ensure the diversity and stability of life on earth. Think globally, act locally is an appropriate slogan.

Let us consider the elements of healthy and unhealthy environments. What kind of environment is healthy?

A healthy environment has clean air, safe clean water for drinking and cooking, food for the family's need, 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.

What kind of environment is unhealthy? An unhealthy environment is one which has smoky air, polluted water for drinking, infertile soil, poor crops, sick or weak people, dirty houses, unattractive physical surroundings, poor waste management practices, litter, graffiti, betel nut spitals and stains, arguments and distrust amongst the people.

Consequences

What are consequences? 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 the 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 diarrhoea, dysentery or typhoid.
- Overgrazing of animals destroys vegetation cover and productive soils.



Activity 2: Which of the above are causes and which ones are effects? The first one has been done as an example for you.

CAUSES AND EFFECTS

| NO | CAUSES | EFFECTS |
|----|---|---|
| 1. | Heavy rain | washed away the top soil from gardens. |
| 2. | A volcanic eruption or tidal wave | |
| 3. | | damages a road and people cannot transport goods to the market. |
| 4. | Forestry projects | |
| 5. | Overuse of chemical sprays and fertilizers. | |
| 6. | | Outbreaks of diarrhea, dysentery and typhoid, cholera |
| 7. | Over grazing animals | |

Summary



You have come to the end of Lesson 7. In this lesson you learnt that;

- Environment means the world around us. It can be described as all the things that surround us.
- There are three elements to any local environments. They are natural, built and social elements.
- The natural environment includes the hills, mountains, valleys, rivers, ocean and lakes as well as the millions of life forms in plants, trees, fish, mammals, insects, spiders, amphibians, crustaceans, birds and reptiles.
- People interact with the natural environment and convert it into a human habitat by arranging and changing their surroundings to suit their needs and wants.
- Humans are social beings and survive in communities which are characterized by friendly companionship and relationships.
- The natural, built and social elements connect in many ways. These parts are interacting and interdependent.
- A healthy environment has clean air, safe clean water for drinking and cooking, food for the family and so on.
- An unhealthy environment has smoky air, polluted water for drinking, 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.
- An element is affected either by natural or human causes, the condition of the environment determines the quality and survival of life.
- Human survival will depend on improved environmental awareness at a global level and appropriate action to ensure the diversity and stability of life on earth.

NOW DO PRACTICE EXERCISE 7 ON THE NEXT PAGE

**Practice Exercise: 7**

Answer the following discussion questions.

1. List the three important elements of the natural environment

2. What impact does local built environment have on the natural environment?

3. What are the unique features of the social environments in your local area?

4. Suggest some measures we can take to protect our environment.

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 10: A Healthy Environment (Community)

This supplementary reading will help you get to understand your own environment a little bit more from a different aspects. Furthermore, in order, for the environment to continue sustaining or supporting us the inhabitants, it must be given time to break down all the unwanted rubbish we produced every day. Otherwise it will not cope with the amount of rubbish or waste we produce. The environment will simply pollute itself.

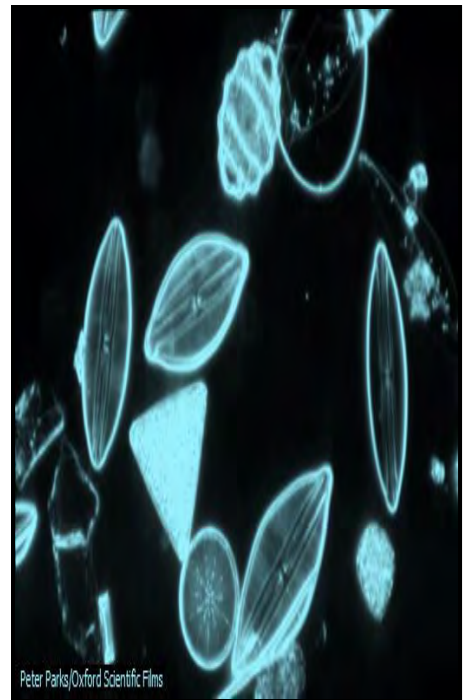
What is an Environment?

The Environment includes all the outside factors that influence your life and activities of people, plants and animals. When the effect on the environment is minimal you will be healthy so as your communities, plants and animals too. However, development always comes with a positive and negative impact on the lives of people, animals and plants.

People who understand how germs live can use this knowledge to make their community healthy. For example, the germs that cause diarrhea and stomach ache like to live in places that are dirty, warm and damp. People who know this can control germs by keeping the place where food is prepared and stored clean, cool and dry. People who understand that flies and mosquitoes can carry germs can prevent these insects from breeding. People who understand that coughing and spitting can spread the germs that cause the common cold can teach other people to cover their mouth when they cough and not to spit.

Knowing the way germs live will also enable people to deal with an outbreak of a disease when it occurs. For example, all families should know that being clean will stop diarrhea spreading from one member of the family to all members of the family. All of this information is important for everyone in the community. However, in order for the community to remain healthy, everybody must behave in ways which make use of this knowledge. When people accept responsibility for their health, think positively and cooperate with each other, then they are better able to solve health problems that arise.

Most health problems can be prevented by the things that people do and the ways that they behave. Health problems can also be cured or solved after they arise, but it is clearly much better to try to prevent the problems in the first place. **'Prevention is better than cure'** is good advice for people who want to remain healthy.



Germs as seen under the microscope

Using clean water

There is a relationship between water, germs and disease. For example, the bacteria that cause typhoid and cholera are carried by water and for this reason hundreds of people can easily become infected from contaminated water. Some germs grow well in damp places. For example, the fungi that cause tinea grow well on damp skin. This can be controlled by drying the body with a clean towel and then using talcum powder. In the same way the fungi that cause wood to rot can reproduce in damp timber. For this reason a shower curtain is used to prevent water spilling onto wooden bathroom floors. Rotten floors are dangerous and can lead to accidents.

Water that is used for cooking and drinking must be clean and protected from pollution. For example, when rainwater tanks are used, the roof and gutters must be kept clean and the small opening in the top of the tank should be kept covered with fly wire. When wells and rivers are used, it is important that the water does not become polluted with faeces or other rubbish.

For this reason pit toilets should be built away from the water supply.



Wash hands with soap and water

Proper and Clean Drainage

The relationship between water, germs and disease has already been described. Because some germs can reproduce in water or be carried by water, it is important that the area near where people live is properly drained. This is particularly important in flat or low-lying areas which have high rainfall. When water is allowed to remain lying around it becomes still and starts to smell.

Still water also allows mosquitoes to breed, which means that people nearby are likely to suffer from malaria. Drainage channels should keep clear so that water flows away. However, the water in drains should not be allowed to run into the water supply.

Use of Clean Toilets

There is a relationship between faeces, germs and disease. Faeces consist of unabsorbed food and bacteria, which is why they quickly begin to decay and smell. The smell attracts flies that settle on the faeces and so bacteria are transferred through the flies. When the flies settle on food or a person's sore then the bacteria are transferred to the food or sore.

Faeces and urine can also easily pollute water supplies and so the removal of these wastes is very important to the community. Everybody needs to go to the toilet every day, and when a number of people live together it is healthier and easier if a special place is provided which people can use. Pit toilets are cheap and easy to build, but they can become smelly and will attract flies unless they are kept clean.

Another type of toilet which works well in coastal areas is the toilet over water. This consists of a small house built on posts over the sea, with a walkway joining the house to the shore. It is important that the walkway is strong and safe. A hole is made in the floor and the wastes drop straight into the sea. Leaves or newspapers can be used to wipe the bottom. At low tide these toilets can attract a lot of flies and cause bad smell.



Open drainage

A flush toilet has porcelain with a plastic bowl seat and lid. The toilet is flushed with water that comes from a small tank or cistern, above the bowl. The content of the toilet is flushed away along a pipe. The pipe is shaped so that some water is always trapped at the bottom of the bowl preventing bad smells from coming up the pipe and into the house. Only toilet paper should be used in flush toilets.

The waste from the flush toilets either flows into a septic tank or a sewerage system. With a septic tank the waste flows into a concrete or fiber glass underground tank. Anaerobic bacteria breaks the waste down and the safe liquid then flows from the top of the tank into the soil. Anaerobic bacteria do not need oxygen.

In a sewerage system the toilet waste flows along pipes away from the houses to special sewage treatment plants. The waste is treated before being discharged into large ponds or into the sea. When sewage is treated and diluted with water, it does not cause a pollution problem. However, in Port Moresby some raw sewage is pumped in to the sea, causing pollution.

Septic tanks are cheaper to install than sewerage systems and are popular in smaller towns and rural areas where there is no alternative.



Safe Rubbish Disposal

People throw rubbish away every day and the kind of rubbish that people throw away tells much about their way of life. People living a traditional way of life throw away such things as vegetable peelings, shells, bones and broken pottery. Many of these things are natural materials which can decay and eventually disappear. Because these materials can be broken down by germs in this way, they are said to be **biodegradable**. Biodegradable rubbish provides a good place for germs to grow and reproduce. The smell of the decay attracts flies which can then spread the germs to people and food.



Flush Toilet

People who buy things from stores also throw away such things as paper, cardboard, tins, bottles and plastics. Many of these things are **non-biodegradable** and last for many years. This means that people have to be careful about the way that they dispose of different kinds of rubbish. When people have the responsibility to dispose of their own rubbish, as is necessary in rural areas, they must be able to sort the rubbish into different groups and dispose of it in different ways.



Biodegradable

Biodegradable rubbish, such as leaves, grass cuttings, vegetable peelings and food scraps, can all be put on a composite heap and allowed to rot. After some time the compost can be spread on the garden to help improve the fertility of the soil.

Rubbish such as paper and cardboard can be burnt in a special place. Fires should not be lit at the base of trees, as this will kill the tree.

Rubbish that will not rot and cannot be burnt such as tins, bottles and plastic or **non-biodegradables** should be buried in a hole in the ground and covered when the hole is nearly full. Where possible, bottles and drink cans should be returned and re-cycled. Tins and bottles should not be left lying around, as they can cut peoples feet and also allow mosquitoes to breed. People who live in towns and on rural stations usually have their rubbish collected by the council. The rubbish is taken away to a special dump. This is a service which has to be paid for by the people to the council.

Caring for animals

Animals are able to spread diseases to people. For example, anthrax, which is caused by bacteria in pigs, can also affect humans. Dogs and other animals that are suffering from rabies can bite people, causing seizures, paralysis and even death. Many different animals are kept in Papua New Guinea and it is important that they are fed regularly and that the owner is responsible for their control and their health. Animal that are not cared for are likely to spread diseases to other animals and people.

Health services

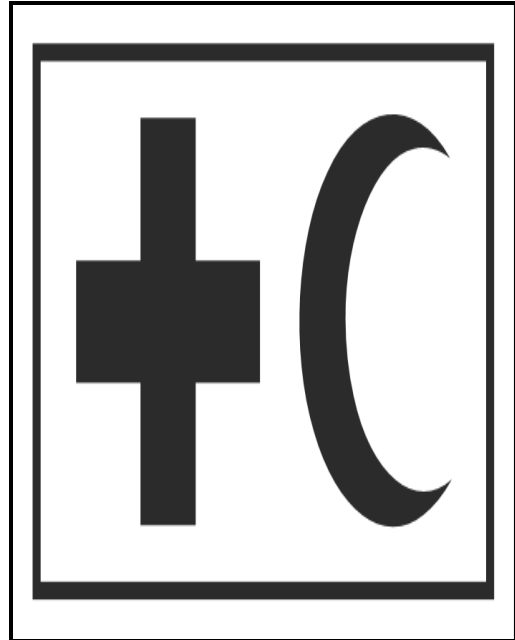
The Department of Health provides health services to people in all parts of Papua New Guinea. Most villages have an aid post close by where an Aid Post Orderly can deal with most of the daily health issues such as cuts, sores, diarrhea and malaria. Cases which require more specialized help, such as women having difficulties in childbirth, are sent to the hospital in the nearest town. When health problems arise in the community, they should be reported to the Department of Health.

Health Inspectors have the job of visiting places such as factories, shops, trade stores, and institutions such as schools. It is particularly important that all places where food is prepared and sold, and where people cook and live in institutions must be kept clean at all times. This is to prevent the rapid spread of disease to large numbers of people. It is

also important for the people who live and work in these places to keep themselves clean so that they do not spread diseases to other people.

Other health organizations

A number of organizations are interested in helping village communities to improve their living conditions. For Example; by building a safe water supply and toilets. These organizations include High Commissions of countries such as Australia and New Zealand, service clubs such as Lions and Rotary, and international groups such as United Nations Children's Fund [UNICEF] and the World Health Organization [WHO]. Village people who are interested in getting help from one of these organizations should plan their project carefully before they apply for help.



INTERNATIONAL RED CROSS SYMBOL

Lesson 8: Household and Community Wastes



Welcome to Lesson 8 of Sub Strand 2. In your last lesson, we learnt that our environment is where we live. It is where we work and study. It is also where we play. It is all around us. There are some things we cannot change about our environment. We can live in a way that does very little damage to it.



Your Aims:

- Identify household and community waste
- Discuss the different kinds of wastes produced today and compare with traditional times
- Discuss the importance of waste management

Waste in Traditional and Modern Times

Firstly, was waste a problem in traditional times? Yes or No. Why do you think it was or was not a problem? Read and think about the following statements on waste in traditional times.

- (a) It was a problem because people in traditional times were uneducated and did not know how to dispose of their wastes.
- (b) It was not a problem because most of the wastes produced in traditional times were not harmful to the environment.
- (c) In traditional times, people did not know and care about hygiene and cleanliness.
- (d) People in traditional times knew and cared about their environment but there were fewer people then.
- (e) They did not use many of the things we have today that are causing problems for us and to the environment.

Comparing the traditional time with our time today, we can agree that waste was not a problem then. They did not use things, we use today. They used traditional materials which were not harmful to the environment. Statements **b**, **d** and **e** are correct.

The following questions will help you to think about traditional times;

1. What kinds of tools did people in traditional times use?
2. What type of houses did they build?
3. What were the materials they used to build their houses?
4. What kinds of food did they eat?
5. What kind of utensils did they use?
6. What kinds of transport did they use?
7. What kinds of work did they do?

People in traditional times knew and cared about their environment. Waste was not a problem because there were less people. They used resources from the environment to

build houses and use as tools. Most of their food was taken from the gardens, the forest, rivers and the sea.

The reason there is very little waste from traditional times is because bush materials are biodegradable. This means that the material is able to break down naturally and eventually return to the soil.

Sources of household Wastes

What is a Household? Underline your answer from the words given in the box.

| | | | | |
|--------|------|-------|---------------|-------------|
| Family | home | house | family circle | family unit |
|--------|------|-------|---------------|-------------|

All the words listed above mean household.

What are wastes? Waste refer to things that are used and no longer have value. They can be little or leftovers. Examples of waste are, litter, garbage, trash, rubbish, misuse, throw away, leftover, excess, surplus, unwanted, unused, discarded, barren, bare, fallow uncultivated, wither and spare. Some of these wastes become toxic because they can not be broken down quickly and easily naturally. Toxic means the waste is poisonous and harmful to the environment because it contains poison or toxin. Today a lot of materials such as; dry cells, car batteries, vehicle oil, tyres, plastics of all kinds and many more are dumped into dump sites and they cannot rot easily. One way people try to get rid of them is burning them. When waste is burnt, it gives off bad odour and poisonous smoke. The smoke is bad and can make people sick or unconscious.

PICTURES OF HOUSEHOLD WASTES



Does a household produce or create wastes? Yes, and plenty of wastes especially wastes from the kitchen.



Activity 1: List three examples of waste created in the kitchen?

1. _____ 2. _____ 3. _____

Kitchen is the place in a house that produces a lot of rubbish. For example, vegetable peelings from kaukau, banana, taro, cassava, yam, potato and sugarcane. We also make rubbish from greens and food scraps. All these rubbish have something that must be thrown away.

Now, what do you think about plastics, packets, tins and glasses that food is packed in? These are also wastes from the kitchen. They will be further studied in Lesson 9 about biodegradable materials.

How about the human wastes? We do produce waste from our bodies and that is part of the household waste. Some households do not have proper toilet facilities. Many households dispose of their rubbish in their backyards. Is it healthy to do that? No, it is very unhealthy as it can bring health problems to the home.

Homes generate a lot of rubbish because we live and carry out many different kinds of activities in our homes. It is part of life and we cannot stop producing wastes but we can try to minimize and help to reduce the amount of waste we produce.



Activity 2: Complete the table below with different household wastes. The first one has been done as an example for you.

OTHER HOUSEHOLD WASTES

| No | Fabrics | Wood | Metal | Glass | Plastics |
|----|--------------------|---------------------|----------------------|----------------------|-------------------------|
| 1 | <i>Old clothes</i> | <i>Broken stool</i> | <i>Piece of iron</i> | <i>Broken bottle</i> | <i>Biscuit wrappers</i> |
| 2 | | | | | |
| 3 | | | | | |
| 4 | | | | | |
| 5 | | | | | |

REMEMBER: Biodegradable means that the material is able to break down naturally and return to the soil

Now, we have confirmed that households produce a lot of rubbish and wastes.

Let us now look at the community. What is the environment like in your community?

Sources of Community Wastes

A lot of rubbish from households spills onto the environment in the community . How? From households, we throw out old furniture, metal, bottles, glass and fabrics. What else do you find in the community rubbish dump?

You can also find old mats, old tyres, rubber tubes, drums, pieces of iron, timber, roofing iron, wire mesh, car parts, cement, damaged machine parts, refrigerators, television, old stoves, bicycle parts and so on. When all these wastes are not disposed off properly, they become a problem for the community.

Some communities do not have proper waste disposal areas so you find human and animal waste where they should not be. How can we improve this situation? Are we able to get rid of all the rubbish we produce? Why can't we get rid of all the rubbish? Let us find out why.

Causes of Household and Community Wastes

Some reasons why waste is becoming a concern today are:

1. **Increased population and food consumption:** The more people there are, the more food that is bought, caught, gathered, grown and eaten. As a result, more waste is created. For example: tins from tinned food, plastic bottles from cordial and other drinks, glass jars from coffee, plastic shopping bags, cardboard boxes from matches or cereals, newspaper used to wrap store goods, bones and vegetable peelings and cloth, plastic and paper packets or bags from flour or rice. Can we reduce, reuse and recycle these waste products? Yes, we can.

For instance, we can give left over food to the dogs to eat and reduce waste. We can reuse glass jars as vases for flowers. Many Papua New Guineans chew betel nut so glass jars are used as lime gourds. Tins can be recycled and made into sawdust stoves or pot plants. Large plastic bottles can be purchased instead of two or more smaller bottles, thereby reducing the amount of waste that is created. Plastic bags can be reused to hold rubbish or carry things. Vegetable peelings can be recycled as compost to enrich the soil.

2. **Excessive packaging:** Packaging is the wrapping or material around a product. The purpose of packaging is to contain, protect, identify and facilitate the sale and distribution of a product. Nearly all manufacturing and processed goods require packaging. The basic materials of packaging include paper, cardboard, cellophane, steel, aluminum. Glass, wood, cloth and plastic. Excessive packaging is when too much or unnecessary material is used.

For instance, a shirt may be packaged in a cardboard box with cellophane see-through front. Many pins are used to hold the shirt in place around a sheet of cardboard inside the shirt. Is all this packaging really necessary? Would you buy the same shirt if it were on a hanger in a shop?

Toys are often presented in colourful attractive boxes. A small baby's rattle or a model toy car, for example, may be packaged in a comparatively large box. The

packaging is costly and adds nothing to the usefulness or quality of the product. If you were to choose, would you buy the same product in or out of a box?
We should think that a product would be cheaper if it was not in the box.

Packaging contributes to environmental pollution. Millions of tons of packaging materials are thrown away as rubbish each year. Some packaging is biodegradable but most are not degradable. Non-degradable material does not decompose.

- 3. Consumerism:** Consumerism involves the repeated purchase of an increasing variety of goods and services. Food, tools, axes, umbrellas, clothing, footwear, stationery, household items, electric goods, televisions, computers, sporting goods, entertainment equipment and vehicles are examples of goods we increasingly want to own. Advertising encourages us to update or improve the things we own. Perhaps families see the things they own as reflecting their status or success in life. This dependence on products and on constant consumption defines our modern consumer society. Obviously, the more things we purchase, the more we create waste and rubbish products. The more things we purchase, the more opportunities we have to reduce, reuse and recycle. When we shop, careful planning enables us to purchase wisely and consider packaging and waste. We can reduce the number of plastic bags we use. We can buy in bulk to reduce unnecessary packaging. If we can reuse a jar or tin for example, we should choose this style of packaging over a cardboard packet. We should also write a shopping list to reduce impulse buying.

Summary



You have come to the end of Lesson 8. In this lesson you learnt that;

- Waste was not a problem in traditional times because most of the wastes produced were not harmful to the environment.
- People in traditional times knew and cared about their environment but there were fewer people then.
- They did not use many of the things we have today that are causing problems for us and to the environment.
- The reason there is very little waste from long ago is because bush materials are biodegradable.
- Biodegradable means that the material is able to break down naturally and return to the soil.
- Homes generate a lot of rubbish because we live and carry out many different kinds of activities from our homes.
- We cannot stop producing wastes but we can try to minimize and help reduce the amount of waste we produce.
- When household wastes are not disposed off properly, they become a community problem.
- Toxic means the waste is poisonous and harmful to the environment because it contains poison or toxin
- Some reasons why waste is becoming a concern today are; increased population, food consumption as well as excessive packaging and consumerism.

NOW DO PRACTICE EXERCISE 8 ON THE NEXT PAGE



Practice Exercise 8

1. Write two examples of waste produced in traditional times

(a) _____ (b) _____

2. Why was waste in traditional times not a big problem?

3. Write down three examples of waste produced nowadays

(a) _____ (b) _____ (c) _____

4. What is the main problem with waste produced nowadays?

5. Write down three examples of toxic waste.

(a) _____ (b) _____ (c) _____

6. Why is toxic waste a problem?

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 11: Different types of waste – pollution

In reading 11, you will learn about the different types of waste and how they pollute your environment. Waste is a very big concern for everyone both in rural and urban areas.

Pollution - Wastewater

The major sources of water pollution can be classified as municipal (public), industrial, and agricultural.

Municipal water pollution consists of wastewater from homes and commercial establishments.

For many years, the main aim of municipal sewage disposal was simply to reduce its content of on hold solids, oxygen-demanding materials, dissolved non-living compounds (particularly compounds of phosphorus and nitrogen), and harmful bacteria.

In recent years, however, more stress has been placed on improving the means of disposal of solid remains from municipal treatment processes.

The basic methods of treating municipal wastewater fall into three stages:

- primary treatment, including grit removal, screening, grinding, flocculation (aggregation of the solids), and sedimentation;
 - secondary treatment, which involves oxidation of dissolved organic matter by means of biologically active sludge, which is then filtered off; and
 - tertiary treatment, in which advanced biological methods of nitrogen removal and chemical and physical methods such as rough filtration and activated carbon adsorption are employed.
- The handling and disposal of solid remains can account for 25 to 50 per cent of the capital and operational costs of a treatment plant.

The characteristics of industrial wastewaters can differ markedly both within and among industries. The impact of industrial discharges depends not only on their collective characteristics, such as biochemical oxygen demand and the amount of suspended solids, but also on their content of specific inorganic and organic substances. Three options are available in controlling industrial wastewater.

Control can take place at the point of generation within the plant; wastewater can be pretreated for discharge to municipal treatment systems; or wastewater can be treated completely at the plant and either reused or discharged directly into receiving waters.

Agricultural pollution happens when chemicals that are harmful to living things get into the environment. Chemicals such as DDT, pesticides, fungicides and insecticides would get into the food people ate. Previously people were scared and governments banned the use of DDT. Other chemicals like pesticides, fungicides and insecticides are widely used by farmers and may run off into streams and pollute fish and other river animals mainly consumed as protein.

Pollution - Environment



Mountains of Trash

Pollution is contamination of the environment by man-made substances or energy that has adverse effects on living or non-living matter. This contamination of air, water, or soil materials interferes with human health, the quality of life, or the natural functioning of ecosystems. In simple terms, pollution can be seen as the wrong substance in the wrong place in the wrong quantities at the wrong time. This implies that harm is caused to the environment, and if the same substance is present at levels too low to cause harm, then it can be considered as contamination.

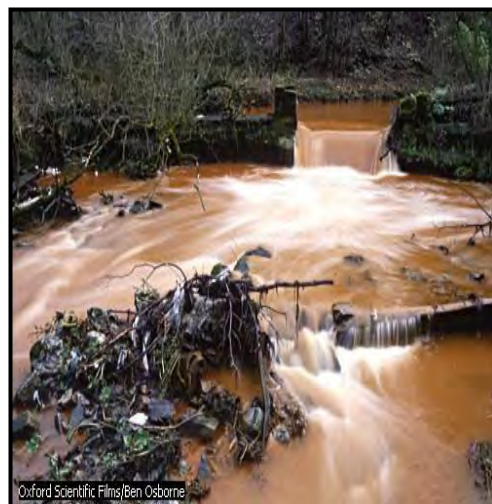
You can keep a lot of this trash out of the garbage dump by recycling it.

Many substances that can be pollutants also occur naturally, in which case they are not classified as pollution. However, other pollutants result entirely from human activity, such as most toxic organic compounds and artificial forms of radioactivity, particularly from nuclear waste.

Pollution - Water

Water pollution arises from the discharge of industrial, agricultural, and human wastes into freshwaters, estuaries, and seas. This may result in the poisoning of aquatic organisms or the depletion of oxygen owing to excessive growth of micro-organisms (anthropogenic eutrophication), which makes the water less habitable for fish.

Metal pollution and toxic organic compounds are a concern for human and environmental health as a result of discharges to water, air, and on to land.



Polluted creek

Pollution - Air

Air pollution can result in adverse effects on health, crops, natural ecosystems, materials, and visibility. The major concerns over air pollution are acidification of soils and waters with its harmful effects on animal and plant life, and the impact of traffic-derived pollutants on health in cities.



Smoke from factories and other sources.

On a global scale air pollution probably represents the greatest problem of all, with greenhouse gases (such as carbon dioxide) resulting in global warming and man-made chlorine compounds (chlorofluorocarbons) reducing the stratospheric ozone layer.

Nuclear Waste

Some of the hardest waste to dispose of comes from nuclear power plants, like the one in this photo. Because nuclear waste is very dangerous to people, it is not usually recycled. It is buried deep underground.

Nuclear waste is a further modern environmental concern, which poses a problem not just for the present generation, but for future generations as the waste remains radioactive for thousands of years



Nuclear power plants

Lesson 9: Disposal of Waste



Welcome to Lesson 9 of Substrand 2. In the last lesson, you learnt about household and community waste. You discussed the different kinds of wastes and compare them with traditional times. You also learnt about the importance of waste management. In this lesson, you will learn about disposal of waste.



Your Aims:

- Define disposal
 - Identify ways of disposing wastes
-

Disposal

Disposal is the process of getting rid of something in an orderly manner. The word *dispose* means to get rid of anything not needed anymore. Any unwanted waste must be disposed or gotten rid off. If waste is left lying around, it can cause problems in the 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 compacted.

Ways of disposing wastes

Burning and burying

In Grade 6 Making a Living, you learnt that tins should be burnt after they have been flattened out. Then they should be buried. Remember, bash, burn and bury.



Activity 1: What can be done to get rid of plastic containers?

Holes should be punched in the bottom of plastic containers and then they should be buried. Plastic containers should never be burnt. Did you know why? The reason is that they give off toxic gases when they are burnt. If someone is standing close by, breathing in the toxic gases, can be bad for their health. If it is not possible to recycle, reuse or reduce glass then it should be buried.

You know that things like plastic, tins and glass are not biodegradable. This means that they will stay in the ground for a very long time when you bury them. It is therefore important to choose a spot on your land or yard very carefully. You can dig a very big hole and gradually fill it up with non- biodegradable waste. When the hole is eventually full, you can cover it with soil. You should remember where you buried these waste so a garden, plant or a fruit tree can not be planted there on that spot.



Plastic Bottles



Tins and Cans

PICTURES
OF
NON-
BIODEGRADABLE



Bottles



Small batteries are toxic wastes

Special care should be taken when disposing of toxic waste like old car batteries, small batteries and used paint and chemical tins. These tins should not be burnt. These items should be buried in a special place, far from any water supply and far from any present or future garden. The spot where you bury such things should be marked. This will help you remember where you have buried them.

All forms of waste should never be thrown into rivers or the sea. It will spoil the water.



Activity 2:

List three problems caused by throwing waste into river systems or the sea.

- (a) _____
- (b) _____
- (c) _____

A river can become polluted if too much waste is thrown into it. The water may become unsafe to use. Fish and other creatures that live in the river may also die. Too much waste in the river can also affect the environment, other animals and plants in the area.



Shredded papers

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

**Activity 3:**

Name another waste material and describe how you would reuse, recycle or reduce it.

Leaves, cut grass and chicken manure can be mixed as compost and later applied to soil as fertilizer. Old paint tins can be reused as pots for ornamental plants and sold in markets for 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.

Environmentally friendly waste management practices benefit the environment. People have attractive healthy environments to live in with clean air and water. There is a reduction in pollution, insects and disease. Before dropping or throwing something on the ground, stop and think of a more appropriate action.



The three pictures show that all waste is separated. Some of the waste is for disposing, some for recycling and some for re-use.

Summary



You have come to the end of Lesson 9. In this lesson you learnt that;

- Disposal is the process of getting rid of something in an orderly manner.
- There are some wastes that you cannot reduce, reuse or recycle. They should be disposed of wisely.
- Tins and plastic containers should be buried and must never be burnt.
- Plastic, tins and glass are not biodegradable.
- Special care should be taken when disposing of toxic wastes.
- Toxic wastes include old car batteries, small batteries and used paint and chemical tins.
- Waste should never be thrown into rivers or the sea.
- Papers and plastic material can be reused, recycled and reduced to minimize pollution.
- Some recyclable items can be sold for cash.
- Leaves, cut grass and chicken manure can be mixed as compost and later applied to soil as fertilizer
- Old paint tins can be reused as pots for ornamental plants and sold in markets for cash. Other waste products from locally produced or imported items can be reused.
- Environmentally friendly waste management practices benefit the environment

NOW DO PRACTICE EXERCISE 9 ON THE NEXT PAGE



Practice Exercise 9

1. What should be done with all the empty coke 500ml plastic containers?

2. Why is it unwise to burn plastic bags and containers?

3. What is the best way to dispose of empty cans?

4. Explain how you can dispose of your pet dogs and cats when they die?

5. What must be done to waste that cannot be recycled, reused or reduced ?

6. List three (3) items that can be recycled.

7. List three (3) items that can be reused?

8. List 3 things that you can do or reduce to have a healthy life and enjoy a clean environment.

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



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

Supplementary Reading 12: Waste Reducing, Re-Cycling and Re-Using

Introduction:

Welcome to supplementary reading number twelve (12). In your last lesson you had a look at how you can care for yourself and not live carelessly and get sick. A lot of people who live in settlements must still, be extra careful taking care of their rubbish. In this lesson, you will learn about ways to minimize waste that is produced as a result of living in the environment. Waste is a result of everyday living and can be from basic kitchen waste to more complex industrial and nuclear waste.

Waste or rubbish is material that is not needed and can be thrown away. It may be in liquid, gas, or solid form and originate from a wide range of human activities such as household and industrial waste.

Waste may be grouped in many different ways, such as according to its origin (for example, domestic, industrial and commercial, clinical, construction, nuclear, agricultural) or its properties (for examples, stagnant, toxic, and inflammable). Without suitable handling waste becomes a source of pollution in the environment. This can lead to air pollution (such as acid rain or traffic pollution), water pollution, and oil pollution.

Waste created must be disposed of properly. Some waste can be disposed easily, however, there are some waste that cannot be, disposed of easily. These are the kinds that pollute our environment.

As it becomes clear that a polluted environment will make us sick, we humans must control our waste so that it doesn't spoil our environment. We do not want to live in an environment that is risky or unpleasant. It is therefore important to control and manage our waste and there are a number of things we can do.

We can **reduce, reuse, recycle** and **dispose waste**. The following are examples of waste materials that can be, reduced, reused, recycled or disposed of.



Empty containers

Reduce

The word **reduce** means to make something smaller in size or less in number. If you can think of ways to cut down on how much waste you make in the first place, it will not be a big problem.

Some goods you buy from stores have so much wrapping. For example, a phone, inside the box there may be soft tissue paper or foam. The box is wrapped in shiny coloured plastic and has some packaging material needed to protect the item.

You might ask the storekeeper not to put goods into a plastic bag instead put it straight into your bilum or basket. This will mean that one has to take a bilum or basket when going to the store. If one person does this, plastic manufacturing companies may stop, for example 50 plastic bags getting into the environment each year. That means, if one million Papua New Guineans did that, we will stop 50,000,000 plastic bags getting into the environment each year. Plastics are non - biodegradable.

Another way in which waste can be reduced is by squashing cartons and stacking them on top of each other. By doing this, space can be created for other things.

Aluminum Cans

The same can be done with aluminium cans. Squashing them up forces air out and they can take up less space. Aluminium is a common packaging material used for beverage cans. In an effort to conserve non-renewable natural resources, many individuals recycle waste aluminium and other food packaging materials in Papua New Guinea.

Recycling Companies in Lae and Port Moresby including other smaller towns repossess aluminium cans, pack them into large bales at various collection points to be exported for cash and reused again.



Crushed cans - ready for export

Papers and Cardboards

Papers are shredded and bailed at the Recyclables Collection Centres. The papers will be used for making recycled paper products.

Reuse

Reuse means to use something again and the use of it is often for a different purpose instead of throwing it out. Pieces of old clothes can be used as rags for cleaning the walls and windows, wiping dirty, wet feet or making a colourful floor mat. Soft drink cans, can be used to make toys and decorations.

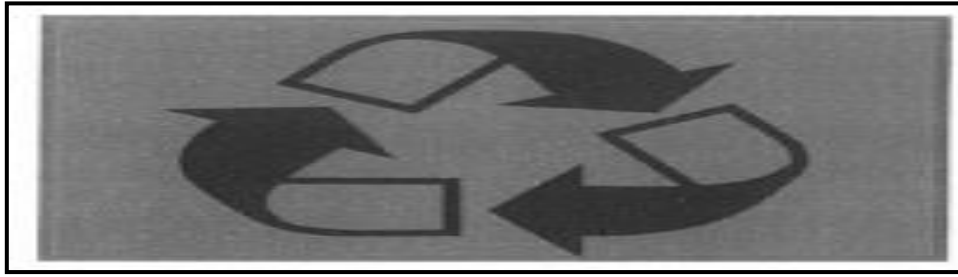


Reusable Containers

Food scraps can be used to feed animals or make compost. Newspapers can be used to wipe glasses, protect the floor during rainy days and when painting and, wet and cover a mumu pit, Soapy water left after laundry can be used to water any citrus trees. It protects the trees from certain plants diseases. Some plastic containers can be used to fill up water, fuel or locally made detergent.

Plastics

Certain types of plastic can be recycled, but they must be sorted into different categories first. Only a very small percent of plastic waste is recycled.



This symbol says that the container or item can be recycled

Recycle

Recycle means to adapt or convert something to be used in a different way. Recycling is the collection, processing, and reuse of materials that would otherwise be thrown away as waste.

Materials ranging from precious metals to broken glass, and old newspapers to plastic spoons, can be recycled. The recycling process reclaims the original material and uses it in new products.

Glass is made from certain kind of sand. The sand is combined with other materials and melted and shaped into things like bottles, vases and crockery. The products are sold to businesses to sell to the public. For example, bottles in good condition can be sold back to the company. They can then reuse the bottles, fill them and sell them again. If the bottles are not in good condition they can be melted and made into other products again. This is recycling and it helps the environment in two ways. It gets rid of old glass bottles which can be dangerous to the public and it also means that factories do not need to use much sand to manufacture again.

Papers can be recycled. Paper is made from wood which comes from a tree. Paper can be made into different products such as newspaper and cardboard. Once these paper products are used, they can be collected. There are special places that will take the old papers and make them into new paper products. This is good for the environment and by recycling paper we do not need to cut down as many trees. This can save our forests around the world.

Some products have special symbols on the bottle or container. These symbols mean that this product can be recycled.

If you live in one of the bigger towns in Papua New Guinea you may be able to recycle some items. However, if you live in the rural or remote part of the country, it may be very difficult to send back these things for recycling. The cost of transport can be expensive. If this is the case, then you can still dispose of the item in a wise way, that will not harm the environment



Dispose

There are some wastes that you cannot **reduce, reuse or recycle**. Such waste should be 'disposed' off wisely. The word 'dispose' means to get rid of. If waste is left lying around it can cause problems in the environment.

Ways of disposing waste

In earlier lessons, you learnt that tins should be burnt after they are been flattened out. Then they should be buried (smash, burn and bury). For plastic containers, holes should be punched in the bottom of them and then they should be buried. Plastic should never be burnt. The reason is that they give off toxic gases when they are burnt. If someone is standing close by, breathing in toxic gas can be bad for their health. If there is no chance of reusing or recycling glass, it should be buried.

Household Waste

Household sources of hazardous wastes include toxic paints, flammable solvents, acid cleaners, toxic batteries, pesticides, drugs, and mercury from broken thermometers. Local waste-disposal systems may refuse these items. If they are accepted, careful monitoring may be required to make sure soil or groundwater is not contaminated. The home owner may be asked to recycle or dispose of these items separately.



Fish intestines & blood are good for composts

Renovations of older homes may cause toxic lead paint to scale off from walls. Insulation material on furnace pipes may contain asbestos particles, which can break off and hang suspended in air and when inhaled, they can cause lung disease and cancer.

Composting and Organic Waste

Waste from the garden and kitchen does not have to be thrown away. It may be condensed and reused as a fertilizer through a process called composting



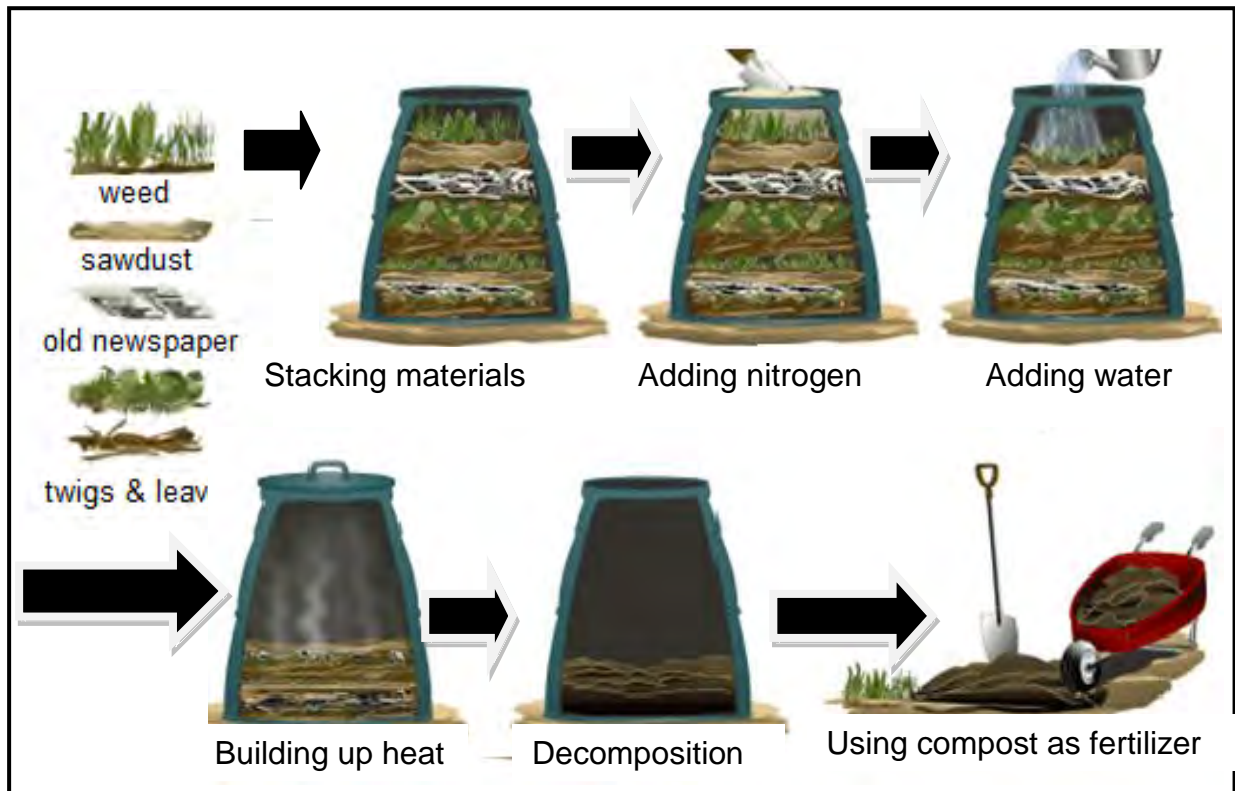
Supplementary Activity

Here is an activity that can be done using decomposable waste at the school or at home.

Making Compost

Follow these basic steps to make your compost

- (1) A compost pile may be built with different layers of waste in a bin or compost area, leaving space between the layers for air to circulate.
- (2) Nitrogen is added to the pile in the form of manure, meal left overs, or green leaves to generate heat.
- (3) Heat helps rotting and kills all undesirable organisms.
- (4) Once the pile is slightly dampened, it is covered. As heat and steam build up, the waste decomposes over time into a nutrient-rich substance called compost.
- (5) The compost is then applied to plants as a fertilizer.



Compost Process

Lesson 10: Practical and Appropriate Waste Management



Welcome to Lesson 10, it is based on Practical and Appropriate Waste Management - how best we can care for our environment – the place where we live, work, play and study. There are some things we cannot change about our environment. We can only live in such a way that does very little damage to it.



Your Aims:

- Identify various ways of waste management
 - Identify practical ways of disposing waste
 - Identify major waste problems in rural and urban communities
 - Discuss a case study of a coastal village in Papua New Guinea that is trying to address this problem in their local area.
-

What is Waste?

Every day we have wastes produced from different areas. They are produced from households, communities, offices, hospitals, mines, industries and factories, agricultural fields and also from the nuclear power plants.

Where does Waste Come From?

Humans produce a huge amount of waste as a by - products of their way of life. There is proof of dumping pits to be found in or around archaeological sites. Every activity from preparing a meal to manufacturing a car is accompanied by production of waste material. These cannot be used for any other things and needs to be disposed off properly. If not handled correctly, waste can end up in the open where it can make humans and animals sick and also damage the environment. We now know that we actually create waste ourselves. Let us consider how we can help to manage our waste.



Activity 1:

Write down three things from your breakfast this morning that became waste immediately or will later become a waste.

(i) _____, (ii) _____, (iii) _____.



An overflowing waste box.

What is Waste Management?

Waste management is about dealing with waste. It involves how the waste is collected, stored and disposed.

Now, let us discuss a little more on waste collection. Waste collection is to do with the collecting of waste, wherever they are produced.

Take note that some waste have to be stored or go through a treatment process before they can be disposed. For example, household waste such as vegetable peelings is biodegradable. They can be piled in the open to dry and be used as mulch for gardening.

Remember; biodegradable means that the material is able to break down naturally and return to the soil. Other biodegradable wastes like papers can be flattened, covered with soil and spread evenly to further neutralise it for useful activities.

Non-biodegradable means that the material is not able to break down naturally and return to the soil. Non-biodegradable wastes come from industries, agriculture, hospitals, household and communities. These are also stored or go through a treatment process before they can be disposed.

Importance of Waste Management

It is a must for people as well as villages, towns and cities in Papua New Guinea and the world to manage their wastes properly. You know by now that if wastes are not managed well, this will lead to big problems. Some of the big problems that can result are health problems in the lives of people, pollution to the air and the sea and also the lives of the plants and animals in the environment can be affected.

For this reason, individuals and organisations have already placed some proper waste disposal systems. For example, in Port Moresby Eda Ranu LTD, takes care of the liquid waste and water, while the National Capital District Commission, takes care of the solid waste. Privately owned cleaning companies like; PNG Superclean Limited, Lae Evergreen, Clean Masters, Ace Cleaning Services, and Proclean Ltd are involved in providing cleaning services and regulate it for safety and efficiency purposes.

In other major centres of Papua New Guinea, the city and town councils with the help of several private contractors provide waste management services.



Activity 2:

List the two types of waste studied?

Practical Ways of Managing Solid Waste

Do you ever notice the type of rubbish that is thrown away the most? Here is my list; kaukau and banana peelings, pawpaw and pumpkin seeds, bread and biscuit wrappers, butter and jam containers, cooked food leftovers and many more. Where do you think most of these rubbish is produced? Did you say kitchen? Yes ...the kitchen is the place in the house that produces a lot of these rubbish which are mentioned above.

Every time a piece of fruit is eaten or a soft drink drunk, you must know that it is going to be a by-product or rubbish which will be a solid or liquid, and at the end it must be disposed .

There are a lot of things you can do to help manage waste production. The many ways of managing wastes are put into four main groups. The three R's of waste management are: **Reduce, reuse, recycle** and **dispose!** Practicing all three of these activities every day is not only important for a healthy environment, but it can also be fun too. Let's discuss more about the three R's of waste management, so you can become a key player in making our world a safe and healthy place.

Reduce or Reduction

What is reduce or reduction? Reduce or reduction is to make something smaller. It can also mean to use less which will result in a smaller amount of waste.

Reducing waste is "conservation" Conservation means using natural resources wisely, and using less than usual in order to avoid waste. When you use natural resources wisely, you are preserving, managing and having care for natural and cultural resources.

You can practice reduction by selecting products that do not have to be added to landfills or the waste stream in general. This is really easy to do. You can follow the tips given.

1. First and foremost, buy and use less.
2. Start making wise "package" selections so you avoid packages that have so much wrapping.
3. Think BIG! Buying in "bulk so there are not many smaller packages
4. Refuse plastic bags and bring your bilum along for shopping
5. Use durable items instead of disposable items
6. Start a compost to transform your household biodegradable materials or wastes into a rich soil. These wastes will include; vegetable peels, coffee grounds and skins, aibika, vegetable stocks etc. Now you can see that these are simple and easy tasks that you can do. Choose carefully and reduce the amount of waste produced.



Kitchen waste is good for compost

Re-use

Some things that you have or own can be made useful by using them for other purposes or giving them away to others to use. Today this has become a big industry. As the saying goes; "One man's trash is another man's treasure". The next method is proving to be helpful to a lot of people and the environment.

You can "reuse" materials in their original form instead of throwing them away, or donate materials on to others who could use them too! Remember, one man's trash is another man's treasure! Here are some examples of reuse.

1. Take along washable cups or travel mugs instead of disposables.
2. When you do use disposables like plastic cups, plates, utensils, and plastic food storage bags, don't throw them away! Wash and reuse them.
3. Hold a garage sale or give-aways if you have things that you do not use any more.
4. Scrap metal can be sold for cash
5. Use washable table napkins instead of paper tissues

Here again you can see that these are pretty easy things that can be done to keep the environment waste free.

Recycle

Recycling occurs when you save and take reusable materials to places where they can be remade into either the same product or new products. Making new items from recycled ones also uses less energy and fewer resources.

Just about anything in your home (or office or school, etc.) that cannot be reused can be recycled into something else.

You'd be amazed what can be done with a recycled product. Try some out today.

1. Old white T shirts can be tie dyed into any of your favourite colours or given away.
2. Telephone Directories can be used to make Origami – Origami is to do with paper art.
3. Plastic containers can be made into flower pots and vases.

Finally if something cannot be reduced, re-used or recycled then, the only option left is to dispose it.

Dispose

Dispose means the process of throwing away or getting rid of something that is not needed any more. Anything that is not needed any more must be disposed off properly. Below are a number of methods for consideration as options when deciding to dispose waste in any area.

Advantages and Disadvantages of Methods Available to Dispose off Rubbish:

| Advantages | Disadvantages |
|--|---|
| 1. Ocean Dumping | |
| <ul style="list-style-type: none"> • convenient • inexpensive • source of nutrients, shelter and breeding | <ul style="list-style-type: none"> • ocean overburdened • destruction of food sources • killing of plankton • desalination (removing of salt) |
| 2. Sanitary Land Fill | |
| <ul style="list-style-type: none"> • volume can increase with little | <ul style="list-style-type: none"> • completed landfill areas can settle and |

| | |
|--|---|
| addition of people/equipment <ul style="list-style-type: none"> filled land can be reused for other community purposes | requires maintenance <ul style="list-style-type: none"> requires proper planning, design, and operation |
| 3. Incineration | |
| <ul style="list-style-type: none"> requires minimum land can be operated in any weather produces stable odour-free remains rubbish volume is reduced by half | <ul style="list-style-type: none"> expensive to build and operate high energy requirement requires skilled personnel and continuous maintenance unsightly - smell, waste, pests |
| 4. Open Dumping | |
| <ul style="list-style-type: none"> inexpensive | <ul style="list-style-type: none"> health - hazard insects, rodents etc. damage due to air pollution ground water and run-off pollution |
| 5. Recycling | |
| <ul style="list-style-type: none"> key to providing a liveable environment for the future | <ul style="list-style-type: none"> expensive some wastes cannot be recycled technological push needed separation of useful material from waste difficult |

Litter: Do you create a lot of rubbish? Do you always put your rubbish in rubbish bins? Litter can be a problem in any community. Broken bottles and tins, for example, can cause injury if people don't put them into rubbish bins. Mosquitoes and other insects can breed in water trapped in old tyres and bottles.

People are more likely to drop litter in places that already have litter lying around. When they see litter on the ground, they may think it is alright for them to also throw their litter onto the ground. Without providing ways for people to stop littering, the whole community can be affected because they don't want to live in a dirty town.

Human waste and diseases

It is very important to keep human waste out of water supplies. Human waste (faeces, urine,) contains diseases that can make people sick. Human waste can get into the community water supplies from leaking septic tanks, releasing contaminated water from sewerage treatment plants, dirty nappies, leaking sewerage pipes and people using local creeks as a toilet.

Waste that is produced can be disposed in various ways. Below is a list of advantages and disadvantages of how our wastes are being disposed. Whichever method we choose it comes with a problem.



Activity 3:

What do you think of when you hear the word 'waste or rubbish'. List them down.

Common Waste (solid) Disposal Problems Faced by Rural and Urban Communities.

Rubbish or waste affects two major areas of our lives – **our health and environment**. In the following exercise find out for yourself, which area of your life the following disposal problems impacts. Health or Environment. If you live in the rural area study the rural waste problems, however if you live in an urban area, give it a go at the urban waste problems. Some problems affect both areas so look at the other area after going through yours.

Read about the common waste (solid) disposal problems faced by rural and urban communities below.

| Waste problem in rural communities | Waste problem in urban communities | Impact areas Health or Environment |
|--|--|--------------------------------------|
| Eg 1. Dumping in areas such as beaches, rivers, near drinking water, backyards etc | Accumulation of waste due to non - collection | Environment/Health (rural/urban) |
| 2. Waste is all mixed up | Attracts pests | Environment (rural / urban) |
| 3. Animals go through the waste and spill | Rubbish or waste not collected on designated days | Environment / Health (rural / urban) |
| 4. Dump overflows sometimes | All the rubbish is mixed up | Health / Environment (rural/ urban) |
| 5. Problems of pests like; rats, mice, cockroaches, dogs, and vultures . | Expensive | Health and Environment (rural/urban) |
| 6. Smelly environment | Waste becomes a health hazard for the workers | Health and Environment (rural/urban) |
| 7. Leachate (Liquid) seeping into clean drinking water | Animals pull and spill the rubbish | Health and Environment (rural/urban) |
| 8. Humans and animals waste dumped into rivers and creeks | Litter on the streets | Health and Environment (rural/urban) |
| 9. Smelly environment | Detoxification (the process of removing a toxic substance from something) | Health and Environment (rural/urban) |

This is a case study on waste management in one of the local villages in Papua New Guinea. Regardless of where people are living, life is the same for most communities around the country. The only difference is that this village – Barakau is one of the Motuan villages who build their houses over the sea. Their experience can be a learning ground for most villages whether in the highlands or coastal area.

Case Study: Practical and Appropriate Waste Management

Management of Waste in Barakau Village

Kelly Madu is trying to help these communities find effective ways to reduce the growing amount of solid and liquid waste that is threatening their health and well-being.

Kelly points to the mounting piles of plastic **accumulating** in the sheltered western end of Barakau beach, “It’s not just plastics and other household waste,” he explains, drawing attention to a row of toilets on the beach, built above the sand along the high-tide water line. “Human waste from these toilets and the houses built over the sea are discharging directly onto the beach or into the sea”, he says.

Kelly says the people in Barakau have disposed of human and animal waste in the same way they have done for generations. “The problem now is that there are simply more people living in the village and more waste being discharged into the environment,” he says.

Kelly says it’s hard for many people in his community to understand the tie between poor waste disposal and their health and wellbeing. “I know that waste is making a major contribution to the causes of various diseases that have occurred in the village – typhoid and severe skin rashes among them. However, because they cannot see the micro-organisms causing these diseases, it is hard for many of my community members to understand the connections between poor waste management and health problems” he says.

With the help of the Pacific Regional Environment Programme (SPREP) and the International Waters Project (IWP), Kelly is now encouraging village residents to pen their pigs and consider options for relocating their household toilets.

Many village residents are cooperating with about 120 pigs penned just above high water. Although the pigs are penned they are still defecating directly onto the beach and into the water under or near their owner’s houses. There are still a large number of pigs roaming freely and rooting in the waste that is accumulating underneath the houses at Barakau and Barakau kahana on the eastern sheltered bay side of the village.

Kelly has assembled a Local Project Management Committee, to try and address the waste problems at Barakau. With the support of the IWP, Kelly and his team have undertaken an extensive series of village and national level consultations to identify the root causes for the threats posed by waste in his community.

Both Kelly and Mr Narua Lovai, the National Coordinator for the IWP in PNG, both agree that the main challenge is getting people to change their behaviour – to work as a group for communal benefit.

Narua says that the last 12 months in Barakau have been a major learning period for his team. Although he comes from a similar community Narua says he never realised that such a community-based initiative was going to be so difficult to establish.

**Activity 4:**

Are the people in this village prepared to address this problem? Do they realize that they have a problem at hand?

“People accept that there is a problem that their immediate environment is threatened and that community well-being is in danger. However, getting the community to work together to do something about it is very intensive, challenging and long-term undertaking.

“I believe we are making progress at Barakau, but it requires a lot of patience, a willingness to listen and a local champion – someone who is respected by the community and willing to challenge them to do something positive to address these problems. Kelly and the local project management committee are our champions in Barakau,” he says.

“Hopefully, what we achieve in this community, will provide valuable lessons and solutions that can be applied in other communities facing similar kinds of problems – in PNG and elsewhere in the Pacific,” he says.

“It is hard for many of my community members to understand the connections between poor waste management and health problems.”
Kelly Madu



Summary



You have come to the end of Lesson 10. In this lesson you learnt that;

- waste management is the collection, storage and disposing of waste.
- waste can be solid or liquid.
- all activities on this earth create waste and must be correctly and safely disposed.
- every member in the community must play a key role in reducing, reusing, recycling and disposing waste in our environment to make it a safe and healthy place to live.
- consumers must choose carefully and reduce the amount of waste produced daily.
- a lot of materials we use can be recycled. Other people may make good use of materials that one doesn't need or want anymore.
- disposal of waste must be done properly so the environment is kept clean and safe for our existence.
- there are a number of ways that solid materials can be disposed off. They can be dumped in the ocean, land fill, incinerated, openly dumped or recycled.

NOW DO PRACTICE EXERCISE 10 ON THE NEXT PAGE



Practice Exercise 10

(1) Describe how solid waste is disposed off in your local area.

(2) Describe one way you can reduce food wastage at home?

(3) How can one recycle an old but working television set?

(4) How is Kelly overcoming the stubbornness of his fellow villagers?

(5) Do the people of Barakau village realize that they have a problem at hand? Yes Or No. How are they responding to address this problem?

CHECK YOUR WORK. ANSWERS ARE AT THE END OF THE SUBSTRAND



Now turn to your Supplementary Book and read all the Additional Readings for Lesson 10.

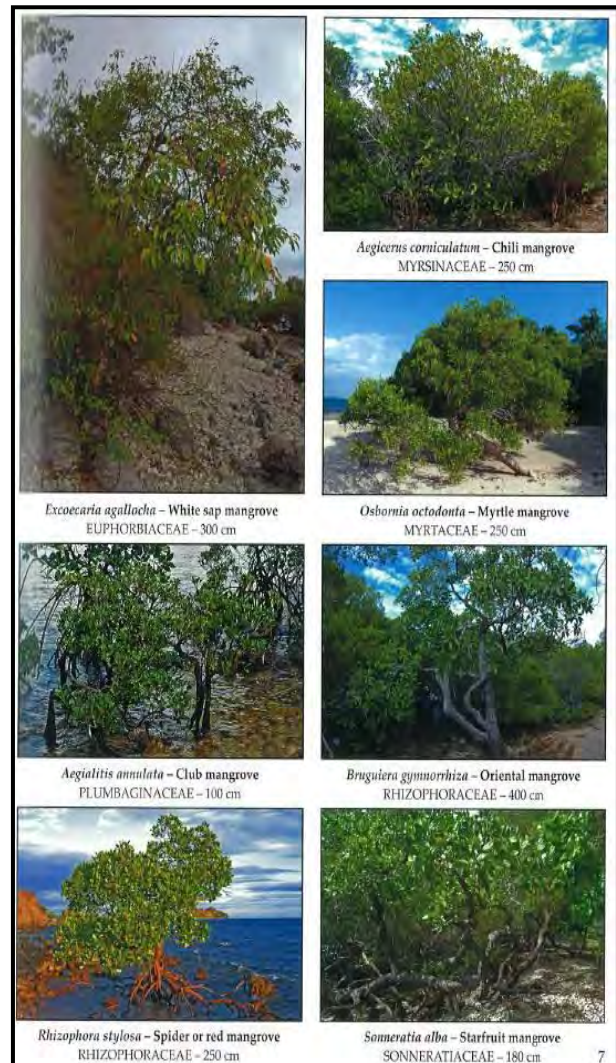
Supplementary Reading 13: Biodiversity on Motupure Island

Introduction

In this reading, you will have a look at lives of plants and animals on a small island outside of Port Moresby. The kinds of plants that grow there and the animals that live in the mud, swamps, mangroves and the reef, and all its inhabitants.

Motupure Island provides a tourist site for city residents and outsiders to snorkel and for the more serious divers various magnificent sites to dive and explore. Coral reefs are generally considered the most beautiful and several of all the marine habitats. Over time, thousands of years, the skeletons of corals, mollusk, shells and coralline algae help build the reef through cementation.

On the surface of the reef a rich variety of living corals and other organisms continue this process of cementation. Worms, sponges, algae and shellfish, for example, all burrow into the coral, producing sand which is then cemented into the reef by the coating coralline algae.



Varieties of mangroves at Motupure

The structure of coral reef is very complicated, providing gaps, overhangs and shade for thousands of vertebrates (with backbone), invertebrates (without backbone) and other organisms that make the reef their home.

The abundant fish enjoy a wide range of feeding, reproductive and territorial habits. There are organisms that do not directly contribute to the structure of the reef, but these reef inhabitants still play important roles, such as the transfer of energy through the food webs based on the reef.

Life on a coral reef involves a complex system of relationships among organisms, between organisms and their environment.

If you pay close attention to the reef when swimming, snorkelling or diving you will not only see amazing diversity of life, but will be able to observe the fascinating behaviour of a wide range of organisms, perhaps nudibranchs laying their eggs or anemones ride on a crabs back.

You may even muse on how they have adapted to their habitat, marveled at how they defend themselves and know that each individual organism is only a small part of a larger thriving system.

Mangroves

In tropical coastal zones rainforests often grade into mangroves. These are not regarded as rainforests, but are swamp forests dominated by species adapted to live in brackish, waterlogged conditions. The plant species diversity is usually lower than the rainforests, but they provide breeding grounds for the marine life upon which coastal fisheries depend.



Mangroves growing along the coast

Mangroves are coastal trees or shrubs that are adapted to the marine environment and inhabit the area between the land and sea..

They have adapted to live in a harsh environment often lacking oxygen environment, where there is large amounts of salt and mud.

One of the most noticeable mangrove variations is in its root make ups, which varies according to the local environment. They include prop roots that arch downwards from the tree trunks for support, and those that are pointing upwards into the air.

Mangroves are trees or shrubs that grow in low and muddy salt water or brackish waters, such as those along shorelines or in estuaries. Found worldwide in tropical and subtropical areas, mangrove swamps provide excellent nesting and feeding areas for a variety of marine fish, invertebrates, and birds.



They survive in salt water environments by excreting the salt through special glands on the leaves, dropping their leaves, or blocking the uptake of salts through the roots. Mangrove seeds germinate on the parent tree prior to their release, when drop into the mud or float away with the tide.

Mangroves provide important feeding and nursery areas for fish and crustaceans. The mangrove roots provide ideal hiding places from predators. The roots display a variety of invertebrates, including hermit crabs, nudibranches, barnacles and shrimps. They also act as buffers to hurricanes.



Further up the tree, the trunks, branches and foliage are also home to other animals, such as bats and insects. The leaves shed by mangroves provide food for a number of

organisms, including fiddlers and ghost crabs. These crabs burrow around mangroves enabling a regular flushing of the mangrove roots by tidal water.

Marine Biodiversity

Marine biodiversity refers to the variety of biological life (plants and animal) found in our seas and oceans.

Biodiversity reaches far astonishing levels in the group of animals known as marine invertebrates (animals without backbone) and vertebrates (animals with bones). It is thought that over 1 million species of animals inhabit the planet earth. They are made up of many single celled organisms, soft and hard corals, and segmented worms.

But you may wonder why marine biodiversity is important to us? There are many reasons depending on personal values. Factors influencing a person's value may include how that person makes a living, culture and education; all of these govern what person knows about the natural environment.

In many areas of the world, fish and other marine animals are an essential source of protein. Each group has a specific task to play in maintaining the ecosystem's health and functions.

Pollution of our marine environment and natural disasters can impact important marine habitats such as mangrove forests, sea grass meadows and coral reefs. The gradual warming of our seas is having a major impact on the coral reefs, increased levels of coral bleaching (remove the colour) and much other harm to the biodiversity.

Whatever, we consider important about marine biodiversity, be its beauty, the thrill of the unknown, the supply of food, the hope of medical discoveries, its natural and conservation value, there is one common need: continuing balance and existence. Everyone must strive to understand the environmental processes and its socio economic of resources use that affects this balance and existence. We must act now and save our biodiversity for the future generations.



Lionfish in mangrove forest

ANSWERS TO SUBSTRAND 2
PRACTICE EXERCISES

ANSWERS TO PRACTICE EXERCISE 7 -10

Practice Exercise 7

Answer the following questions.

1. List the important elements of the natural environment
Hills, Valleys, Rivers, Ocean, Plants, trees, .(Accept any three answers).
2. What effect do the local built environment have on the natural environment?
 - It destroys the natural environment.
 - It destroys animal and plant habitats.
3. What are the distinctive features of the social environments in your locality?

Social groupings are important because people obtain a sense of belonging and establish cultural values. A person cannot live in isolation.
4. Suggest some ways we can take to protect our environment.
 - improved understanding at a global level
 - appropriate action to ensure the diversity and stability of life on earth.
 - moderate use of land and its resources

NOW GO BACK AND STUDY LESSON 8

Practice Exercise 8

Answer the following questions.

1. Write two examples of waste produced in traditional times.

Possible answers

- Garden food peelings
- Remains of garden plants and the natural forest
- Animal wastes
- fish scales and sea shells

2. Why is waste produced in traditional times not a big problem?

Waste produced in traditional times was not a problem because all the waste were of materials which was biodegradable. This means that the material is able to break down naturally and eventually return to the soil easily.

3. . Write down three examples of waste produced nowadays.

Possible Answers

-tins, cans, bottles, glass, wood, iron roofing, plastics, food packets, cement, Clothes , and kitchen wastes

4. What is the main problem with waste produced nowadays?

- The main problem with waste produced nowadays is that it is not biodegradable.
- Modern waste cannot be broken easily to return to the soil.

5. Write down three examples of toxic waste.

Possible Answers

- Waste such as oil from vehicles
- Chemical wastes from the mines that get washed down into the rivers
- Smoke from factories and vehicles
- old car batteries
- small batteries
- used paint and chemical tins.

6. Why is toxic waste a problem?

It causes serious harm, danger or death to plants, animals and human beings

NOW GO BACK AND STUDY LESSON 9

Practice Exercise 9

1. What could be done with all the empty coke 500ml plastic containers?

Use them for water otherwise make holes and bury them.

2. Why is it unwise to burn plastic bags and containers?

Plastic bags and containers should never be burnt because they let off toxic gases when they are burnt

3. What is the best way to dispose off empty cans?

Tins and cans should be burnt after they have been flattened out. Then they should be buried.

4. Explain how you can dispose of your pet (dogs and cats) when they die?

Holes should be dug to bury dead pets or animals.

5. What can we do if we cannot re-cycle, re-use, done to waste or reduce our rubbish?

Wastes that cannot be reduced, reused or recycled should be disposed off wisely.

6. List 3 items that can be recycled.

- Tins and cans
- Bottles and jars
- Plastic containers
- Clothes
- Plastic bags
- Newspapers

7. List 3 items that can be reused?

- Bottles and jars - truck tyres - paint tins as pot plants
- Plastic containers
- Bags like rice and flour bags - drink cans
- Drums and tins
- Vehicle tyres

8. List 3 things that you can do or reduce to have a healthy life and enjoy a clean environment.

- Collecting and using too many plastic shopping bags. Use bilum to carry shopping and market goods
- Buy less canned foods to reduce empty tins and cans
- Eat less processed foods to avoid having too many empty packaging and wrappings.
-

Practice Exercise 10

(1) Describe how solid waste is disposed off in your local area.

-**Rural** - Solid waste in the rural setting is dumped by throwing in holes, alongside mountains, along the beach or on the edges of the village

- **Urban** - Solid waste is collected on designated days and disposed in dumpsites authorized by the city or town counsel.

(2) Describe one way you can reduce food wastage at home?

- Food waste can be reduced at home by planning meals
- Reducing non biodegradable material

(3) How can one recycle an old but working television set?

You can recycle an old television set by;

- (i) trade – in
- (ii) selling at a reduced price
- (iii) giving to someone who needs it

(4) How is Kelly overcoming the stubbornness of his fellow villagers?

Kelly is serious and is conducting awareness to educate his fellow villagers

(5) Do the people of Barakau village realize that they have a problem at hand?
Yes Or No. How are they responding to address this problem?

The people in this village do realize their problem of waste management, but they do not want to do anything about it because they have always disposed rubbish from their houses into the sea and will take time to adjust to any new ideas and teachings that are taught.

NOW GO BACK AND STUDY LESSON 11

REVISE SUBSTRAND 2 AND DO SUBSTRAND 2 TEST IN YOUR ASSIGNMENT 3 BOOK

SUBSTRAND 3

CROP AND ANIMAL MANAGEMENT

In this substrand, you will:

- **Discuss the importance of food security to achieve sustainable living**
- **Identify and describe a range of appropriate management practices**
- **Make judgements about the consequences of mismanagement**
- **Investigate resources necessary for undertaking a practical project**
- **Plan and apply skills necessary for managing crops and animals and evaluating outcomes of a project**

SUBSTRAND 3: CROP AND ANIMAL MANAGEMENT



Welcome to Substrand 3. In this strand, 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 11: Importance of managing Crop and Animal Production

This lesson covers the Importance of managing crop and animal production. You will identify and discuss the cultural, nutritional and economical benefits of crops and animals to humans and the advantages and disadvantages of traditional and introduced crops and animals in Papua New Guinea.

Lesson 12: Appropriate Crop Management Practices

This lesson covers appropriate crop management practices. You will look at various ways or methods that can be used to improve crop production.

Lesson 13: Appropriate Animal Husbandry Practices

This lesson covers appropriate animal husbandry practices. You will identify ways to improve animal farming and the problems of large-scale animal farming.

Lesson 14: Case Study on Crop and Animal Farming in Papua New Guinea

This lesson will provide some case studies of crops and animal farming in Papua New Guinea. Case studies will help you to explore and find appropriate ways to improve crop and animal farming in Papua New Guinea. You will then write a report to present your findings



Good crop management and animal husbandry practices will improve and increase production

Lesson 11: Importance of Managing Crop and Animal Production



Welcome to Lesson 11 of Sub Strand 3. The idea of managing resources has already been developed and looked into when you learnt about Land and Water Management. We will now continue the same concept by going into the Crop and Animal Management in these lessons.



Your Aims:

- Discuss food security
- Discuss cultural and nutritional value of crops and animals
- Discuss economic benefits of crops and animals
- Identify the benefits of traditional and introduced crops and animals

Firstly, plants and animals depend on each other simply because plants are energy producers whilst animals are energy consumers. Crop management practices and animal husbandry practices are required to implement successful agriculture. Therefore better understanding and good crop and animal husbandry is important to food security in many areas of Papua New Guinea.

Food Security

Food security relates to the supply of food. When everyone in a community always has enough good food to live an active and healthy life then food security is good. If a community has frequent food shortages then food security is poor. There are many ways of improving food security in Papua New Guinea.



Fresh Green Leafy Vegetables are found in abundance in the highlands of PNG

They include;

- better management for both crops and livestock, including soil fertility maintenance
- the use of new alternative cash crop and livestock
- improved transport such as roads, bridges, wharves and airstrips to get produce to market
- better distribution of farming advice to rural areas, through radio and print materials
- more information to villages, particularly on subsistence food production, animal production and cash crops
- improvement in the provision of financial services to rural people, such as low cost loans
- the ability to securely move small amounts of money around the country
- securing public highways and ports against criminal activity, which seriously limits people's willingness to travel to sell produce
- the international marketing of agricultural produce



Activity 1:

What is the food security like in the place that you live in?

Cultural and Nutritional Value of Crops and Animals

Crop and animals have a big effect on the culture, nutrition and economy for many people in different areas of Papua New Guinea. Papua New Guineans always have great respect for the land on which they live. Through this, skills and knowledge that have been developed have been part of our traditions.

Agriculture

Subsistence farming and gardening is mainly carried out by everyone in the family and the clan. Men are mainly involved in cleaning the land while women maintain gardens and cook. Much of the social festive and daily living activities revolve around subsistence agriculture. The traditional village calendar highlights this. Festivals are common at times of planting and harvesting crops. These festivals involve dancing and singing, the beating of drums and blowing of conch shells. Musical instrument are made from wood, bamboo, vegetable fibre, gourds, seeds, animals and reptile skins, bones, shells and clay.

Animal Raising

Animals are raised for food and ceremonial rituals. They include; pigs, chickens, pigeons, cats, dogs, ducks, goats and sheeps.

Hunting and Gathering

Men and boys do most of the hunting while women and children hunt small animals and gather fruit and nuts from the forest. Traditional weapons are made, for example, bows and arrow, spears and nets.

Arts and Crafts

There is a great variety of art and craft including paintings, sculpture, carvings, masks, bark cloth, baskets and string bags. Decorated craft including clay bowls, jars and shields.

Significant crops grown in Papua New Guinea can be categorised as follows:

Tubers

Root crops that is our most important source of carbohydrate. The main tubers grown are sweet potato, yams, taro, potato and tapioca.

Fruits and Nuts

Our main source of vitamins and fat for the body. The main fruits include banana, pineapple, pawpaw, passionfruit, citrus, guava, avocado, mango and breadfruit.

Vegetables

Our main source of vitamins for the body. The most common vegetables include cabbage, eggplant, lettuce, tomato, onion, cucumber, cauliflower, broccoli, pumpkin and silver beet.

Grain Legumes

A source of protein for the body. The most common grain legumes include peanuts various beans (including the winged bean), cowpea, soy beans and peas.

Spices

Used mainly for seasoning. These include cardamom, ginger, turmeric, peppers, and chillies.

Tree Crops

These are called permanent crops, cash crops or perennial crops. These are crops that grow and produce for many years and they include coffee, coconut, cocoa, rubber, oil palm and citrus.



Activity 2:

Name at least three crops and animals that are culturally valued by your people.

Economic Benefits of Crops and Animals

Economy refers to the distribution and the use of resource that are not wasteful. It is the control and management of resources. The most important type of business in this county is the growing of crops to sell. People who grow certain kinds of plant to sell specialises in it. Plants such as coffee, coconut trees, cocoa and tea are called commercial crops. Any plants that are grown so they can be sold, even sweet potato can be a commercial crop if the grower intends to sell them for money. Commercial crops are sometimes called cash crops. Some people have business that involves animals.

Pigs, cattle and chickens are raised to sell for their meat. Animals that are kept for business are called livestock. Many of the cash crops and animal products that are produced in Papua New Guinea are not consumed here. Many cash crops are sold to other countries as exports.

The Benefits of Traditional and Introduced Crop and Animals

Of all the crops and animals in Papua New Guinea, some are traditional which have been introduced. There are benefits for people from both traditional and modern crops and animals. The benefits of traditional crops and animals are that they are suited to local conditions, resistant to diseases, sustained by familiar farming methods and used in ways to maintain cultural heritage. For generations people have developed effective ways of seed collection and propagation to sustain their food supply.

Traditional crops and animals are also important for maintaining the local biodiversity. Bio means life and diversity means variety, so biodiversity refers to the variety of

plant and animal life forms living on Earth and the habitats or environment in which they live.

One benefit of introduced crops and animals is that they provide a greater diversity of food for the meals that people eat. People have the advantage of greater choice of different flavours. Many of the modern crops and animals have commercial benefits for people that are; they provide a monetary source of income. People have a greater variety of food and animal to sell in the market and can attract a wider range of customers and people.

Modern crops and animals are high yielding and have fast growth. Many Papua New Guineans cultivate a mixture of traditional and modern crops and animals. Sometimes the best and greatest area of land is given to cash crops and poorer land is used for the family food crops. The best food crops are taken to the market for sale and poorer food crops kept for family consumption. People need to make wise decisions about their farming methods in order to provide the greatest benefit to the family.

The table below shows introduced and traditional food.

| Traditional | Introduced |
|---|--|
| Pigs Seafood such as fish, crabs, crayfish, prawns, turtle, dugong Sweet potato, yam, taro, sago, cassava Bananas, breadfruit Coconuts Sugar cane Wild fruit, berries, nuts | Chickens Cattle English potato, carrots, tomatoes, pumpkin, cucumber Broccoli, cauliflower Strawberries, pineapples, pawpaw Coffee, tea, cocoa, oil palm, vanilla, rubber |



Activity 3:

- (a) Evaluate the benefits of traditional and commercial farming.

- (b) Name the farming system that would be most beneficial.

Summary



You have come to the end of Lesson 11. In this lesson you learnt that;

- Crops are all the plant produce from the land that is cultivated to meet human needs. It may be for personal use or to generate an income.
- Animals include all the living creatures of the air, sea and lands that meet human needs in one way or another.
- Crops and animals provide food that enables us to have healthy bodies.
- Traditional crops and animals have always been important for rituals, trade, relations between clans, bride price, compensation and celebrations.

NOW DO PRACTICE EXERCISE 11 ON THE NEXT PAGE



Practice Exercise 11

1. List some reasons that are affecting food supply for most people in Papua New Guinea.

2. How are crops and animals important to human survival? Give a brief explanation.

3. Complete the table with the crop and give by writing its cultural, nutritional and economical values.

| Crop and animal | Cultural Value | Nutritional Value | Economical Value |
|-----------------|----------------|-------------------|------------------|
| Peanut | | | |
| Fish | | | |

4. List all commercial cash crops that Madang and Eastern Highlands Provinces produce to contribute to the country's economy.

| Cash crops in Madang | Cash crops in Eastern Highlands |
|----------------------|---------------------------------|
| | |
| | |
| | |
| | |
| | |

5. Identify and list four advantages and disadvantages of traditional and introduced crops and animals.

TRADITIONAL AND INTRODUCED CROPS AND ANIMALS

| Advantages | Disadvantages |
|-------------------|----------------------|
| 1. | |
| 2. | |
| 3. | |
| 4. | |

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 11.

Supplementary Reading 14: Sustainable Development

Welcome to supplementary reading fourteen (14).

It is on Sustainable Development. Development that takes place within the acceptable levels of harvesting of resources with small or minimal environmental pollution. It must be balanced in order for the whole mankind to be able to sustain itself and for the benefit of the next generation.

In your last reading, you had a look at biodiversity on Motupore Island. The mangroves, reefs, fish and all the marine life on the island, they play important roles in the environment. The environment is all the external factors that influence the life and activities of people, plants and animals that live in that place.

What is sustainable development?

Sustainable development offers a way out of this downward twist. Laws that promotes zero growth do not recognize that poverty is the root cause of environmental use. Standard of living must be improved if nations are to avoid wasteful use of scarce natural resources. The idea of 'sustainable development' dates back to late 1960s. It gained more support acceptance in 1987 after the publication of "Our Common Future" the report of the World Commission on Environment and Development (WCED).

Sustainable development means satisfying the needs of the present population without compromising the ability of the future generation to meet their own needs.

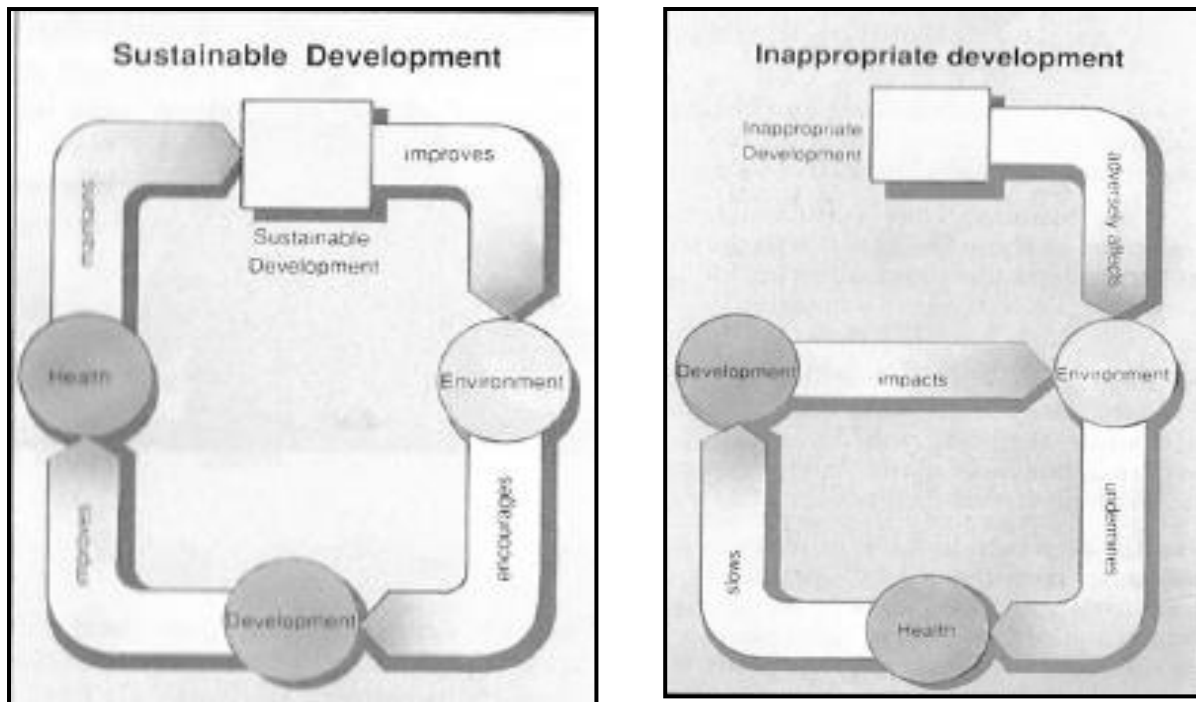
Sustainable development

Concerns for the environment is not a luxury which only developed countries can afford. It is a need for every country in the world. You and I are all dependent on the world's natural resources. Careless use of these resources may provide a quick profit, but it could also destroy the livelihood of future generations. Protection of the environment is therefore needed if economic development is to be continued.

Development need not destroy the environment. New technologies can help to improve it by using raw materials and energy more efficiently, by re-cycling waste materials and reducing industrial discharges. Advances in biotechnology means that industrial emissions and wastes can be treated well. Better equipment has been developed to monitor and limit discharges from industrial processes, and to give greater protection to workers and the environment.

The world's population is growing fast. Between 1950 and 1987 it doubled from 2.5 to 5 billion. By the turn into the twenty first century it has increased by a further 1 billion. That means over 200,000 people more to feed and clothe every day.

SUSTAINABLE DEVELOPMENT



Sustainable and inappropriate development machine

The additional burdens on natural resources to provide the basic requirements of life can result in environmental poverty. A declining resource base in turn makes economic and structural development more difficult. The results are increasing poverty and ever greater pressure on the environment.

Where resources do not renew themselves quickly or easily, such as tropical hardwood trees which take many years to grow, replacements should be developed. Our environmental concerns must be fully combined into economic decision making. Remember, today's short-term gain is not to become tomorrow's permanent loss.

If future generations are to live as well as, or better than, we do then economic development must be managed to maintain or improve the resource base. Sustainable development creates an upward spiral from which more stable economy develops. This in turn generates a stronger resource base and a healthier and more cost-effective active population.

Putting Sustainable Development into Practice

Energy

Future development must depend on the availability of energy from the sources that are dependable, safe and environmental friendly. The greater part of the world's energy needs will continue to be met in the likely future by the combustion of fossil fuels. This gives rise to emissions of sulphur dioxide and oxides of nitrogen (which contributes to acid rain) carbon dioxide (a major greenhouse gas) and other atmospheric pollutants.



Solar energy

Energy policies must aim to minimize the environmental impacts of energy production by promoting energy efficiency; pricing energy to reflect the environmental costs; assisting research and development into clean combustion technology and promoting the use and development of non- fossil- fuel electricity generation (renewable energy sources and nuclear.)



Bananas from a banana plantation.

Agriculture

Food production can be sensitive to the environment, if it uses carefully chosen farming methods and takes greater care with pesticides and fertilizers. Changes along these lines would be steady with current efforts to reform agricultural policies worldwide. Policies which encourage excessive levels of production in developed countries lead to depressed commodity prices which, in turn, make it more difficult for developing countries to strengthen their economies through export.

Industrial development

Thriving economic growth requires the development of industry in all countries but not at the expense of the environment. Adequate and internationally agreed standards for the control of pollution must be useful and enforced. Happily, industry itself is becoming more and more aware of the need to adopt corporate environmental strategies which includes such goals as energy efficiency, waste minimization, and recovery and recycling.



Car factory – Assembly line

Deforestation to reforestation

The destruction of forest trees contributes 30 per cent of the build- up of carbon dioxide in the atmosphere. Reversing the policies that encourage deforestation and implementing land reforms will require the commitment, not only of tropical nations, but also of international agencies and the global community at large.

Tropical nations should be helped to shift to sustainable harvest of timber and should be offered more equitable terms of trade, plus an easing of the debt burden.



Reforestation

One of the best ways to counter the build – up of carbon dioxide is through reforestation. About 1000 000km² (sq. km) of fast growing trees absorb 1 billion tonnes of carbon annually during their major growth period of up to several decades. Reforestation on this scale would absorb one – quarter of the net annual build –up of carbon dioxide in the atmosphere.

Each working day, 126,000 cars roll off the production lines, nearly 33 million annually. Carbon dioxide, nitrous oxide, methane and ozone are by - products of burning petrol in the internal combustion engine. Car makers have been quick to climb aboard the green bandwagon, but even a high mileage per gallon car is an inefficient mode of transport when it carries just the driver. New transport policies to counter the car culture will play an important role in tackling the greenhouse problem. Flexible public transport systems will be needed to make private cars far less necessary. The development of non-polluting vehicles is just one side of the equation.



Land transport – uses petrol

Lesson 12: Appropriate Crop Management Practices



Welcome to lesson 12 of Sub Strand 3. As you go through the lesson, you will come to learn more about appropriate crop management practice.



Your Aims:

- Explain the term 'appropriate management practice'
 - Identify various crop management practices
 - Discuss the crop management practices
-

Well appropriate management practices may refer to a practice that is suitable, planned or a proper way to do something. However, crop management practices that we will be studying covers land preparation, planting methods such as nursery or direct planting, weeding, mulching, irrigation, processing, storage, and pest and disease control.

Land preparation

It is important that land is well prepared before planting. Healthy soil is necessary for good crop yields. Plants get water, oxygen and essentials from the soil. Not all soils have enough nutrients. For this reason we should add green weeds, manure, compost and other fertilisers to the soil. Organic matter and improved drainage 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 organics. 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 rake or spade.
-



Activity 1:

(a) What factors do you think are causing soil to lose its good soil nutrients?

(b) Will the soil be infertile and cannot be used for agricultural purposes?

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. It allows seeds to germinate and become young seedling in an area that is protected from heavy rain, wind, insects and weeds. Tiny seeds for cabbages, lettuces carrots and tomatoes can be started in this way;

- seeds are sown on or close to the soil surface
- they develop into tiny plants or seedlings and
- they 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 3-4cm below the soil surface by;

- A small hole is made and the seed placed in.
- It is gently covered with soil to keep the seed moist
- It can then germinate and develop its root system.



Boys cutting cassava sticks for planting

Crops such as taro, yam sweet potato, sugar cane cassava, aibika and pitpit can be grown from cuttings 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.

Stems and leaves grow on the section of the cutting that sits above the soil. In this way a new plant is generated.



Activity 2:

(a) Which one of the two planting methods discussed above is common in your village? _____

(b) When is the right time for farmers and people to do planting? _____

Weeding

Weeds are plants that grow where they are not wanted. Weeds are not wanted in cultivated areas because they compete with crops for sunlight, water and soil nutrients. Many weeds also carry organisms that infect crops and cause disease.

One way for removing weeds is simply to pull them out of the ground by hand or to remove them using a spade or hoe. It is important to remove the underground roots of weeds, together with the tops. Weeding should be done when the soil is moist as the roots are more likely to stay attached to the upper part of the weed. Another way to control weeds is by mulching.

Covering soil with mulch prevents weeds from germinating. Mulching also adds nutrients to the soil.

Another way to control weeds is by the use of 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.



Activity 3:

Give your own explanation on what you think weeding is all about?

Mulching

Mulching is about covering the soil with organic materials such as dry leaves and grass to prevent the soil from losing its moisture and sometimes to enrich the soil. Mulching is a good crop management practice. Mulch may be straw, sawdust, shredded tree bark, leaves, coconut waste, grass or manure. It is spread 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 decays 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:

(a) Why is mulching important?

(b) Write down at least two reasons why mulching is important.

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 insufficient, 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 plant. When enough water has reached the crops, the barrier is replaced.

Sprinkler irrigation place sprinklers at regular intervals a land a pipe. Water droplets spray out of each sprinkler irrigation 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 made 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.

Methods of Irrigation



Flood Irrigation



Channel Irrigation



Drip Irrigation



Sprinkler Irrigation



Activity 5:

- (a) In Papua New Guinea, what are the common types of irrigation that are used?
- _____
- (b) If you were a farmer, owner of a cocoa plantation and you have new cocoa seedlings planted, what form of irrigation will you use? Give your reason.
- _____

Harvesting

Harvesting is the time when crops are gathered. If you harvest good quality and quantity crop then you have good 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. In some cultures, 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 are 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-shaped cuts in the trunks of the rubber trees. Vanilla and cocoa pods and coffee beans 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 6: Before harvesting crops what must you do or know?

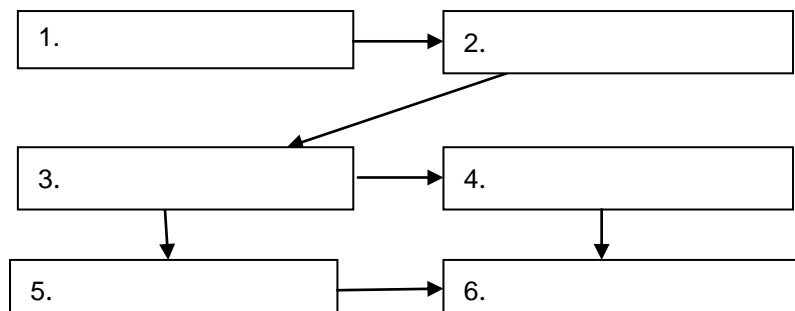
Food Processing

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 the 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 produced from sago palms. Cash crops such as coffee, rubber, cocoa, coconut and vanilla require complex processing before they are sold.



Activity 7: The steps in processing peanuts are jumbled. Rearrange them on the flow chart.

- Peanuts are roasted
- Peanuts are dug
- Peanuts are boiled
- Peanuts are sold
- Peanuts are washed
- Peanuts are dried



Food Storage

Most often food crops are not stored; they are eaten or taken to market after harvesting. When the produce is plentiful, prices drop. When the 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 from spreading to other food.

**Activity 8:**

All food are processed before they are actually stored. What do you do to damaged food and why?

Pest and Disease Control

Fungi and bacteria attack plants and cause disease. When you first see signs of diseased leaves, look for ways to get rid of them very quickly. In Papua New Guinea, common pests are insects, locusts, snails, weevils, rats and mice. Insecticides and poisons can be used to control pests but these are poisonous and can affect humans. For these reasons, food should be washed before being cooked or eaten.

Steps taken to get rid of pests;

- As you walk, round the ground, 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 right time of the year when there are fewer insects.
- If you feed and water plants, they will be more resistant to insects.

**Activity 9:**

What are your feelings towards the harmful and beneficial insects?

(a) How often can you control the damage caused by insects to the food you are growing? Put a tick.

- Most often
- Daily
- Not at all
- Once after planting

Summary



You have come to the end of Lesson 12. In this lesson you learnt that:

- Land preparation methods and weeding are some of the good crop management practices.
- Before planting a crop or cash crop the land must be prepared.
- the methods used for planting are the nursery and direct planting.
- Weeding is a method of removing unwanted weeds.
- Mulching stops weeds from growing and enriches the soil.
- There are four different methods of supplying water to the crops, which are Flood, Channel, Sprinkler and Drip Irrigation.
- Harvesting is the time when crops are gathered when they have matured and are ready for consumption.
- Not all plants are harvested and consumed directly. Some are processed in some ways and stored for later use.
- Quality and quantity are two important factors for growers because these factors determine the value of a crop.
- Some crops are sometimes affected by insects where as others are resistant to pest and diseases.

NOW DO EXERCISE 12 ON THE NEXT PAGE



Practice Exercise 12

1.
 - (a) Explain the different planting methods

 - (b) Explain the difference between plants and seeds that are planted in a nursery and plants planted directly into the soil.

 - (c) Write up the steps in nursing seedlings.

2. For any planting to take place, firstly the land must be prepared. Furthermore you should know the different methods of planting that is required.
 - (a) Explain the steps taken in preparing the land.

 - (b) Describe briefly three (3) good crop management practices you, your parents or relatives use.

 - (c) Select a particular food or cash crop and write about the appropriate methods to cultivate and manage the crop. Your discussion may involve or include land preparation, planting methods, weeding, mulching, irrigating, harvesting, processing, storing and pest and disease control.

Write your answer on a blank piece of paper.

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 12.

Supplementary Reading 15: Different Types of Environment.

Introduction

Environment refers to the surroundings, wherever you live, work and study. Where ever you live, whether in the Highlands or Coastal areas of Papua New Guinea, that is your environment.

Background

The second largest island- New Guinea in the world (after Greenland), is situated just below the Equator in the Pacific Ocean. The island covers an area of about 800,000 square kilometres and is about 2,400 kilometres long and 650 kilometres wide at its widest.

In Papua New Guinea there are more than 800 different languages and dialects that are spoken among the Papuans and Melanesians. Melanesian languages belong to the Austronesian language family, which includes most of the native languages of the Pacific Islands. Papuan languages belong to a distinct language family called Papuan.

The geographical distribution of Papuan languages is limited to New Guinea and the easternmost islands of Indonesia. Enga is the most common Papuan language and is spoken in the central highlands of mainland Papua New Guinea. English is the official language and the language of instruction in schools, a legacy of colonial rule. It is widely understood, but only a small proportion of the population can speak it fluently. The principle lingua franca, spoken by more than half the population, is Tok Pisin, a pidgin language based on English, German, and Melanesian languages.

NATURAL ENVIRONMENT

Natural environment includes; valleys, mountains, hills, trees, rivers animals, birds, and all the other things created by nature. Wherever people live, they make up the population of the place. They live in cultural groupings, speak the same language, do and behave in certain ways, celebrate special occasions and follow the same beliefs. If you live in a rural area of Papua New Guinea, you know that the wildlife is abundant. However, if you live in town there are preserved areas or botanical gardens that look after some local animals. The government has preserved various sites around the country for the benefit of people living in urban areas to see some natural surroundings and for future generation. In the Highlands there is Baiyer Sanctuary, Momase; Habitat and Port Moresby has the Nature Park and other eco-tourism sites around the country.

Commonly found mammals include the tree kangaroo, wallaby, wild pig, deer, and varieties of squirrel, rat, bat, and mouse. Many species of butterflies and tropical birds abound, including the world's largest butterfly, the birdwing, and a variety of the bird of paradise. There are also many reptile species. The coastal waters support many species of fish, shellfish, and turtle.

Bird of Paradise, common name for any member of a family of birds, is noted for the wonderful feathers of the adult males of many species. They are native to New Guinea and neighbouring islands; four species reach



Trees growing naturally

Eastern Australia. About 45 species are known.

Protected from their natural enemies by their dull colour, the females and young gather in small flocks. The more obvious males are often single but at times engage in elaborate mating or other social display. Birds of paradise are omnivorous (eats both plants and animals), and their food consists largely of fruit, insects, and snails.

Demand for the male plumage has threatened the survival of some species.



Bird of Paradise

Most of the paradise plumes used for decoration are obtained from the smaller bird of paradise, which is smaller in size. Other species include the king bird of paradise, with two tail feathers adapted into spiral shafts bearing an emerald disk at the end, and the “12-wired” bird of paradise, which has 12 lateral plumes ending in black re-curving filaments. The things provided by nature make up the natural environment.

Land

A backbone of central mountains with peaks more than 4,000 meters high extends across the island from northeast to southwest. Many of the mountain summits are permanently snow covered. Rugged hills that extend from the central mountains cut the land into deep river valleys and plateaus. Mountains descend abruptly to the sea and in the island is a vast, low-lying, swampy plain. There are several active volcanoes in and the coasts are highly indented.

Numerous rivers—including the Fly, Bian, Digul, Mapi, Sepik, and Pulau—crisscross the swampy plains. The rivers carry huge amounts of water and cross broad belts of evergreen rainforests. Most of the rivers are navigable in their lower courses. There are some small lakes too.



Swampy waterways

Climate

The tropical climate has high annual temperatures and humidity. Daily temperatures vary little, ranging from about 22° C in the early morning to 33° C at noon. Daytime annual temperatures in the highlands generally exceed 22° C. The lowlands are very humid year-round. Cooler temperatures prevail with the rise in altitude. The rainy season lasts from January to April. The central mountains receive rains throughout the year totalling between 100 and 250 and 400 centimetres. The southern

swamplands are one of the wettest places on Earth. Mangrove swamps overflow along the coasts.

Forests, covering almost three quarters of the island area, consist of several kinds of palm, bamboo, oak, beech, and pine trees. Orchids and figs grow wild. Papua New Guinea has nearly 500 species of birds. Colourful tropical birds include the bird of paradise, parrot, cockatoo, and flightless cassowary. Wildlife includes the tree kangaroo, wallaby, ring-tailed opossum, and bandicoot.

Among abundant reptiles are the crocodile, lizard, and many varieties of snake, including the python. Insects—especially the malaria-carrying mosquito—are widespread.



Malaria-carrying mosquito



Traditional Papua New Guinean house

SOCIAL ENVIRONMENT

Social environment includes regional groups, provincial groups, clan or tribe groups, church groups, work groups, gender groups, student groups and singing groups to mention a few. Man is a social being so in these groups man finds its sense of belongingness.

History

New Guinea was occupied possibly as early as 50,000 years ago. The Portuguese were the first Europeans to sight the island, in 1511. The Dutch occupied the western half of the island in 1828, and Germany and Great Britain set up protectorates in the eastern half in 1884. British New Guinea passed into Australian control as the Territory of Papua in 1906. German New Guinea was taken over by Australia, first as a League of Nations mandate and territory and later as a trusteeship under the United Nations (UN). The Japanese occupied the island during World War II.



Huliman wigman

People and Culture

The island is occupied by many tribal communities of Melanesians and indigenous people. Cultural structure is complex among the Papuans, who speak some 800 of the different languages. Each group has its own language, which is seldom understood by neighbouring peoples. Bahasa Indonesia, the official language of Indonesia, is spoken in the province of Papua, while English is the official language of Papua New Guinea.

Descendants of some of the original settlers of the island live mainly in the interior and use tools similar to those used by Stone Age peoples of prehistoric times. Villages sometimes communicate with one another by the beat of drums made of hollowed logs. The mountain communities exchange food, bird-of-paradise feathers,

weapons, and other goods for salt, pearls, and clam and cowry shells with people on the coasts.

The small thatched houses are set on piles above swampy and often flooded ground. Sometimes huts are placed in large trees. Walls are decorated with carvings and images representing gods, spirits, or tribal hunters. The family is the basis of tribal society, and a village is the largest social unit. In some tribes women and children live in individual huts, while men live in large shared houses.

The majority of the population are animists, and traditional religious beliefs and rituals based on magic are widely practiced. More than three quarters of the Papua New Guinea population follow Christianity. There are a few Muslims and Hindu's.



A bung lunch

Way of life

Most people in villages follow a traditional way of life that revolves around subsistence agriculture and fishing. Extended families are the basic social unit. There are also many tribal groups, subdivided into clans and sub clans. These groups help families preserve and transmit the store of traditional knowledge. They support clan members through major events such as birth, marriage, and death. Most villages are led by men, called "big men" in Tok Pisin, who win leadership positions by their own efforts. Hereditary chiefs are rare. The most experienced men in the village normally form a body of decision-makers, and no important actions are taken without their permission. Women typically do the planting. They rarely have much voice in village affairs. In some groups, however, people inherit land through the female line.

Villagers live in small houses with frames built of wood, walls made of plaited bamboo strips or leaves, and roofs thatched with grass or palm leaves. Often there is a larger men's house and separate small cooking houses. Some villages have a medical post and small store.

Marriage and Family

Marriage ceremonies vary greatly among the many cultures of Papua New Guinea. A marriage ceremony may take place over a period of days or weeks and involve a great deal of feasting, all-night singing, and exchanging of gifts and food. In some cultures, the members of the groom's extended family contribute to a bride-price; this might include several pigs, money, and food,



Huli men in traditional attire

which are shared by the extended family of the bride.

The extended family is the basis of support for most people. Members of the extended family usually live near one another and often form small communities; they share food and other resources, and help each other with the work that needs to be done. Great emphasis is put on family obligations and duty. The average nuclear family has several children. Aunts, uncles, and cousins might be referred to as mothers or fathers, sisters or brothers by Papuan children. Couples who are infertile or who have recently lost a child are often given an infant or child by relatives. The most able family members take care of aging parents.

Roles in the society

The majority of family structures are patriarchal (male controlled), although there are some matriarchal (female controlled) societies in Papua New Guinea. Men usually handle construction activities, such as building houses or boats, or clearing land.



Thatched roof home

Traditionally, they were responsible for protecting tribal honour and possessions; in a few areas they still do this physically, using bows and arrows and, increasingly, homemade shotguns

and other modern weapons. Women usually cook and prepare food and take care of small children, animals, and the garden. In cities, both men and women may work outside the home.

Rural dwellings usually have thatched roofs and are made of locally available materials. Urban housing is generally modern and expensive.

Eating

In the highlands of Papua New Guinea the staple food is *kaukau*, which are sweet potatoes. On the coast and in the lowlands *saksak*, a starchy extract from the sago palm, is the main source of calories. Taro is a staple in both regions, as are many fruits and vegetables from bananas to yams. Along the coast, seafood and coconuts are important. Throughout the country, pigs are raised and butchered for feasts. Small marsupials, wild pigs, birds, and eggs are additional sources of protein. Bats, eels, and tree kangaroos are eaten in some areas. Store-bought items, such as rice and tinned fish, are popular among wealthier people.

The common method of cooking for a small family is in a pot or hollow piece of bamboo over an open fire. A *mumu* is traditional for large groups. It is made by heating rocks over a fire and lining a hole in the ground with them.



A family paddling out to fish.

Food is placed on leaves in the hole and covered with a mound of mud or leaves, and then water is poured in to steam-cook the food.

In general, two large meals are eaten, with snacking throughout the day. Breakfast is called *kaikai bilong moning* (“morning food”), and the evening meal is *kaikai bilong apinun* (“afternoon food”). Some people also eat lunch (*kaikai bilong belo*). The most common utensil is the spoon; hands are used otherwise. Tin plates, bowls, and cups are common throughout the country, but large leaves are often used for plates in rural areas. Food is carefully divided by someone important: a village elder, a guest, or a parent. Guests are not expected to eat everything, but it is important to eat some food and then either take the rest home or give it to others at the gathering. There are rarely second helpings, and to ask for one may be seen as implying that the hosts have not provided adequately. Most people sit on the ground or floor when eating, although tables might be used in urban areas.

Socializing

Papua New Guineans greet by shaking hands. The question *Yu orait?* or *Yu stap i orait?* (“How are you?”) is often asked in Melanesian Pidgin. A typical response is *Mi orait. Na yu?* Which means “I’m all right? And you?” Other greetings vary depending on the area and language group. It is considered rude to use one’s local language, called their *tok ples* or “talk place,” if members of other ethnic groups are present.

When passing a stranger, a nod of the head and a smile are adequate. When passing friends one adds a short greeting such as *Moning* (“Good morning”), *Apinun* (“Good afternoon”), or *Gutnait* (“Good night”). When addressing an important official, one uses the appropriate title with a full name. In most other cases, people use first names to address one another. It is common to call an older man papa and an older woman mama.

Papua New Guineans may spend a large part of each day visiting, often stopping in at the home of a relative or friend to share some food, smoke tobacco, or chew betel nuts and discuss the day’s news. Even unexpected visitors are welcomed. Visits are usually informal and often lengthy. Gifts are not expected, although visitors often bring a gift of food, especially if their hosts have brought them a gift on an earlier occasion. Visits from relatives can last days or weeks, with the host family providing food and shelter for as long as the guests stay. Accommodating long-term guests is becoming especially difficult for urban families because of the high cost of living.

Recreation

The national pastime is to sit and talk (*stori*). Men (and occasionally women) enjoy playing cards. The most popular sport is rugby, but basketball, volleyball, and soccer (taught in schools) are also enjoyed. Community tournaments are sometimes held, often in connection with a celebration or political campaign. People also spend leisure time fashioning useful items such as bilum bags or weapons. Boys and men hunt birds and wild game with slingshots and bows and arrows. Traditional musical instruments include the *kundu* (an hourglass-shaped drum covered with lizard skin) and the *garamut*, a log with a small, hollowed-out portion, struck with one or two wooden beaters.

BUILT ENVIRONMENT

This is the second type of environment, built environment. . It refers to things that man has made to suit its needs and wants. It includes houses, wharves, playing fields, roads, bridges; town's etc. Small-scale industries include the manufacture of paint, matches, soap, cigarettes, and furniture; the building of boats; and the assembly of electrical appliances.



Port Moresby City, PNG

Papua New Guinea is politically divided along the line of 141° E. longitude into two parts. Its western half forms West Papua (formerly Irian Jaya) a province of Indonesia, and the eastern half starts the major part of the country of Papua New Guinea. Large portions of the island are still unexplored because the dense rainforests, huge swamps, and rugged mountains make its interior almost isolated, except to the indigenous people, who are more experienced with the terrain.

The majority of people are engaged in agriculture, lumbering, petroleum drilling, fishing, and pearl diving. Although a somewhat small area is under agriculture, the bulk of Papua New Guinea's population are subsistence farmers. Slash-and-burn or shifting cultivation—locally known as swidden—is largely practiced in the forested foothills. Yams, taros, sago, sweet potatoes, corn (maize), bananas, cassavas, rice, and sugarcane are the chief crops.

Cash Crops

Tropical fruits grow abundantly. Major cash crops of Papua New Guinea are coffee; cocoa, and coconut. A newly established sugar industry in Papua New Guinea has made the country self-sufficient in this commodity.



Copra making

Resources

Natural resources of the island include water power, forests, and minerals, but most of them are not developed because of very limited transportation facilities. Copper is the major mineral resource. Petroleum is produced here as well, and natural gas has been discovered recently and extracted. Large gold deposits were discovered at Ok Tedi in Papua New Guinea.



Rural dwelling

Transport

There are a few small coastal roads. Riverboats are used for local transportation. Airways are increasingly used as the chief means of transportation, especially in the interior. There are regular shipping services with Australia and New Zealand. Telecommunications are fairly developed in Papua New Guinea. Radios, mobiles and television are the principal means of mass communication, with broadcasts in English and major local languages.

Lesson 13:**Appropriate Animal Husbandry Practices**

by

Welcome to Lesson 13 of Substrand 3. This lesson is on appropriate animal husbandry practices. Before we proceed, please match these animals with the correct breeding places drawing arrows.

**Your Aims:**

- Define 'Animal Husbandry'
- Identify the processes involved in 'Animal Husbandry'
- Describe the processes involved in 'Animal Husbandry'

Introduction**Animals**

Duck and hens

Pigs

Bees

Breeding Place

Beehive

Poultry

Piggery

Now then, what is animal husbandry?

Animal Husbandry

Animal husbandry is the term used as the agricultural practice of breeding and raising livestock. In Order to breed and raise livestock, proper practices must be applied. What do you know about livestock? Livestock are animals that are kept on a farm for personal use or for profit.

Good appropriate practices for animal husbandry include;

- Housing
- Feeding
- Choosing breeding stock
- Health of animals
- Hygiene
- Handling
- Slaughtering and processing

We shall now read and look into each of the appropriate practices.

Housing

Many types of animals are kept for personal use or to generate an income. These include pigs, ducks, chickens, goats, rabbits, cassowaries, sheep, cattle and horses. While animals can be free-range (allowed to wander freely), housing provides protection from weather and harm for most of these animals.

Housing for livestock should;

- 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 locality and 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 chained 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 minimise bad smells and help keep the area dry.



Activity 1:

Have you ever seen an animal housing? What type of house is it? What animal was housed and how was it fed?

Feeding

To be healthy, farm animals need food and water. Water should be available at all times. If animals are left to roam freely, what animals forage for the water and food will they need. If you watch chickens, ducks, pigs or goats feeding around villages, you will see them eating leaves on plants, digging worms, scratching for seeds and seeking other food.



Food and water is given to the calf in the cage

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 for 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 vegetables 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.



A modern method is used to help the piglets feed from the mother

'Chicken starter', 'Growers', 'Mash' are different types of feed for chickens.

**Activity 2:**

Give two differences between animals that roam freely and those held captive.

Choosing breeding stock

It is essential to choose breeding stock with care. Domestic pigs and chickens look very different from their wild ancestors. Popular animal breeds are the result of selective breeding practices.

Imagine that you are looking at six pairs of pigs, each pair is a different breed and you are required to choose one pair for breeding purposes. How would you make your choice? Imagine that you are looking at six pairs of chickens, each pair is a different breed and you must choose one pair for breeding. How would you make your choice?

Choice of breeding stock may be determined by; the availability of breeds, quantity, quality, cost, personal preference, climatic conditions, veterinary services or feeding requirements.

Desired characteristics include: appearance, age, sex, egg-laying ability, quality of meat produced, rate of growth, resistance to disease, absence of physical defects and fertility. By choosing to breed from stock with desirable characteristics, we promote the survival of selected breeds and the possible extinction of other breeds.

Scientists are concerned that selective breeding reduces biodiversity and threatens the survival of some breeds. Conservation programs for threatened domestic breeds of cattle, sheep, horses and pigs have been established in some countries.

**Activity 3:**

If you are a bird watcher, what type of bird will you choose and why would you choose this type of bird?

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 the economic well-being of many industries.
- Some animal diseases can be passed on to humans and control of these types of diseases is vital to public health.

Mad Cow Disease and the 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 viruses cause infectious disease when they enter an animal's body. Non-infectious diseases 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 build-up of disease organisms.
- Provide plenty of good quality feed as malnourished animals can easily get sick.
- Store feed in proper containers.
- Manage pest problems such as rats and mice.
- Always buy disease free animals.
- Separate sick animals from healthy animals to prevent sicknesses spreading.
- Seek advice from a veterinarian (a doctor who treats animals) if health problems persist.



Activity 4:

Name at least two things you know that have affected and reduced the productivity of animals.

Handling

We need to take care in handling animals to prevent injury to animals or ourselves. Common injuries include being bitten, scratched, butted, knocked down, kicked or pinned between an animal and a hard surface. We should never relax when handling animals as they behave in unpredictable ways. Animals react unexpectedly when you remove them from their home.



Students are in overalls and handling a sick calf

- 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 would make you (or the animal) trip or slip.
- 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.
- Animal 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.



A cow being slaughtered



The veterinarians are treating the cows. They are wearing plastic coats.

All these factors need to be considered when planning livestock handling facilities.



Activity 5:

Write at least three problems or dangers in handling animals.
State ways to avoid the problems you stated in handling animals.

Slaughter and Processing

To slaughter means to kill an animal and processing 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 can 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 have severed the main veins and arteries. Wash the pig down.

Large Scale Animal Farming

Farming is done to raise plants and animals to provide raw materials for food, clothing and shelter. Farmers benefited from the experience of their elders and passed on their own skills and knowledge to younger generation. Changing from one system of farming to another requires many changes by the people. These can damage the way of life of the people and the environment if not done properly.

Farming involves farmers, consumers, plants, animals, land and climate. Plants, animals, humans, earth and atmosphere are interdependent and interact according to laws we call the laws of nature. When we violate the laws of nature, we harm ourselves and all other life on earth.

To manage or run a large scale animal farming is very big responsibility. Here are some things to consider in large scale farming,

- When there are farmers with different levels of resources, knowledge and skills there will be different farming systems.
- When there are not many animals, it's a waste managing large farming area.
- More number of animals means more money will be spent on food, chemicals, fertilizers and pesticides.
- When more chemicals are used (pollution is done) to the air, land and sometimes water can be polluted .
- Animals can be infected with diseases when there are too many of them.
- Housing and space can be a problem with too many or too few animals
- When animals are infected with diseases it affects the productivity and the market.

Summary



You have come to the end of Lesson 13. In this lesson you learnt that;

- Animal husbandry is the agricultural practice of breeding and raising livestock.
- Type of housing provided will depend on the livestock being kept, resource availability, locality and climate.
- Animal growth depends on the quality and type of feed for the different types of animals, in respect to their age and weather conditions
- It is essential to choose breeding stock with care as it may increase or reduce your animal stock.
- Appropriate animal husbandry practices protect the health and hygiene of animals and prevent animal diseases.
- To prevent injury to animals or ourselves, taking care in handling animals is needed.
- Slaughter means to kill an animal.
- Processing refers to the steps required to prepare animal meat for consumption.
- Stunning is a technique used to kill pigs in Papua New Guinea.

NOW DO PRACTICE EXERCISE 13 ON THE NEXT PAGE



Practice Exercise 13

1. Explain what animal husbandry is.

2. List and explain the issues that need to be considered when looking after and raise animals properly.

3. List three and describe briefly problems that may happen in a large scale animal farming.

CHECK YOUR ANSWERS AT THE END OF THE SUBSTRAND



Now turn to your Supplementary Reading and read all the Additional Readings for Lesson 13.

Supplementary Reading 16: Threat to the Environment.

Introduction

In this supplementary reading sixteen (16) you are going to look at threats to the environment. You will look at the things needed to live and what happens to them after one has used them. You will also see that there are things that will build up in your environment as a result of your way living. If you are not careful, they will quickly harm your environment.

General Knowledge

What happens to all the tinned fish tins, shopping plastic bags, banana peels, coconut shells and bottles that you use? What happens if you throw plastic bags into rivers and the sea? What can happen if there are lots of broken bottles lying around the place? Is it all right to burn plastic bottles and bags?

Pollution is contamination of the environment by man-made substances or energy that has undesirable effects on living or non-living matter. This contamination of air, water, or soil materials interferes with human health, the quality of life, and the natural working of ecosystems.

In simple terms, pollution can be seen as the wrong substance in a place and in excessive quantities. This implies that harm is caused to the environment. If the same substance is present at levels too high, then it can be considered as contamination.

Many pollutant substances occur naturally, in this case they are not classified as pollution. However, other pollutants result entirely from human activity, such as most toxic organic compounds and artificial forms of radioactivity, particularly from nuclear waste. This is a man's traditional worship house, made from of bush materials and located along on the bank of Sepik River. The materials used when decayed will easily return to the soil.



Bush material house

Since the 1990s environmental issues have been a major cause of concern for island population. These issues include global warming; loss of ocean resources such as fisheries and coral reefs; continuation of nuclear testing and its aftermath; loss of forest cover, mangroves, and other natural vegetation and fauna; and natural disasters, especially destructive tropical storms.



Map of Papua New Guinea

Global warming

The predicted global warming caused by the greenhouse gases is a great concern for Papua New Guinea and the world too. If the Earth's temperatures should rise even slightly, ice at high latitudes could melt and cause sea levels to rise around the world. If this happened, all islands would lose some measure of shoreline, and low lying islands, especially atolls, could disappear altogether.

Several nations in the Pacific region have held international conferences to address the issue. Australia, in particular, has provided resources for monitoring and scientific study of regional climatic change and global warming.

There are already signs and evidences of islands sinking and losing shores in Papua New Guinea due to global warming. Central, Milne Bay, Manus, New Ireland and Carteret Island on Bougainville are provinces which are already experiencing such situations.

The continual build-up of greenhouse gases is changing the composition and behaviour of the atmosphere.

The major responsibility for the production of these gases lies with the industrialized countries. People living in the developed world each add an average of around 3.2 tonnes of carbon dioxide into the atmosphere each year. This is times the amount added by an average person developing country.

But, as the population of developing countries increase, so will their contribution to pollution. It predicted that by 2025, developing countries will discharging 16.6 billion tones of carbon dioxide annually. The number of cars in the world is set grow from 400 million to 700 million by the end the century. Much of this growth is expected to occur in the developing world.



Islands sinking due to heavy flooding

on
four
in a

is
be

to
of

Urbanization

In the last century, population in urban areas has grown even faster than the overall population growth. Constant increases in urban population have stretched services to the limit and the future prospects for many urban areas are uncertain. The main problem is housing, sanitation and transport.

Food

As the world's population has grown, food technology has improved also. If food was equally distributed, the world would have enough to feed everybody. However, due to unequal distribution,



Rainforest

millions of people do not have enough to eat. More babies are born in the less developed world, who are already struggling. In theory, it is possible to grow enough food for everybody – but at what and who's cost? Large amount of money will be spent to pay for fertilizer; seeds, labour, machinery and shocking amount of rainforest will have to be cleared. In practice this is not realistic because a massive environmental damage and financial support will be needed to do this.

Each year logging and agriculture destroys rain-forest terrain, threatening the survival of tropical rain forests throughout the world. Located in a narrow belt within four or five degrees of the equator, rainforests often provide the only home for thousands of known or as yet undiscovered species of animals and plants. The destruction of these rain forests is removing many of these unique species at an alarming rate.

Soil degradation and deforestation

Soil erosion is now a severe problem in Papua New Guinea and the world. It is estimated that a great deal of agricultural land is made unproductive each year by soil erosion. The actual cause of most land degradation is loss of vegetation, but the primary cause is people.

Slash-and-Burn Deforestation

The deforestation technique of slash and burn. This has been used widely to clear large areas forest for agricultural and other purposes, causes an enormous amount of environmental damage. The large amounts of carbon dioxide given off into the atmosphere during burning adds to the greenhouse effect. The removal of all trees

and groundcover destroys animal habitats and greatly speeds up erosion, adding to the sediment loads of rivers and making seasonal flooding much more severe.



Slash and burn,

of

Forests and woodlands are cleared for farmland and wood. Where there is a shortage of land, the same piece of land is used over and over and this causes the soil to use up all the soil nutrients. The soil becomes less fertile and the vegetation becomes poor. In the tropics, where land is cleared by burning and planted with crops, the loses its fertility in just a few years. Slowing population growth will slow down further degradation.

Gully (gap) formation is a severe form of soil erosion. It is a natural geologic process that can be greatly speeded by human activities such as urbanization, deforestation, overgrazing of cattle, and poor agricultural practices. Erosion attacks the moisture-bearing ability of soils and adds deposits to waterways. These destructive processes continue at an increased rate in every continent, as over population and industrialization weaken the remaining soil.



Gully formation due to soil erosion

Water

Water is a useful resource. There is a fixed amount circulating within the earth's system and it is unevenly distributed. Many parts of the world suffer from water shortage. The availability of water is becoming a problem and the quality is declining. The industrialized countries have dumped billions of tonnes of pollutants into their rivers. Added to this is the fact that measures adopted to clean up the water only tend to tackle the result rather than the cause.

An indigenous lodge is nestled deep in the Amazon rain forest on the Napo River, a tributary of the Amazon River, in Peru. About 5,000 indigenous groups remain today in Peru, but few are untouched by the outside world.



A local lodge

Lesson 14: Case Study on Crop and Animal Farming in Papua New Guinea



Welcome to Lesson 14 of Sub Strand 3. Already we have looked at crop and animal management. The appropriate crop and animal farming practices have been identified. So now we are reading a case study about a crop and animal farming in Papua New Guinea.



Your Aims:

- Discuss a case study on 'fish farming'
- Discuss a case study on 'coffee'

By the way, a case study is an extended study of work that have been studied already. Our case studies will be on fish farming and coffee.

Fish Farming

The idea of fish farming came from expatriate companies who recognised the profitability of raising fish ponds and dammed rivers and harvesting them for sale. Fish provide a good source of income when they reach a marketable size.

Selecting a site for a fish pond

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
- Land slope
- Freedom from pollution
- Freedom from floods



A fish pond

Water

Fish take their oxygen and food from water in the pond. Therefore the fish must be sited near a good water source.

Soil type

Soil must be able to hold water and nutrients. A clay soil is good because the clay particles when wet will expand and not allow water to sip through.

Land slope

The proposed fish pond should be at the lowest point of the slope because this is where all the drainage water will tend to flow and accumulate.

Pollution free fish farming

The water flowing into the pond must be free of chemicals from factories or areas sprayed with chemicals such as DDT and grammoxone.

Freedom from floods

The site should be free from floods during rainy season.

Types and construction of fish pond

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

Care of pond and fish

Ponds should be kept in good condition. This is done by checking the pond and at the same time each day.

Common diseases 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 creates development of parasites.
- Rough handling of fish causes injury and infection of wounds
- Disease brought into the pond by diseased fish
- Eating birds flying from one pond to another

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 and that is by completely draining the pond or with the use of a fishing net. Draining the water is the best way to harvest fish because of all the required sizes can be collected. With the net, the net is pulled across with one person holding one end and the second person the other.

Marketing

Fish can be sold fresh or preserved. Fish which are to be sold live must be transported in a container of water. Fresh fish can also be frozen in deep coolers for transportation for later use. Fish which have been salted and dried or smoked can be sold directly to buyers.

**Activity 1:**

1. What is a fish pond?

2. Why is a clay soil good for a fish pond?

3. Name factors which may lead to a disease outbreak in a fish pond

Tree Crop Farming: Coffee

We will base our study on coffee.

Coffee is a plant with two different kinds, Arabica coffee and Robusta coffee. Arabica Coffee is the familiar highlands coffee and Robusta is coffee the lowland coffee. Coffee originated in East Africa.

Environments requirements

Arabica coffee grows in highland areas at altitude between 1370m and 1830m above sea level. That is why coffee grows well in the Goroka, Kainantu and Mt Hagen areas. Robusta coffee is a lowlands coffee and grows best in hot, wet lowlands with a height of less than 600 m above sea level. The bulk of robusta coffee grown in PNG is from East Sepik province.



A coffee tree

Gardening Methods

a. Land Preparation

Land preparation for Arabica coffee is similar to that for robusta coffee. Land on which coffee is to be planted is not likely to become very dry at any time of the year.



Ripe coffee cherries are ready to be picked

b. Planting Materials

Coffee can be planted using cuttings. Seeds are the usual planting materials. Seeds must first be planted in a nursery. The nursery should be close to the main garden so that transportation problems and seedlings death resulting from transportation will be avoided. Nurseries may be prepared on the ground or poly bags may be used. Poly bag nurseries are recommended because they give the farmer fewer problems.

Harvesting

Coffee trees bear fruit about three to four years after transplanting and continue to produce fruit for more than fifteen years, if the garden is properly maintained. It takes about seven to nine months for fruit to mature after flower formation.

Marketing

Selling coffee is a big business and an important aspect of coffee growing. Some farmers sell the cherries to road-side coffee buyers whereas others take them to the factory to sell. Farmers who sell cherries get less money for their coffee than if they process the coffee and sell parchment coffee.

Diseases and Pests

Compared to other coffee-producing countries, PNG is free of serious diseases and pests. However, the following diseases and pests are found in PNG.

- Coffee rust is the most common and most serious fungal disease. Thread blight is a fungal disease of robusta coffee.
- Sooty mould is a common fungal disease found in coffee trees in the highlands.

Insects are major pests of coffee:

- Mealy bugs and scale insects suck the plant juice of young stems and weaken the coffee plants.
- Coffee stem borers are larvae which make holes in coffee stems.

Storage

Coffee beans should be stored after they have been properly dried. They can be stored in bags for a few weeks before sale. Cherries should not be stored but should be pulped within twenty four hours after harvest. After roasting and processing into instant coffee, ground coffee and other forms, the coffee can be stored in sealed containers for several months or years.



Dried coffee beans ready for selling

So far you have undertaken and read through specific readings about the coffee plant and of fish farming. Here are some activities to work on.



Activity 2:

1. What is coffee?

2. Explain how coffee is picked.

Summary



You have come to the end of Lesson 14. In this lesson you learnt that;

- Fish farming generates income
- Fish take their oxygen and food from water, therefore a good water source is needed for the pond
- A clay soil is needed for a fish pond. It holds water and nutrients for the fish to feed from
- Water flowing into the pond must be free from pollution
- There are two types of fish ponds. One is the production pond and the other is the nursery pond.
- Pond fish may be infected by diseases if not looked after well.
- Fish is harvested at six to twelve months. It can be done through draining the water or using the net.
- Fish can be sold fresh or preserved.
- There are two different kinds of coffee. One is Arabica coffee and the other is robusta coffee.
- Arabica coffee is the familiar highlands coffee and Robusta coffee is the lowland coffee.
- Arabica coffee grows in highland areas at altitudes between 1370m and 1830m above sea level.
- Robusta coffee is a lowlands coffee and grows best in hot, wet lowlands with a height of less than 600 m above sea level.
- Coffee is harvested when the fruits are matured after seven to nine months.
- A coffee tree will continue to bear fruits up to fifteen years
- Some farmers sell coffee at the road sides while other take their coffee to the factories to sell.
- Coffee rust is the most common and most serious fungal disease for coffee in PNG.
- Insects such as mealy bugs, scale insects and coffee stem borers are major coffee pests.

NOW DO PRACTICE EXERCISE 14 ON THE NEXT PAGE



Practice Exercise 14

1. In a paragraph, explain what kind of coffee grows in your local area, why and also state the importance of the crop to the people, do they value it or no, do a bit of research and write about it.

2. Select one crop cultivated locally or an animal farmed locally, example, pigs and carry out research following the given guideline below.

Crop

- a. Name the plant.
- b. How is it planted?
- c. Write two important use of the plant.
- d. When is it harvested?
- e. Can it be marketed or stored?

Animal

- a. Name and describe the type of animal.
- b. Give a brief explanation about the animal in the area of: feeding method
- c. Can it be easily affected by diseases?
- d. How is it marketed?

Answer Question 2 in this space provided below.

Supplementary Reading 17: Appropriate Crop Management Practices

At first people hunted and fished for animal, food and clothing and gathered plant parts for food, fibre, and medicine. They wandered in search of these necessities. About 10,000 years ago they started to grow plants and began to tend herds of animals. This was the beginning of farming. So farming allowed people to settle and stay in one place. As farming became more efficient, it freed more people to work at other things like building towns, cities, develop industries, and create paintings and other forms of art.

This reading is on appropriate crop management practices. The manner in which soil or land is used determines, how long it will continue to provide for its people.

Soil provides substance for trees to grow, worms to crawl, people to build houses, and gardens to grow.

Soil

One of the most important natural resources is soil. Like air and water, soil is necessary to life on Earth. Without it, plants could not grow and plant-eating animals could not live, meat-eating animals would also perish. Civilizations depend on the quality of their soil to grow their food and to serve as a living filter that purifies the wastes they produce.

Only a thin layer of soil, called topsoil, can successfully support plant life. While along great rivers the soil favourable to plant growth may be hundreds of centimetres thick. In most places it extends down only about 15 centimetres. People must protect the fertility of this thin layer by preventing erosion and by replacing the food values that crops remove from the soil. Erosion can strip soil from unprotected land. The replacement of such losses is very slow. Nature takes from 500 to 1,000 years to make 2.5 centimetres of topsoil and from 2,000 to 5,000 years to replace a loss of 13 to 25 centimetres. Therefore people must learn to conserve their productive soil.

Soil and Water Management

The study of soil is carried out by several types of scientists. Pedologists study the soil as an ordinary body without necessarily focusing on its use. Soil chemists, physicists, mineralogists, and microbiologists conduct research on soil properties and behaviour. Edaphologists study the soil as a medium for the production of crops.

Soil scientists try to find ways of managing the soil so that it will provide maximum crop yields without depleting this valuable resource.

Irrigation has long played an important part in agriculture in many countries. Individual farmers or groups of farmers may get water for their fields from streams and wells. Others may get water from large irrigation systems. These systems dam the mountain's rivers and send their water through canals or pipes to the fields.

Principles of Gardening

The range of plants available to the modern gardener is rich, and new varieties are constantly being offered by nurseries. Most of the shrubs and flowers used are descendants of plants imported from other countries. Plant breeding continues to

improve the adaptability of such plants. The more closely the new habitat resembles the original, the better the plant will flourish.

Soil and Humus

Soil is the basic factor in plant cultivation. It consists largely of mineral particles derived from the breakdown of rocks and other substances and also contains organic matter. Plant roots go through spaces between the particles where air, water and micro - organisms circulate. Ideal garden soil is a clay and sand mixture, rich in organic materials and of the proper degree of acidity or alkalinity for the plants. The organic materials in the soil are known as humus. The finest humus can be produced on what is called a compost pile. Gardeners use the words humus and compost interchangeably. By heaping rotted plants and other plant wastes onto such a pile, humus can be cheaply produced.

Feeding, Watering, and Protecting

The three main elements that plants need for growth (other than light and water) are nitrogen, potassium, and phosphorus. Animal manures or composts of decayed plant matter can supply most requirements to the soil.

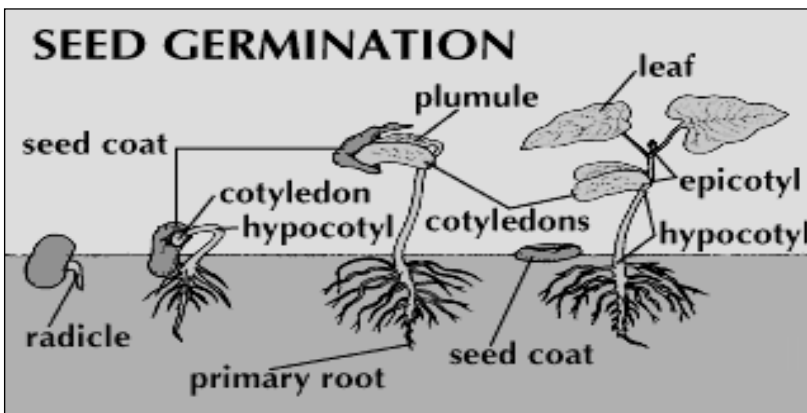
Thorough watering is essential, furnishing the plants with needed moisture and making minerals available in solution. Drainage is also vital. All plants need water but the amount needed varies, and if plants are forced to absorb more than they need, a form of drowning occurs.

Roots require air as well as water and depend on drainage of sub surface water for their oxygen. Earthen ware piping or sumps, holes dug to a depth of about 4 feet (1.2 meters) in strategic areas, are used to achieve drainage.

Many plants can withstand temperatures below freezing but less hardy plants may have to be protected from cold weather by wrapping them or covering them with a mulch of leaves, soil, or ashes. Glass frames provide greater protection, and heated greenhouses permit plants to grow throughout the winter.

Pruning and propagating

Trees and shrubs sometimes require pruning (cutting off branches or shoots) to restrict the plant to a desired size and shape. Shrubs may flower more abundantly after pruning, and pruned fruit trees often yield larger and better fruit.



Stages in Seed Germination

New plants can be propagated, or reproduced, either from seeds or from a part of the parent plant. Seeds of vegetables and annual plants are usually sown in the cooler part of the year. Trees and bushes can be produced by a variety of propagation methods from parent shoots or buds.

Gardens and Gardening

A garden is a wonderful place to learn about life and growth. A dry seed in the hand looks not important. Yet inside is a plant-to-be, pushed into some warm, rich earth and given a little water and sunshine, the seed begins to develop.

Seed germination begins when the seed takes in water, causing the inner layers to swell and a root breaks out of the seed coat and pushes deep in search of plant food and water. A tender green leaf thrusts its way upward through the soil and reaches toward the sun. If all goes well, there soon will be flowers or edible produce to reward the gardener.

The gardener soon learns that plants differ in many ways from one another. Some plants grow best in cool weather, while others like a warmer environment. Some thrive in sandy soils, others in clay. Cacti grow in the desert where rains fall only once or twice a year. Marsh marigolds must live in swamps. The prairie rose blooms in open, sunny fields. Its relative, the wild strawberry, prefers the shade of woods.

Types of Gardens

Gardens can take any shape and size the owner wishes within the limits of climate, materials, and space. Modern gardens are becoming ever smaller because many people live in urban areas where space for gardening is limited. Formal gardens, those that are laid out in strictly geometric patterns with boundaries that are clearly defined by hedges, stone or gravel walkways, statuary, fences, walls, and fountains, were popular during the early 1800s. Although they can still be found as part of large estates or botanical gardens, most domestic gardens are now much smaller and less formal. Let's have a look at some of these gardens.

I. Flower gardens

Trees and shrubs often go together with a well-designed flower garden. The layout of these features is usually planned first and then annuals, perennials, and biennials are arranged around the trees and shrubs. Both blending and contrast of colours as well as forms are stressed in the design of a flower garden.

Because annuals must finish their growth in one short season, they need plenty of sun. A few will survive in light shade. In heavy shade perennials must be used, or it may not be possible to grow anything.

II. Vegetable gardens

The vegetable garden requires an open and sunny location. Good crop growing and preparation of the ground are important for successful vegetable growing. It is also desirable to practice a turning round of crops as in farming. The usual period of rotation for vegetables is three years. This helps to prevent the carryover from season to season of certain pests and diseases. Additionally, vegetables should be planted in straight rows to make them easier to cultivate and weed.

For a small vegetable garden, plants that produce heavily yet need little space are ideal. Such plants include bush beans, tomatoes, lettuce, radishes, Swiss chard, summer bush squash, onions, and parsley. Vegetables that occupy the ground for a long season or need a great deal of room include potatoes, pumpkins, sweet corn, peas, and cabbage. These vegetables need so much room that they are usually only grown when a large plot is available in which they can be planted.

Seed packages inform gardeners how far apart plants should stand in the row and the right distance between rows. Three or four seeds are sowed for every plant needed for a full row. Most vegetable seeds break through the soil in seven to ten days.

III. Herb gardens

Most of the medieval gardens and the first botanical gardens were largely herb gardens containing plants used for medicinal purposes or such herbs as thyme, parsley, rosemary, fennel, marjoram, and dill used for flavouring food. Herb garden is now usually used to describe a garden of herbs that are grown for cooking, and the medicinal aspect is rarely considered. Herb gardens need a sunny position because the majority of the plants grown are native to warm and dry regions.

The colouring of the plant life of herbs is a strong reason why gardeners plant herb gardens. Herbs are noted for their many different shades of gray and blue-green leaves. Mixing herb plants together to achieve a matched effect is a challenge to many gardeners. Although herbs are not known for their showy blooms, a few, such as lavender, germander and thyme, do make colourful displays. Many gardeners add ornamentation or showy perennials to herb gardens to give them a focal point. Sundials, birdbaths, beehives, or small figurines are traditional examples.

IV. Rock gardens

Rock gardens are intended to look as if they are a natural part of a rocky hillside or slope. If rocks do not occur naturally and must be added, they are generally laid on their larger edges, as they would be found in nature. A few large boulders usually look better than a number of small rocks. In a well-designed rock garden, rocks are arranged so that there are various exposures for sun-tolerant plants, such as rockroses, and for shade-tolerant plants, such as primula, which often do better in a cool, north-facing plot. Many smaller perennial plants are available for filling spaces in vertical cracks among rock faces. The main rocks from which rock gardens are constructed are sandstone and limestone.

V. Roof gardens

These gardens are fitting for people who live in urban areas where very little or no space is available on the ground for planting. Since many urban apartment and commercial buildings have flat roofs, development of attractive roof gardens is possible. These gardens follow the same principles as others except that the depth of soil is less, to keep the weight on the rooftop at a minimum, and so the size of the plants is limited. The plants are generally set in tubs or other containers, but elaborate roof gardens have been made with small pools and plots.

VI. Organic gardens

This term may apply to all of the gardens mentioned above as long as the gardener uses only biological fertilizers and pesticides. Many health experts and other people feel that chemical fertilizers and pesticides can cause health problems and that they are not necessary for successful gardening. Organic gardening is practiced all over the world wherever mixed organic materials, including animal manure, clean sewage sludge, compost, grass, straw, and other residues are used to fertilize gardens. Natural pest control is achieved through preventive methods, including crop rotation and the planting of pest-deterrent species of plants, and by pest-managing ways, such as the release of germ-free male insects and predators of pests.

VII. Public gardens

Many of the techniques used in home gardening are also engaged in the creation of world-famous public gardens. Public gardens are maintained by many cities and towns.

**ANSWERS TO SUBSTRAND 3
PRACTICE EXERCISES**

ANSWERS TO THE PRACTICE EXERCISE 11 -14

Practice Exercise 11

1. List some reasons that are affecting food supply to most people in Papua New Guinea.

Food supply must reach and benefit people in all communities. However, not all people are advantaged due to some factors.

Possible reason may be:

- High population growth rate.
- Land degradation
- Climate
- Low cash income
- Land shortage

2. How are crops and animals important to human survival? Give a brief explanation.

Crops and animals are important because of their economic, nutritional and cultural values. Economically for personal purposes such as food, clothing and traditional dress. Most important as food that enables us with healthy bodies. They are also valued traditionally and with modern ceremonial occasions.

3. Complete the table with the crop and give by writing its cultural, nutritional and economical values.

| Crop and animal | Cultural Value | Nutritional Value | Economical Value |
|-----------------|---|-----------------------------|--|
| peanut | Occasions (events) e.g singsings | Provide protein requirement | Provide revenue Production of Peanut butter |
| Fish | Bride price payment Traditional singings occasions | Provide protein | Provide revenue Assist in the production of tinned fish |

4. List all crops as commercial cash crops that Madang and Eastern Highlands Provinces contribute to the country's economy.

| MADANG | EASTERN HIGHLANDS |
|---------|-------------------|
| Coconut | Coffee |
| Cocoa | Timber |
| Yams | Potatoes |

5. Identify and list the advantages and disadvantages of traditional and introduced crops and animals.

| ADVANTAGES | DISADVANTAGES |
|--|--|
| 1. Suited to local conditions | Best and greatest area of land is given or used to plant cash crops |
| 2. Resistant to diseases | Poorer land used for family food crops |
| 3. Sustained by familiar farming methods | Best food crops are sold and poorer ones are kept for family consumption |
| 4. Maintain cultural heritage | |
| 5. Sustain food supply | |
| 6. Provide source of income | |
| 7. High yielding and fast grow | |

NOW GO BACK AND STUDY LESSON 12

Practice Exercise 12

1. Two types of planting methods are planting seeds in a box tray in a nursery and planting seeds or cuttings directly into the soil.

- a. Explain the different planting methods

Nursery: A nursery is a place or built shelter under which seed trays are placed and cared for. As seeds develop into tiny plants then they are transplanted into the prepared garden soil.

Direct planting: Direct planting refers to seeds or cuttings that are planted directly into the soil / garden/ plot .

- b. Differentiate between plants and seeds that are planted in nursery and direct planting

In a nursery, seeds sown are tiny ones. These are small seeds from cabbages, lettuces, carrots and tomatoes. Bigger seeds of crops such as corn, pumpkin, beans, peas and peanuts can be planted directly into the prepared garden soil. For crops like taro, yam, cassava and others, their cuttings are planted directly into the soil.

c. Write up the steps in nursing seedlings.

Steps in nursing seedlings.

- i. Produce or build a seed box.
- ii. Put in loam soil in the seed box.
- iii. Sprinkle soil with water.
- iv. Plant seeds one at a time, 5 cm apart.
- v. Cover with thin layer of soil if seeds are small.
- vi. Check and leave healthy seedlings and pull out the rest and those diseased and weak.
- vii. Water every day, after 3 – 4 weeks allow sunlight for 1 – 3 hours.
- viii. Transplant the seedlings into the soil.

2. For any planting to take place, firstly the land must be prepared. Further more you should know the different methods of planting that is required.

(a) Explain the steps taken in preparing the land.

These are the common step.

- Cut down weeds with bush knives.
- Dig out big stumps, dead logs, shrubs.
- Turn over the top soil with hoes.
- Spread manure or compost evenly over the soil.
- Bury the manure or compost in the soil.
- Smooth the surface soil and get it ready for planting.

b.

(a) Describe briefly three (3) good crop management practices you, your parents or relatives use.

For better yields and production, crop management practices is vital. These are appropriate crop management practices, land preparation, planting methods, weeding, mulching, irrigation, harvesting, processing, storage, pest and disease control.

c. Select a particular food or cash crop and discuss appropriate methods to cultivate and manage the crop. You may involve land preparation, planting methods, weeding, mulching, irrigator, harvesting, processing, storage and pest and disease control.

Tomato

Answers may vary for food or cash crop selected. This is only a suggested one.

Tomato is a plant with tiny seeds that are planted in the prepared soil. It must be cared for in the nursery. When in the soil other plants compete in growing that they must be pulled out. Supply of water is greatly needed in the early stage. Mulching is necessary and helps with good production. Insects are destroyed when attacking and ready they are harvested. Growers then prepare their produce for own consumption and marketing. Commercially it is processed and packed and stored in the freezers.

Practice Exercise 13

1. Explain what animal husbandry means.

Animal husbandry is the agricultural practice of breeding and raising livestock. Livestock are animals that are kept on a farm.

2. List and explain the issues that need to be considered to look after and raise animals properly.

To raise animals, certain things must be thought of. When these things are met and considered then looking after and raising animals will not be a problem.

All animals must be housed and fed. Choose a breeding stock that you like and the health and hygiene is the first priority. Always handle animals with care. Environment and weather conditions will determine the animal shelter and housing.

3. State some problems that are likely to happen in large scale animal farming.

Some possible problems to be faced in large scale animal farming are;

- having more animals creates housing and space problems.
- type and amount of food required can become a problem.
- animals can be infected more easily with diseases.
- Will need more money to buy feed
- Need additional labour

NOW GO BACK AND STUDY LESSON 14

Practice Exercise 14

1. In a paragraph, explain what kind of coffee grows in your local area, why and also state the importance of the crop to the people, do they value it or no, do a bit of research and write about it.

Arabica coffee grows very well in the cooler climate of Papua New Guinea. Provinces like Eastern Highlands, Simbu, Jiwaka, Western, Enga, Southern and Hela are the ideal provinces to plant coffee. PNG coffee is one of the worlds finest coffee in the world because it is organic. This means no chemical is used in the growing and harvesting of the crop. It is the number one export crop my the Highlands Region. Money from coffee is used to pay for people's daily needs. People really value this crop and work hard in their gardens.

2. Select one crop cultivated locally or an animal farmed locally, example, pigs and carry out research following a given guideline. Below is a guideline.

Crop

- a. Name the plant. Eg, Tomato
- b. How is it planted? It is firstly put in a nursery and then transplanted.
- c. Write two importance of the plant. It is a source of food and income.
- d. When is it harvested? When they are matured, ready in size and red in colour for some.
- e. Can it be sold or stored? For some it can be processed and stored in refrigerators or otherwise they are directly sold in the market.

Animal

- a. Name and describe the type of animal. Eg, Pig is a land animal that can be left to roam freely or be kept in the fence.
- b. Give a brief explanation about the animal in the area of:
 1. feeding method
Since it is inside the fence the owner feeds it always with some food. While they are in captivity, the farmer must provide the balanced meal.
- c. Can it be easily affected by diseases? It can be infected easily when not fed well, sheltered properly and its breeding place is not kept clean.
- d. How is it marketed?
When it is big enough and reached the size wanted by buyers, then it is sold.

Accept answers following the guide provided

REVISE SUBSTRAND 3 AND DO SUBSTRAND 3 TEST IN YOUR ASSESSMENT BOOK 1

ANSWERS TO LESSON ACTIVITIES

Answers to Lesson Activities in Substrand 1

Lesson 1

Activity 1: many things such as clothes, transport, money, food, radio, mobiles, computers, etc.

Activity 2: many things such as big rooster, cakes, sweet biscuits, soft drinks, etc.

Activity 3

| | Plant Resources | Legumes | Edible Greens | Fruits and Nuts | Beverages and Stimulants | Spice |
|----|-----------------|--------------|---------------|-------------------------|--------------------------|--------------------|
| 1. | cassava | winged beans | aibika, | soursop pineapple | tea | Mustard vanilla |
| 2. | yam | soya beans | pumpkin tops | Custard apple | coffee | chilli cardamon |
| 3. | taro | peas | ferns | Mangoes guava | ginger tea leave | Curry leave |
| 4. | banana | snake beans | cabbage | Oranges passionfruit | tobacco | ginger |
| 5. | corn | mung beans | bean leaves | coconut | betel nut | garlic |
| 6 | potatoes | peanut | aupa | panda nut | wine | onion |

Activity 4

1. Rain forests are important because;
 - They provide products such as, firewood, timber, logs for people to use and to generate income.
 - They protect the forest soil from erosion caused by rain.
 - They help to keep the soil fertile.
2. Swamps are important because;
 - They are a place where other animals such as fish and crocodiles breed. These animals are food sources for people and also they can be sold to earn money
3. Wetlands are important because;
 - They are places where rice growing can be done
 - They are places where you find sago trees which are a source of both food and building materials for people in that area.

Activity 5

| DOMESTIC ANIMALS | WILD ANIMALS |
|---|--|
| 1. Poultry Chickens, ducks | 1. Birds Pigeons, cassowaries, parrots |
| 2. Livestock Pigs, sheeps, goats, cattles, deer | 2. Mammals cuscus, tree kangaroos, flying foxes and bandicoots |
| 3. Insects Butterflies, bees | 3. Reptiles Snakes, crocodiles, turtles, eels |
| | 4. Insects Grasshoppers, beetles, dragonflies, moths |

Lesson 2

Activity 1

1. Name the river. The name you give will definitely be in your local language
2. For fishing, for transportation, for washing, for crabbing

Activity 2

(Possible Answers)

From rivers, wells, water supply, tanks, and tap water

Activity 3

(Possible Answers)

- The elders restrict people from fishing in the rivers for at least three months to allow the fish to mature
 - The elders check that no rubbish is dumped into the rivers
 - The elders check that no mangroves are chopped in a destructive manner
-

Lesson 3

Activity 1

- Ownership of land
- Unequal distribution of royalties especially in areas where there is major

developments. Eg, In Tari (Southern Highlands) where the LNG Project is located.

Activity 2

Clearing of trees for roads or perhaps for other developments

Lesson 4

Activity 1

some causes of water pollution are; waste from the human body, waste from animals, fuel and oil spills, dead animals, household waste such as plastic bags, tins and tyres, chemical waste from industry.

Activity 2

Rivers are used for water and transportation

Activity 3

Mainly Plastics, empty bottle containers, tins and tyres

Lesson 5

Activity 1

-movement of water (hydropower, tidal power and wave power from ocean surface waves), wind (used for wind power), geothermal heat (used for geothermal power); and radiant energy (used for solar power) are practically infinite and cannot be depleted, unlike

-Soil, water, forests, plants, and animals are all renewable resources as long as they are adequately conserved.

Activity 2

- Hunt only the mature animals
- Catch only the mature fish/ I would let go fish that are small

Activity 3

- (a) Dry leaves – use them as mulch. Pile them in the flower gardens to keep the soil moist and to stop unnecessary weeds growing
- (b) Food scraps – Feed the dogs with the leftover food staff. Place the orange skin and the corn stock in the vegetable garden as compost.
- (c) Empty tin cans and aluminium – crush them with others that you may have collected and sell them to tin recycling factory.

Lesson 6

Activity 1

Coral - a marine organism that lives in colonies and has an external skeleton

- a hard deposit consisting of the skeletons of coral, often forming ocean reefs

Activity 2

Reef – a ridge of coral or rock in a body of water, with the top just below or just above the surface

Activity 3

Island – a piece of land surrounded by water

- an area of land, smaller than a continent, that is completely surrounded by water

END OF ANSWERS TO LESSON ACTIVITIES IN SUBSTRAND 1

Answers to Lesson Activities in Substrand 2

Lesson 7

Activity 1

- (a) Roads, houses, churches, schools, hospitals, markets, shops, bus stops, electricity power poles, vehicles, drains, footpaths, roadside flower gardens, recreation parks, swimming pools, rubbish, etc
- (b) There would be no changes made to the environment if there was no human being living on the land.
- (c) Social element in the environment is referring to the human beings relating to each other. Talking with each other, doing things together, having fun together, sharing with each other, etc
- (d) family groups, wantok groups, villages, sporting teams, church groups, schools and clans, district and provincial groups, informal business sector groups, professionals, etc.
- (e) -People obtain a sense of belonging
 - People establish cultural values
 - People develop and enhance abilities
 - For security purpose

Activity 2

| NO | CAUSES | EFFECTS |
|----|---|---|
| 1. | Heavy rain | washed away the top soil from gardens. |
| 2. | A volcanic eruption or tidal wave | <u>destroys a town or community.</u> |
| 3. | <u>A landslide</u> | damages a road and people cannot transport goods to the market. |
| 4. | Forestry projects | <u>cause a loss of habitat for animals.</u> |
| 5. | Overuse of chemical sprays and fertilizers. | <i>can pollute water supplies.</i> |
| 6. | <u>Polluted water and unhygienic conditions</u> | causes outbreaks of diarrhea, dysentery and typhoid. |
| 7. | Over grazing animals | <u>destroys vegetation cover and productive soils.</u> |

Lesson 8**Activity 1**

Food scraps, peelings from the garden vegetables, packets and plastics from manufactured goods

Activity 2

CAUSES AND EFFECTS

| No | Fabrics | Wood | Metal | Glass | Plastics |
|----|------------------------------|---------------|---------------|--|------------------|
| 1 | Old clothes | Broken stool | Piece of iron | Broken bottle | Biscuit wrappers |
| 2 | Old tea towels, table cloths | Broken tables | Broken pots | Broken drinking glass, glass cup and plate | Bread packet |

| | | | | | |
|----------|---|-----------------------------------|--------------------------|---|-------------------------------|
| 3 | <i>Old bedsheets, pillow cases, bed spreads</i> | <i>Broken bed</i> | <i>Old window frames</i> | <i>Broken window blade</i> | <i>Plastic Shopping bags</i> |
| 4 | <i>Old curtains</i> | <i>Broken shelves, cardboards</i> | <i>Old chair frames</i> | <i>Broken mirror</i> | <i>Glad wrappers for food</i> |
| 5 | <i>Old cushion Covers</i> | <i>Old chopping board</i> | <i>Old table frames</i> | <i>Broken glass lid for electrical cooking pots</i> | <i>Lunch pack packets</i> |

Activity 3

Plastic shopping bags, used bumbum napkins for babies, empty food cans, empty food bottles, empty food packets and household items

Lesson 9**Activity 1**

Plastics should be buried

Activity 2

A. Water pollution

B. Habitats may die

C. May cause problems to the propellers of water/sea transports such as dingy motors

Activity 3**Possible Answers**

- Left over fabrics can be sewn together to make quilts
- Chicken feathers can be treated, dried, inked and be put together to make dusters for dusting the windows
- Old tyres can be made into out stairs mats
- Sawdust can be comprised and used as a fuel to cook
- Pigs waste can be stored in a hole in the earth and be connected with a hose leading upwards to produce gas for cooking

Lesson 10

ACTIVITY 1

Liquid and solid waste.

ACTIVITY 2

Bread wrappers ,Tea bags/ box, Butter bottles and plastic containers, Milk containers, Sugar packet, Bake bean tin, Coffee packet, Banana peels, Weet bix box/ plastic.

ACTIVITY 3

All kinds of things comes to my mind such as kaukau, fruits and vegetable rotting, animals going through the rubbish, bad smell, plastics flying around, flies sitting on wastes, illnesses etc.

ACTIVITY 4

The two major problems that are evident are;

- Increased population
- Attitude – the villagers do not see any problems with the way things are done and do not see any linkage of poor waste disposal and their well – being.

END OF ANSWERS TO LESSON ACTIVITIES IN SUBSTRAND 2

Answers to Lesson Activities in Substrand 3

Lesson 11

Activity 1

Possible answers

- enough good food to eat
- frequent food shortages
- abundance of food
- total scarcity – food has to be bought from the neighbouring villages

Activity 2

Possible answers

Crops: - Sago, Yams, special bananas for feasting or mumu,

Animals: - pigs, Cassowaries, wallabies, certain species of fish meant for feasts

Activity 3

(a) -Benefits of traditional farming: it was healthy, no chemicals involved, there was

plenty good food to eat

-Benefits of commercial farming: to generate income

(b) traditional farming

Lesson 12

Activity 1

- (a) Continuous use of the soil in planting crops without adding organic matters to the soil.
- When we burn foreign matters such as plastics and papers and leaving their ashes to spread and sink into the soil
 - When we plant the kinds of plants that use up the nutrients and we do not think of planting the other kind of plants that adds nutrients back to the ground.
- (b) Yes, the soil can be infertile and agriculture purposes can be difficult to carry out.

Activity 2

- (a) One of the both. It really depends on where you are from and the kind of food plant you plant in your regions, districts or Province.
- Plant seeds in a box-tray in a nursery ,or
 - Plant seeds or cutting directly into the soil.
- (b) The right time to do planting depends on the kind of crop. For some, it would be just a few weeks before the rainy season begins. For others, it would be a 1 month, before the rainy season begins. Others would it begins to rain. There are others such as coconut trees, mango trees, bread fruit trees, that can be planted at any time of the year.

Activity 3

Weeding is about pulling out weeds and unwanted little plants that are growing around the food plant

Activity 4

- (a) It keeps the soil cool for seeds to grow.
- (b) - Mulch decays in time and enriches the soil
- Mulching prevents weeds from growing and water from evaporating from the soil.

Activity 5

- (a) It really depends on where you are making your garden. For some, it would be channel irrigation and others may be sprinkler irrigation or drip irrigation
- (b) channel irrigation because the crops are growing in rows

Activity 6

You must know if the crop is ready in size or matured

Activity 7

There could be other processes but this one could be just an example;

1. Peanuts are dug out of the earth
2. They are left in bags for a long time to dry
3. The shells are removed

4. They are roasted a little while, than seasoned with salt and packed in packets

Activity 8

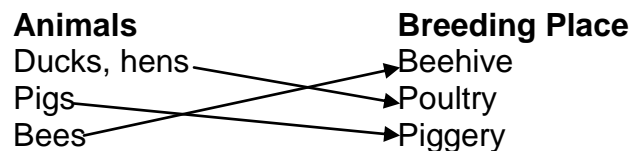
Damaged food cooked and given to animals to eat. They are kept separate from the other good food.

Activity 9

- (a) Possible answers; Get angry because they will spoil your crops , Fear for them, Enjoy their presents, love to watch them, do not want to get closer to them
 (b) Daily

Lesson 13

Introduction Activity Answer



Activity 1

Yes, you could say it was a chicken house, pig house, duck house, sheep house, goat house, or horse shed which was made out of kunai grass and iron roofing, etc. Then, you can describe how that animal was fed. Example, if it is a chicken house, then obviously, the chickens are given plenty of water and stock feed at least three times a day. If it is sheep, then, they are taken out each day to eat grass.

Activity 2

1. The animals that roam freely find their own food which is natural and healthy and does not cost money
2. The animals that roam freely can also be unhealthy if they do not find enough food for themselves. They could be smaller in size even though they may be older.

Activity 3

Example, I would choose to raise the village chickens so that they would freely roam and find their own natural food. I would at least look after 4 only. This is because I live in the village. (You can have your own answer)

Activity 4

Things that have reduced the productivity of animals are climate, pollution of flesh river water, extinction of natural food that animals eat, chopping and clearing of forest where bird's habitat and ignorance of human masters of the raised animals.

Activity 5

Some dangers are; being bitten, scratched, butted, knocked down, kicked or pinned between an animal and a hard surface.

Lesson 14

Activity 1

1. A fish pond is a controlled pond, artificial lake or large reservoir that is used in the farming of ocean and freshwater plants and animals for human consumption.
2. A clay soil hold water and nutrients for the fish to feed from
3. Some of the factors which may lead to a disease outbreak in the pond are:
 - Too many fish creates development of parasites.
 - Rough handling of fish causes injury and infection of wounds
 - Disease brought into the pond by diseased fish
 - Eating birds flying from one pond to another

Activity 2

1. Coffee is a;
 - **strong caffeine-rich drink:** a drink containing caffeine and with a mildly stimulating effect that is made from the ground or processed seeds of a tropical tree
 - **seeds for making coffee:** the roasted seeds coffee beans of a tropical tree used to make coffee.
 - **bush yielding coffee beans:** a bush cultivated for its seeds coffee beans that are used to make coffee.
2. A ladder may be used to climb up the coffee tree and collect the ripe coffee cherries from the branches

END OF ANSWERS TO LESSON ACTIVITIES IN SUBSTRAND 3

Reference

- 1) **NORMAN P.** & et al, (2005), *Making a Living, Book 1*, Oxford University Press, Victoria 3205, Australia.
- 2) **NORMAN P.** & et al, (2005), *Making a Living, Teacher Resource Book*, Oxford University Press, Victoria 3205, Australia.
- 3) **NORMAN P.** & et al, (2005, *Making a Living, Book 2*, Oxford University Press, Victoria 3205, Australia.
- 4) **REID K.** (2005) & et al, (2005), *Making a Living, Grade 6, Teacher's Resource Book*, Pearson Education , Victoria, Australia.
- 5) **ROBERTSON B.** & et al (2008), *Making a Living, Outcomes, Grade 7, Teacher's Resources Book* ,_Pearson Education , Victoria, Australia.
- 6) **ROBERTSON B.** & et all (2008), *Making a Living, Outcomes, Grade 7, Students Book*,_Pearson Education , Victoria, Australia.