

VQA Level: 1

Learner Guide

**Certificate I in Climate Change and
Disaster Risk Reduction**

Units 6 & 7: CGMC0616 & CGCA0716

Demonstrate ways of
contributing to the mitigation
of climate change

Demonstrate ways of
adapting to climate change



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(SPC/GIZ CCCPIR, 2013)*

Copyright information



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Introduction

This Learner Guide supports the units of competency CGMC0616 (*Demonstrate ways of contributing to the mitigation of climate change*) and CGCA0716 (*Demonstrate ways of adapting to climate change*), which specify knowledge, skills and attitudes associated with learning about the mitigation of, and adaptation to, climate change. These units are the sixth and seventh in a series of eleven units that comprise a training programme on climate change and disaster risk reduction at Certificate Level 1.

The Learner Guide provides guidance and relevant educational resources that address the required elements and performance criteria. It is accompanied by a Learner Workbook that provides learner-centred activities and assessment tools to foster learning of key concepts and skills. The competencies developed are in line with the key competencies promoted by VQA to foster greater empowerment and success in the work place. Additionally, a Facilitator Guide for this unit provides further background knowledge and teaching notes for facilitators, trainers and teachers.

The sixth unit, CGMC0616, defines the standard required to: demonstrate the need for a world-wide mitigation of greenhouse gas emissions; demonstrate the need for communities in Vanuatu to reduce their emissions of greenhouse gases; illustrate mitigation measures that can be taken by individuals and communities in Vanuatu; and differentiate between mitigation and adaptation. The seventh unit, CGCA0716, defines the standard required to: demonstrate the need for adaptation strategies; illustrate appropriate adaptation measures; show that many measures include both adaptation and mitigation benefits; and assist the development of adaptation and mitigation measures in a local community.

The development of all units was guided by consultations with government and non-government stakeholders in Vanuatu and was based on the SPC's Community Education Training Centre draft training unit *Community Based Disaster Risk Management and Climate Change* (SPC/GIZ/USP, 2013). The units have been produced with technical and financial assistance from EU PacTVET and the SPC/GIZ's Coping with Climate Change in the Pacific Island Region (CCCPIR) programme. The University of the South Pacific's Pacific Centre for Environment and Sustainable Development (USP PACE SD) contributed to its technical review. The curriculum writer is Charles Pierce.



Icons



Activity to complete in the workbook



How am I doing?



Definition



Example

Course Outline

Before we start...

Dear Learner - This Learner Guide contains all the information to acquire all the knowledge, skills and attitudes leading to these unit standards:

Title: Demonstrate ways of contributing to the mitigation of climate change

VQA Level: 1

Credits: 5

Title: Demonstrate ways of adapting to climate change

VQA Level: 1

Credits: 5

The full unit standards will be handed to you by your trainer/facilitator. Please read them in your own time. Whilst reading the unit standards, make a note of your questions and aspects that you do not understand, and discuss them with your trainer/facilitator.

These unit standards are two of the building blocks in your qualification at Certificate level 1 listed below. Please write in the names of all the units of competency that you are currently doing:

Title	VQA Level	Credits
Certificate I in Climate Change and Disaster Risk Reduction	1 & 2	46
.....
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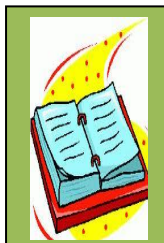
You will also be handed a Learner Workbook. This Learner Workbook should be used in conjunction with this Learner Guide. The Learner Workbook contains the activities that you will be expected to do during the course of your study. Please keep the activities that you have completed as part of your Portfolio of Evidence, which will be required during your final assessment.

You will be assessed during the course of your study. This is called formative assessment. You will also be assessed on completion of this unit standard. This is called summative assessment. Before your assessment, your assessor/ trainer/ facilitator will discuss the unit standard with you.

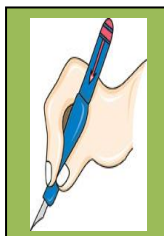
Enjoy this learning experience!

How to use this guide ...

Throughout this guide, you will come across certain re-occurring “boxes”. These boxes each represent a certain aspect of the learning process, containing information that will help you with the identification and understanding of these aspects. The following is a list of these boxes and what they represent:



What does it mean? Each learning field is characterized by unique terms and **definitions**. It is important to know and use these terms and definitions correctly. They are highlighted throughout the guide in this manner.



You will be requested to complete **activities**, which could be group activities or individual activities. It is important to complete all the activities as your facilitator will assess them and they will become part of your portfolio of evidence. Activities, whether group or individual, will be described in this type of box.



Examples of certain concepts or principles will be shown in this type of box. Examples help you to relate what you are learning to a real life situation.



This type of box indicates a **summary** of concepts that have been covered, and offers you an opportunity to ask questions to your facilitator if you are still feeling unsure of these concepts.

My Notes ...

You can use this box to jot down questions you might have, words that you do not understand, instructions or explanations given by the facilitator, or any other remarks that will help you to get a better understanding of what you are learning.

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Key competencies / employability skills to be acquired

Competency/skill	Example of application
Initiative	<p>Adapting to new situations • developing a strategic long-term vision • being creative • identifying opportunities not obvious to others • translating ideas into action • generating a range of options • initiating innovative solutions</p> <ul style="list-style-type: none"> • <i>Work with a local community to help it develop appropriate measures to mitigate GHG emissions.</i> • <i>Work with a local community to help it develop appropriate measures to adapt to future climate change.</i>
Communication	<p>Verbal or non-verbal that includes: • speaking clearly and directly • writing to the needs of the audience • understanding the needs of internal and external parties • persuading effectively • establishing and using networks</p> <ul style="list-style-type: none"> • <i>Present information both visually and verbally (using hand-drawn illustrations and technology) to explain the need for the global mitigation of GHG emissions, the difference between GHG mitigation and climate change adaptation, and appropriate GHG mitigation measures for communities in Vanuatu.</i> • <i>Present information both visually and verbally (using hand-drawn illustrations and technology) to explain the importance of climate change adaptation measures in Vanuatu and appropriate climate change adaptation measures for communities in Vanuatu.</i>
Teamwork	<p>Working with people of different ages, gender, race, religion or political persuasion • working as an individual and as a member of a team • knowing how to define a role as part of a team • applying teamwork skills to a range of situations</p> <ul style="list-style-type: none"> • <i>Cooperate in a small group to deliver a meaningful presentation to people in the local area on GHG mitigation.</i> • <i>Cooperate in a small group to deliver a meaningful presentation to people in the local area on climate change adaptation.</i> • <i>Consult with this local community regarding appropriate mitigation and adaptation measures to be undertaken.</i>
Information & Communication Technology	<p>Having a range of basic IT skills • applying IT as a management tool • using IT to organise data • being willing to learn new IT skills • having the occupational health and safety knowledge to apply technology • having the appropriate physical capacity</p>

	<ul style="list-style-type: none"> • <i>Use the internet and printed documents to discover examples of mitigation and adaptation strategies appropriate to the local area, Vanuatu and the Pacific region.</i> • <i>Use mobile phones for taking photographs of mitigation and adaptation measures appropriate for the local area.</i> • <i>Use phones, email and social media to access information on adaptation and mitigation strategies.</i>
Problem solving	<p>Developing creative, innovative solutions • developing practical solutions • showing independence and initiative in identifying problems solving problems in teams • applying a range of strategies to problem solving • applying problem-solving strategies across a range of areas</p> <ul style="list-style-type: none"> • <i>Develop suitable mitigation measures for reducing the causes of climate change in a local community</i> • <i>Analyse features of a local area and determine how it will be affected by the impacts of future climate change, suggesting adaptation measures for reducing the severity of these impacts.</i>
Self-management	<p>Having a personal vision and goals • evaluating and monitoring own performance • having knowledge and confidence in own ideas and vision • articulating own ideas and vision • taking responsibility</p> <ul style="list-style-type: none"> • <i>Reflect on knowledge and understanding of strategies to mitigate the causes of climate change in Vanuatu.</i> • <i>Reflect on knowledge and understanding of strategies to adapt to the impacts of climate change in Vanuatu.</i> • <i>Seek advice from others (through conversations and/or technology) and be ready to express their own views in discussions on mitigation and adaptation strategies for climate change.</i>
Planning	<p>Managing time and priorities – setting timelines, coordinating tasks • being resourceful • taking initiative and making decisions • establishing clear project goals and deliverables • allocating people and resources to tasks • participating in continuous improvement and planning • developing a vision and a proactive plan to accompany it</p> <ul style="list-style-type: none"> • <i>Plan, collect, organize and analyse information on GHG mitigation measures that can be taken by individuals (both men and women) and communities in Vanuatu.</i> • <i>Plan, collect, organize and analyse information on climate change adaptation measures that can be taken by individuals (both men and women) and communities in Vanuatu.</i>

Learning (gaining new skills and knowledge)	<p>Managing your own learning using a range of learning options suited to the individual learning style– mentoring, peer support, networking; • having enthusiasm for ongoing learning; • being willing to learn in any setting • being open to new ideas and techniques • being prepared to invest time and effort in learning new skills</p> <ul style="list-style-type: none"> • <i>Participate in group discussions to share knowledge and gain new skills and learning that will assist in community planning for strategies to contribute to the mitigation of climate change and strategies to adapt to the impact of climate change.</i>
GESI (Gender Equity and Social Inclusion)	<p>Valuing and supporting women and disadvantaged persons and equal opportunity for all in workplaces and communities • mentoring younger people • valuing and respecting older people • having respect for different cultural, social, religious and political values</p> <ul style="list-style-type: none"> • <i>Ensure that discussions in the communities are inclusive of both male and female perspectives on strategies for mitigating the causes of climate change and strategies for adapting to the impacts of climate change.</i> • <i>Ensure that planning and information on adaptation and mitigation strategies reflects cultural values and practices.</i>

What am I going to learn?

- Section 1: Demonstrate the need for a world-wide mitigation of greenhouse gas emissions
- Section 2: Demonstrate the need for communities in Vanuatu to reduce their emissions of greenhouse gases
- Section 3: Illustrate mitigation measures that can be taken by individuals and communities in Vanuatu
- Section 4: Differentiate between mitigation and adaptation
- Section 5: Demonstrate the need for adaptation strategies
- Section 6: Illustrate appropriate adaptation measures
- Section 7: Show that many measures include both adaptation and mitigation benefits
- Section 8: Assist the development of adaptation and mitigation measures in a local community

What do I need to know?

Before you start these two units, you should:

- be aware of some of the human actions that lead to increased amounts of greenhouse gases in the atmosphere
- have some understanding of how increased atmospheric greenhouse gas content will lead to global warming and climate change, and of how climate change is likely to affect the atmosphere and oceans
- have knowledge of a local community, especially in terms of leadership structure, cultural and religious practices, and livelihoods
- have basic skills in mapping and the construction and interpretation of graphs and diagrams

What are my learning outcomes?

When you have achieved this unit standard you will be able to:

- justify the need for a world-wide mitigation of greenhouse gas emissions;
- explain why communities in Vanuatu should try to reduce their emissions of GHGs;
- describe, with examples, some of the mitigation measures that can be taken by individuals and communities in Vanuatu;
- differentiate between mitigation of climate change and adaptation to climate change;
- explain why adaptation strategies must be adopted by communities in Vanuatu;
- outline and demonstrate some of the adaptation measures that are appropriate for Vanuatu, with examples;
- show that many of these measures are strategies for both adaptation and mitigation;
- assist a local community to develop appropriate measures for adaptation and mitigation.

Introduction to the Unit

You are about to start on the sixth and seventh Units of the Certificate I course on Climate Change and Disaster Risk Reduction. In these Units, you are going to find out more about the measures that can be taken to adapt to climate change and reduce the emissions of greenhouse gases.

You already know that human activities in the last 200 years have resulted in greater quantities of greenhouse gases such as carbon dioxide and methane being put into our atmosphere, and that this is making the atmosphere warmer. The increase in atmospheric temperatures also warms up our oceans and affects humidity and rainfall patterns, so leading to changes in the global climate.

To reduce the risks from current and future climate change, we must try to cut or slow down the emissions of greenhouse gases. This is called “**mitigation**”. The first three sections of Unit CGMC0616, corresponding to sections 1-3 of this Learner Guide, will explain why world-wide emissions of greenhouse gases must be mitigated, how mitigation will help Vanuatu, and the measures that can be taken by men, women and communities in this country.

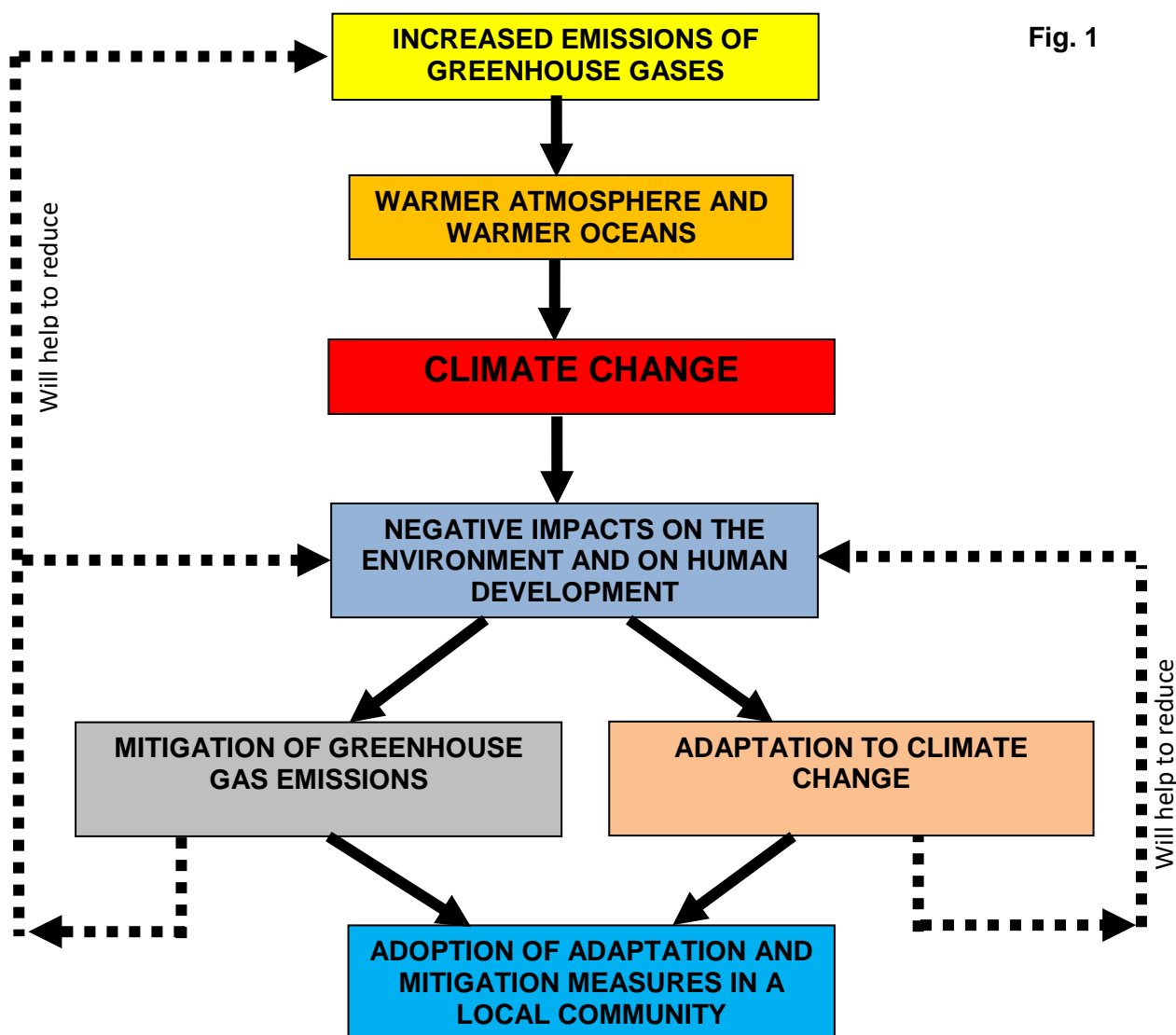
However, despite the steps that are being taken to mitigate carbon dioxide emissions, climatic statistics show that global warming is in fact accelerating. This means that climate change is already happening. Pacific island populations are very vulnerable to the negative effects of climate change because most islands are small and remote, with most people living close to the coast and depending on natural ecosystems for their livelihoods. For this reason, it is important to take steps to adapt to the changes that are already taking place and those that are going to come. In other words, we must urgently make modifications to our way of living that enable us to become more resilient to warmer temperatures, longer droughts, more extreme rainfall events, stronger cyclones, rising sea levels, increasing ocean acidification, more floods and landslides, more erosion, a loss of biodiversity, and other risks. This process is called “**adaptation to climate change**”. Adaptation also means that we learn how to take advantage of any benefits that climate change may bring.

After studying mitigation, you will complete Unit CGMC0616 by looking at the difference between mitigation and adaptation. Then, in Unit CGCA0716, you will learn why it is essential for communities in Vanuatu to start adopting strategies for adaptation now. You will examine some of the adaptation measures that are already being developed, and learn how to actually demonstrate some of them to others. Many of these measures, in fact, are strategies for both adaptation and mitigation: tree planting, for example, contributes towards the reduction of the carbon dioxide content of the atmosphere, and at the same time, will help to protect communities from future flooding, erosion and landslides.

In the final section of Unit CGCA0716, which corresponds to section 8 in this Learner Guide, you will consider how women and men have different roles to play in mitigation and adaptation, and how it is important for women, the elderly, and those living with disabilities to be included in the planning of community activities related to mitigation and adaptation. With this knowledge, you will then work in small teams to facilitate discussions with people in a local community. The goal is to help them identify steps they can take to mitigate and adapt to climate change, and then assist them to start implementing some of these measures. If the community has already made some development plans, you will be looking at ways to ensure that these plans include provisions for adapting to the impacts of climate change.

Your learning from these two Units will enable you to become agents of change in the community, equipped to help others to better prepare for climate change.

Fig. 1 shows how the content of this Learner Guide has been organized:



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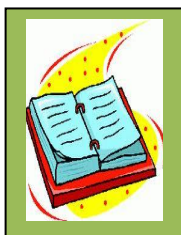
Section 1

Demonstrate the need for a world-wide mitigation of greenhouse gas emissions

After completing this section, you should be able to:

- 1.1 define greenhouse gas mitigation in the context of climate change;
- 1.2 justify the global need to reduce emissions of greenhouse gases;
- 1.3 clarify the role of the UNFCCC and the main agreements made at an international level.

1.1 A definition of “greenhouse gas (GHG) mitigation”



To “mitigate” means to make something less severe, serious or painful. When talking about climate change, **mitigation** means to reduce the causes of climate change, in other words, to lower the levels of greenhouse gases in the atmosphere. This can be done by reducing GHG **emissions** as well as by improving and increasing **carbon sinks** (especially the vegetation cover).

Greenhouse gases (GHGs) are gases in the Earth’s atmosphere that trap outgoing heat energy from the Earth. Such gases include carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O).

This **natural greenhouse effect** keeps our atmosphere warm and enables life to exist on our planet. However, in the past 200 years, human activities have been adding extra quantities of carbon dioxide, methane, nitrous oxide and other GHGs into the atmosphere, so causing the **enhanced greenhouse effect** and leading to **global warming**.

The main human activities that are causing an increase in the quantity of greenhouse gases in the atmosphere include the following:

- The burning of **fossil fuels** (coal and oil) in factories and power stations, which causes the emission of additional CO₂, as well as N₂O.
- The burning of fossil fuels in vehicles, aircraft, ships and trains, causing the emission of CO₂.
- Deforestation, which means that there are fewer trees to absorb the CO₂.
- Agricultural activities such as cattle rearing and rice cultivation, which emit CH₄, and the use of chemical fertilizers, which produces N₂O.
- Emissions of CH₄ from rubbish dumps and rotting vegetation.

Some of the human activities causing an increase of carbon dioxide in the atmosphere are shown in Figs 2, 3 and 4 below:

Fig. 2



Andreas/Wikimedia Commons, 2014

Fig. 3



Pierce, C., 2013

Fig. 4



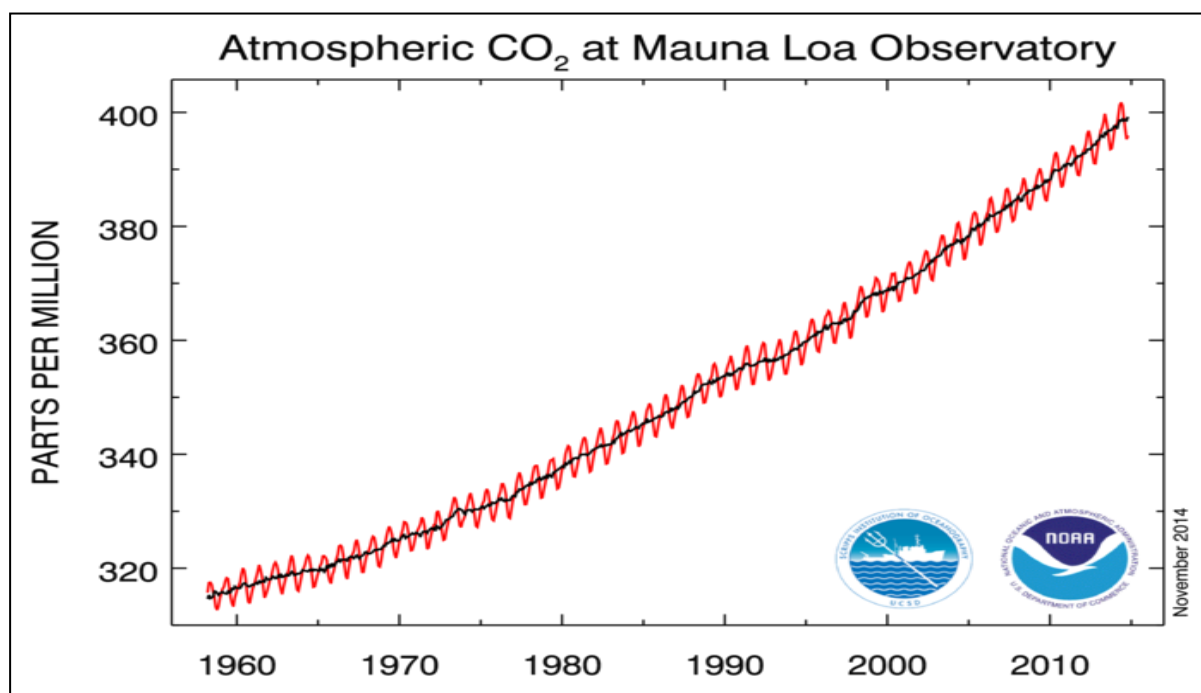
Morley Read / Shutterstock, 2007-2015

1.2 Reasons for reducing GHG emissions

Climate scientists have shown that there is a clear link between increasing emissions of greenhouse gases and rising atmospheric temperatures.

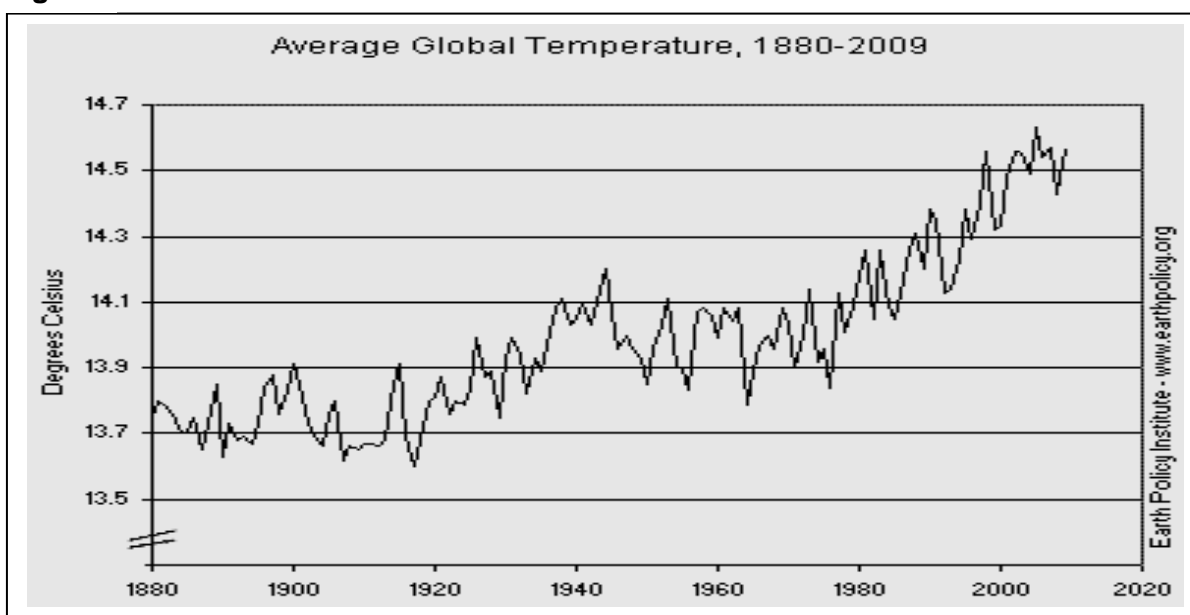
Fig 5 on the next page shows how the carbon dioxide content of the atmosphere, measured on the top of Mauna Loa in Hawaii, increased between 1960 and 2013. Fig 6 shows how the Earth's average temperature has risen between 1880 and 2009.

Fig. 5



ESRL/NOAA, 2014

Fig. 6



Earth Policy Institute, 2014

Many of the effects of these rising temperatures can already been seen. The most obvious is the warming of the oceans, leading to a slow rise in world-wide sea levels (Fig. 7). Other impacts are the increasing number of extreme weather events (Fig. 8), the acidification of sea water, the loss of snow and ice, and the loss of biodiversity. These impacts are already affecting people's health, their education, their food security, their culture and their social relationships. It is expected that the increasing negative impacts of climate change will put increased pressure on fresh water and other resources, with a likelihood of more rural-urban migration and more conflict.

Fig. 7

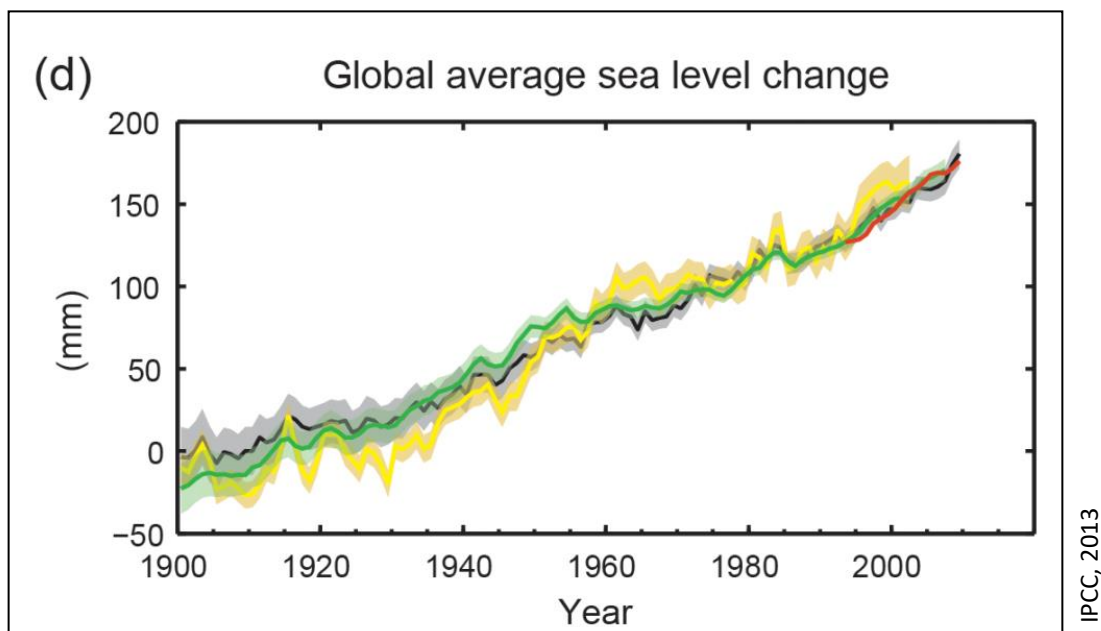
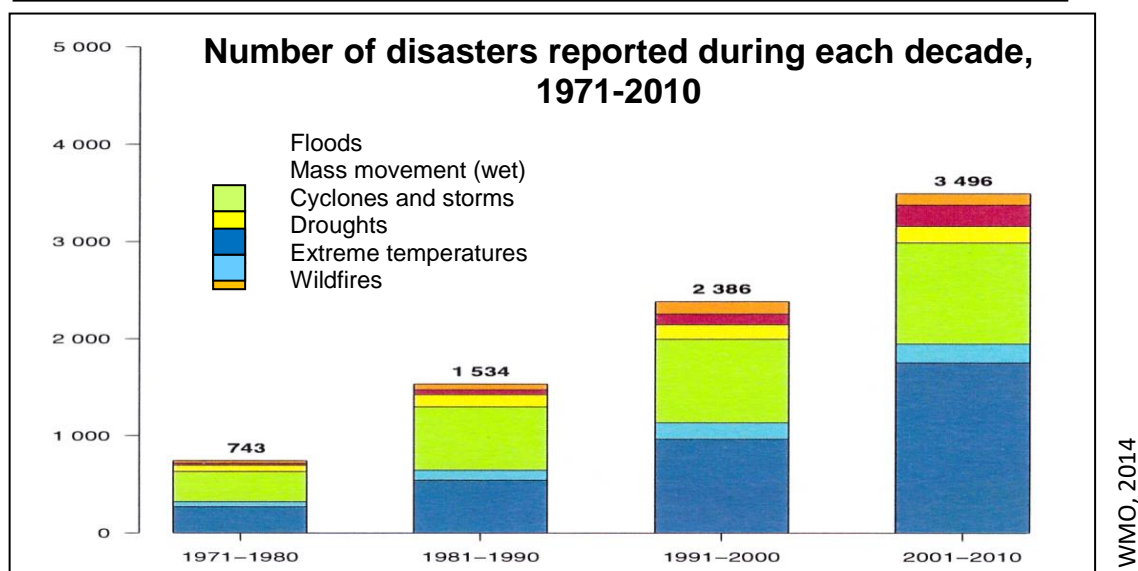


Fig. 8



This is what the Intergovernmental Panel on Climate Change (an agency of the United Nations) said in a summary of its 5th Report, issued in 2014:

“Warming of the climate system is unequivocal, and since the 1950s, many of the observed changes are unprecedented over decades to millennia. The atmosphere and ocean have warmed, the amounts of snow and ice have diminished, and sea level has risen.”

(IPCC Fifth Assessment Synthesis Report, 2014, p. 1)

“unequivocal” means that there is no doubt about it

“unprecedented” means that it has never happened before

**“decades” - tens of years.
“millennia” - thousands of years**

The IPCC states that humans are responsible for the recent increase in global warming:

“Human influence on the climate system is clear, and recent anthropogenic emissions of greenhouse gases are the highest in history... This has led to atmospheric concentrations of carbon dioxide, methane and nitrous oxide that are unprecedented in at least the last 800,000 years. Their effects ... have been detected throughout the climate system and are extremely likely to have been the dominant cause of the observed warming since the mid-20th century”

(IPCC Fifth Assessment Synthesis Report, 2014, pages 1 and 4).

“anthropogenic” means produced by humans

“unprecedented” means that it has never happened before

The IPCC also warns that the continued rise in temperatures is expected to continue. If we want climate change to slow down, it says, we must reduce our emissions of greenhouse gases:

“Continued emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change would require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks.

(IPCC Fifth Assessment Synthesis Report, 2014, pages 1 and 4)

“pervasive” means that the impacts spread everywhere

“irreversible” means that the impacts cannot be stopped

So if the human race does not reduce its emissions of greenhouse gases from their present levels, what is likely to happen? You can reflect on this with your facilitator and your fellow-learners.



Now please complete Activities 1.1a, 1.1b, 1.1c and 1.2 in your Learner Workbook

My Notes:

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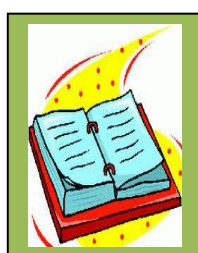
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Concept	I understand this concept	Questions that I would still like to ask
1.1 Mitigation of greenhouse gas emissions. 1.2 The global need to reduce greenhouse gas emissions and the possible consequences if there is no such reduction.		

1.3 The United Nations Framework Convention on Climate Change and international agreements



The United Nations Framework Convention on Climate Change (UNFCCC) was established in 1992 in order to find ways of solving the world-wide problem of climate change. Governments of all member nations of the UN were invited to sign an agreement to work towards keeping atmospheric GHG concentrations at a level that will gradually slow down global warming and reduce its dangerous impacts. The Convention has been signed by 195 countries, known as the “parties to the agreement”.

Since the adoption of this Convention, the parties have met annually at the **Conference of the Parties (COP)** in order to check on progress and continue to talk about how best to tackle the problem of climate change. In November 2016, for example, 22 officials from Vanuatu joined representatives from over 190 countries at the 22nd annual COP in Marrakech, Morocco.

When governments signed the Convention, they realized that it was not sufficient by itself to reduce GHG emissions. So the **Kyoto Protocol** was adopted in 1997. In 2005, under the Kyoto Protocol, 37 industrialized countries and the European Union adopted **legally binding targets** to reduce their GHG emissions between 2008 and 2012. The world’s leading industrial nation, the USA, refused to **ratify** the Protocol on the grounds that it would seriously damage its economy. Under the Doha Amendment of 2012, the plan was to get more countries to adopt targets for reducing their emissions between 2013 and 2020. However, the Amendment has not become binding because not enough countries were willing to make a commitment.

Discussions at COP meetings have led to what is known as the “climate divide”. Industrialized countries feel that all nations should be cutting their carbon emissions and that developing countries should reduce their rates of deforestation, since deforestation removes “**carbon sinks**” that absorb carbon dioxide from the atmosphere. Developing countries feel that it is the industrialized nations that are mostly responsible for the high level of GHG emissions, as a result of their industrial activities over the last 150 years; so it is the industrial nations who should be cutting emissions the most, as well as providing financial support for vulnerable developing countries who are already facing impacts of climate change such as sea level rise.

But more recently, as industrialization takes place in more and more developing countries, and there is greater awareness of the problems brought by increasing GHG emissions, there have been moves at the annual COP meetings to get **all nations** to sign legally binding targets. Significant progress has now been achieved. In November 2014, the world's two largest carbon emitters - the United States and China - agreed to start cutting their emissions. Then, in December 2015, at COP 21, a historical treaty was signed in Paris that requires all nations to start reducing their carbon emissions by 2020, when the Kyoto Protocol finishes. The agreement came into force on 4th November 2016.

The main aims of the Paris Agreement on Climate change are:

- to hold the increase in global average temperatures to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to only 1.5°C;
- to increase the ability to adapt to the negative impacts of climate change and to encourage the development of climate resilience and low greenhouse gas emissions, making sure that food production is not threatened;
- to ensure more finance for the development of low greenhouse gas emissions and climate resilience.

The Paris Agreement is very important since most climate scientists believe that a rise of more than 2°C will bring great danger to the world. In its Climate Change Synthesis Report of 2014, the IPCC says that risks from an increase of 4°C will bring widespread extinction of species, world-wide loss of food security, and difficulties in carrying out normal human activities. Even a temperature increase of between 1-2°C is highly likely to result in risks to “unique and threatened ecosystems” (coral reefs and polar ice sheets, for example), as well as “risks associated with extreme weather events” (IPCC, 2014, Synthesis Report).

Under current international agreements, industrialized countries can take part in **emissions trading**. This means that a country or an organization receives permits to produce a certain amount of carbon dioxide and other greenhouse gases. These permits, or **carbon credits**, can be traded with other countries or organizations. So if a country's emissions are less than its target, it can sell carbon credits to nations that are over their target. A company can sell its carbon credits to other companies. In other words, those that make more pollution will pay more.



Fig. 9:
Coal-fired power station in Poland, regulated by an emissions trading scheme

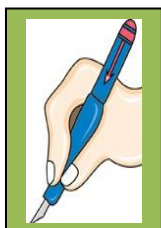


Jakubson, 2008

Industrial nations can also receive carbon credits if they finance the reduction of emissions in developing countries, for example by paying for renewable energy projects or reforestation schemes.

In addition to working towards the mitigation of GHGs, the UNFCCC and its Kyoto Protocol are designed to assist countries to adapt to the effects of climate change. For example, countries are helped to develop National Adaptation Plans (NAPs) and to receive technical support from various UN bodies and working groups. Funding is available through the Adaptation Fund and the Green Climate Fund.

Vanuatu has been part of the UNFCCC since 1991. In the Pacific, it is a leading advocate for the need to adopt urgent adaptation measures for our people.



Now please complete Activities 1.3a and 1.3b in your Learner Workbook

My Notes:

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Concept	I understand this concept	Questions that I would still like to ask
1.3 The UNFCCC and international agreements regarding GHG emissions.		

Section 2

Demonstrate the need for communities in Vanuatu to reduce their emissions of greenhouse gases

After completing this section, you should be able to:

- 2.1 identify the advantages for communities in Vanuatu of switching from fossil fuels to renewable sources of energy;
- 2.2 identify the steps being taken by the Vanuatu Government to promote the mitigation of GHG emissions;
- 2.3 explain why mitigation measures in Vanuatu should also focus on forest conservation.

2.1 Switching from fossil fuels to renewable sources of energy

Refined forms of petroleum, a fossil fuel, are widely used in Vanuatu. Think of the petrol, diesel fuel and kerosene used in vehicle engines, outboard motors, aircraft, chainsaws, lawn mowers and private generators. Think of the electricity produced in urban areas by Union Électrique du Vanuatu Limited (UNELCO) from refined petroleum.

So at present we are highly dependent on fossil fuels, particularly in towns. And even in rural areas, our transport, our tools and our machines are dependent on imported oil. What do these examples (Figs. 10 and 11) show?

Fig. 10



SPC /GIZ CCCPIR, 2013

Fig. 11



Rowhani Sch., 2015



Rowhani Sch., 2015



SPC/ GIZ CCCPIR, 2013

In Vanuatu, the share of energy from renewable sources is not yet as big as the share of energy from fossil fuels, but there are some positive developments.

In January 2013, the Government's Utilities Regulatory Authority (URA) estimated that 30% of the total electricity produced in Vanuatu by UNELCO and the Vanuatu Utilities and Infrastructure Limited (VUI) came from renewable sources.

UNELCO operates in the urban areas of Port Vila, Lakatoro and Lenakel, while VUI operates in Luganville. These renewable sources include:

- the Sarakata hydro plant (9%)
- the wind farm on the Kawene plateau at Devil's Point, Efate (9%)
- solar panels at Tagabe, Lakatoro and Lenakel (1%)
- biofuel (coconut oil mixed with diesel oil) at the Tagabe and Lakatoro power stations (10%).

Energy is being produced on a small scale in a number of villages from renewable sources such as wind power, micro-hydro-power, solar panels, coconut oil and pig waste. Further details will be given in Section 3 of this Unit.

Although Vanuatu, like all Pacific island nations, is still dependent on fossil fuels, there are several reasons why we must move towards a much greater use of renewable sources of energy:

1. **Cost:** Refined petroleum is one of Vanuatu's main imports. It is brought in by oil tankers from Singapore, New Caledonia and other places. The high transport costs, plus the costs of the fuel itself, mean that our petrol and diesel costs more per litre than in most other countries. Vanuatu's electricity charges in the urban areas (Port Vila, Luganville, Lenakel and Lakatoro) are among the highest in the world, although they are similar to charges in other small Pacific island states. When petrol and diesel fuel are transported to outer islands in Vanuatu, the cost to consumers is even higher. How much does one litre of petrol cost in your area?
2. **GHG emissions:** The more petrol and diesel fuel that is consumed in cars, trucks, buses, ships, speedboats, generators, lawnmowers, chainsaws and other equipment, the more carbon dioxide is being put into the atmosphere. When we burn firewood, carbon dioxide is emitted, but no more than the amount that would be released if the tree was left to rot. Although quantities are very small by world standards, Vanuatu is still adding to GHG emissions. We can say that Vanuatu has a **carbon footprint**, and in a minor way is contributing to global warming. It is also true to say that each individual person has a carbon footprint.
3. **Other forms of pollution:** Engine oil pollutes coastal areas and can be a threat to marine life. In urban areas the soot (small black particles of carbon) emitted from vehicles can be a threat to human health, as it may bring on respiratory infections.
4. **Availability of renewables:** Energy obtained from solar radiation and wind is always available in the islands of Vanuatu. But it costs money to buy and maintain the necessary equipment. Running water is available for conversion to hydro-power on many of Vanuatu's islands. Geothermal power can be obtained from hot springs on islands such as Efate, Tanna and Ambae. Coconuts grow everywhere and can be a source of biofuel.

2.2 Steps being taken by the Vanuatu Government to promote the mitigation of GHG emissions and adaptation to climate change

The Vanuatu Government realizes the need to move away from using expensive imported fuels and the importance of reducing GHG emissions. So it is active in global forums and agreements to promote GHG mitigation and adaptation to climate change. It is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC). It wrote its initial National Communication to the UNFCCC in October 1999 and prepared the National Adaptation Program of Action in 2007 (Vanuatu Red Cross, 2013).

An important step towards the mitigation of Vanuatu's GHG emissions was taken by the Government in June 2013, when the Council of Ministers passed the National Energy Road Map. The Road Map was officially launched by the Prime Minister on 10th April 2014. Its target is to **diversify** the sources of energy used in Vanuatu, so as to increase the share of **renewables** in power generation to 40% by 2015 and 65% by 2020 (IRENA, 2013).

Because of its commitment to mitigation and adaptation, the Vanuatu Government has created a multi-sectoral body called the National Advisory Board on Climate Change and Disaster Risk Reduction (NAB). The NAB is a committee made up of government and non-government members. It promotes national action on climate change and disaster risk reduction, and is involved in negotiations at an international level.

Another indication of the Government's desire to promote mitigation and adaptation was the decision in April 2013 to create a new ministry to deal with climate change issues. The Ministry for Climate Change, together with NAB, has the task of coordinating all government and non-government initiatives addressing climate change and disaster risk reduction in Vanuatu (The REDD Desk, 2014).

Fig. 12

Vanuatu opens new climate change ministry

9 July 2013, Nadi, Fiji –

Pacific Island countries can learn from the Vanuatu experience, in terms of mainstreaming efforts to deal with climate change hazards. Vanuatu has created a new ministry to deal with climate change to see how best to respond climate anomalies.



Minister for Climate Change Adaptation, Meteorology, Geo-Hazards, Environment, Energy and Disaster Management, Thomas Laken says this is important for Vanuatu, because it is listed as among the most high risk Pacific Island countries to natural disasters.

He says the creation of the Ministry by the new Vanuatu government was timely as they need to mainstream their efforts to address climate change and disaster risk management.

Secretariat of the Pacific Regional Environment Programme

SPREP, 2013

2.3 Mitigation measures in Vanuatu must also focus on forest conservation

In Sections 1.1 and 2.1, we saw that the mitigation of climate change refers to the way that we must lower the levels of greenhouse gases in the atmosphere. This can be done in two ways:

- Reducing GHG emissions by switching from fossil fuels to renewable sources of energy. Less carbon dioxide and other greenhouse gases will be put into the atmosphere by industries, power stations, aircraft, ships and vehicles.
- Improving and increasing the planet’s carbon sinks. A carbon sink is a natural or artificial reservoir that takes up and stores carbon. Trees, plants, oceans, rocks and soils are natural carbon sinks. Landfills are artificial sinks.

Here in Vanuatu, our islands are naturally covered in tropical rain forest, which is a very important carbon sink. Trees and other plants in the forests absorb carbon dioxide from the atmosphere and store it until they are cut down and burnt.

On a world scale, Vanuatu’s carbon emissions from industries, power stations and means of transport are extremely small, and we can do little to influence the overall quantity of GHGs put into the atmosphere. But what we can do is to avoid cutting down our forests and to replant trees as much as we can. This contributes towards improving global carbon sinks. It also contributes towards a sustainable lifestyle for everyone living in our islands. More details will be given in section 3.5.



Now please
complete
Activities **2.1a**,
2.1b, **2.1c**, **2.2**
and **2.3**
in your Learner
Workbook

My Notes:

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Concepts	I understand this concept	Questions that I would still like to ask
2.1 Advantages for communities in Vanuatu of switching from fossil fuels to renewable sources of energy.		
2.2 Steps being taken by the Vanuatu Government to promote the mitigation of GHG emissions and adaptation to climate change.		
2.3 In Vanuatu, mitigation of climate change must also be done through forest conservation.		

Section 3

Illustrate mitigation measures that can be taken by individuals and communities in Vanuatu

After completing this section, you should be able to:

- 3.1 identify examples of the use of renewable sources of energy in Vanuatu;**
- 3.2 state some strategies for the more efficient use of electricity;**
- 3.3 justify the importance of separating and recycling waste, and the benefits of garden composting and mulching;**
- 3.4 justify the need to walk, cycle and canoe instead of using motorized forms of transport;**
- 3.5 explain why it is important to plant and replant more trees and how this impacts on atmospheric GHG concentrations;**
- 3.6 discuss the different roles played by women and men in the mitigation of climate change.**

3.1 Using renewable sources of energy in Vanuatu

As you saw in Section 2.1, renewable sources of energy are becoming more and more important in Vanuatu, although we are still very dependent on imported oil.

Examples of the use of renewable energy in Vanuatu

- UNELCO (Union Électrique du Vanuatu Limited) and VUI (Vanuatu Utility Infrastructure) are the two companies generating electricity for the urban areas of Vanuatu. Of the total electricity they produced in January 2013, 30% came from renewable sources - running water, solar power, wind and biofuel.
- UNELCO's power plants at Lakatoro, Malakula, and Tagabe, Efate, are now generating 10% of all electricity from biofuel - coconut oil mixed with diesel fuel - and this percentage is expected to rise. The combustion of coconut oil does not emit as much CO₂ as comes from the combustion of petroleum.



Fig. 13:

Coconuts waiting to be processed into coconut oil. The coconut oil is then mixed with diesel fuel to make biofuel.

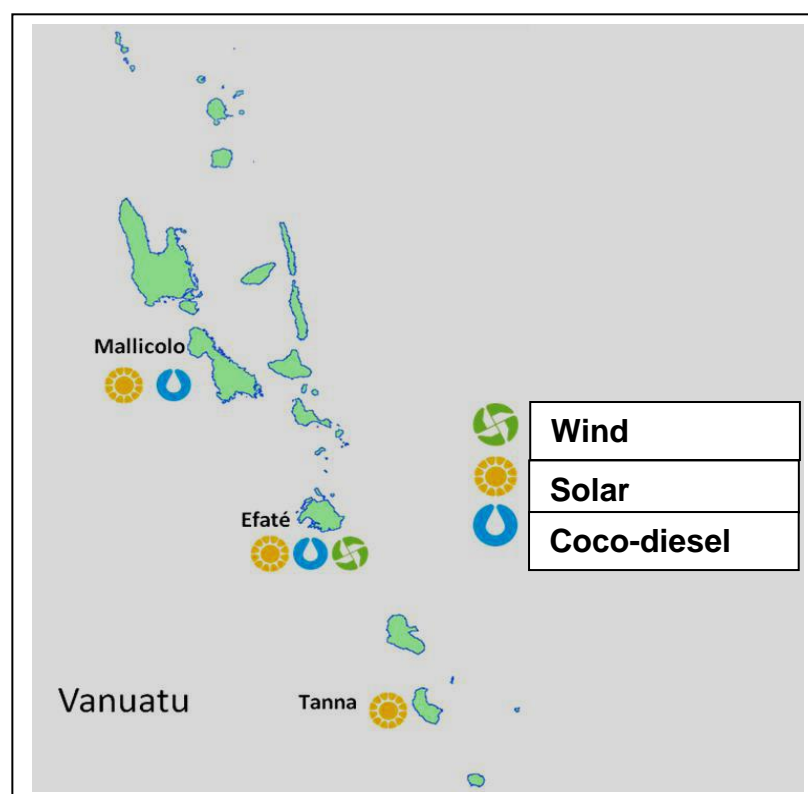


Pierce, C., 2014



Fig. 14

UNELCO's electricity production from renewable sources in 2013



UNELCO, 2013

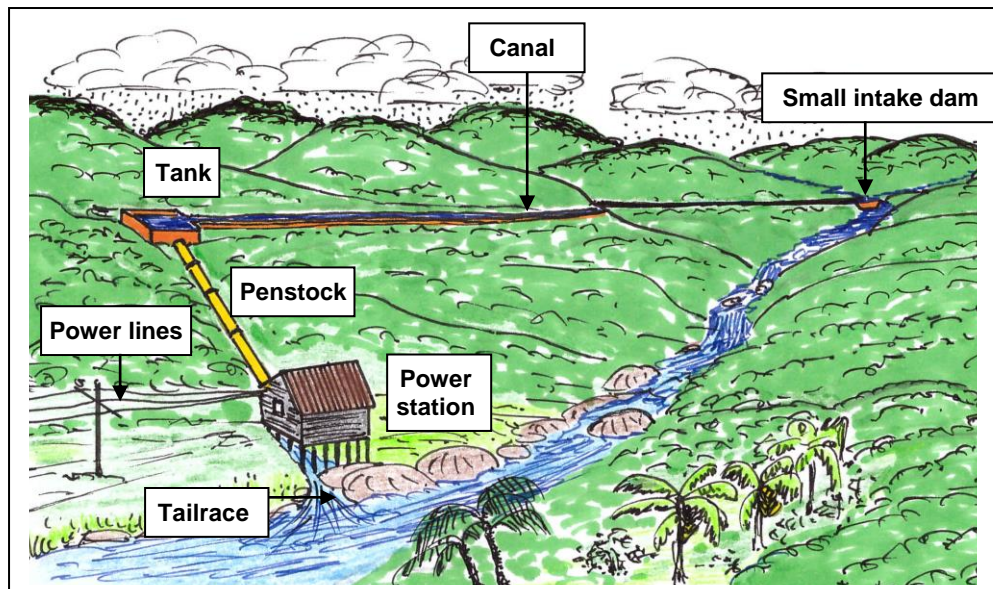
- Projects run by the Vanuatu Renewable Energy and Power Association (VANREPA), an NGO that is installing power systems in 5 secondary and 20 primary schools using wind, solar and micro-hydro technologies, e.g. wind-operated turbines at Eles School, Nguna, and Vulumanu School, Pentecost.
- A solar energy plant at Fareavau, Nguna, installed by UNELCO.
- The Talise micro-hydro project serving three villages on Maewo, with the assistance of the International Union for Conservation of Nature (IUCN).
- The installation of wind turbines at dispensaries and schools on Futuna and Aneityum, funded by the European Union and the African, Caribbean and Pacific group of states (EU-ACP) under the Pacific Islands Greenhouse Gas Abatement through Renewable Energy Project (PIGGAREP) run by the Secretariat of the Pacific Regional Environment Programme (SPREP).

- Biofuel projects using locally-produced coconut oil in villages in north-east Malakula (4), Ambae (3), and Vanua Lava (2), funded by UNELCO and the EU-ACP - also under PIGGAREP.
- Two biogas projects on Efate, at Bouffa and Epau.

Using renewable forms of energy in rural areas

Micro-hydro projects can be set up along small streams. Water from the stream is led to a point where it can fall down a pipe (called a penstock) to a small power station below. The force of the falling water turns a large wheel, called a turbine, which then converts this energy into electricity using a generator. The power is only enough to meet the demands of a small village for lighting, cooking and possibly refrigeration. People in the village learn how to install, maintain and repair the system. There is no pollution, but a micro-hydro scheme is costly to establish, and most communities in Vanuatu would need to have external funding to set one up. Hydro-power can also have negative effects on wildlife habitats and biodiversity.

Fig. 15:
Features of a micro-hydro project



Pierce, C., 2014

Biomass is wood or other vegetable matter that can be burnt to provide heat for cooking. It is the traditional source of energy in Vanuatu, and is cheap. But with increasing deforestation, sources of firewood are gradually decreasing, especially for people living in urban areas, who must now buy their firewood from the market. Some rural communities are now planting fast-growing cassis trees in order to obtain firewood.

Biogas comes from animal wastes. The decomposition of the wastes releases methane, which can be led to small gas stoves for domestic cooking. In Vanuatu, biogas is already being obtained from pig dung at an experimental site at Bouffa, Efate, operated by SPC-GIZ, and from cow dung at Epau, Efate, under a project funded by Japan. The Department of Livestock launched a huge expansion of biogas projects in all six Provinces in October 2014, funded by the European Union.

Biofuels are natural plant materials that are processed to make liquids such as alcohol and coconut oil. In Vanuatu, coconut oil is already being used on Efate and Malakula as a source of energy. Coconuts do not have to travel long distances before they are transformed into energy, unlike imported petroleum, so transport costs are low. GHG emissions from burning coconut oil are much less than for fossil fuels, but three hectares of coconut plantations are needed to produce the same energy as the amount that comes from one fuel truck (IUCN, 2012). Coconuts are of course renewable, but if they are used for fuel, there are fewer for domestic use and for export. Also, if people put more of their land under coconuts, they often have to grow their food crops on steep, unsuitable land.

Wind turbines need to be set up in open areas, so that they can receive the maximum amount of wind. If there is no wind, there is no power! They work best when the winds are constant, but are easily damaged during a cyclone. There is no waste and no air pollution. However, there is an initial cost for setting up the turbine.

Fig. 16: Small wind turbine



Fig. 17: Solar panel



Solar panels (photovoltaic cells) use the free energy that comes from the sun. However, they need to be in direct sunlight and do not function properly when the sky is covered in cloud. They are safe, make no noise and do not emit any greenhouse gases. They enable village people to have lighting and to use appliances such as refrigerators, radios and DVD players. But they need to be carefully maintained, are costly to repair, and the batteries that are used can contaminate the environment.

Now you should think about all these forms of renewable energy.

- What are their advantages and disadvantages?
- Which are the best for rural areas in Vanuatu?

3.2 Ways in which electricity can be used more efficiently

You have seen that at present, it is expensive to use electricity in Vanuatu. People in the towns have high electricity bills. Village people have to pay high prices for fuel for their generators, and high prices for solar panels and wind turbines.

There are two ways of reducing these costs - saving electricity and using more **efficient** electrical appliances. Saving electricity refers to actions like switching off electrical appliances when we are not using them. Efficient electrical appliances are those that require less energy but give the same outcome. In both cases, we stop wasting electricity. If the electricity comes from imported petroleum this will not only cut costs, but contribute towards the reduction of CO₂ emissions.

Here are some of the ways in which we can reduce our electricity consumption:

- Use energy-efficient light bulbs (Fig. 18).
 - Turn off electrical appliances (DVD players, radios, lap-tops, lights, etc.,) when not in use.
 - Clean filters on generators, boat engines, etc.
 - Avoid using electric jugs, hair driers, irons and fans, because they consume a lot of electricity.
 - Always look for the **energy rating** on a new appliance, such as a refrigerator. The more red stars it has, the greater the efficiency.
 - If you are using a refrigerator, make sure the thermostat setting is correct, don't put food and liquid in the refrigerator while they are still hot, keep the door closed, check that the door closes properly, do regular de-frosting, etc.
- (SOPAC, 2001 and SOPAC, 2008)

Fig. 18



Pierce, C., 2014



Now please complete Activities 3.1a, 3.1b and 3.2 in your Learner Workbook

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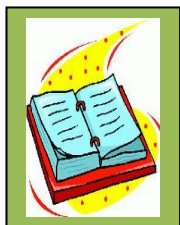
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Concepts	I understand this concept	Questions that I would still like to ask
3.1 Examples of the use of renewable sources of energy in Vanuatu. 3.2 Ways in which electricity can be used more efficiently.		

3.3 Recycling, composting and mulching

In 3.2, we saw how the use of renewable sources of energy can contribute towards greenhouse gas mitigation. Now we will consider how the recycling of non-biodegradable materials and the use of mulching and composting is also very important in slowing down greenhouse gas emissions.



Recycling means to treat or process used or waste materials so that they can be used again. It usually refers to the way that **non-biodegradable materials** like metals, glass and plastic are collected up, melted down and made into new articles. It also includes the way that paper and other biodegradable materials are reused. Before recycling can take place, household and industrial waste must be separated into different categories.



Recycling is only one way of dealing with our waste. We should be thinking in terms of these actions:

“REFUSE, REUSE, REDUCE AND RECYCLE”

Discuss the meaning of these actions with your facilitator!

Composting means making a fertilizer from rotting plants. It is cheap and easy to make. Vegetable waste such as leaves, grass, rotten vegetables and fruit, sawdust and egg shells is left in a pile or a container to decay, and is broken down by bacteria. It is best if the waste is put down in layers of different types of vegetable matter. Meat should not be used. Compost is a natural fertilizer and does not contaminate the ground in the way that chemical fertilizers do.

Mulching means to spread a layer of natural rotting vegetation, usually leaves, twigs and wood chippings, around crops or flowers to help them to grow. Mulch is like the leaf litter on a forest floor. It is full of microbes and insects that benefit plant growth. Mulching enriches the soil with nutrients, enables the soil to retain its moisture in times of drought, and prevents the growth of weeds.



Fig. 19

Mulching of taro plants in a food garden in Hawaii.



PermablitzHI, 2012

So how do the separation of waste, recycling, reusing, refusing, composting and mulching contribute towards the mitigation of greenhouse gas emissions, as well as being important ways of adapting to climate change?

Think about the following:

- If household waste can be separated into different categories, then recycling is easy. The different materials can be collected up separately and stored in different containers ready for recycling. Some of the main categories of waste are: aluminium cans or tins; iron and steel; batteries; plastic; glass; paper, cardboard and wood; and green or vegetable waste. If the waste is not sorted out and all put together in a garbage tip or a landfill, then rotting waste will emit methane - a greenhouse gas. But if separation is carried out, the vegetable waste can be used as compost, the paper and cardboard can be recycled into new paper, and so on.



Fig. 20

Separation of household waste in the Cook Islands, ready for recycling



© E. Richards / SPREP, 2011

- Recycling, reducing, reusing and refusing **conserve** energy. They reduce the amount of new glass, paper, metals and other materials that have to be manufactured in factories. Manufacturing requires energy made from fossil fuels. Less manufacturing should lead to a reduction in the emissions of GHGs.
- Recycling conserves natural resources of wood and fresh water. If old newspapers, waste paper and cardboard are recycled, this reduces the need to cut down trees for making paper. There are therefore more trees available to absorb carbon dioxide and to transfer water vapour into the atmosphere.
- Composting and mulching reduce the need to manufacture artificial fertilizers, and at the same time they increase our agricultural productivity. Making chemical fertilizers consumes a lot of energy, usually obtained from fossil fuels. Also, when chemical fertilizers are applied to the soil, large amounts of nitrous oxide (N₂O) - another greenhouse gas - are released into the atmosphere.

- Composting and mulching make use of natural vegetable matter that is freely available and costs nothing. Their use does not increase the emissions of greenhouse gases. But if this natural vegetable matter is simply burnt, then its usefulness as a fertilizer is lost, and the CO₂ it contains is given off more quickly.

Fig. 21

**Preparation
of compost**



Morgan, B., 2014

3.4 Walking, cycling and using canoes

Today, many people in the islands have access to modern methods of transport such as trucks, buses, inter-island cargo ships, speedboats and aircraft - all of which depend on fossil fuels and add to greenhouse gas emissions. Electric cars and vehicles that run on solar power are being developed in other parts of the world, but have not yet reached Vanuatu, and anyway, would be far too expensive for people to purchase.

So if we want to contribute to a reduction in our carbon footprint, perhaps we should consider the following actions, even if we only do them from time to time:

- Walking to school or to work instead of using a bus or truck.
- Using a bicycle to travel from place to place.
- Using a canoe, or a sailing canoe, to travel along the coast or between islands, instead of a speedboat.

Such methods of transport would also keep us more healthy.



Now please complete Activities 3.3 and 3.4 in your Learner Workbook

My Notes:

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Concepts	I understand this concept	Questions that I would still like to ask
<p>3.3 The importance of separating and recycling waste and the benefits of garden composting and mulching.</p> <p>3.4 Reduction of our carbon footprint through walking, cycling and using canoes instead of using trucks, buses and speedboats.</p>		

3.5 Planting more trees

Although 70% of Vanuatu is still covered in forest, deforestation is occurring at a steady rate because of logging projects, the need to make gardens and the expansion of settlements.

But forests are **carbon sinks** for greenhouse gases. In other words, trees absorb carbon dioxide from the atmosphere through the process of photosynthesis (Fig. 22), and then store the carbon.

Therefore communities in Vanuatu must try to manage and conserve their forests, using traditional and modern methods. They should also carry out agroforestry and reafforestation.

Such actions will contribute towards the mitigation of GHG emissions.

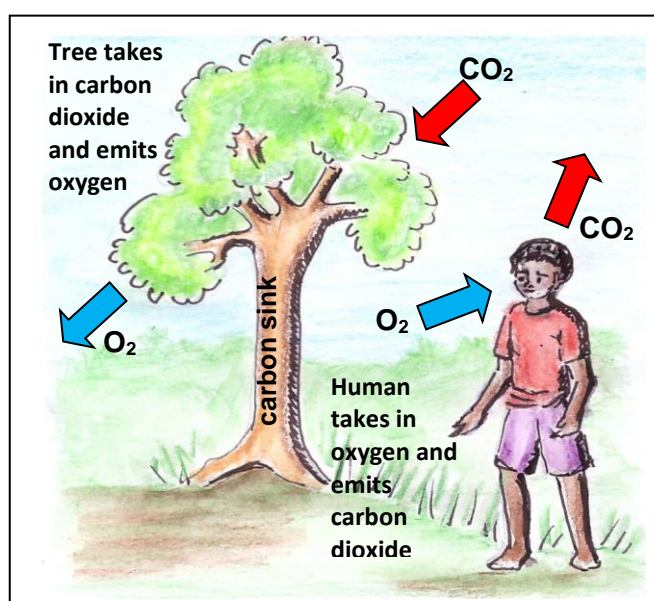


Fig. 22

Morgan, B. and Pierce, C., 2014

Forest conservation

A well-known example of **forest conservation** in Vanuatu is the Vathe Conservation area in Espiritu Santo, which covers 2,276 hectares of lowland rain forest at the southern end of Big Bay. It was declared as a protected area in 1994.



Fig. 23

**Vathe
Conservation
Area, Santo**



Donna Kalfatak, 2010

Reafforestation and forest management

Since 2005, the United Nations Framework Convention on Climate Change (UNFCCC) has encouraged nations such as Vanuatu to adopt the REDD + scheme. REDD stands for “Reducing emissions from deforestation and forest degradation”. The aim is to mitigate climate change through forest conservation and better forest management in developing countries. According to the UN-REDD programme, deforestation and forest degradation account for about 20% of all global emissions of carbon dioxide - more than the entire global transportation sector - and mitigating the impacts of climate change will be impossible to achieve without reducing emissions from the forest sector (UN REDD, 2009). Clearing and burning of forest puts carbon dioxide into the atmosphere. It also means that there are fewer trees to serve as carbon sinks for all the extra CO₂ emissions from human activities.

Vanuatu has had its own national REDD + programme since 2007. Under the National REDD+ Scheme, Vanuatu can access funds to the value of US\$ 3.6 million from the World Bank’s Readiness Fund (The REDD Desk, 2013). If a province or an island can show that it is maintaining or increasing its forest carbon stocks, then it can receive funding from REDD+. The money can be used for investment into sustainable ways of using the land. The Department of Forests (DOF) and the Vanuatu Meteorological and Geohazards Department (VMGD) are the main government agencies involved. Other important stakeholders are the Food and Agricultural Organization (FAO), the Secretariat of the Pacific Community and Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (SPC-GIZ), and Live and Learn Environmental Education.

Two examples of reafforestation and **sustainable** forest management in Vanuatu are as follows:



- Under the REDD+ scheme, a community-based pilot project is being carried out by Live and Learn Environmental Education and Carbon Partnership, Ltd. on a 400 hectare plot at Loru, in Eastern Santo. The project runs from 2011 to 2016 and is funded by the European Union and the Asian Development Bank. The aim is to provide benefits for local people who depend on the forest ecosystem, and at the same time reduce GHG emissions through better conservation and management of the forest. Trees are being replanted, and agroforestry (forest planting combined with cultivation of food crops and Canarium nuts) is taking place. Advantages include the conservation of biodiversity, the use of non-timber forest products, and better community resilience to climate change.



- There are several pilot forestry projects on Efate, funded by the European Union (EU)/ University of the South Pacific (USP)/ Global Climate Change Alliance (GCCA) project, as well as by the Coping with Climate Change in the Pacific Region (CCCPIR) project run by SPC/GIZ. They include sites on Moso and Pele islands. These are not REDD+ activities but are being developed as strategies for adaptation to climate change rather than for the mitigation of GHG emissions. (Further information will be provided in Section 6.2 of this Unit.)

Fig. 24: Forestry planting on Moso island, North Efate



EU/USP/GCCA, 2013

Usefulness of forest products

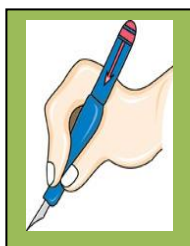
We should note here that forests provide us with an enormous range of products. Branches, trunks and leaves can be used for building construction. Furniture can be made from bamboo and other timber. Tree ferns are carved into tamtams. Other products include firewood, charcoal, nuts, fruit, medicinal plants, and bush ropes. Can you think of any more uses?

3.6 Roles of men and women in the mitigation of climate change

Are women and men equally involved in the mitigation of greenhouse gas emissions, or do they have different roles?

Discuss the following questions with your fellow-learners, and then carry out activity 3.6:

- In your local area, who are more likely to want to conserve the forests - men or women? Why?
- Which forest products are usually collected or obtained by women, and which by men? Does this influence the way that men and women think about forests?
- Who are more likely to consume more fossil fuels in vehicles and speedboats - men or women? Why?
- How do women's activities in gardening help them to mitigate GHG emissions?
- Because it is usually the woman's role to feed and care for the family, does this make women want to get involved in any activities that might mitigate climate change and reduce the negative effects of hazards and climate change?
- Who should take the lead in trying to use renewable forms of energy in rural areas - men or women? Why?



Now please complete Activities 3.5a, 3.5b and 3.6 in your Learner Workbook

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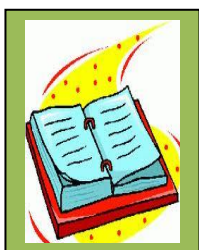
Concepts	I understand this concept	Questions that I would still like to ask
3.5 The importance of planting and replanting more trees, and how this impacts on atmospheric GHG content. Role of REDD+ in Vanuatu.		
3.6 Roles of men and women in the mitigation of climate change.		

Section 4 Differentiate between mitigation and adaptation

After completing this section, you should be able to:

- 4.1 make a distinction between the mitigation of greenhouse gases and climate change adaptation;
- 4.2 give an opinion on which should be of higher priority for local action by ni-Vanuatu - GHG mitigation or climate change adaptation.

4.1 Definitions



Mitigation of climate change: According to the Oxford Dictionary, mitigation means “the action of reducing the severity, seriousness or painfulness of something.” So the mitigation of climate change means the reduction, or the slowing down, of global warming. The UNFCCC says that the mitigation of climate change refers to actions that reduce the sources of greenhouse gases, or that increase the sinks of greenhouse gases.

Adaptation to climate change: According to the Oxford Dictionary, adaptation means “the process of change by which an organism or species becomes better suited to its environment”. So adaptation to climate change means the way in which people must **adjust** their ways of living in order to cope with warmer temperatures and other climatic changes. These changes in climate are going to affect the physical environment and human society, and therefore we must take steps to ensure that we can live **sustainably** in a different environment. The IPCC defines adaptation as “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” (IPCC, 2007)

So, in simple language, what is the difference between the two?

Perhaps we can say that mitigation of climate change means taking action to reduce the causes of climate change, and so slow it down.

On the other hand, adaptation means changing our life style to meet the demands of a warmer world, because climate change is already happening.

4.2 Which is more important - mitigation or adaptation ?

Both mitigation and adaptation are important.

Regarding mitigation, small Pacific island states such as Vanuatu contribute very little to world-wide greenhouse gas emissions, but individuals and communities can still take responsibility for reducing emissions and for increasing carbon sinks. This will not stop the process of global warming, but it will contribute towards slowing it down.

It is true that major steps to reduce GHG emissions will come from international agreements that involve all the major producers of carbon dioxide and methane - nations such as the USA, Canada, Australia, member nations of the European Union, Japan, and large countries such as Russia, China, Brazil and India. At these international meetings, an important contribution that Pacific island nations can make is to **advocate** for the world-wide reduction of emissions and the increase of carbon sinks. However, all individuals and communities can also take action to reduce emissions. We do not have to wait for others.

With adaptation, on the other hand, there is no question that climate change is happening, and that local communities in Vanuatu must take steps to prepare for its negative impacts - rising sea levels, loss of biodiversity, less food security, lack of fresh water, greater damage from storms, and so on. Pacific communities have thousands of years of experience in adapting to environmental changes and extremes. We can adapt our behavior if conditions force us to do so.

There are many simple actions that we can do by ourselves at home or in our communities to reduce the difficulties that climate change is bringing and to make our living more sustainable. We can make plans to improve our ecosystems, our livelihoods and our social lives. So at this stage, perhaps adaptation is more important than mitigation.



Now please
complete
Activities 4.1a,
4.1b and 4.2
in your Learner
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Concepts	I understand this concept	Questions that I would still like to ask
4.1 Differences between the mitigation of climate change and adaptation to climate change.		
4.2 Opinion on which has higher priority for local action by ni-Vanuatu - GHG mitigation or climate change adaptation		

Section 5 Demonstrate the need for adaptation strategies

After completing this section, you should be able to:

- 5.1 provide evidence to show that climate change is inevitable;**
- 5.2 justify why communities in Vanuatu must adopt adaptation measures to prepare for the impacts of climate change.**

5.1 Why climate change is inevitable

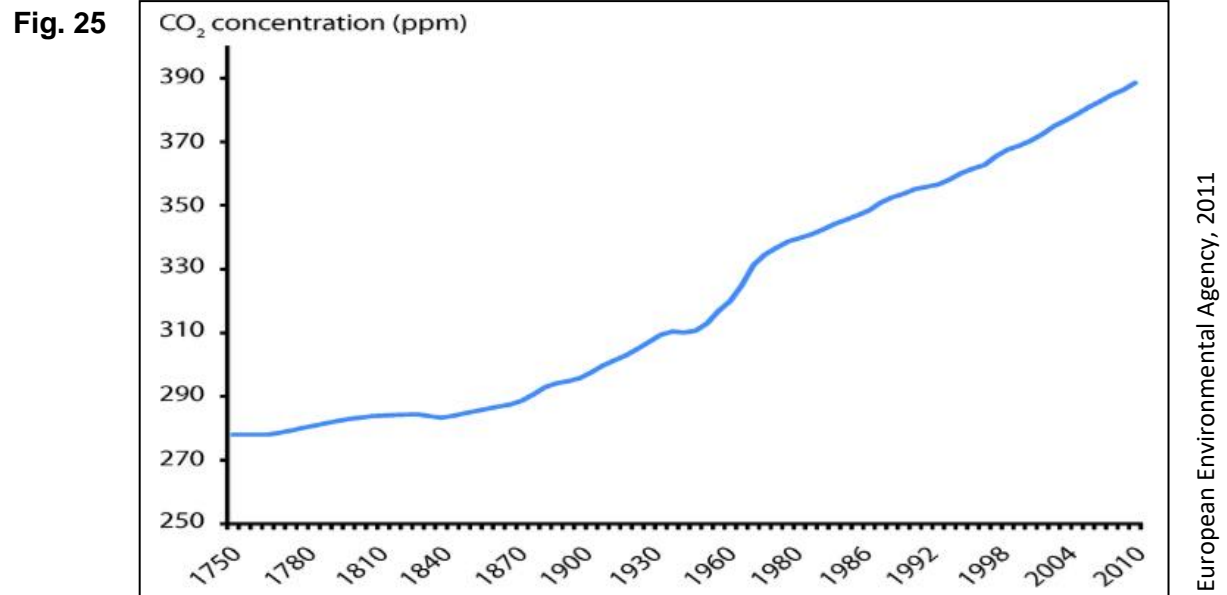
In Section 1, we saw that in 1992, the United Nations Framework Convention on Climate Change (UNFCCC) was established in order to work towards reducing the atmospheric concentration of greenhouse gases. However, it was only in December 2015 that all countries in the world were ready to sign a universal and legally binding agreement requiring them to gradually cut their GHG emissions.

This is a major reason why the atmospheric concentration of carbon dioxide and other greenhouse gases has continued to rise. There are other reasons too. Developing countries want to have more industries and they see that the easiest forms of energy to use are fossil fuels. Individuals want to have their own cars or motorcycles, and they want to travel by plane. More and more cheap goods are produced to satisfy people's wants, and this creates more pollution, and more waste. The need for **sustainable development** is often not considered.

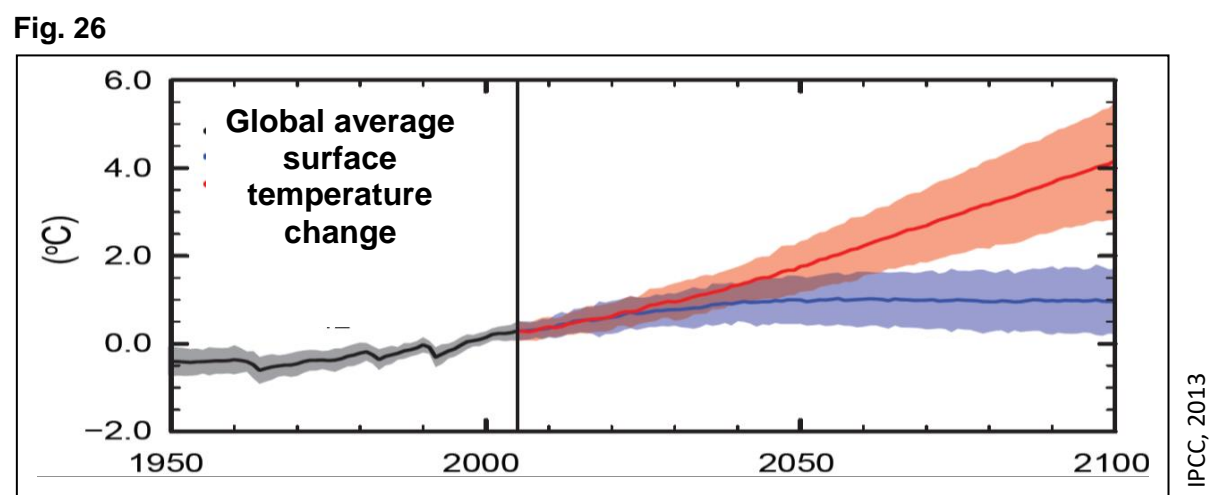
For these and other reasons, GHG emissions rise, and so do average world temperatures. The World Meteorological Organisation announced in November 2016 that the five years from 2011 to 2015 were the warmest ever recorded, and that 2016 is expected to be the hottest year since meteorological records were first collected. The WMO points out that the average world temperature in 2015 is already 1°C above pre-industrial levels (BBC News, 8 November 2016)!

To demonstrate the increase in GHG emissions and average world temperatures, please look at the following graphs.

The first one (Fig. 25) shows how the concentration of carbon dioxide in the atmosphere increased between 1750 and 2010:



The second graph (Fig. 26) was produced by the Intergovernmental Panel on Climate Change (IPCC) in 2013. It shows how average temperatures (land and sea combined) have increased between 1950 and 2005 (black line). The red line shows how they will continue to rise if humans do not change the quantity of greenhouse gases they are putting into the atmosphere. The blue line shows what will happen if we manage to reduce our emissions of greenhouse gases.

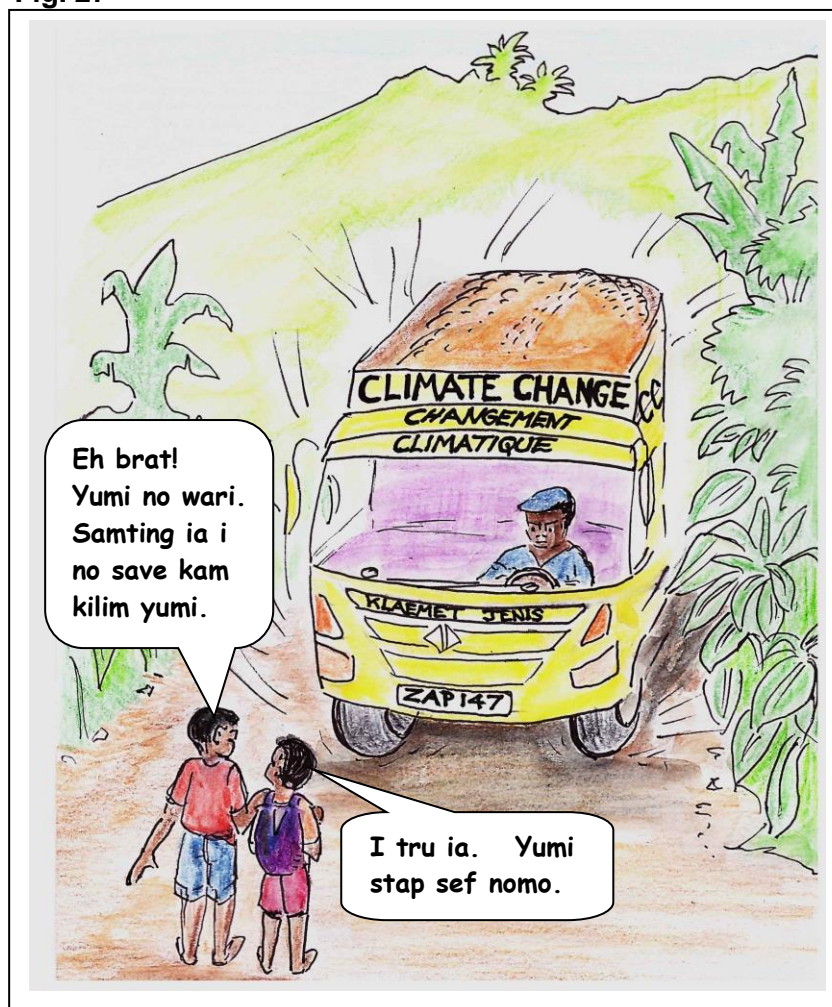


It is generally agreed by climate scientists that a rise of over 2°C in the Earth's average surface temperature will have dangerous consequences. As you can see from the graph, we are likely to see a rise of as much as 4°C by the year 2100 if GHG emissions are not reduced.

One problem is that there are politicians, government leaders and directors of industry in a number of nations who say that climate change is not happening, and that their national economies will suffer if they have to take measures to reduce GHG emissions. Look at this cartoon (Fig. 27):

Another problem is that although world leaders reached a historic agreement in Paris in December 2015 to reduce GHG emissions, this agreement still has to be actually followed in practice by all nations, particularly those that are the greatest emitters of greenhouse gases.

Fig. 27



Morgan, B. & Pierce, C., 2014

For all these reasons, we can say that global warming and climate change are **inevitable**, in other words, they are happening now and will continue to happen. We cannot stop them. Even if we manage to reduce global GHG emissions, the IPCC says that the effects of global warming and climate change will continue long after 2100:

"Most aspects of climate change will persist for many centuries even if emissions of CO₂ are stopped." (IPCC, 2013)

5.2 Why communities in Vanuatu must adopt adaptation measures

The coastal populations of Vanuatu are very **vulnerable** to the negative impacts of climate change. In particular, communities are likely to suffer from the following:

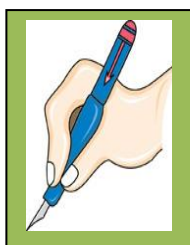
- More floods
- Very hot days
- Sea level rise
- Coastal erosion

- Landslides
- Ocean acidification
- Droughts
- Loss of fresh water supplies
- Destruction of ecosystems
- Destruction of property
- Injuries and loss of life
- Loss of food security
- Loss of livelihoods
- Out-migration
- Stress
- Other impacts

Vulnerability to these impacts will vary from community to community and from person to person. The most vulnerable are likely to be women, children, elderly people, people living with disabilities, and those who are poor.

Thus communities in Vanuatu must start to prepare for these impacts and to adjust their life styles in order to become more **resilient**.

This preparation for the future is called adaptation to climate change and disaster risk reduction!



Now please
complete
Activity 5.1 in
your Learner
Workbook

My Notes:

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Concept	I understand this concept	Questions that I would still like to ask
5.1 et 5.2 Mitigation measures have not been universally adopted in all countries, and climatic statistics show a continuation of global warming. Thus climate change is inevitable, and communities in Vanuatu must prepare for its impacts.		

Section 6 Illustrate appropriate adaptation measures

After completing this section, you should be able to:

- 6.1 identify and demonstrate adaptation techniques being implemented by various government, civil society and development organizations;**
- 6.2 justify the importance of agroforestry;**
- 6.3 identify and demonstrate traditional and modern methods of food preservation that can provide food security;**
- 6.4 identify ways of protecting coral reefs, sea grass beds and mangrove ecosystems;**
- 6.5 demonstrate the advantages of establishing a community conservation area;**
- 6.6 identify measures for ensuring household water security;**
- 6.7 give reasons why some settlements in Vanuatu may need to be relocated;**
- 6.8 discuss other aspects of adaptation.**

6.1 Some adaptation techniques being implemented by government departments, civil society and development organizations

Summary

In Vanuatu, a number of government departments are working on projects to help people and communities to adapt to climate change - for example, the National Advisory Board on Climate Change and Disaster Risk Reduction (NAB), the Vanuatu Meteorological and Geohazards Department (VMGD), the Departments of Agriculture and Rural Development (DARD), Livestock, Forestry and Fisheries; the Department of Environmental Protection and Conservation; the Department of Energy; the Vanuatu Agricultural Research and Training Centre (VARTC).

Non-government organizations are also very active - for example, Live and Learn Environmental Education, Oxfam, Save the Children Australia, Care International, Red Cross, Wan Smol Bag, International Union for the Conservation of Nature (IUCN).

Overseas agencies, working in partnership with government and non-government bodies, are making a significant contribution, especially in terms of funding.

Some examples are the United Nations Development Programme, the European Union, the Global Climate Change Alliance, the World Bank, the Asian Development Bank, the Food and Agricultural Organisation, and the governments and government agencies of the USA, Australia, New Zealand, Germany and Japan. There are also regional organizations such as the Secretariat of the Pacific Community (SPC), the Secretariat of the Pacific Regional Environment Programme (SPREP), The International Renewable Energy Agency (IRENA), and the University of the South Pacific (USP).

Examples of adaptation measures that are suitable for local communities are:

- Breeding varieties of crops and animals that are better adapted to droughts, floods, salty water, salt spray, pests and diseases, etc.
- Planting different varieties of crop with different fruiting and harvesting seasons, so that not all crops are damaged by a hazard at the same time.
- Reducing coastal and soil erosion by planting trees and vetiver grass.
- Sustainable forest management and agroforestry.
- Food preservation techniques.
- Protection of coral reefs, sea-grass meadows and mangroves.
- Community conservation areas and marine reserves.
- Non-destructive fishing techniques.
- Helping households to have better water security.
- Relocation of buildings and settlements.
- Promotion of solar power, wind power, biogas and other renewables.

Breeding varieties of crops and animals that are better adapted to droughts, floods, salty water, salt spray, pests and diseases, etc.

- Yam planting using yam vines as well as the normal tubers. This can be done with yam species such as soft yam, wild yam and Wailu. When yams can be grown from vines alone, a farmer can quickly replant an entire yam garden if it is destroyed by climate change impacts such as floods, cyclones, landslides, pests and diseases. Approximately 3-5 months after a tuber has been planted, the main vine will have a number of side shoots. These side shoots can be carefully cut off from the main vine, placed in a plastic bag and then transferred to a nursery. The nursery must be shaded.

Cuttings are grown in small plastic cups, surrounded by carbonized husks burnt from leftover rice, coffee shells, coconut shells and sawdust. After 2-4 weeks, the cuttings can be transplanted into the garden (Fig. 28). In this way, one yam tuber can yield many more yams than would otherwise be possible.

(NAB/VMGD, 2013, *Training Series # 1*)

Fig. 28



Tari Molisale, 2013

- Yam minisett technique. This means cutting up a yam tuber into small pieces (Fig. 29) and then planting the pieces in a nursery. Before planting, the pieces are coated with fire ashes to prevent the growth of fungus, then left to dry for 1-2 days. Following this, the pieces or minisettts are grown for 3-5 weeks in a nursery, with daily watering.

The minisett seedlings are then planted in the garden 30 cm apart. This technique can be used with soft yam, strong yam, wild yam and Wailu. It means that many yams can be produced from just one yam. This helps a farmer to cope with loss of yams due to the effects of climate change. Also, the coating of fire ashes protects the yams against pests such as fungi. (NAB/VMGD, 2013, *Training Series # 2*)

Fig. 29



Tari Molisale, 2013

- Taro breeding technique. The purpose is to cross-breed varieties of taro that are more adapted to droughts and floods, are resistant to pests and diseases, and are more nutritious. Varieties such as island taro, Fiji taro and giant taro are used. Healthy plants are prepared for artificial pollination by removing the male part of the taro flowers and hand-pollinating the female part using pollen from a male flower of a different variety. The plant grows and produces fruits. Each fruit will carry more than one thousand seeds, which are then planted in pots and grown in a nursery. Each one of the thousand seeds will produce a slightly different kind of taro, and some of these will probably be better adapted to climate change. If we plant taro using a shoot in the normal way, each taro plant is the same, and all will suffer in the same way from climate change. After 2-3 weeks, the seedlings can be planted in the garden. (NAB/VMGD, 2013, *Training Series # 3*)

Fig. 30:

Taro field after transplanting



Tari Molisale, 2013

- **Banana multiplication technique.** This is a way of obtaining several banana suckers from one healthy stem. The technique was first developed in Samoa and is called the Samoan Laufasi Technique. The stem root is cut into small pieces of 5cm by 5cm square, and then each piece is placed into a 10 cm hole and covered with soil. After a few weeks, suckers will emerge. They are carefully removed and planted in plantations. This is a very useful strategy because bananas are easily damaged by cyclones, and the multiplication techniques enables a lot of food to be grown in a short time (SPC/GIZ CCCPIR pamphlet, 2013)
- **Pig breeding.** The SPC/GIZ CCCPIR project has a site on Pele island, North Efate, where pig **husbandry** trials are conducted (Fig. 31). The aim is to develop a system that enables pigs to adapt to climate change. This means having a compound that protects pigs from high temperatures, heavy rain and strong winds, and provides separate pens for farrowing (producing babies), breeding, growing and exercising. The compound includes a sales yard, a water tank, a storage and cooking unit, a chicken unit and a mixed root crop garden.



At the site, native breeds of pig are being cross-bred with **exotic** varieties such as the large white and the black and white spotted pig. The resulting **hybrid** (Fig. 32) combines the advantages of the exotic pig (large size, fast growth, many offspring) with the ability of the native pig to cope with a hot climate. (SPC/GIZ CCCPIR pamphlet, 2013)

Honey bee husbandry improvement

Honey bees are important to the people of Vanuatu as a source of food security and income (through sales of honey). They are also valuable pollinators of agricultural crops, and so if a farmer keeps honey bees close to his/her garden, this will help crop production when climate change brings warmer conditions and more extreme weather events. To enable honey bees to survive under warmer conditions, CCCPIR is conducting trials at its site on Pele island. It is testing new hive designs, breeding varieties that are resistant to disease, and finding out how to get bigger crop yields using bee pollination (SPC/GIZ CCCPIR pamphlet, 2013).

Reducing coastal erosion and soil erosion by planting trees and vetiver grass

There is already evidence of sea level rise in Vanuatu, and the Vanuatu Meteorological and Geohazards Department predicts that it could rise by between 20cm and 60cm by 2090. As sea levels rise, there will be more coastal erosion. One way of reducing this erosion is to plant more trees along the shoreline, so that their roots will hold the sand and soil (Fig. 33). Planting of mangrove seedlings (Fig. 34) or other coastal species is particularly effective.



Fig. 33:

**Native tree species
planted on the shore
at Piliura, Pele island**



SPC/GIZ CCCPIR, 2013



SPC/GIZ CCCPIR, 2013

Fig. 34:

**Planting mangrove
seedlings on Pentecost**

On sloping land, there is always the danger of soil erosion once the vegetation cover has been removed. In the worst cases, landslides can also occur. Climate change is already bringing more extreme weather events such as severe cyclones and storms, which will only increase risks of soil erosion on bare slopes.

One example of a project to combat soil erosion comes from Aneityum. In the 1970s, with the help of the New Zealand Aid Programme, 800 hectares of badly eroded land was reforested with pine seedlings. The pine forest has grown to maturity and regenerates itself. It is managed by the Aneityum Forest Timber Community Project, which allows selective logging to take place to provide income for the local community. Soil erosion has been greatly reduced, especially as the gullies that are too steep for tree planting have now been planted with vetiver grass. New Zealand Aid continues to support forestry in Vanuatu through training, as well as the establishment of community forestry nurseries on 12 islands, including Aneityum (NZ Aid Programme, 2012).

A very effective way of preventing soil erosion is to plant vetiver grass. This is a tropical grass that grows to a height of 1.5 metres. Its thick fibrous root system holds the soil and adds nutrients. Eventually, the soil can be used for gardening. Vetiver grass can be used for mulching, compost and roof thatch. It has already been planted successfully at Port Patrick and Anelgowhat on Aneityum (Fig. 35), and is being planted at sites at Teouma (Efate) (Fig. 36) and on Pele and Pentecost.



Fig. 35:

Planting of vetiver grass on Aneityum



SPZ/GIZ CCCPIR, 2013

Fig. 36: Planting of vetiver grass at Teouma



SPZ/GIZ CCCPIR, 2013

Backyard tilapia farming

One way of improving food security in the face of climate change is to encourage the breeding of tilapia fish in your own back yard. Tilapia is a freshwater fish native to Africa. When cooked, it has firm and delicious flesh, but it can also be converted into dried and salted fish. It can also reduce the number of mosquito larvae.

Tilapia can be raised in a 200-litre plastic drum kept close to the house (Fig. 37). A drum of this size can support 10 tilapia. The drum is filled with rain water, and fertilized weekly with leaves, manure and scraps to encourage the growth of algae for feeding the fish. Fish can be harvested 5 months after the drum is first stocked (SPC/GIZ CCCPIR, 2013, *Training Series # 0*).

Fig. 37: Raising tilapia fish in a 200 litre drum



SPC/GIZ CCCPIR, 2013

However, if tilapia escape into freshwater streams, they can become an invasive species, and in Kiribati, their use is banned. It is therefore recommended that you check with the Vanuatu Fisheries Department before you start using this technique in your area.

Soil improvement in rural areas

Several techniques are being used in Vanuatu to improve the soil, so enabling a farmer to cultivate his or her land for a longer period, with a much shorter period of fallow:

- Alley cropping: This is a form of agroforestry, but is mentioned here because of its positive impacts on soil fertility. Food crops such as taro and ginger are planted in narrow strips between rows of legume trees such as *Glyricidia* and *Erythrina*. The legume trees add nitrogen to the soil, making it more fertile (Live and Learn, 2011).

Fig. 38: Alley cropping - ginger planted between legume trees



Morgan, B., 2014

Fig. 39: Ground cover of lablab beans



Morgan, B., 2014

- Cover crops: After the main crop has been harvested from a plot, legumes such as glycine, mucuna and lablab (hyacinth bean) can be used to cover the ground. They protect the soil from heavy rain, and reduce water loss through evaporation. At the same time, they add nitrogen to the soil (Live and Learn, 2011).
- Crop rotation: Planting a different crop on the same plot of land after the first crop has been harvested. Crops such as peanuts are legumes that return nitrogen to the soil. Crop rotation prevents a build-up of pests and diseases in an area - a biological hazard that is being made worse by climate change.

Climate Change Resource Centre at Lume RTC

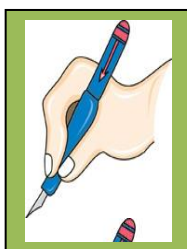
A recent initiative of the Vanuatu Rural Development Training Centres Association (VRDTCA) is the establishment of a climate change resource centre at Lume Rural Training Centre in Middle Bush, Tanna. Funded by Australia's Aid Programme, and with the technical support of Oxfam Vanuatu and SPC/GIZ CCCPIR, the new centre serves as a base for learning about adaptation to climate change and natural disasters. The cyclone-proof building was constructed by carpentry trainees at Lume RTC.

Fig. 40:

Lume RTC trainees painting the new climate change resource centre



VRDTCA, 2014



Now please complete Activities **6.1a** and **6.1b** in your Learner Workbook

My Notes:

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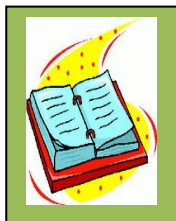
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Concepts	I understand this concept	Questions that I would still like to ask
6.1 Adaptation measures appropriate for Vanuatu - breeding varieties of crops and animals that are better adapted to drought, flooding, pests and diseases, etc.; honey bee husbandry improvement; reducing erosion by planting trees and vetiver grass; backyard tilapia farming; soil improvement in rural areas; climate change resource centre at Lume RTC.		

6.2 Agroforestry



Agroforestry can be defined as a way of combining forestry with agriculture. It is a method of growing trees with crops in such a manner that the trees help the crops to grow - by protecting them and providing them with nitrogen and other natural nutrients. It is a way of using the land that is healthy, productive and sustainable. Communities who practice agro-forestry become more resilient to climate change.

Here are some of the advantages of agroforestry:

- It restores soil fertility, and so enables better production of food crops. In this way food security is increased.
- It enables the farmer to harvest tree products such as fruits, nuts and oils.
- Trees such as “kasis” (*Leucaena leucocephala*) can be harvested for fuel wood, with new seedlings planted in their place.
- There is less soil erosion.
- The trees absorb carbon dioxide from the atmosphere and store carbon.
- There is no need to buy chemical or harmful fertilizers. Natural mulch is always available from the leaves and twigs of the trees.
- The trees provide shade for crops planted between them, reduce evaporation from the soil, help keep soils moist, and offer protection against floods and drought.
- The trees act as wind breaks to protect food crops from strong winds.
- The different crops that are grown help to improve human nutrition.
- There is space for growing medicinal and ornamental plants, as well as plants needed for construction, handicraft and traditional purposes.

In Vanuatu, the Departments of Forestry and Agriculture are encouraging farmers to adopt techniques of agroforestry as a way of adapting to climate change.

Some examples of agroforestry projects are as follows:



Fig. 41:

Alley cropping at the SPC/GIZ CCCPIR site at Teouma, Efate



SPC/GIZ CCCPIR, 2013

At the SPC/GIZ CCCPIR pilot site at Teouma, Efate, an alley cropping farming technique is being used to prevent wind and sun damage to vegetable crops and to hold soil moisture. *Glyricidia* trees are planted in strips, with vegetables in between (Fig. 40). The trees fertilize the vegetables with nitrogen and other nutrients.

Another example is the agroforestry demonstration farm being developed on the remote island of Ureparapara in the Banks Group, with the technical assistance of SPC and financial assistance from USAID. Farmers are learning how to design and manage a forestry nursery and produce seeds and seedlings. They will be able to improve food security, conserve biodiversity and gain a better livelihood from their land. Similar projects will be established all over Vanuatu. (SPC, 2014)

In agroforestry, trees that can be planted in Vanuatu include coconuts, nangai, breadfruit, pawpaw, citrus and legumes like *Glyricidia*. Crops include pumpkin, beans, kava, taro, manioc, ginger, cabbage, pineapple and sweet corn.

6.3 Techniques of food preservation

To become more resilient to hazards and climate change, there are several techniques of preserving foods so that they are available when normal sources are in short supply or have been damaged or destroyed. This can happen after cyclones, floods, tsunamis, outbreaks of pests and diseases, and long periods of droughts. Root crops and bananas are particularly vulnerable to such hazards.

Here are some examples:

- Traditional Futunese method of preserving bananas and breadfruit. A ripe head of bananas is selected from the garden, and then harvested. On the same day, the bananas are mashed into a pulp using a clam shell or spoon, then put into a dish. The pulp is then wrapped inside laplap leaves and placed in a local basket woven from coconut leaves. Holes in the basket allow liquid from the pulp to drain away. The banana mix is left to hang in this basket for 14 days, by which time it will be dry. Meanwhile a large hole is dug in the ground ready to receive the banana pulp. Before it is placed in the hole, the pulp is mixed with fresh water to ensure that it is free from smell and there is no longer any of the old banana water present. Coconut leaves are placed inside the hole in a special way, and covered in laplap leaves. The banana pulp is tipped on to the bed of leaves and then mixed with more water. Then more leaves are placed on top and covered again with stones. The banana pulp will now be preserved for 7 months, after which the coconut and laplap leaves must be replaced. If required, the banana can now be harvested. It will smell, but if mixed with coconut scrapings will taste like banana again. It can be roasted and eaten by the family. (SPC/GIZ CCCPIR manual, 2013)

- Preparing silage (pig food) from kumala. Silage is a nutritious pig food that can be stored for a long time and used after a cyclone or during a drought. It can be made by harvesting kumala from the garden and separating the tuber from the leaves. The kumala tubers are washed, dried in the sun, then cut into small pieces. Kumala leaves are dried separately and cut into pieces. When both are dry, but not too dry, they are mixed up together (Fig. 42) and salt is added. The mixture is put into a strong plastic bag that has been placed inside a bin. Care is taken that no air can enter the bag. When the bag is full, more salt is added, and then the bag is tightly closed. All this work must be done on the same day! The bin is kept in a safe place for three weeks until the silage is ready to be fed to the pigs. (SPC-GIZ CCCPIR manual, 2013)

Fig. 42



SPC-GIZ CCCPIR, 2013

- Drying of vegetables and fish. There are several traditional techniques for drying yams and fish in order to keep them for long periods. They can be left in the sun, or else smoke-dried. Perhaps you know about these techniques from your own island.

Another reason for preserving **perishable** foods is so that they can be sold to earn an income. One modern example is the solar fruit drying project on Pele island. The SPC-GIZ CCCPIR project, in close association with Charlot Long Wah of Kava Store in Port Vila, has trained village women to use a solar panel to power two fans that blow heated air around the inside of a drier. No batteries are needed. The programme encourages people to expand the planting of fruit and nuts in order to gain a small income that is sustainable. At the same time, food security is improved and greater resilience to climate change is being built.

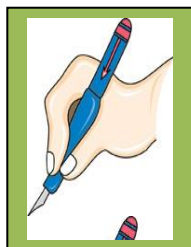


Fig. 43:

Dried fruit and nuts produced by village women from Pele



SPC/GIZ CCCPIR, 2013



Please complete
Activities 6.2a,
6.2b and 6.3 in
your Learner
Workbook

My Notes:

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Concepts	I understand this concept	Questions that I would still like to ask
6.2 The importance of agroforestry. 6.3 Food preservation techniques.		

6.4 Protecting coral reefs, sea grass and mangrove ecosystems

Fig. 44

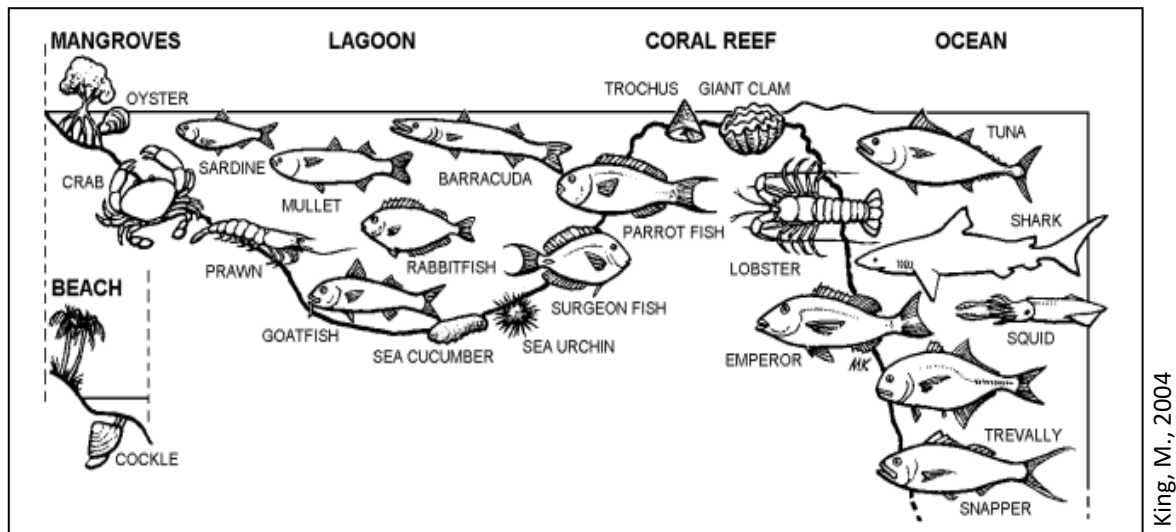


Jim E Maragos / Wikimedia Commons, 2013

Coral reefs and mangrove ecosystems are very important fishing grounds for coastal communities, and have rich **biodiversity**. They protect our coasts from storms and tsunamis.

Seagrass beds are important marine ecosystems in Vanuatu that provide habitats and breeding areas for fish and shellfish; they also trap sediments that can harm coral reefs and are an important sink for carbon dioxide and other GHGs.

Fig. 45: Some common marine species found near the shores of Pacific islands



But coral reefs, sea grass beds and mangroves all suffer from pollution and over-exploitation. Mangrove swamps are often used as rubbish dumps, and trees are cut down to make room for settlements and tourist resorts. Coral reefs are easily damaged by engine oil and harmful fishing methods. They are also very vulnerable to climate change, since polyps are likely to degrade as oceans become warmer and more acidic. Sea grass beds are being degraded by warmer sea temperatures and by human activities on land. Deforestation, for example, may lead to greater run-off and increased sediment in rivers and streams, which can smother the sea grass.

For these reasons, we must find ways of protecting our reefs, our sea grass beds and our mangroves. Protecting them is an adaptation measure that will help coastal communities to have better food security and to be more resilient to coastal erosion.

Here are some of the adaptation methods that can be used:

- Replant mangroves in areas where they have been removed.
- Conserve or plant trees along river banks and on slopes to reduce the amount of sediment that enters the river in times of flood. River mud kills coral reefs that lie close to a river's mouth.
- Plant trees and bushes along the coastline to reduce the amount of sediment entering the sea.
- Avoid using dynamite and other destructive fishing methods on coral reefs.
- Remove crown-of thorns starfish from reefs and change them into compost.
- Avoid dumping waste and sewage into rivers and the ocean
- Declare parts of a reef or mangrove ecosystem as taboo areas, where no fishing can be done during a certain season, or for several years.
- Avoid walking on fresh coral reef exposed at low tide
- Encourage people to find other sources of fish to reduce the pressure on coral reefs: backyard tilapia breeding, aquaculture in fresh water ponds and lakes.
- Decrease the pressure on coastal fisheries by using fish-aggregating devices (FADs).
- Coral gardening, or mariculture.

- Avoid using nets with a small mesh size.
- Only use fishing nets outside reefs and sea grass beds.

(SPC & GIZ, 2014, *Teacher's guide*)

In the waters around Nguna and Pele, North Efate, two of these strategies are being used - mariculture (Fig. 46) and fish-aggregating devices (Fig. 47):



Fig. 46



SPC/GIZ CCCPIR, 2014

CLIMATE CORAL GARDENING DAY

23 June 2014

Over 40 men, women, boys and girls attended a Climate Coral Gardening Day organized by the Nguna-Pele Marine and Land Protected Area Network today at Worasiviu village on Pele. After months of preparation, four specially-built coral beds were lowered into the water and put in place by scuba divers, and the first pieces of coral reef were planted.

Coral gardening (mariculture) is carried out by collecting small pieces of broken coral reef and re-attaching them to a solid surface. After many years, the pieces grow into full-sized coral colonies. In this way, reef can be planted in places where it has been destroyed by cyclones, crown of thorns starfish and other hazards. The Worasiviu community sees that visiting tourists can also take part in this activity.

The day was a great success. It was great to see the participation of Nguna-Pele girls, many of whom snorkelled for hours to collect fragments of coral for the new garden. By the end of the day, four new coral beds with over 40 coral colonies were planted. The beds are in about 6 metres of water - safe from cyclone swells, but shallow enough for tourists to interact and enjoy. "It's a great achievement for Nguna-Pele and for climate adaptation in Vanuatu", said village leader Carlos Tangarasi.

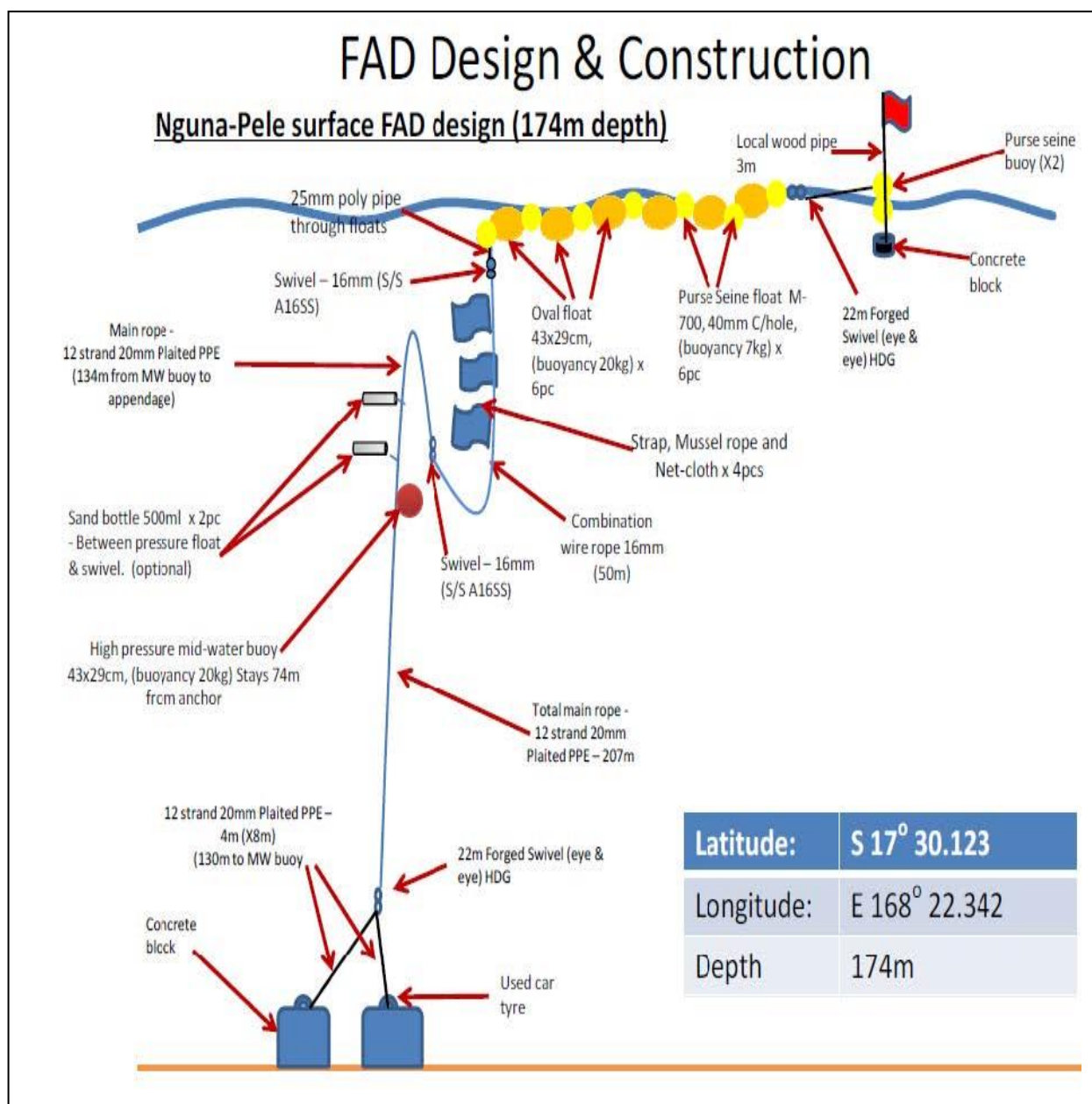
www.nab.vu / SPC-GIZ CCCPIR



The Department of Fisheries and the SPC/GIZ CCCPIR programme are trialling a fish-aggregating device (FAD) in the waters just south of Nguna and Pele. A FAD is a way of attracting deep water fish such as tuna and mahi-mahi to a point close to the shore. The FAD being developed is known by the brand name "*Vatu-Ika*".

When the fish gather around the FAD, they can easily be caught. With a FAD, fishermen no longer need to travel long distances into the ocean to catch large fish. **Food security** is improved, and village people can sell the fish to gain an income (Fig. 48). At the same time, the pressure to fish on coral reefs is reduced, so the reefs are better protected.

Fig. 47: Fish aggregating device



SPC/GIZ CCCPIR, 2013

Fig. 48

Toktok blong Paramaon Jif Mariwota, Taloa vilij:

“FAD ia hem i helpem ol fisaman blong mifala blong mitim ol nid blong mifala mo blong ol famle. Naoia ol fisaman blong mifala oli save huk klosap long haos mo bae hem i wan gudfala catch, mo tu oli sevem money mo taem blong olgeta. Naoia mifala i gat wan solusen blong ol ovahavesting long ol risos mo animol we oli stap liv long rif”.

SPC/GIZ CCCPIR, 2013

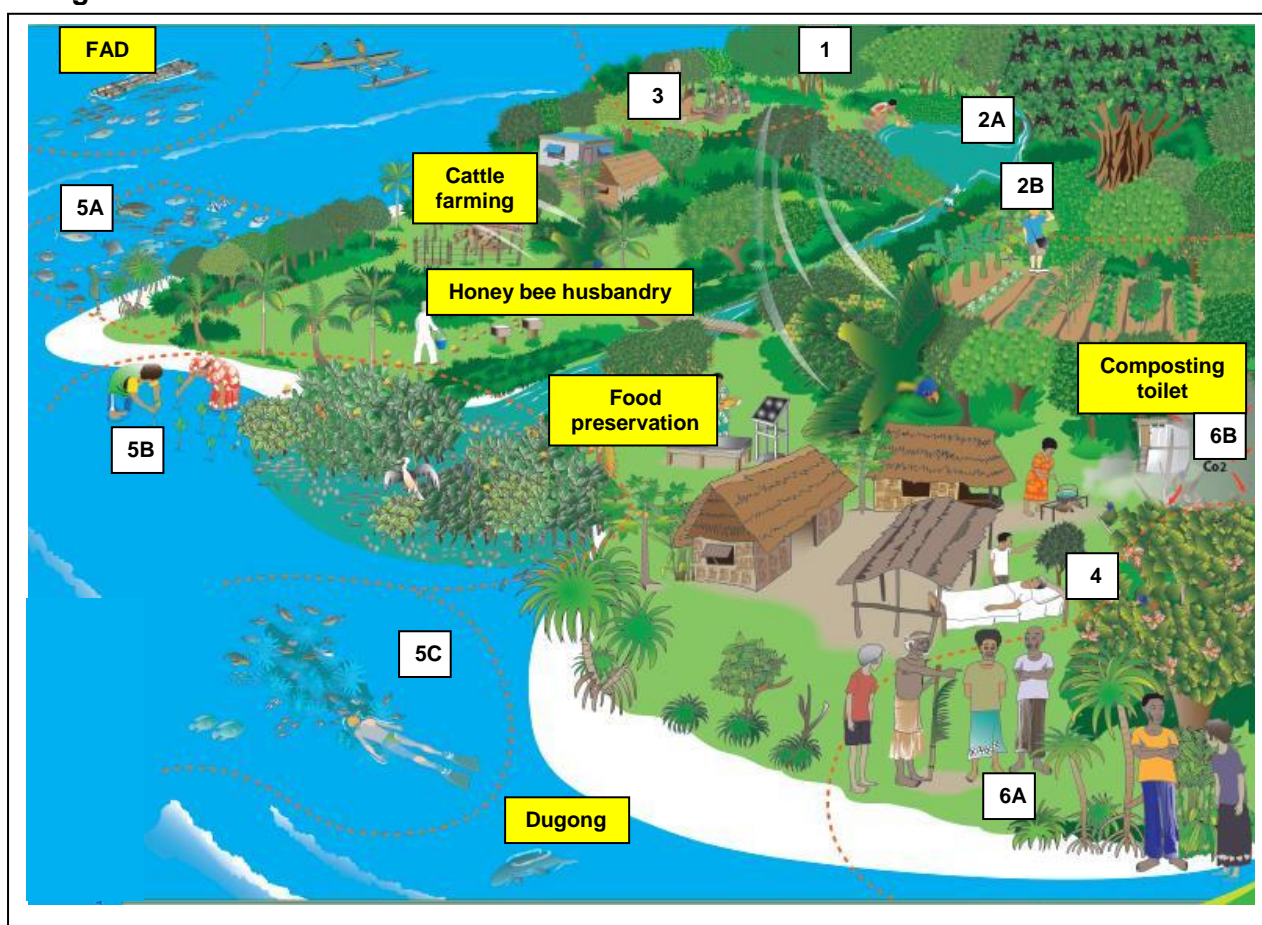
6.5 Establishing a community conservation area

Many of the above ideas are brought together when a “community conservation area” can be established. This is simply an area where a village community decides to implement measures that will conserve its natural resources, and so be better able to adapt to the impacts of hazards and climate change.

Here is a picture (Fig. 49) that shows you some of the features of a community conservation area, as well as adaptation activities that are taking place.

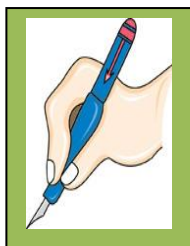
Discuss these features and activities with your facilitator.

Fig. 49



Department of Environmental Conservation and Protection, 2014

1	The conservation area covers both land and sea	4	Natural medicines from the forest and the sea are always available. There is food security and livelihoods are sustainable.
2A	The conservation area has clean water, carbon sinks, and healthy ecosystems. Soils are protected.	5A-C	Important animals and plants are protected, in the sea, along the shore and on land
2B	The conservation area supports eco-tourism	6A	There is a local management committee that promotes activities to help everyone to adapt to climate change
3	Kastom sites are protected	6B	By protecting the forests, carbon dioxide emissions are reduced.



Now please complete Activities 6.4 and 6.5 in your Learner Workbook

My Notes:

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Concepts	I understand this concept	Questions that I would still like to ask
6.4 Adaptation measures for protecting coral reef, sea grass and mangrove ecosystems.		
6.5 Community conservation areas		

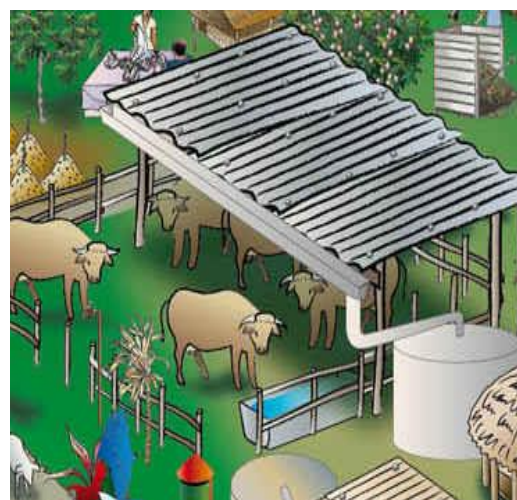
6.6 Household water security

As climate changes and temperatures become warmer, there may be longer periods of drought associated with El Niño, and less rain in seasons when rain is expected. For this reason, it is important for communities to ensure that they store water, make more efficient use of their water sources, and provide security for their water supplies.

Here are some of the steps that can be taken at community level to prepare for water shortages:

- Encourage families to save up and invest in corrugated iron roofs and strong rain water tanks. This is a way of harvesting rain water and storing it for future use. Rain water can also be harvested from other buildings with corrugated iron roofs - cattle sheds (Fig. 50), schools, churches, etc.
- Fix broken gutters on buildings that already have them.
- Fix leaks from piped water schemes.
- Set up village water committees to protect water sources, conserve water and promote wise use.

Fig. 50: Harvesting rain water



SPC & GIZ, 2014: A visual guide

- Cover wells and water tanks securely.
- Increase awareness at village level about how underground water sources can be polluted.
- Encourage local schools to educate children on the conservation of water and the protection of water sources
- Introduce composting toilets (Fig. 51).

Fig. 51: A composting toilet



SPC/GIZ CCCPIR, 2013

6.7 Relocating buildings and villages

A long-term measure for adapting to climate change is to relocate buildings and villages that are in vulnerable locations. Villages built on low-lying ground next to the sea shore are vulnerable to sea level rise, storm surges and coastal erosion. Villages in river valleys can be vulnerable to floods and landslides.

Eventually people living in such risky locations will have to find another, safer, place to live. It would be wise to start planning for such a move.

In fact, one village in Vanuatu has already been relocated to higher place because of the effects of climate change, tectonic subsidence and rising sea levels. The settlement of Lateau, on Tegua in the Torres islands, faced frequent flooding from storm surges and high tides, and in 2005 its people moved to Lirak, 600 metres further inland and 15 metres higher up. The United Nations announced that the 70 inhabitants of Lateau were the “first climate refugees in history” (Univers Nature, 2007).



Fig. 52:

Tegua island in the Torres group, where the people of Lateau village have had to move 600 metres further inland.



© Taito Nakalevu / SPREP, 2004

It should be noted that it is not always easy to relocate a village to a new area. Communities are attached to their own customary land, and new sites in other places might not be freely available because of land ownership issues, or might be too costly.

6.8 Other aspects of adaptation

Importance of traditional methods of adaptation to hazards and extreme weather events

This topic will be dealt with more fully in the next Unit (CCDRR06). However, at this point we should mention that in addition to all the strategies just described, there are some important techniques that have been carried out for hundreds of years in Vanuatu. These techniques ensure that communities are better able to cope with risks from natural hazards and extreme weather events.

Some examples are:

- placing traditional taboos to protect forests, wildlife and marine life;
- using traditional food gardens and other agricultural techniques that are in balance with the environment;
- non-destructive methods of fishing;
- traditional house designs;
- and smoking fish and meat to conserve them for long periods.

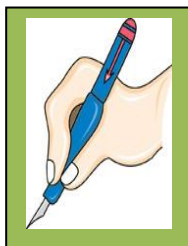
Some adaptation strategies may not always bring benefits

Strategies for adaptation to climate change may not work every time or in every place. Extreme weather events such as Cyclone Pam may still cause loss or damage. Also, a strategy may help people in some ways but also bring some disadvantages.

Think about these two examples:

- A decision is made to clear forest and bush in a wide area around a village so as to reduce the number of sites where mosquitoes can breed and bring malaria, as temperatures get warmer. This may reduce sickness, but the loss of trees means that there are no wind breaks to reduce damage from cyclones. Soil erosion and landslides may also occur.
- People are asked to relocate their homes away from their traditional sites, in order to reduce risks from flooding or erosion. They may then lose the ancestral ties binding them to their land, as well as other aspects of their heritage

Can you think of any other examples?



Now please complete Activities 6.6, 6.7 and 6.8 in your Learner Workbook

My Notes:

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Concepts	I understand this concept	Questions that I would still like to ask
6.6 Measures for ensuring household water security. 6.7 Relocation of settlements. 6.8 Other aspects of adaptation.		

Section

7

Show that many measures include both adaptation and mitigation benefits

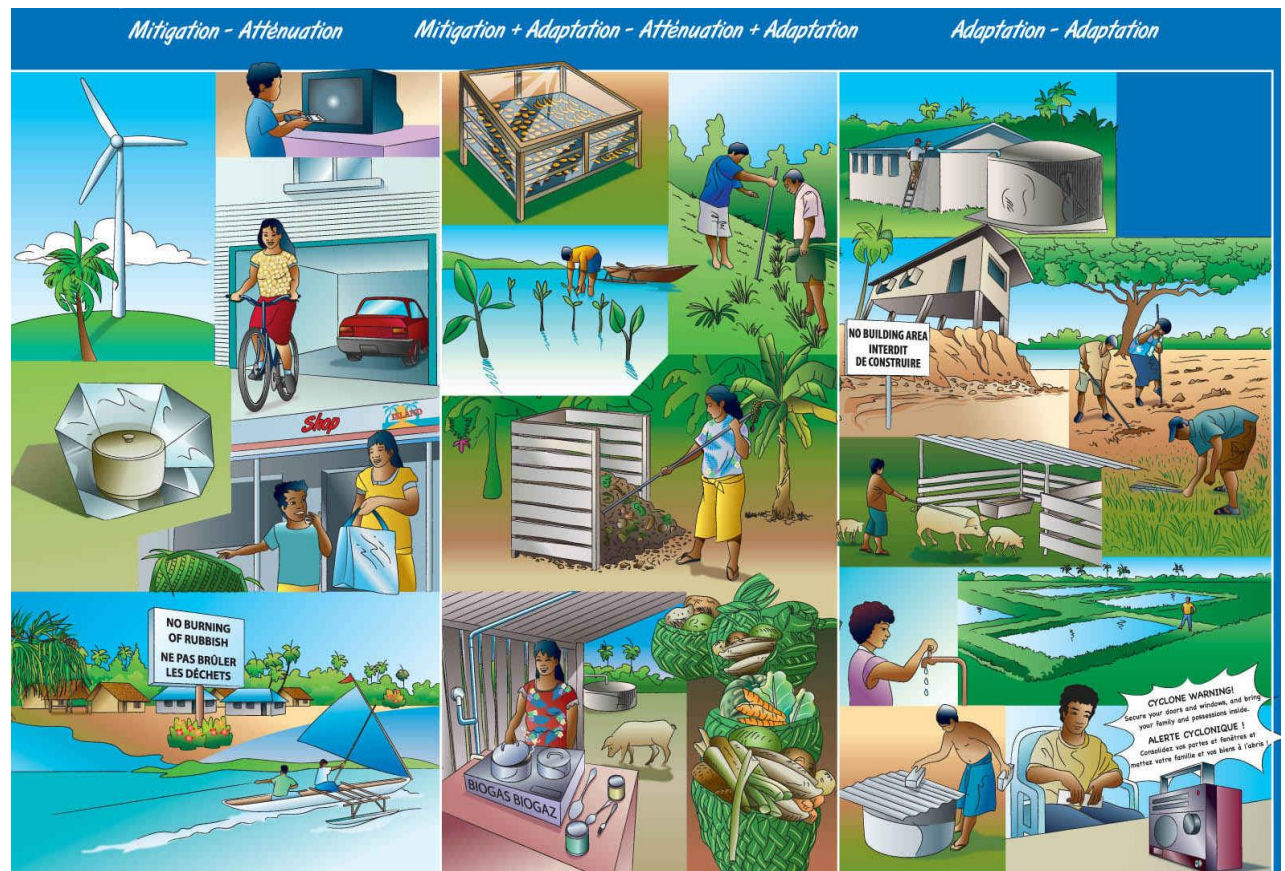
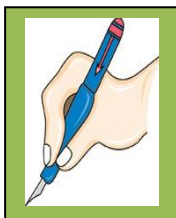
After completing this section, you should be able to:

7.1 identify strategies that provide both adaptation and mitigation benefits

7.1 Strategies for both adaptation and mitigation

Study Fig. 53. Activities that promote mitigation of greenhouse gases are shown on the left. Those that promote adaptation to climate change are on the right. Those that are both mitigation and adaptation are in the middle. Can you name them all?

Fig. 53

SPC & GIZ, 2014: *A visual guide*

Now please
complete
Activities 7.1a
7.1b and **7.1c** in
your Learner
Workbook

My Notes:

[illegible]

Concepts	I understand this concept	Questions that I would still like to ask
7.1 Examples of strategies that provide both adaptation and mitigation benefits.		

Section

8

Assist the development of adaptation and mitigation measures in a local community

After completing this section, you should be able to:

- 8.1 discuss the roles played by women and men in climate change adaptation, and the barriers faced by each gender;**
- 8.2 discuss ways of ensuring that vulnerable people are included in the planning of community activities, so that their needs are met and their capacities used;**
- 8.3 work with a local community to prepare a display of adaptation and mitigation measures that might be used;**
- 8.4 consult with a local community about the adaptation and mitigation measures it might wish to adopt, and participate in their implementation.**

8.1 Roles of women and men in adaptation and mitigation

In Section 3.6, we discussed the different roles played by women and men in the mitigation of GHG emissions. Now we will look at their roles in both adaptation and mitigation.

Discuss the following questions with your fellow-learners:

- In your local area, who are more likely to want to plant trees and vetiver grass to reduce erosion - men or women or both? Why?
- Who are more likely to introduce adaptation measures in relation to pigs, cattle and other livestock - men or women? Why?
- Do women and men have different roles in agroforestry and crop cultivation? How are they different?
- Are men more involved than women in the protection of coral reefs and mangrove ecosystems?
- Who are likely to be more interested in FADs - men or women? What about solar fruit drying? Why?
- Who collects the firewood and the fresh water - men or women or both?

- Do women in your community have access to information about adaptation activities, or to strategies for “development” in general? Can women make decisions about these activities, or must they always have the agreement of men?
- Who should decide whether an area of a reef should be made taboo for a few years in order to stop over-fishing and dumping of rubbish?
- In general, do you think that women and men should have an equal say in promoting activities that encourage mitigation of climate change and adaptation to climate change? What about children and young people - should they have a say too? Why do you say this?

8.2 Ensuring that vulnerable groups are included in planning for community activities

We know that there are certain groups of people in the community who are more **vulnerable** to the negative effects of hazards and climate change - women, babies and young children, girls and boys, the elderly, people living with disabilities, and those who are poor.

Discuss the following:

- What are the needs of these vulnerable groups?
- How can we ensure that these needs are met when our climate is warmer, with more extreme events?
- How can vulnerable groups contribute to adaptation and mitigation activities? Do some of them have skills, capacities and experience that others do not have?
- How can we give vulnerable groups a voice in the planning of adaptation and mitigation activities? For example, are women and girls consulted in issues related to farming, fishing, forestry, waste disposal and fuels? Is there any consultation with people living with disabilities?



Now please complete Activities 8.1 and 8.2 in your Learner Workbook

My Notes:

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Concepts	I understand this concept	Questions that I would still like to ask
<p>8.1 Roles played by women and men in adaptation and mitigation, and the barriers they face.</p> <p>8.2 Ensuring that women, children, the elderly and people with disabilities are included in planning for community activities, so that their needs are met and their capacities used.</p>		

8.3 Preparing a display of adaptation and mitigation measures

In Section 3, you learnt about measures that can be taken in a local community to mitigate climate change - either by reducing emissions of greenhouse gases or by expanding carbon sinks such as forests. In Section 6, you learnt about measures that can be taken to adapt to climate change and increase community resilience. You also prepared materials for demonstrating these measures to others.

Now you are going to prepare a display of adaptation and mitigation measures, ready to present and demonstrate in a local community.

You should talk with people from the local community, your facilitator and your fellow-learners, and decide on the adaptation and mitigation measures that might be appropriate to present and demonstrate in the community.

Then you should divide up into small groups and start preparing your charts and other materials. Try to include some interested people from the community in your groups, since by doing this, you are building up their capacities.

You may also wish to invite an agricultural field assistant, a local forestry or fisheries officer, and/or a representative of an NGO to help you.

When working with your local community, you should also make sure that the adaptation and mitigation measures you demonstrate are those that can link with any plans or priorities for local development that already exist.



Now please
complete
Activity 8.3

My Notes:

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Concept	I understand this concept	Questions that I would still like to ask
8.3 Adaptation and mitigation measures.		

8.4 Consultation with a local community on adaptation and mitigation measures to adopt, and helping this community with implementation

With the help of your facilitator and members of your local community, you can now present and demonstrate a number of adaptation and mitigation techniques to this local community.

After you have done the presentations and demonstrations, you can consult with people in the community about which of these measures they would like to introduce or to continue, and offer to help in the **implementation**. Activity 8.4b will help you with your planning.

You may find that small groups of trainees will go and help particular families, each with a different project. On the other hand, the community may ask all of you together to help it implement just one project that will help everyone.

Remember that the adaptation and mitigation measures that are being introduced should be linked to any plans for development that the community has already made.

Glossary

Adaptation to climate change	How people adjust their ways of living in order to cope with the harmful effects of warmer temperatures and other climatic changes, as well as to benefit from new opportunities that arise.
Adaptive capacity	Ability to adjust to climate change, to moderate (reduce) possible damages, to take advantage of opportunities, and to cope with consequences.
Adjust	To change something slightly in order to achieve a desired result
Advocate	To publicly support, or to draw the attention of the public to a particular line of action that needs to be carried out.
Agroforestry	Way of combining forestry with agriculture. Trees and crops are grown together in such a way that the trees help the crops to grow.
Alley cropping	Planting trees or shrubs in two or more rows, with crops cultivated in the alleys or spaces in between.
Biodegradable	Substance that will naturally rot or decompose
Biodiversity	The variety of plant and animal life in a particular area, or in the world. The large number of plant and animal species that are found.
Biofuel	Natural plant material that can be processed to make liquids such as alcohol and coconut oil, which can then be used for fuel in machines or engines.
Biogas	Methane or other gases that are produced from the decomposition of animal wastes
Biomass	Organic matter. Something that is, or was, living
Breeding	The mating and reproduction of offspring by animals
Carbon credit	A permit which allows a country or organization to produce a certain amount of carbon emissions and which can be traded if the full allowance is not used.
Carbon footprint	The amount of carbon dioxide released into the atmosphere as a result of the activities of a particular individual, organization or community.
Carbon sink	A natural or artificial reservoir that takes up and stores carbon. Trees, plants, oceans, rocks and soils are natural sinks, while landfills are artificial sinks.
Climate change	Long term continuous change in the climate or in the range of weather (e.g. more extreme events), measured over several decades, hundreds of years or millennia, and supported by statistical evidence
Composting	Making a natural fertilizer from rotting plants.
Conserve	To keep. To protect from harm or destruction.

COP	Conference of the Parties. An annual meeting of nations who have signed the UNFCCC.
Decade	Ten years
Degradation	When something loses its quality, or is spoilt.
Diversify	To make or become more diverse or varied; to increase the range of products or sources of energy, so that there are many different kinds and not just one or two.
Ecosystem	A group of living organisms and non-living elements of the environment that are found together and affect each other.
Efficient	Functioning in the best possible manner without wasting time or effort.
Emissions	Gases or substances that are put into the atmosphere.
Emissions trading	A system by which countries and organizations receive permits to produce a certain amount of carbon dioxide and other greenhouse gases, which they may trade with others
Energy rating	A label on a new electrical appliance (e.g. a refrigerator) that tells you how much electricity it will consume in one year. The more red stars on the label, the more efficient the appliance is.
Enhanced greenhouse effect	Increase in the greenhouse effect caused by the emissions of greenhouse gases through human activities. Sometimes referred to as “global warming”.
Exotic	Originating from another country, place or environment.
Fish aggregating device (FAD)	Floating object in the sea that is designed to attract deep water fish
Food security	When all people at all times have access to sufficient, safe, nutritious food that enables them to maintain a healthy and active life.
Forest conservation	Planting and maintaining forested areas for the benefit of future generations.
Fossil fuel	Substance containing carbon that was once a living organism. Examples are coal, petroleum (oil) and natural gas. Fossil fuels can be burnt to provide energy, but at the same time, they give off CO ₂ .
Global warming	Increase in atmospheric temperatures caused by the enhanced greenhouse effect and largely due to human activities.
Greenhouse gases (GHGs)	Gases in the Earth’s atmosphere that trap outgoing heat energy from the Earth. Examples are carbon dioxide (CO ₂), methane (CH ₄) and nitrous oxide (N ₂ O).
Harvesting rain water	The collection of water from surfaces on which rain falls, and then storing this water for later use.
Husbandry	Care, cultivation and breeding of crops and animals.
Hybrid	Offspring of two plants or animals of different varieties or species.

Impact	How something affects or causes a change in something else; how hazards and climate change affect natural ecosystems and human societies.
Implementation	Carrying out a decision or a plan.
Inevitable	Certain to happen.
Legally binding target	A goal or aim that must be achieved according to international law.
Living sustainably	Meeting present needs without spoiling things for future generations.
Livelihood	Ways in which a person obtains or meets his/her basic needs in life - food, water, shelter, clothing etc.
Micro-hydro project	Small project that takes water from a stream to make electricity.
Millennia	Thousands of years.
Mitigation of climate change	Reduction in the causes of climate change, through actions that lower the levels of greenhouse gases in the atmosphere. Done by reducing GHG emissions as well as by improving and increasing carbon sinks (especially the vegetation cover).
Mulching	Spreading a layer of natural rotting vegetation around crops or flowers to help them to grow.
Natural greenhouse effect	Way that certain gases in our atmosphere trap outgoing heat energy from the Earth, so making the atmosphere warmer and retuning some of the heat back to Earth. The natural greenhouse effect enables life to exist on Earth.
Negative effect	An impact that causes damage, harm or distress.
Ocean acidification	Increase in the acidity of the oceans, caused when sea water absorbs the extra carbon dioxide produced by human populations.
Perishable	Goes rotten or decomposes quickly.
Priorities	Things that are considered to be the most important, to be done or considered first.
Ratify	To agree officially to something. In other words, the government has passed a law to say that it agrees.
Reafforestation (or reforestation)	Establishing a forest in an area where there was no forest or where forest has been cut down.
Recycling	Treating or processing used or waste materials so that they can be used again.
REDD	Reducing emissions from deforestation and forest degradation.
Refugee	Person who has been forced to leave their home or country in order to escape war, persecution or a natural disaster.
Relocation	Movement to a different place.

Renewable energy	Energy from a source that does not get used up when the energy is taken. An example is solar energy.
Renewables	Renewable sources of energy such as solar power, hydro-power, wind power, biomass, biogas, biofuels and others.
Resilience	Ability of a person, household or community to cope with hazards, to prepare for hazards and climate change, and to recover from disasters that occur.
Resilient	Able to cope with, and recover from, injury, stress or damage.
Sewage	Human waste that normally travels along pipes to septic tanks or sewage tanks.
Solar panel	Flat plate that absorbs the sun's rays and uses them as a source of energy for generating electricity or heating.
Sustainable	Can be kept at a certain level, or at the same level, in the future.
Sustainable development	Using natural resources without spoiling the ability of future generations to meet their own needs; economic development that takes place without using up natural resources.
Sustainable livelihood	Ways in which a person or a community is able to meet their basic needs for food, water, shelter, etc., and at the same time can cope with stress and shocks and provide opportunities for the next generation.
Turbine	Machine for producing continuous power in which a wheel is made to revolve by a fast-moving flow of water, steam, gas, air, or other fluid.
Unequivocal	There is no doubt about it.
UNFCCC	United Nations Framework Convention on Climate Change. It is an agreement between nations to work towards keeping atmospheric greenhouse gas concentrations at a level that will gradually slow down global warming and reduce its dangerous impacts.
Unprecedented	It has never happened before.
Vulnerability	The extent to which persons, families or communities are likely to suffer from a hazard or from the effects of climate change because they lack the capacity to cope and adapt.
Vulnerable	Easily hurt, affected or damaged.
Water security	Having sufficient quantities of clean water to maintain adequate standards of food and drink, proper sanitation and sustainable health care.

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Illustrations

Fig. number	Source
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