



NATIONAL ADAPTATION PLAN TRAINING MODULE



<i>Topic 1</i>	<i>General Information on Climate Change in PNG</i>
<i>Topic 2</i>	<i>Basic Climate Change Science</i>
<i>Topic 3</i>	<i>Climate Change Vulnerability</i>
<i>Topic 4</i>	<i>Climate Change Risks</i>
<i>Topic 5</i>	<i>Climate Change Adaptation and Resilience</i>
<i>Topic 6</i>	<i>Climate Change Adaptation and Health</i>
<i>Topic 7</i>	<i>Climate Change Adaptation and Agriculture</i>
<i>Topic 8</i>	<i>Climate Change Adaptation and Transport</i>
<i>Topic 9</i>	<i>Climate Change Adaptation and Infrastructure</i>
<i>Topic 10</i>	<i>Climate Change Adaptation Policy and Governance</i>
<i>Topic 11</i>	<i>Climate Change Adaptation and Partnership</i>
<i>Topic 12</i>	<i>Climate Change Adaptation and Communications</i>

*University of Papua New Guinea Centre for Climate Change and Sustainable
Development*

University of Papua New Guinea

March 2022

Message by Mr William Lakain

**Acting Managing Director - Climate Change and Development
Authority**



National Adaptation Plan (NAP) Training Module

Climate Change continues to be the greatest challenge for our planet. For Papua New Guinea it is of great national interest. Papua New Guinea is aligning this theme with the implementation of the UN Sustainable Development Goals, SDG 13 (Climate Change) to Papua New Guinea Vision 2050 (Pillar 5- Climate Change and Environment Sustainability) which states “We will be Smart, Wise, Fair, Health and Happy Society by 2050”, and tackling the impacts of climate change are also crucial to meeting our development goals.

The University of Papua New Guinea (UPNG) with the Ministry of Environment, Conservation and Climate Change through the Climate Change and Development Authority (CCDA) and the United Nations Development Programme (UNDP) have developed this climate change module on Climate Change Adaptation (CCA), supported by the Green Climate Fund (GCF) Readiness Programme as part of Papua New Guinea’s National Adaptation Plan (NAP) process. The module is aimed at guiding and supporting the government of PNG to implement adaptation planning and policies across all sectors at national, regional, provincial and district levels, targeting in a first phase, areas of priority such as agricultural, health, infrastructure and transport.

Furthermore, the production of this adaptation module is written and developed by staff of the University of Papua New Guinea, UNDP and CCDA in consultations with provincial governments and NGOs. This module will contribute immensely to teaching, learning and understanding of climate change impacts, climate change adaptation planning and strategies for Papua New Guinea and the Pacific region in achieving sustainable development measures.

Essentially, this module on adaptation is designed to support knowledge on the integration of adaptation planning for Papua New Guinea. Providing support and understanding across local to national scales for how to integrate climate change adaptation into sectors of work. The issue of climate change and variability is very complex and entails addressing the science, impacts, responses, policy and planning development within cross cutting issues such as capacity building and human resources.

A number of activities and programmes are modelled in PNG and the Pacific setting and will assist in understanding climate change as a complex issue and the need to develop appropriate responses such as adaptation and mitigation measures. This will address sectors such as health, agriculture, transport and infrastructure as the groundwork for establishing Papua New Guinea’s National Adaptation Plan. Education and awareness are an integral part of the process to understand climate change and its effects on communities and nations and emphasis on adaptation application as a priority.

William Lakain
Acting Managing Director, Climate Change and Development Authority (CCDA)

TABLE OF CONTENTS

TOPIC 1: GENERAL INFORMATION.....	1
1.1 Introduction.....	1
1.2 PNG Context.....	1
1.3 Vision.....	2
1.4 Goal	2
1.5 General objective	2
1.6 Principles	3
1.7 Techniques and tools	4
1.8 Training prerequisite.....	4
1.9 Acronyms and abbreviations	5
TOPIC 2: BASIC CLIMATE CHANGE SCIENCE	6
Overview	6
Aims of Topic 2.....	6
Objective	6
Knowledge and Understanding:	6
Knowledge Base	7
2.1 Takeaways	7
2.2 Basic science of climate.....	7
2.2.1 Climate and Weather	7
2.2.2 Climate Variability and Climate Change.....	8
2.2.3 Climate System and Climate Components	9
2.2.4 Greenhouse Effect	10
2.2.5 Global Warming	11
2.2.6 Climate Change	12
2.3 Climate change impacts.....	12
2.4 Further Resources.....	15
2.5 Activity One: Impacts of Climate Change.....	16
2.6 Self-Evaluation	16
2.7 References.....	17
TOPIC 3: CLIMATE CHANGE VULNERABILITY	18
Overview	18
Aims of Topic 3.....	18
Objective	18

Knowledge and Understanding:	18
Knowledge Base	19
3.1 Takeaways	19
3.2 Vulnerability concept	19
3.3 Climate change vulnerability	21
3.4 Further Resources	23
3.5 Activity Two: Climate Change Vulnerability	24
3.6 Self-Evaluation	25
3.7 References	26
<i>TOPIC 4: CLIMATE CHANGE RISKS</i>	27
Overview	27
Aims of Topic 4	27
Objective	27
Knowledge and Understanding:	27
Knowledge Base	27
4.1 Takeaways	27
4.2 Risk concept	28
4.3 Risk Management	29
4.4 Risk assessment	30
4.5 Risk communication	31
4.6 Climate change risk	32
4.7 Further Resources	34
4.8 Activity Three	35
4.9 Self-Evaluation	28
4.10 References	29
<i>TOPIC 5: CLIMATE CHANGE ADAPTATION AND RESILIENCE</i>	30
Overview	30
Aims of Topic 5	30
Objective	30
Knowledge and Understanding:	30
Knowledge Base	30
5.1 Takeaways	30

5.2	Climate change adaptation.....	31
5.3	Climate change resilience	34
5.4	Resilience development framework.....	36
5.5	Further Resources.....	38
5.6	Activity: Resilient Development Framework approach.....	39
5.7	Self-Evaluation	39
5.8	References.....	40
TOPIC 6: CLIMATE CHANGE ADAPTATION AND THE HEALTH SECTOR.....		41
	Overview	41
	Aims of Topic 6.....	41
	Objectives.....	41
	Knowledge and Understanding:	41
	Knowledge Base	42
6.1	Takeaways	42
6.2	Climate change and health.....	42
6.3	Climate-sensitive health risks	44
6.4	Climate change adaptation and health sector	45
6.5	Climate change adaptation, health sector and gender	46
6.6	Climate change adaptation framework for health.....	47
6.7	Further Resources.....	48
6.8	Activity: Climate change and malaria	49
6.9	Self-Evaluation	49
6.10	References.....	47
TOPIC 7: CLIMATE CHANGE ADAPTATION AND THE AGRICULTURE SECTOR.....		49
	Overview	49
	Aims of Topic 7.....	49
	Objectives.....	49
	Knowledge and Understanding:	49
	Knowledge Base	50
7.1	Takeaways	50
7.2	Climate change and agriculture	51
7.3	Climate change adaptation and agriculture sector.....	52

7.4	Climate change adaptation, agriculture sector and gender	54
7.5	Climate change adaptation framework for agriculture	57
7.6	Further Resources.....	58
7.7	Activity: Climate change and food security.....	59
7.8	Self-Evaluation	60
7.9	References	61
<i>TOPIC 8: CLIMATE CHANGE ADAPTATION AND THE TRANSPORT SECTOR</i>		62
	Overview	62
	Aims of Topic 8.....	62
	Objectives.....	62
	Knowledge and Understanding:	62
8.1	Takeaways	63
8.2	Climate change and transport	63
8.3	Climate change adaptation and transport sector.....	65
8.4	Climate change, transport sector and gender	65
8.5	Further Resources.....	66
8.6	Activity	67
8.7	Self-Evaluation	67
8.8	References	68
<i>TOPIC 9: CLIMATE CHANGE ADAPTATION AND THE INFRASTRUCTURE SECTOR</i>		70
	Overview	70
	Aims of Topic 9.....	70
	Objectives.....	70
	Knowledge and Understanding:	70
	Knowledge Base	70
9.1	Takeaways	70
9.2	Climate change and infrastructure	71
9.3	Coastal Protection.....	73
9.4	Climate change adaptation, infrastructure sector and gender.....	76
9.5	Climate change adaptation framework for infrastructure sector.....	78
9.6	Further Resources.....	78
9.7	Activity: Field excursion to the beachfront	79

9.8	Self-Evaluation	79
9.9	References	80
TOPIC 10: POLICY DEVELOPMENT AND GOVERNANCE		82
	Overview	82
	Aims of Topic 10.....	82
	Objectives.....	82
	Knowledge and Understanding:	82
	Knowledge Base	83
10.1	Takeaways	83
10.2	Policy development cycle.....	83
10.3	Papua New Guinea Climate Change (Management) Act.....	87
10.4	Governance.....	87
10.5	Good Governance.....	87
10.6	Climate change governance	89
10.7	Further Resources.....	90
10.8	Activity: PNG Climate Change (Management) Act	91
10.9	Self-Evaluation	91
10.10	References.....	92
TOPIC 11: CLIMATE CHANGE ADAPTATION AND PARTNERSHIP		94
	Overview	94
	Aims of Topic 11.....	94
	Objectives.....	94
	Knowledge and Understanding:	94
	Knowledge Base	95
11.1	Takeaways	95
11.2	Climate change and partnership	95
11.3	Climate finance.....	96
11.4	Climate finance and gender	97
11.5	Accessing climate finance	98
11.7	Further Resources.....	104
11.8	Activity: Writing a logical framework of a funding proposal	105
11.9	Self-Evaluation	106

11.10 References.....	107
TOPIC 12: CLIMATE CHANGE ADAPTATION, COMMUNICATION, AND INFORMATION.....	109
Overview	109
Aims of Topic 12.....	109
Objectives.....	109
Knowledge and Understanding:	109
Knowledge Base	109
12.1 Takeaways	109
12.2 Climate change and communication/information.....	110
12.3 Climate Change Communication Strategy.....	111
12.4 Further Resources.....	113
12.5 Activity: Developing a fact sheet	114
12.6 Self-Evaluation	115
12.7 References.....	116
GLOSSARY OF TERMS.....	117

List of Tables

Table 1: Greenhouse Gases.....	11
Table 2: Climate Change Impacts.....	13
Table 3: Dimensions of Vulnerability.....	20
Table 4: Types of Vulnerability	20
Table 5: Vulnerability Elements	22
Table 6: Types of Risks	29
Table 7: Effects of Climate Change on Key Resource Systems.....	32
Table 8: IPCC's Climate Change Entry Points.....	34
Table 9: Steps for developing climate resilience framework.....	35
Table 10: Impacts of climate change on agriculture.....	52
Table 11: Key Areas for Agricultural Adaptation	53
Table 12: Key Areas for gender equality and social inclusiveness in agriculture	56
Table 13: Climate change impacts and transport sector	64
Table 14: Potential impacts of climate change on transport infrastructure	72
Table 15: Drivers and Effects of Coastal Erosion	75
Table 16: Barriers to gender-responsive infrastructure development.....	77
Table 17: Main Climate Funds Available to PICs and Their Financial Instrument	99
Table 18: Key principles for good communication	111
Table 19: Methods for communication.....	112

List of Figures

Figure 1: Climate and Weather Differences	8
Figure 2: Weather, climate change and climate variability differences.....	9
Figure 3: Climate System and Climate Components	10
Figure 4: Greenhouse Effect	10
Figure 5: Global Concentration of Carbon Dioxide over Time	11
Figure 6: Climate change and global warming	12
Figure 7: Impacts, Adaptation and Vulnerability in the Pacific	15
Figure 8: Vulnerability Situation	19
Figure 9: Pressure and Release Model.....	21
Figure 10: Key components of vulnerability – illustrating the relationship among exposure.....	23
Figure 11: Risk Management Process.....	30
Figure 12: Risk Assessment Process.....	31
Figure 13: Organizational Structure of Communication	32
Figure 14: Concept of risk and vulnerability to climate change.....	33
Figure 15: Adaptation planning cycle.....	33
Figure 16: Climate change adaptation planning in PNG	33
Figure 17: Overview of Climate Resilient Principles	36
Figure 18: CHARM Framework.....	37
Figure 19: Resilient Development Framework.....	38
Figure 19: Resilient Development Framework.....	39
Figure 20: Impacts of climate change on health	43
Figure 21: Climate-sensitive health risk, the exposure pathways and vulnerability factors.....	44
Figure 22: WHO guidance on climate change health issues within NAP process (HNAP).....	45
Figure 23: Effect of climate change on human health and current responses	47
Figure 24: Framework for climate change impacts on human health and wellbeing in NSW	48
Figure 25: Impacts of climate change on subsistence agriculture in PNG	52
Figure 26: Women in Agriculture in PNG.....	55
Figure 27: Impacts of climate change on cash crops within the coastal areas of PNG	57
Figure 28: Five-step process of adapting to climate change.....	57
Figure 29: APEC Building - example of infrastructure built without climate change influences	72
Figure 30: Modern coastal infrastructure without consideration of climate change influences ...	73
Figure 31: Rapid coastal erosion along the coastlines in PNG.....	73
Figure 32: Adaptation systems for Coastal Defence.....	74
Figure 33: Coastal protection systems	75
Figure 34: PNG’s Experiences in Coastal Protection	76
Figure 35: Climate change adaptation framework for infrastructure.....	78
Figure 36: Policy Making Cycle	84
Figure 37: Eight good governance principle.....	88
Figure 38: Top-down and bottom-up approaches to inform climate adaptation policy	89
Figure 39: Programmatic areas for the Green Climate Fund (GCF)	96
Figure 40: Financial flows for climate change mitigation & adaptation in developing countries	97
Figure 41: Climate finance enhancing women empowerment	98
Figure 42: How to access Green Climate Fund	100
Figure 43: Actions under Climate Finance	101

Figure 44: Logical Framework Matrix (log frame) 105
Figure 45: Tipping points in the climate system: Example of developing a Fact Sheet..... 114

Cover page: New APEC Building on Ela Beach, Port Moresby, Papua New Guinea

TOPIC 1: GENERAL INFORMATION

1.1 Introduction

Climate change continues to negatively impact Papua New Guinea (PNG). Efforts to pursue PNG's sustainable development continue to raise the importance of strengthening the legislative frameworks and appropriate policy settings that promote better governance of PNG's unique natural resources, its biodiversity and addressing the social, economic, and environmental impacts of climate change. Building resilience to climate change has featured in national dialogue and political commitments for over a decade. Recognised as an acute challenge for PNG, Government and partners have committed to mainstream climate action in their planning and delivery. Adapting to climate change is becoming a routine and necessary component of planning at all levels. The United Nations Framework Convention on Climate Change (UNFCCC) established the National Adaptation Plan (NAP) process to facilitate adaptation planning. The NAP process in PNG will require robust management, operational and coordination capacities, and skills in place to enable cross-sectoral policy integration and allocation of sectoral and subnational responsibilities towards implementation. These training modules thereby support knowledge development and information to assist in Papua New Guinea's integration of the National Adaptation Plan (2022) throughout sectoral planning at local, provincial, regional, and national scales. Promoting technical capacities to support planning for and monitoring of climate change at the local level.

At the national level, the Climate Change and Development Authority (CCDA), Conservation and Environment Protection Authority (CEPA), Department of Provincial and Local Level Government Affairs (National Disaster Centre), Transport (National Weather Office), Department of Agriculture and Livestock, Department of Health, PNG Ocean Office, Department of Public Works and Implementation, and PNG National Forest Authority are taking action to address climate change and variability through their national sustainable development policy, linked to adaptation strategies as well as in national budgetary and planning processes. The implementation of the programmes and activities by all partners of governments, NGOs and international organizations are coordinated and facilitated by the Climate Change and Development Authority (CCDA) and Department of National Planning and Monitoring (DNPM). The CCDA continues to coordinate and implement more specific national instruments and plans across specific sectors that link to weather and climate including water; agriculture; energy; forestry and land use; health; coastal zone management; marine ecosystems; ocean policy and management; tourism and transport. Addressing the issues of climate change and environmental sustainability requires a whole country and a multi-stakeholder approach. Furthermore, a strategic programmatic approach is required rather than an increase in *ad-hoc* stand-alone project initiatives.

1.2 PNG Context

The IPCC 2007-2022 Reports and its global climate models indicate that PNG and the Pacific region will be warmer between the ranges of 2- 4⁰C than it is today and consequently more vulnerable to climate change with the increased intensity and frequency of extreme events. The projected warming of the ocean and atmosphere will contribute and result in higher maximum temperatures, more hot days, and intense precipitation events.

Droughts and floods associated with El Nino and La Lina events and monsoons are likely to be more frequent and persistent. Sea levels are also predicted to rise and impact on low lying atolls and islands of PNG and Pacific islands, alongside warming ocean environments and increased ocean acidity. The impacts of these climate events will exacerbate already stressed marine, freshwater and terrestrial environments. PNG's peoples' ability to achieve sustainable development will be affected, their livelihoods, economic wellbeing, health and culture will be at risk to increasing numbers of disaster events.

To enable PNG and its communities to build their resilience to this increasing vulnerability, an integrated and holistic approach that considers the complete cycle of interlinked causes and effects, within the context of risk management across all sectors (implemented by National Disasters Centre), is vital. A high priority is the need to develop and strengthen community-centered initiatives.

1.3 Vision

PNG people, their livelihoods and the environment are resilient to the risks and impacts of climate and environmental changes through the application of adaptation strategies.

1.4 Goal

Increase knowledge, information, and access to approaches for anticipating climate change risks and impacts that enable effective decision making for undertaking measures and the integration of adaptation planning; ensuring PNG and its people build their capacity to be resilient to the risks and impacts of climate change and variability.

1.5 General objective

The overall objectives of this training module are to enable participants to achieve:

- To understand the science of climate change, climate risks, climate resilience and climate change adaptation concepts.
- Ability to mainstream and provide strategic direction for their sectors such as agriculture, health, infrastructure, and transport to engage and effectively manage the challenges presented by climate change.
- Develop and adapt scenario-based planning and specific tools required to address climate change and other sources of risk and uncertainty prevailing within these key sectors.
- Experiences in developing logical framework and its linkage with monitoring and evaluation which is an essential skill in project management.
- Exposure to write project proposal to funding organizations and institutions and PNG government.

1.6 Principles

Principle 1: Implementing adaptation measures

Building resilience through adaptation to climate change including climate variability and climate extremes has been identified as the key priority for PNG. The PNG government has agreed with the IPCC 2007-2022 Assessment Reports and Conferences of the Parties (COP 26). Reports are already documenting the adverse effects of climate change at the global and Pacific region. All PNG Coastal Provinces believe that their very survival is now threatened.

The ecological fragility, economic vulnerability and remoteness of many Provinces makes recovery from extreme weather and climatic events very difficult.

National adaptation policies and measures reflecting a whole country approach need to integrate into national sustainable development strategies and plans.

PNG will encourage adaptation measures based on the precautionary approach and principles of risk management, with a focus on improving the livelihoods of its people. Such an approach will recommend the implementation of resilience-building measures that have multiple benefits, including disaster risk reduction.

The expected outcomes by 2030 include:

- Adaptation science - research especially on extreme events, waves, storm surges and monsoons in the region.
- Adaptation measures to the [adverse] effects of climate change developed and implemented at all levels- agriculture, infrastructure, health, transport, forestry, oceans etc.
- Highly vulnerable priority areas identified through site-specific baseline data, collection and interpretation and adaptive actions developed.
- Integrated approaches to adaptation embedded in national sustainable development plans and budgeting process.

Principle 2: Education and Awareness.

Strengthened human capacity to monitor, assess and predict environmental, social, and economic risks and effects of climate change is critical for developing and implementing a viable and sustainable national programme on cost effective adaptation and mitigation response measures that incorporates both scientific and traditional knowledge.

Concerted efforts need to be undertaken to enhance capacity of appropriately trained personnel in the assessment of the risks and impacts of climate change, climate variability and extreme weather events. A pool of informed resource persons conversant with development and application of practical steps in adaptation tools and methods is critical. Increased awareness and

understanding of risks and effects of climate change is particularly important at the community level to increase their resilience.

The expected Outcomes by 2030 include:

- Human capacity to monitor and assess environmental, social, and economic risks and effects of climate change strengthened.
- To identify, analyse and implement cost effective adaptation and mitigation response measures and creation of a pool of informed resource persons conversant with development of practical steps in adaptation tools and methods strengthened.
- Enhance human resources and capacity to identify and integrate scientific and traditional knowledge into adaptation and mitigation practices strengthened.
- Negotiation and advocacy skills of government and non-governmental organizations to engage in the international fora strengthened more effectively, such as Paris Agreement on Climate Change and environmental sustainability information and products distributed to all.

1.7 Techniques and tools

Numerous teaching techniques that will be used in this training will include PowerPoint presentations, group activities, group discussions and showing of climate related documentaries. The tools needed for the training include online terminals or PC workstations, training manuals, classroom facilities, and any computer centre resources.

1.8 Training prerequisite

This training is designed for the four identified sectors for the first phase of the NAP - namely agriculture, health, transport, and works. It will involve selected participants who are within managerial and planning roles, as well as technical staff.

1.9 Acronyms and abbreviations

The list of the acronyms and abbreviations that is relevant for this training and the meaning for each.

CbA	Cost-benefit Analysis
CBA	Community-based Adaptation
CCDA	Climate Change and Development Authority
CEPA	Conservation and Environment Protection Authority
CFC	Chlorofluorocarbon
CH ₄	Methane
CO ₂	Carbon Dioxide
DNPM	Department of National Planning and Monitoring
EbA	Ecosystem-based Adaptation
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NDC	National Disaster Centre
NDC	Nationally Determined Contributions
NOW	National Weather Office
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UPNG	University of Papua New Guinea
WMO	World Meteorological Organization

TOPIC 2: BASIC CLIMATE CHANGE SCIENCE

Overview

Climate change is the greatest challenge to humanity. It is defined as the long-term changes in the climate that occur over decades, centuries or longer. Climate change is caused by rapidly increasing greenhouse gases in the Earth's atmosphere primarily due to human activities like burning of fossil fuels.

These heat-trapping gases are causing the Earth and the ocean to warm leading to rising sea levels, changes in storm patterns, altered ocean currents, changes in rainfall, melting of snow and ice, more extreme heat events, bushfires, drought, and floods. The changes to the physical environment have drastically impacted the human environment like human health, infrastructure, forest, agriculture, freshwater supplies, coastlines, and marine ecosystems. These impacts are projected to intensify in the next hundred years.

This section focuses on the basic science of climate change. The key message is to understand the concepts and how you can apply it based on your own situation.

Aims of Topic 2

- ❖ To enable the participant to have the basic understanding of the climate and the climate systems.
- ❖ To enable participants to understand the natural and enhanced greenhouse effect and their implications.
- ❖ To enable the participants to understand the cause of climate change and its impacts.

Objective

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- Understand the climate system and cause of climate change.
- Identify how the four sectors will be affected by the potential (direct and indirect) impacts of climate change.
- Identify the emerging potential (anticipated and unanticipated) climate risks that will affect their sectors.
- Understand why it's challenging to the levels of uncertainties.

Knowledge Base

2.1 Takeaways

The following are key points relating to the science of climate change include:

The Earth is continuously being driven by an energy input-output system which originates from the sun. This energy enters the Earth's systems including climate system and keeps them functioning. Without the energy, there will not be any life on earth. Within the earth's systems, energy is used and released back into the space. It is vital also to understand the concept of feedback in its numerous as energy is transferred from one system to another in order to improve the current climate models. Additionally, it is crucial to know the mechanisms by which climate changes over both the long and short time periods. Specifically, the role in climate change of forcing agents, both natural and those derived from human activity. In simple terms, the main models that have been developed to simulate climate, how it changes historically, and how it is predicted to change.

2.2 Basic science of climate

2.2.1 Climate and Weather

Climate and weather are important for the existence of life on earth. They are part of our daily routines and also vital for all living organisms. They are crucial for food production, good health and for sustaining our livelihoods.

Both are used interchangeably to mean the same thing, but they are not. The "weather" is the daily experience of the fluctuation in the state of atmosphere around us and is characterized by the temperature, wind, precipitation, clouds and other weather elements. The "climate" is defined as the average weather in terms of the mean and its variability over a certain time period in a given area (Figure 1).

Climate differs from place to place, depending on the latitude, distance from the sea, vegetation, presence and absence of topography or other geographical factors. Climate also differs in time, from season to seasons, year to year, decade to decade or on much longer scale like the Ice Age.

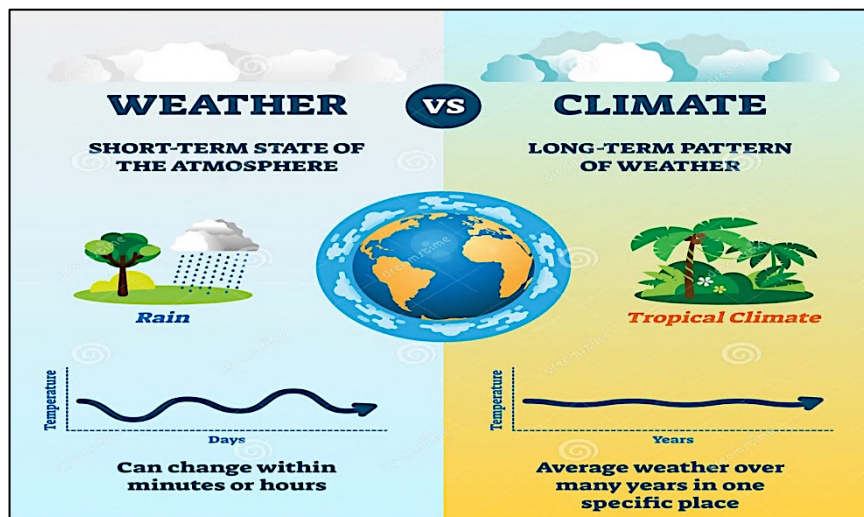


Figure 1: Climate and Weather Differences

2.2.2 Climate Variability and Climate Change

Climate variability and climate change have often been used as substitutes in our daily activities when in fact they are two different things.

Climate variability refers to deviations of the climate statistics over a given period of time (e.g. specific month, season or year) from the long-term climate statistics relating to the corresponding calendar period. In short, it is short term variations (daily, seasonal, annual, inter-annual, and several years). Weather patterns change daily, climate changes too, over a range of timeframe from years, decades, centuries, to millennia and to geological timeframes of the earth. These natural occurring changes, driven by factors both internal and external to the climate systems, are intrinsic to climate itself. The number of important climate drivers in the country and Pacific such as monsoons, ENSO, SPCZ, ITCZ and warm pool, ocean currents and winds impact on our daily lives.

Climate change is the statistically significant variations of the mean state of the climate or of its variability persisting over decades or longer. In other words, a significant change in the mean values of a meteorological element (e.g., temperature, rainfall, etc.) in the course of a certain period of time where the means are taken over periods of the order of a decade or longer (Figure 2).

Climate change can be caused naturally or caused by humans through their activities.

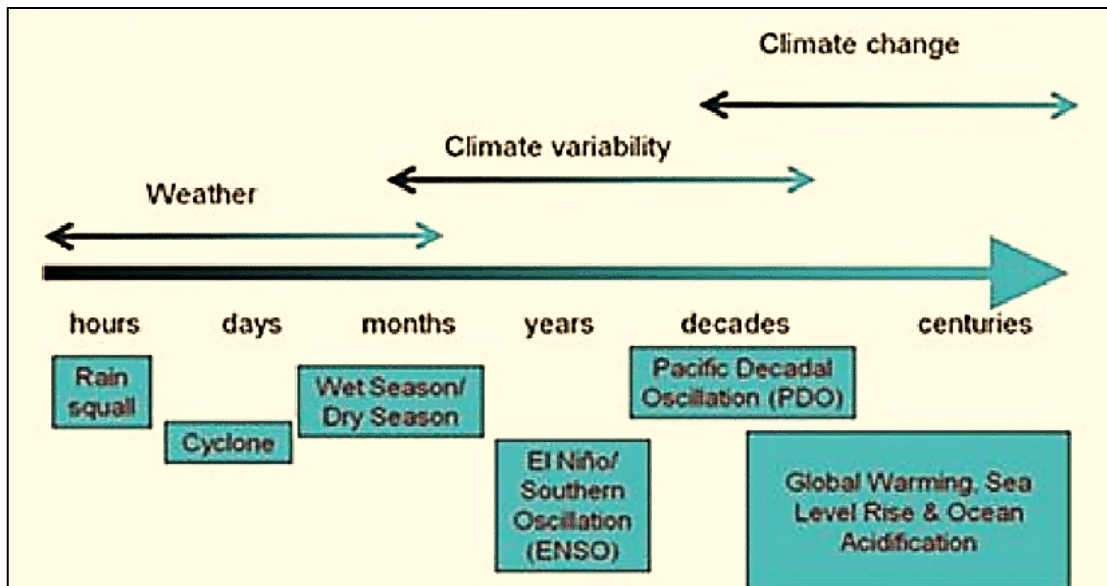


Figure 2: Weather, climate change and climate variability differences¹

2.2.3 Climate System and Climate Components

Our basic knowledge of weather and climate are mostly focused on climate variables (e.g., temperature, rainfall, wind speed, humidity, cloud cover, solar radiation, etc.) that affect our daily lives.

In essence, we should understand that the growth and decay of weather systems also largely influenced by the vertical structure of the atmosphere, the influence of the underlying land and sea and other factors that we are not directly experiencing. The Earth’s climate is determined by the atmospheric circulation, the interaction of the large-scale ocean currents and the land surface with its features like albedo, vegetation, and soil moisture.

The Earth’s climate also depends on factors that influence its radiative balance, like the atmospheric composition, solar radiation and volcanic eruptions. The Earth’s climate system is a highly complex system comprising of five major interacting components which are the atmosphere, the hydrosphere, the cryosphere, the lithosphere, and the biosphere (Figure 3).

¹ Bureau of Meteorology and CSIRO 2022, ‘Understanding climate variability and change’, Pacific climate change futures, Australian Government, <https://www.pacificclimatefutures.net/en/help/climate-projections/understanding-climate-variability-and-change/>

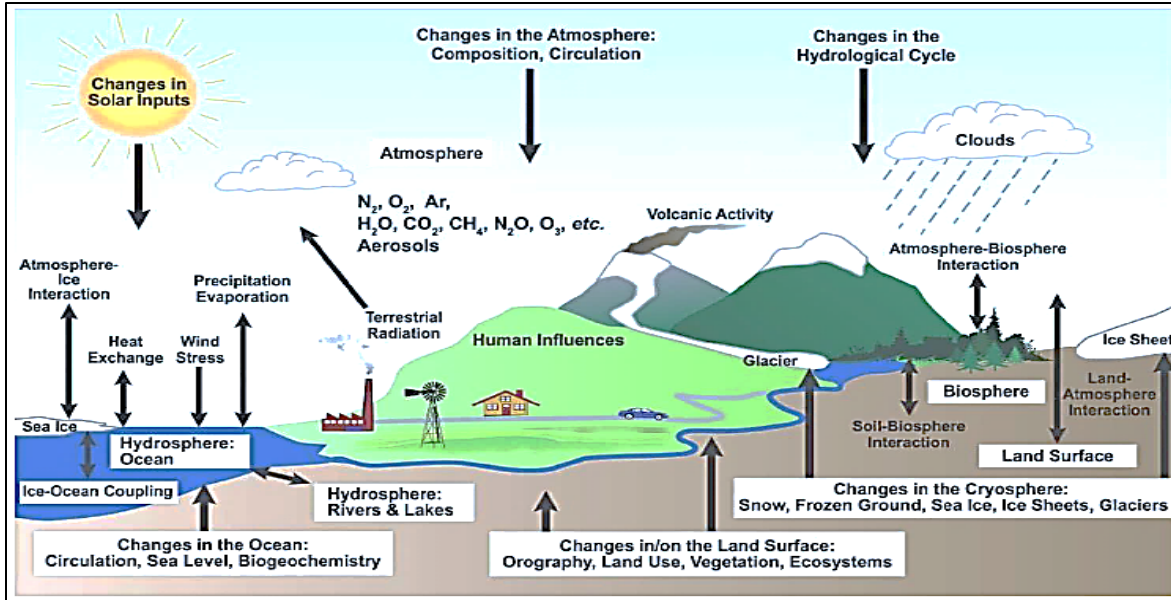


Figure 3: Climate System and Climate Components²

2.2.4 Greenhouse Effect

Greenhouse effect is a natural process in which the greenhouse gases trap the heat (long wave radiation) emitted by the earth, thus keep it within the earth's atmosphere to sustain the life on Earth. The greenhouse gases are heat-trapping gasses (Table 1) which act like a blanket that is wrapped around the Earth to keep it warmer than it would be without them. The Earth's surface will be about 33°C (59°F) colder without the greenhouse gases and no life will persist. Because of their presence and existence, Earth's temperature is kept constant at 15°C (59°F) warmer enabling life to continue flourishing (Figure 4).

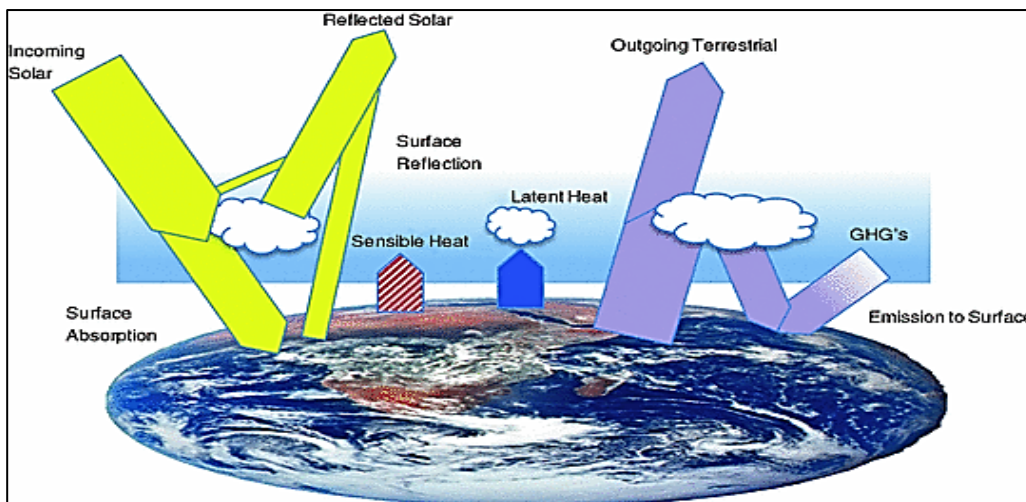


Figure 4: Greenhouse Effect

² Schematic view of the components of the climate system, their processes and interactions (Treut et al., 2007)

Table 1: Greenhouse Gases

Greenhouse gas	Chemical symbol
Water vapour	H ₂ O
Carbon dioxide	CO ₂
Methane	CH ₄
Nitrous oxide	N ₂ O
Hydrofluorocarbons	HFC ³
Perfluorocarbons	PFC
Sulphur hexafluoride	SF ₆

2.2.5 Global Warming

Global warming is defined as a gradual increase in Earth's temperature generally due to the enhanced greenhouse effect caused by the increased levels of carbon dioxide (Figure 5). As the levels of carbon dioxide and other greenhouse gasses increase in the atmosphere, more of the sunlight reflected and solar radiation emitted by the Earth's surface will be absorbed and accumulated. This accumulated heat will cause the atmosphere to become warmer, which then gets transmitted back to the Earth's surface, the ocean, and cryosphere (the frozen parts of the planet that also control the temperature of the planet) and they also become warmer (Figure 6).

The unequivocal warming of the planet Earth is largely attributed to the human activities especially the burning of the fossil fuels that continuously pump more carbon dioxide into the atmosphere.

There are many examples of global warming including extreme weather (e.g. cyclones, droughts, floods, rising sea level and wildfires) that are closely linked to climate change. Global warming is a multitude of associated risks that pose real threats to biodiversity and human health.

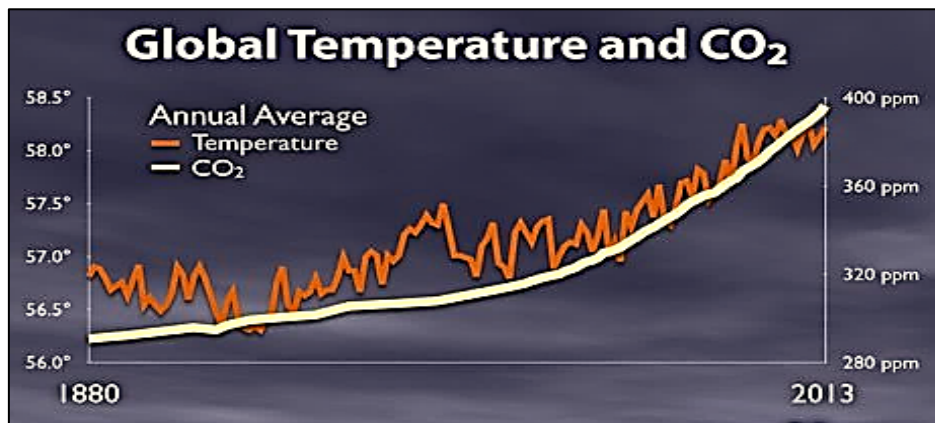


Figure 5: Global Concentration of Carbon Dioxide over Time⁴

³ Both HFC and PFC are organofluorine compounds and PFCs contains only carbon fluorine.

⁴ Columbia Climate School. 2017, The Science of Carbon Dioxide and Climate, Earth Institute, <https://news.climate.columbia.edu/2017/03/10/the-science-of-carbon-dioxide-and-climate/>

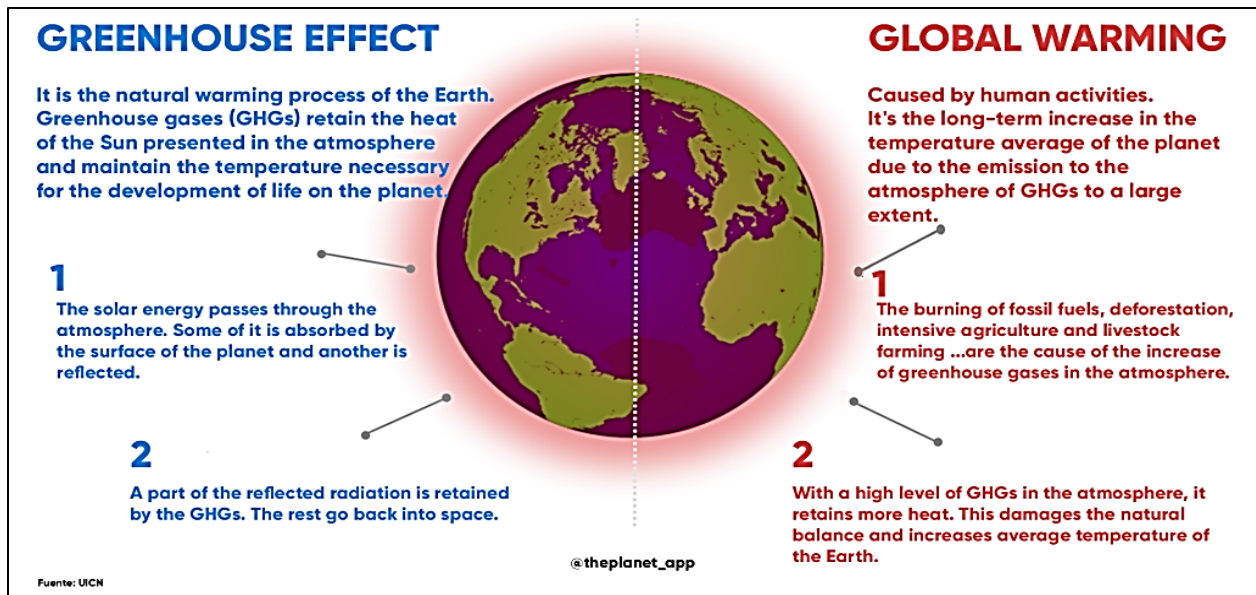


Figure 6: Climate change and global warming⁵

2.2.6 Climate Change

Climate change is generally referred to as the long-term shifts in temperature and weather patterns. These shifts may be natural however since the 1800s human activities have been the main drivers of climate change primarily due to the burning of the fossil fuels such as coal, oil and gas. Fossil fuels contain most of the greenhouse gases which are heat-trapping gases that are released into the atmosphere.

2.3 Climate change impacts

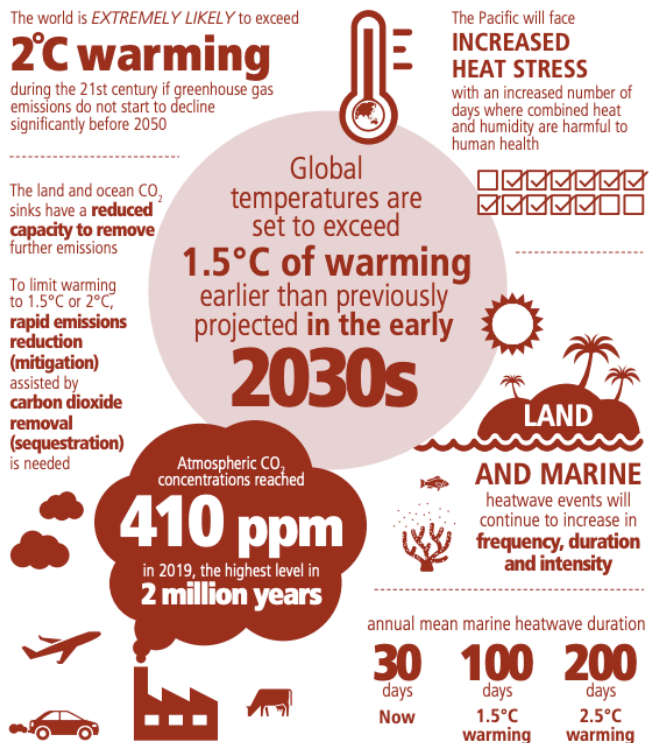
Climate change is already causing widespread disruption in every region in the world with just 1.1 degrees C (2022) of warming. Global climate system is a connected system climate impacts are felt in everywhere around the globe and has impacts (Table 2).

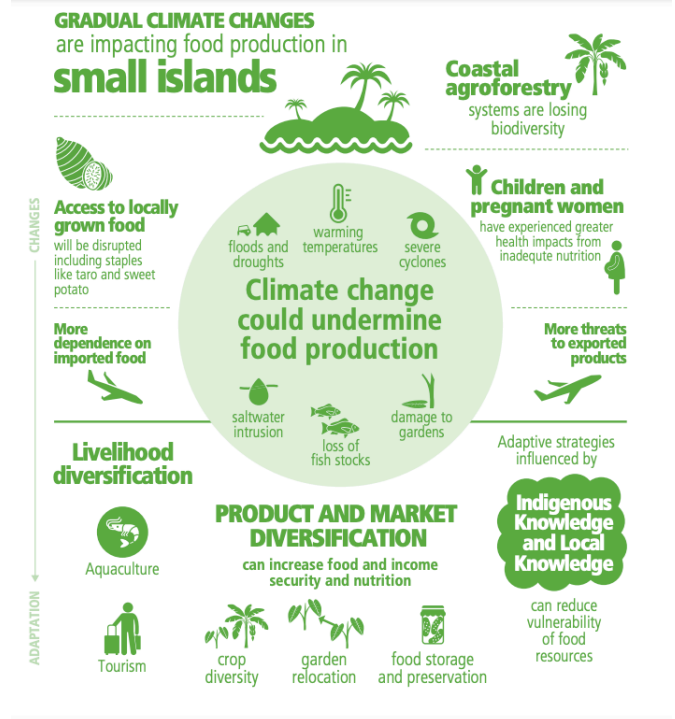
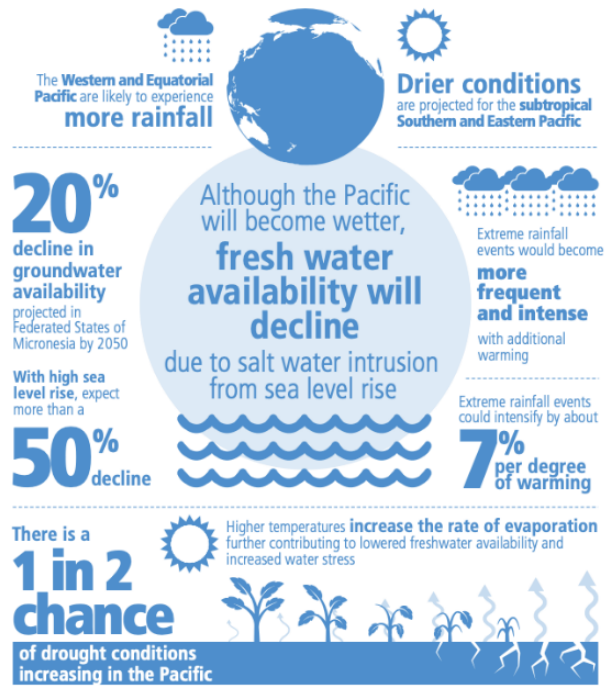
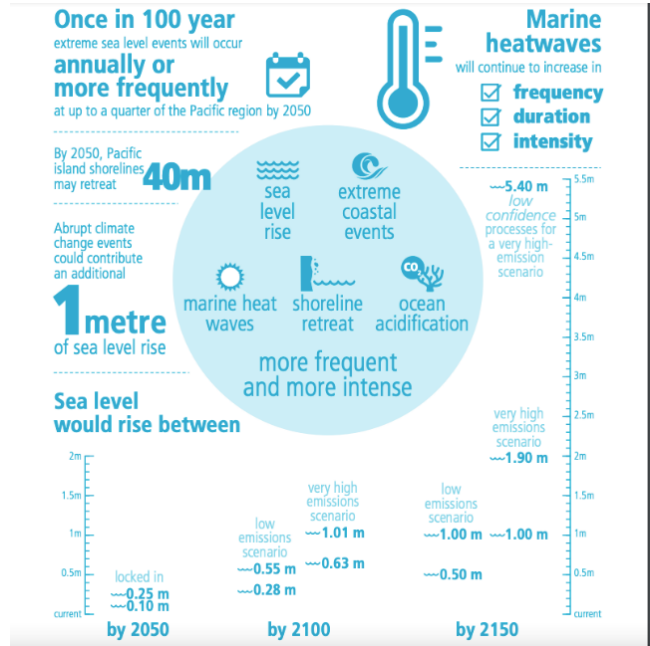
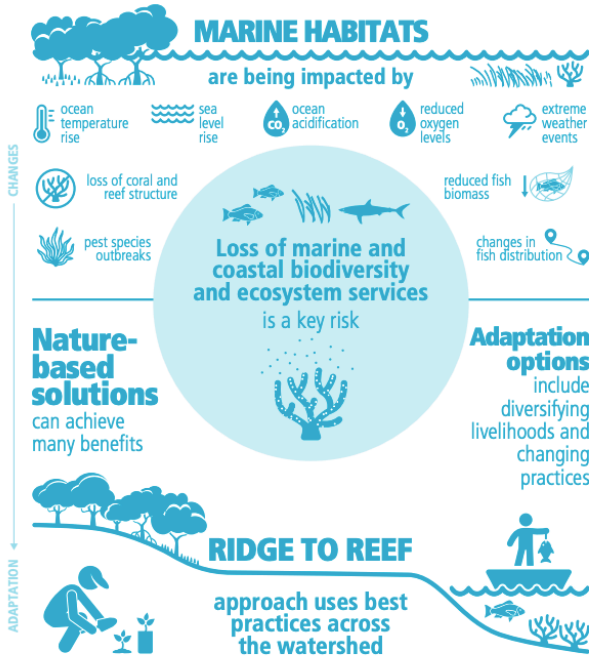
In the Pacific, there will be impacts such as Heat Stress, Slow Onset Stressors & Extreme Events, Loss of Marine Biodiversity Marine, Fresh water, Food security, Health and Adaption (Figure 7).

⁵ The Planet App, 'What are climate change and global warming?' <https://theplanetapp.com/what-are-climate-change-and-global-warming/?lang=en>

Table 2: Climate Change Impacts

Impacts	Explanation
Sea level rise	Average sea level global rose by 20cm in the last 100 years and continue to rise. Many low lying area coastal regions and atolls will submerge under the sea.
Melting ice	Projections suggest the world’s glaciers will have disappeared in the next 100 years including the Polar ice cap, huge Antarctic ice shelf and Greenland may be green again
Torrential rainfall and powerful storms	Increased amount of water in the atmosphere causing heavy and violent downpours. Tropical cyclones will increase in frequency and intensity, and flooding and associated landslides threaten all provinces and sectors.
Heat waves and drought	Despite heavy downpours in some places, severe drought and prolonged heat waves will be experienced more and more
Changing ecosystems	As the word warms, entire ecosystems will change and collapse – particularly marine and coral ecosystems.
Reduced food security	Global and PNG agriculture is threatened by rising temperature though the impacts vary for different areas. Different crops (rice, coffee etc) grow well at certain temperatures hence when temperature changes, their productivity changes significantly
Pests and Diseases	Rising temperatures and humidity favor agricultural pest, diseases and disease vectors. Pest populations are on the rise and sickness common in tropical areas are becoming endemic in much wider zones, e.g. malaria, dengue fever, etc.





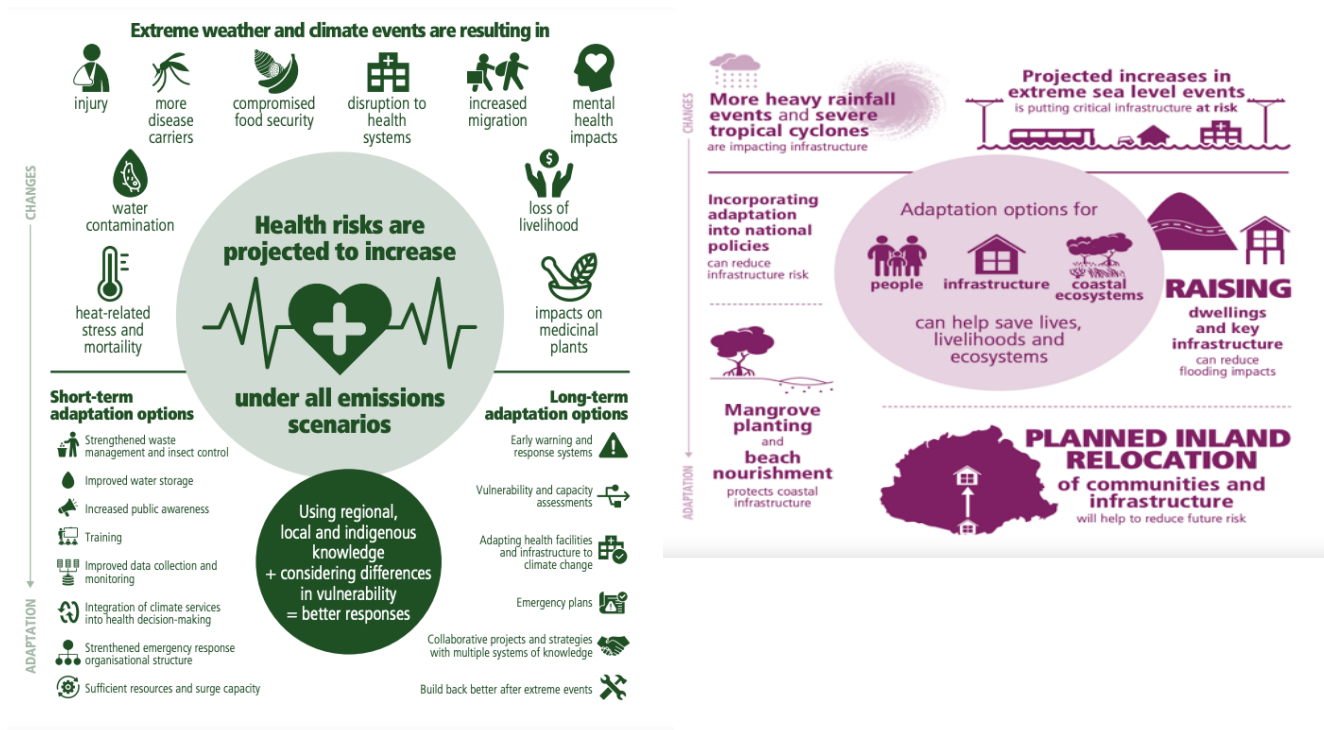


Figure 7: Impacts, Adaptation and Vulnerability in the Pacific ⁶

2.4 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information.

Climate Change & Development Authority (CCDA)
P.O. Box 4017
Boroko
National Capital District
Papua New Guinea Email: info@ccda.gov.pg
Website: www.ccda.gov.pg

⁶ ICEDS. 2022, Factsheets on Impacts, Adaptation and Vulnerability, IPCC Pacific, Institute for Climate, Energy and Disaster Solutions (ICEDS), Australian National University (ANU)

2.5 Activity One: Impacts of Climate Change

Impacts of Climate change increasing

Post Courier dated December 8th 2017

By Nellie Setepano

The impacts of climate change-related hazards in Papua New Guinea have been increasing in intensity and frequency, a climate change meeting in Port Moresby heard. Most coastal and riverine areas are prone to extensive flooding which is one of the most devastating impacts observed to date, it was told.

The country's economy, environment and people are vulnerable and at risk of not meeting basic human development needs due to drastic onset and multitude of this climate change impacts. As a result- five community resilient projects funded by Climate Change Adaptation Fund has seen the five-year projects in five provinces. These projects are as follows: early warning system and mangrove rehabilitation and reforestation program, and climate

change training and livelihood protection in Madang, Morobe, Northern, New Ireland and East Sepik provinces. The meeting by project stakeholders heard that the five-year projects have reached its completion and there was a need for their sustainability.

Inputs from stakeholders such as National Weather Services, Climate Change and Development Authority, Conservation and Environment, civil organizations have come together in Port Moresby this week to present the project, identify lessons and to look for a way forward to sustain the projects. The United Nations Development Program has supported the projects with funding from Adaptation Fund and the Australian Department of Foreign Affairs and Trade.

Source: Setepano, N. 2017, Impacts of Climate Change Increasing, *Post Courier*, December 9, 2017:

<https://postcourier.com.pg/impacts-climate-change-increasing/>

After reading the article from the Post Courier, work individually to identify possible impacts of climate change in Papua New Guinea. In your group, discuss these impacts and group them into direct and indirect impacts.

The facilitator will ask each group to present their discussion to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

2.6 Self-Evaluation

What did you acquire in this session which is beneficial to you?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

2.7 References

- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop
- Australia Institute. 2008, Module 2: The impacts of climate change, <https://australiainstitute.org.au/wp-content/uploads/2021/03/module2.pdf> cited on 2/12/2021
- Britannica. 2022, Methane <https://www.britannica.com/science/greenhouse-gas/Methane> cited on 2/12/2021
- Britannica. 2022, Greenhouse effect, <https://www.britannica.com/science/greenhouse-effect> cited on 30/11/2021
- EPA. 2021, Climate Change Indicators: Atmospheric Concentrations of Greenhouse Gases, United States Environmental Protection Agency, <https://www.epa.gov/climate-indicators/climate-change-indicators-atmospheric-concentrations-greenhouse-gases> cited on 2/12/2021
- Gottelman, A., Rood, R.B. (2016). Components of the Climate System. In: Demystifying Climate Models. Earth Systems Data and Models, vol 2. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-662-48959-8_2
- NASA. 2022, 'What is the Greenhouse Effect?', NASA Climate Kids, <https://climatekids.nasa.gov/greenhouse-effect/> cited on 30/11/2021
- NYC. 2022, Climate Change Education Module, Resources for Educators, <https://www1.nyc.gov/site/dep/environment/climate-change-education-module.page> cited on 2/12/2021
- PSU. 2022, The Physical Basis, Environment and society in a changing world, Department of Geography, <https://www.e-education.psu.edu/geog30/node/383> cited on 2/2/2021
- The Planet App, 'What are climate change and global warming?' <https://theplanetapp.com/what-are-climate-change-and-global-warming/?lang=en> cited on 7/12/2021
- UNEP. 2021, Adaptation Gap Report 2021: The gathering storm – Adapting to climate change in a post-pandemic world. United Nations Environment Programme, Nairobi.
- WHF. 2021 Climate Change Primer, Warm Heart Foundation, <https://warmheartworldwide.org/climate-change/> cited on 5/12/2021
- WMO. 2021, Greenhouse Gas Bulletin: Another Year Another Record, World Meteorological Organisation <https://public.wmo.int/en/media/press-release/greenhouse-gas-bulletin-another-year-another-record> cited on 2/12/2021
- Yoro, K. Michael O. Daramola. 2020, Chapter 1 - CO2 emission sources, greenhouse gases, and the global warming effect (Ch1), In: Rahimpour, M.R., Farsi, M., Makarem, M.A. 2020, *Advances in Carbon Capture*, Woodhead Publishing, pp 3-28 <https://doi.org/10.1016/B978-0-12-819657-1.00001-3>

TOPIC 3: CLIMATE CHANGE VULNERABILITY

Overview

Vulnerability refers to the tendency of something to be damaged or destroyed. It is the inability or susceptibility of something when exposed to an event that it cannot resist. Vulnerability is a new approach to an age-old problem. Instead of focusing on what is going to be wrong, vulnerability gives us the opportunity to focus on getting prepared and doing things right for the future. As a future-focused approach, it is a way of using our strengths and strategically improving our weaknesses.

Climate change vulnerability emerges as a result of poor design, planning and management of climate-related events, or limitations of access or resources. For humanity to be safe and its future to be sustainable, we clearly need to learn to manage our vulnerabilities. Understanding our vulnerabilities enables us to identify the problems from all angles, instead of just focusing on the threats of climate induced events or disasters.

This topic focuses on vulnerability in the context of climate change. The key message is to understand these concepts and how you can apply it to your specific situation and the 4 main sectors.

Aims of Topic 3

The aims of this section include:

- ❖ To enable the participants to have the basic understanding of the concept of vulnerability.
- ❖ Participants understand climate change vulnerability and the implications.
- ❖ The participants plan and develop ways to reduce climate change vulnerability.

Objective

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the concept of vulnerability and also climate induced vulnerability.
- ❖ Identify and explain how the potential (direct and indirect) impacts of climate change cause these sectors to be vulnerable.
- ❖ Identify the potential vulnerability factors within these sectors that cause them to be vulnerable.
- ❖ Understand why it is challenging to respond swiftly due to unpredictable sources and varying range of vulnerabilities.

Knowledge Base

3.1 Takeaways

The following are significant points about vulnerability:

Vulnerability is a concept that has its root originating from the social science field. It is mostly referring to the inability of a unit or a system to withstand the effects of a hostile environment. It involves the extent to which an exposure element (individuals, community, society, or a system) is likely to suffer from harm, injury or even a loss.

Vulnerability demonstrates the connection that people have with their environment including the social, political, economic, cultural and institution values that sustain or challenges them. In the context of climate change, vulnerability refers to the degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes.

3.2 Vulnerability concept

Vulnerability describes the characteristics and circumstances of an individual, community, asset, or a system that makes it susceptible to the damaging effects of an event or a hazard. In other words, vulnerability is about the underlying or pre-existing conditions that exist before a person, community or a system becomes exposed to an event or hazard that causes it to become susceptible (Figure 8). There are several aspects of vulnerability that arise due to these four factors which are physical, social, economic, and environment. Examples include:

- ❖ Poor design and construction of buildings.
- ❖ Inadequate protection of assets.
- ❖ Lack of public information and awareness.
- ❖ Limited recognition of risks and preparedness measures.
- ❖ Disregard of wise environmental management.

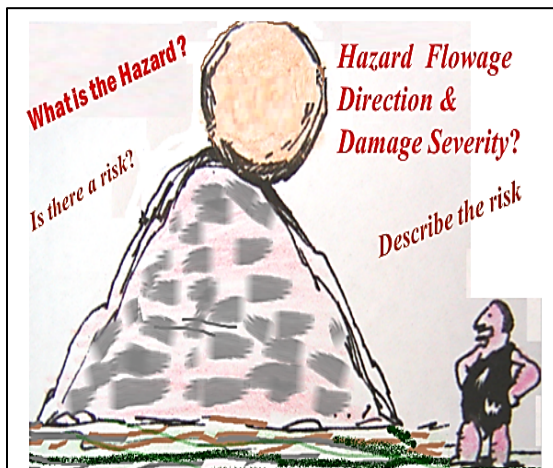


Figure 8: Vulnerability Situation

This person is highly exposed, and they are extremely vulnerable.

What is the underlying condition?

- The underlying conditions are twofold:
 - a. a natural hazard (*external force*)
 - b. a weak condition (*internal force*)

Vulnerability has several key characteristic. They are multi-dimensional, dynamic, and scale-dependent and site specific (Table 3.)

Table 3: Dimensions of Vulnerability

Characteristics	Explanation
Multi-dimensional	It is multi-dimensional in that it can be grouped into physical, social, economic, environmental, institutional aspects and can be influenced by human factors
Dynamic	It is not static but changes over time and from one hazard/disaster to another
Scale-dependent	It can be expressed in different scales from individual person, family, community, sector and even nation as a whole
Site-specific	Every place, locality or site has its own vulnerability and is different from other areas.

There are also four main types of vulnerability, and they are physical vulnerability, social vulnerability, economic vulnerability, and environmental vulnerability (Table 4).

Table 4: Types of Vulnerability

Vulnerability Type	Explanation
Physical vulnerability	Determined by aspects such as population density levels, remoteness of a community, the site, design and materials used for critical infrastructure and for housing (UNISDR)
Social vulnerability	Determined by features like the inability of people, organizations, or societies to withstand adverse impacts to hazards due to characteristics inherent in social interactions, institutions and systems of cultural values. It is linked to wellbeing of individuals, communities, and society. It includes literacy and educational levels, peace and security, access to basic human rights, systems of good governance, social equity, positive traditional values, customs and ideological beliefs and the overall collective organizational systems (UNISDR).
Economic vulnerability	Determined by economic status of individuals, communities, and nation as a whole. The poor are mostly more vulnerable to hazards or disasters because of lack of resources to build sturdy structures and include other engineering measure in place to protect themselves from the negative consequences of disasters
Environmental vulnerability	Determined through depletion of natural resources and resource degradation

There are several vulnerability models that are used to understand the different components of vulnerability. The most common model is known as Pressure and Release (PAR) model of vulnerability (Figure 9).

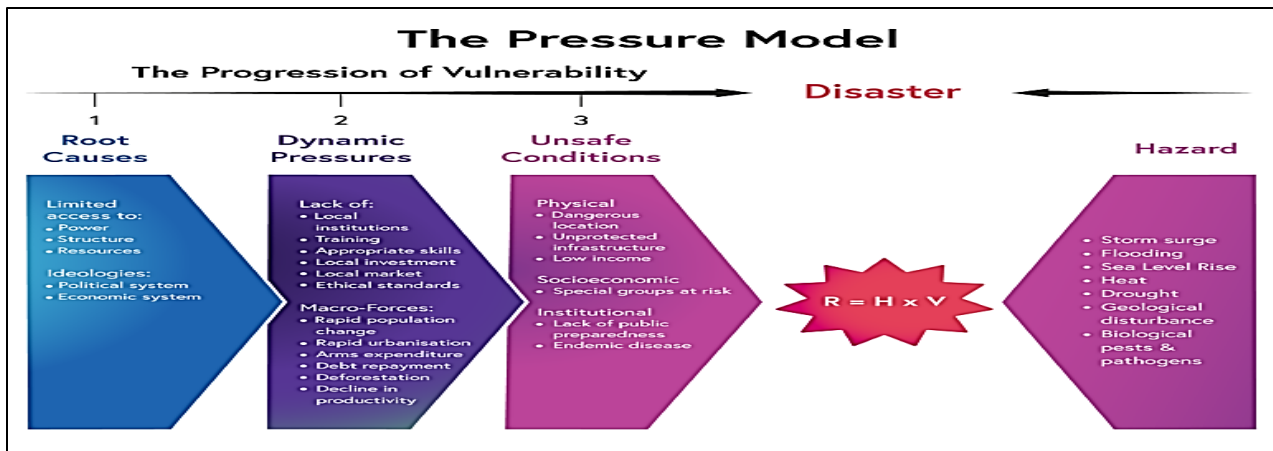


Figure 9: Pressure and Release Model⁷

PAR is a tool that shows that disaster is a product of hazard and vulnerability. It shows that people’s vulnerability is a combination of three factors: (a) root causes, (b) dynamic pressures and (c) unsafe conditions.

These factors are interlinked hence the root causes lead to dynamic pressures which result in unsafe conditions. This is termed as the “progression of vulnerability”.

Hazard is the potential of an event (human or natural) to cause harm, injuries, losses, damages or even deaths to any individual, community, society or economy exposed to that situation. When vulnerability is relatively high, a hazard will inevitably have a catastrophic impact on those exposed to the hazardous event, substance, situation, etc.

Disaster risk emerges when a hazard meets the vulnerability ($R = H \times V$)

3.3 Climate change vulnerability

There are numerous interpretations for climate change vulnerability. Moreover, vulnerability changes with the scale of observation and the system in question.

For example:

A community may not be vulnerable to climate change yet a population within the community can be extremely vulnerable to climate change (assuming this population is located near the coast, etc.) Human population in a certain location may not be vulnerable to climate change yet the wildlife of that place may be extremely vulnerable.

Under climate science, three terms have been coined to determine the extent of climate change vulnerability and a means to assign indicators to measure the vulnerability. They are also referred to as the vulnerability elements and include exposure, sensitivity, and adaptive capacity (Table 5).

⁷ CU. 2022, Progression of vulnerability and hazard: Hazards, vulnerabilities and risks- the Pressure and Release (PAR) model, Coventry University (CU) <https://www.futurelearn.com/info/courses/humanitarian-action-response-relief/0/steps/60984>

Table 5: Vulnerability Elements

Element	Explanation
Exposure to climate change	<p>Implies contact between a system and climate. It is external to the system: climate events from outside are impact the system and causing an effect</p> <p>Common examples of exposure to climate risks include exposure to extreme events and diseases.</p> <p><i>Example: Assume a coast village is within 5km from the sea, it is exposed to cyclones, rising sea level, coastal flooding, etc.</i></p>
Sensitivity to climate change	<p>Implies the degree to which the system is affected by its exposure to event. It represents the internal characteristics of the system</p> <p>It is like immunity: if you do not get seasonal flue whenever the weather changes (exposure), it means you are less sensitive to the changing weather.</p> <p><i>Example: Our coastal villages would be more sensitive to cyclones if their livelihood depends on sea-based tourism or if there are no wind-resistant trees within their area or if their locations are below the sea level.</i></p>
Adaptive capacity	<p>Refers to the ability of an individual, community or society to develop resilience and adjust to the climate impacts and risks.</p> <p>Adaptive capacity is a function of access to financial, technical, educational, and community resources.</p> <p><i>Example: If our coastal villages have access to early warnings of cyclones and have the ability to move to higher ground fast, they would be considered to have high capacity.</i></p>

In practice, these three aspects of vulnerability are interconnected. There is a positive relationship between exposure and sensitivity and this connection influences the level of impacts. Conversely, there is a negative relationship between the impact and adaptive capacity hence increasing adaptive capacity leads to reduction in the impact level.

For example, the coastal villages can reduce their sensitivity to cyclones if they invest in an intensive tree plantation program that protects their livelihoods and assets from the cyclones. Their ability to invest is their adaptive capacity. This also applies to building resilient infrastructure which reduces exposure to climate change risks.

High vulnerability implies a situation where the exposure to climate risks is high, the sensitivity of the system is high, and the adaptive capacity is low. Climate change adaptation projects and programmes use this approach to assess climate vulnerability, define the indicators and measures to improve the resilience of a community towards climate risks (Figure 10).

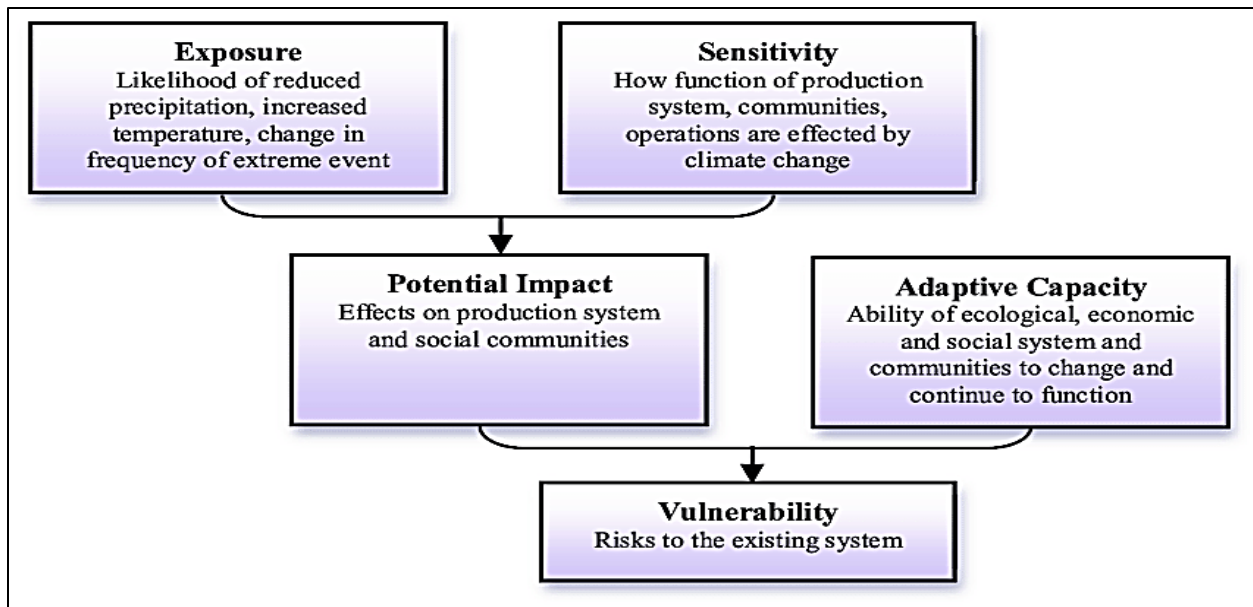


Figure 10: Key components of vulnerability – illustrating the relationship among exposure⁸

3.4 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)
 P.O. Box 4017
 Boroko
 National Capital District
 Papua New Guinea Email: info@ccda.gov.pg
 Website: www.ccda.gov.pg

⁸Jamshidi, Omid & Asadi, Ali & Kalantari, Khalil & Azadi, Hossein & Scheffran, Jürgen. 2019, Vulnerability to climate change of smallholder farmers in the Hamadan province, Iran. *Climate Risk Management*. 23. 146-159. 10.1016/j.crm.2018.06.002.

3.5 Activity Two: Climate Change Vulnerability

Climate Vulnerability Assessment Underway in Bougainville Atolls



A United Nations-backed team in touring Bougainville's outer islands in February 2022, was conducting climate change vulnerability assessments on the islands and its communities. Community leaders during the consultations on climate change impacts on Tasman Island, emphasized that that climate change and sea level changes continues to pose long term disaster to coastal areas and its resources such as agriculture, health and infrastructure. The team was on a 30-day sea journey, sailing to Nuguria, Tasman and Mortlock Island Groups, northeast of Bougainville. They're also in consultations at Tinputz on Bougainville's mainland, with resettled Carteret Islanders. These are communities at risk from rising sea levels affecting housing, health, and food and water security.



These consultations are initiatives UN Development Programme, PNG's government and the Asian Development Bank. UNDP's Resident Representative, Dirk Wagener said the discussions are intended to inform decision makers on the existing threats and impacts of climate change. "These efforts will result in UNDP supporting these communities deliver practical and sustainable measures to help them better adapt to these impacts that are rapidly altering the way people live." According to *Relief Web*, to date the team have conducted assessments in Morobe Province on PNG's mainland, as well as East New Britain and Manus Provinces in the New Guinea Islands region, visiting a total of 12 islands and atolls.

A series of community consultations and activities were conducted, with a total of over 500 men, women and children consulted on the impacts and developing adaptation and mitigation options on climate change for their communities. The team also offers among other support, Climate Change Vulnerability Assessment training for authorities and other "critical stakeholders". The UNDP team also conducted training in Buka Island.

Source: Radio New Zealand. 2021, Climate Vulnerability Assessments underway in Bougainville Atolls, Radio New Zealand (RNZ), <https://www.rnz.co.nz/international/pacific-news/434815/climate-vulnerability-assessment-underway-in-bougainville-atolls>

After reading the article on climate vulnerability assessment in PNG, work individually to identify possible underlying vulnerability factors to climate change induced sea level rise within the island and atolls of Papua New Guinea.

In your group, discuss and cluster these factors into the four categories (Underlying vulnerability factors, Vulnerability components and Vulnerability Level):

CLIMATE CHANGE VULNERABILITY				
SECTOR				
Underlying vulnerability factor	Vulnerability component			Vulnerability level
	Impact		Adaptive Capacity	
	Exposure	Sensitivity		
	H M L	H M L	H M L	H M L

H = High M = Medium L = Low

The facilitator will ask each group to present their discussion to the audiences. After the group presentations, an open 10 minute discussion follows afterwards.

3.6 Self-Evaluation

Answer these questions:

What did you acquire in this session which interested you?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

3.7 References

- Aung T; Kaluwin.C; Kilepak.M and Samuel.P: Book Title: Climate Change in the Pacific, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop.
- Kaluwin.C and Samuel.P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- FAO. 2015, Assessing climate change vulnerability in fisheries and aquaculture, available methodologies and their relevance to the sector, fisheries and aquaculture technical paper, Food and Agriculture Organization (FAO), Rome.
- Fellmann, T. 2012, The assessment of climate change-related vulnerability in the agricultural sector: reviewing conceptual frameworks, *Building resilience for adaptation to climate change in the agriculture sector*, Proceedings of a Joint FAO/OECD Workshop, UN Food and Agriculture Organisation (FAO) <https://www.fao.org/3/i3084e/i3084e04.pdf> cited 2/12/2021
- UMass. 2017, Climate Action Tool: Climate Change Vulnerability Assessments, University of Massachusetts Amherst, [Climate Change Vulnerability Assessments | Massachusetts Wildlife Climate Action Tool](#) cited 2/12/2021
- UNISDR. 2004, What does vulnerability mean? Learning from today's disasters for tomorrow's hazards: 2004 World Disaster Reduction Campaign, United Nations Office for Disaster Risk Reduction (UNISDR) <https://www.unisdr.org/2004/campaign/booklet-eng/Pagina8ing.pdf> cited 2/12/2021
- World Bank. 20021, 'Papua New Guinea: Vulnerability', Climate Change Knowledge Portal for Development Practitioners and Policy Makers, World Bank, <https://climateknowledgeportal.worldbank.org/country/papua-new-guinea/vulnerability> cited 2/12/2021

TOPIC 4: CLIMATE CHANGE RISKS

Overview

Though risk is a familiar term, there is no agreed definition of risk. In the risk literature, the concept of risk is used as an expected value, a probability distribution, as uncertainty and as an event. Risk usually implies an unexpected loss, an unexpected disutility, the probability of an adverse outcome or a measure of the probability and severity of an adverse effect. Climate change risk refers to the consequences, likelihoods, and responses to the impacts of climate change. The impacts of climate change produce multitudes of risks which can both be expected and unexpected.

Understanding the basic components of risk is crucial to the assessment and management of risks. It is vital to know that ongoing changes in the climate system pose great challenge to assessing climate risks. Applying current knowledge to understanding climate risks is further complicated by the massive differences in the regional climate projections, the expanding numbers of climate model results, and the need to select an appropriate set of future climatic scenarios to compile the assessments.

This topic focuses on risks in the context of climate change. The key message is to understand these concepts and how you can apply it to your specific situation.

Aims of Topic 4

- ❖ To enable the participant to have the basic understanding of the concept of risk,
- ❖ To enable participants to understand climate change risks and their implications, and
- ❖ To enable the participants plan and develop ways to reduce climate change risks.

Objective

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the concept of risk and climate change risks.
- ❖ Identify the potential (anticipated and unanticipated) climate change induced risks that affect these sectors.
- ❖ Apply the risk assessment techniques and tools to evaluate and prioritize the risks.
- ❖ Understand why regular risk assessment appraisal is crucial due to the level of uncertainties and the existence and presence of emerging residual risks.

Knowledge Base

4.1 Takeaways

The key points regarding concepts of risk and climate change risk are:

Risks are inevitable part of our society. Risks have shaped our society while human have also influenced the nature of risk through our choices and our activities on this planet Earth. There are a multitude of descriptions of risk, however it is normally defined as a combination of both the probability and the consequences of the event. In other words, risk may involve a degree of uncertainty and a potential loss from a given situation at a given time. In our daily activities, risk is an exposure to a loss, injury, or death. Risk is a factor, thing, element, or situation that involves undefined threat. From the climate change perspective, climate risks refer to the potential for adverse consequences for human or ecological systems, recognizing the diversity of values and objectives associated with such systems.

4.2 Risk concept

A precise definition of risk is difficult, and its measurement is also debatable. Risk means different things, although the general description implies “chances or probability of danger, loss, peril, injury”.

Risk is a condition in which there is a possibility of an adverse deviation from a desired outcome that is expected or anticipated. This implies:

- Risk is not subjective – it is a state of the real world.
- Risk can exist regardless of whether it is perceived.
- Risk can be imaged where the possibility of loss does not exist (subjective).
- Risk is an uncertainty event or condition that, if it occurs, will produce either a negative or positive effects or consequences.

Risk is commonly characterized by two factors: the likelihood of the event occurring and the impact of the event.

The likelihood: the probability of the risk event occurring in each place at a given time.

The Impact: the consequences that occurs after the event has taken place.

General risk equation is **Risk = Likelihood x Impact**

Generally, the concept of risk is more complex than the simple equation stated above, it comprises issues requiring cognitive analysis relating to the nature of the risk, the organization and people exposed to the risk

Risk Profile	Set of risks that may affect all or part of an organization
Risk Perception	It describes how people perceive risks according to their values and interests
Risk Attitude (Existing Risk Profile)	If an organization is particularly effective in managing certain types of risks, it may be willing to take on more risk in that category, conversely, it may not have any appetite in that area

Risk Capacity	The maximum level of risk that an organization can assume without violating the regulatory burden
Risk Acceptance	Refers to the maximum potential impact of a risk event that an organization could withstand.
Risk Retention	Considers stakeholders' conservative return expectations and a very low appetite for risk-taking.
Risk Tolerance	Refers to the level of variation that the entity is willing to accept around specific objectives

Risk can be categorized into many types. Examples include social risks, economic risks, environmental risks, political/regulatory risks, legal risks and management risks (Table 6).

Table 6: Types of Risks

Risk Type	Explanation
Social risks	The impact of changes in social norms, movements and unrests
Economic risks	The impact of changes in the economic growth and economic development
Environmental risks	The uncertainties about environmental liabilities or impacts on the changes to the environment
Political risks	The impact of political decisions and changes in regulations
Legal risks	The uncertainties related to lawsuits or the freedom to operate
Management risks	The impact of the decisions by the management team on the company, entity, institutions, etc.

4.3 Risk Management

The risk management is the process of identifying, assessing, and controlling the threats to an individual, community, organization or society's livelihoods and assets (Figure 12). This process provides a clearly defined method of knowing what risks and opportunities are present, how they could impact the elements at risk and how to respond swiftly to them. A successful risk management programme will enable individuals, communities and organizations consider the full range of risks that they will face



Figure 11: Risk Management Process

Implementing risk management process is vital for any organization (Figure 11). Good risk management does not have to be resource intensive or difficult for organizations to undertake. With a little formalization, structure, and a strong understanding of the organization, the risk management process can be rewarding.

The key steps are; (1) identify risks, (2) assess the risks, (3) control risks and (4) review risks. These steps have to be prudently followed in order to ensure that unacceptable risks are made tolerable.

4.4 Risk assessment

Risk assessment is the overall process or method that includes (1) identification of hazards or risk factors that have the potential to cause harm [*hazard identification*], (2) analysing the risks associated with the hazard [*risk analysis*], (3) evaluating the those associated risks [*risk evaluation*], (4) determining appropriate ways to eliminate the hazard or control the risk when hazard cannot be eliminated [*risk control/treatment*]. The risk assessment process is crucial to identify things, situations, processes, etc. that may be a potential cause of harm, injury and loss to the people, economy, and environment (Figure 12).



Figure 12: Risk Assessment Process

The aim of risk assessment process is to evaluate hazards, then remove that hazard or minimize the level of its risk by imposing control measures, as appropriate. By doing so, you have created a safer and healthier workplace.

The goal is to try to answer the following questions:

- ❖ What can happen and under these circumstances?
- ❖ What are the possible consequences?
- ❖ How likely are the possible consequences to occur?
- ❖ Is the risk controlled effective or does it need further actions?

4.5 Risk communication

Risk communication is a process of exchanging information amongst the interested parties about the nature, magnitude, significance, or control of the risk. It should be a two-way messaging process and is often associated with an expected event that examines outcomes from behaviours or exposures. In this process, messaging should be consistent and sensible in order to protect the people affected by a hazard, pandemic or disasters.

In this process, delivering timely and accurate information in an open discussion with the audience is crucial to build trust from those exposed to the hazard, pandemic or disaster (Figure 13). The prime goal of risk communication is to reduce and contain any harm during the time of a crisis. In a disaster or pandemic situation, a risk communication plan is the best way to prevent, contain, and mitigate the spread of the contagion.

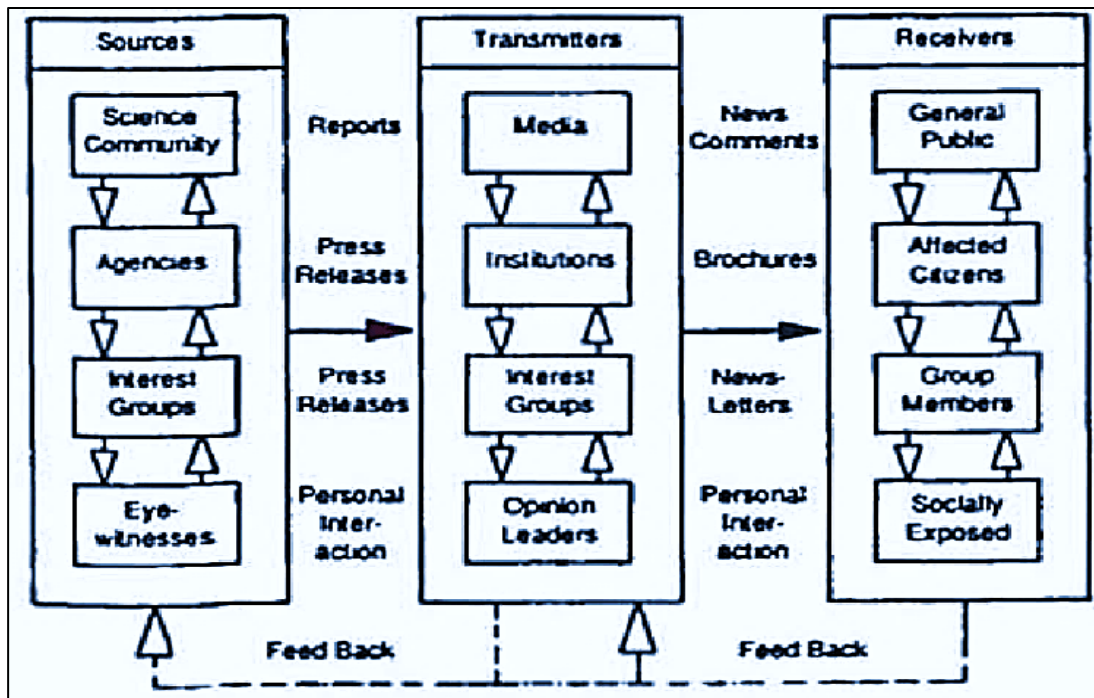


Figure 13: Organizational Structure of Communication⁹

4.6 Climate change risk

According to IPCC Assessment Report 6 (2022), risk is the potential for adverse consequences for human or ecological systems, recognizing the diversity of values and objectives associated with such systems.

In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. Relevant adverse consequences include those on lives, livelihoods, health and wellbeing, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species

In the context of climate change impacts, risks result from dynamic interactions between climate-related hazards with the exposure and vulnerability of the affected human or ecological system to the hazards. Hazards, exposure and vulnerability may each be subject to uncertainty in terms of magnitude and likelihood of occurrence, and each may change over time and space due to socio-economic changes and human decision-making (see also risk management, adaptation, mitigation).

In the context of climate change responses, risks result from the potential for such responses not achieving the intended objective(s), or from potential trade-offs with, or negative side-effects on, other societal objectives, such as the Sustainable Development Goals (see also risk trade-off).

⁹ Renn, O. (1991). Risk communication and the social amplification of risk. In: Kasperson, R.E., Stallen, P.J.M. (eds) *Communicating Risks to the Public. Technology, Risk, and Society*, vol 4. Springer, Dordrecht. https://doi.org/10.1007/978-94-009-1952-5_14

Risks can arise for example from uncertainty in implementation, effectiveness or outcomes of climate policy, climate-related investments, and technology development or adoption, and system transitions.

In recent decades, changes in climate have caused substantial impacts on both natural and human systems on all continents and across the oceans.

Based on IPCC Working Group II AR5, climate change risk comprises (1) the likelihood of impacts of climate-related hazards (single events or trends) like sea level rise, acidification, increases in water temperatures, (2) an understanding of how exposed the system is to the hazard such as the number of coastal communities in a region, the number of commercially vital fish species in a lake, the existence of coral reefs, and (3) an understanding of the vulnerability context existing within the system especially the exposure, sensitivity and adaptive capacity. It also includes the socioeconomic factors (demographics, governance frameworks, etc.) that can influence how a system is exposed to climate-related drivers, how it is sensitive to such drivers and whether or not the system is able to adjust, cope or take advantage of change (Figure 14).

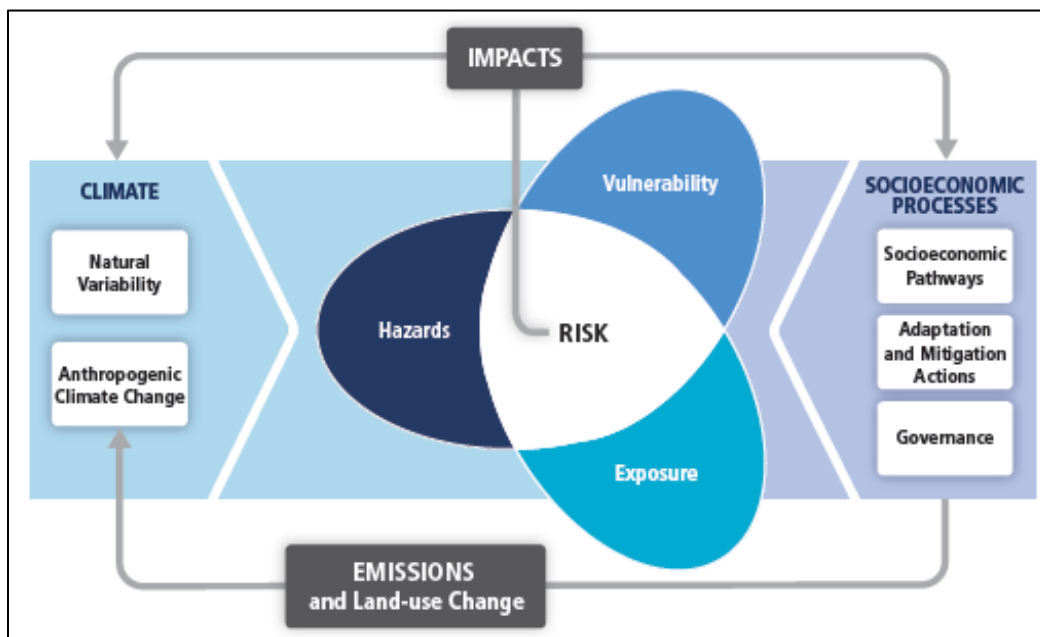


Figure 14: Concept of risk and vulnerability to climate change¹⁰

As illustrated in the Figure 14, the risk of climate related impacts are the result of the interactions between the climate-induced hazards (including hazardous events and trends) and the vulnerability and exposure of humans and natural systems. Changes in both the climate system (left) and socioeconomic processes including adaptation and mitigation (right) are drivers of hazards, exposure, and vulnerability.

¹⁰ Illustration of the fundamental concept of risk and vulnerability to climate change. Source: IPCC 2014 (Fifth Assessment Report, Working Group 2, Chapter 19, Figure 19-1).

4.7 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)

P.O. Box 4017

Boroko

National Capital District

Papua New Guinea Email: info@ccda.gov.pg

Website: www.ccda.gov.pg

4.8 Activity Three

Atolls at Risk, Say Mori

Post Courier, dated June 2nd, 2021

By Romalus Masio

Climate change is a big threat to the small atoll islands of Bougainville and PNG. This was revealed by the Honourable Mr. Wera Mori, the Minister for Conservation, Environment and Climate Change during the farewell function at Reasons Bar and Grill on Buka Island. The reception was hosted by ABG member for Konnou Constituency Willie Masiu and his wife Betty who is from Chuave in Simbu.

Mr. Mori had the first-hand information after spending a day and night at Han Village of Carterets Island, the home of the first climate refugees in the country and the world. Mr. Mori who the chairman of the 52 countries on impacts of climate change witnessed and saw first-hand the rising sea level, dying reefs, waves coming in and destroying the atoll islands creating a big problem and put lives of people in the island in big danger. “We must find ways to solve this problem caused by climate change,” he said. “It is now our duty as leaders in the government to help our people. The National Government must support ABG so that our people can stay safe and enjoy their stay at their homes.” During Mr. Mori’s visit to Bougainville he travelled to Amun, Petats, Tinputz, Kunua and Carterets Islands and stated that now he has a fair idea

what people are facing here on Bougainville I regard to climate change.

He urged all Bougainvilleans along the shores to start planting mangroves (adaptation options) because the sea is rising and destroying the shores due to melting of ice from both South and North poles and warming of the oceans from the Pacific region adding that in a year. The relative sea level rise in Bougainville is between 8-10 millimetres each year. It is challenge and will cause a big problem for us because a lot of mangroves will die out due to too much salt from the sea water. Mr. Mori said the impact of the pollution from greenhouses was causing the temperature to rise, creating airborne diseases to easily spread. He said he witnessed first-hand the threats of climate change on the island of Bougainville. For himself Bougainville was the first victims of climate change and now he has a story to tell in the next meeting on Climate change in Glasgow in Scotland. “I want to assure you that this trip was not a waste. I will tell your story to the world.” The minister said. Present also during the night was the Bougainville Regional Member Peter Tsiamalili and a live band and bamboo band to entertain the guests.

Source: Masiu, R. 2021, ‘Atolls at Risk, Says Mori’, *Post Courier*, June 2, 2021, <https://postcourier.com.pg/atolls-at-risk-says-mori/>

After reading the article “Atolls at Risk, Says Mori”, work individually to identify possible potential risks from climate change facing the atolls Islands of Bougainville and PNG. Then in a group discuss your individual findings:

- Participants must be arranged into groups of 10 or less (depending) people
- Participants agree on a facilitator and someone to be the recorder and presenter for them
- Each participant has to identify climate change risks for their specific sector.
- Group discusses all ideas and use the WGII AR5 climate risk framework to assess and prioritize the risks

CLIMATE CHANGE RISK										
SECTOR										
IMPACT (H x E x V)									RISK	
Climate Change induced Hazards	Hazard (H)			Exposure (E)			Vulnerability (V)			RISK
	H	M	L	H	M	L	H	M	L	
Sea level rise										

The facilitator will ask each group to present their results to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

4.9 Self-Evaluation

What did you acquire in this session which are you most proud of?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

4.10 References

Aung.T; Kaluwin.C; Kilepak.M and Samuel.P: Book Title: Climate Change in the Pacific, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.

Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop

Accastello, C., Cocuccioni, S., & Teich, M. (2021). The Concept of Risk and Natural Hazards. In M. Teich, C. Accastello, F. Perzl, & K. Kleemayr (Eds.), Protective forests as Ecosystem-based solution for Disaster Risk Reduction (ECO-DRR) [Working Title]. IntechOpen.
<https://doi.org/10.5772/intechopen.99503>

CCOHS. 2022, Risk Assessment, OSH Answer Factsheets, Canadian Centre for Occupational Health and Safety, https://www.ccohs.ca/oshanswers/hsprograms/risk_assessment.html cited on 4/12/2021

Cisneros, H. et al. 2021, Risky Business: The Economic Risks of Climate Change in the United States, Risky Business Project, <https://riskybusiness.org/report/national/> cited on 4/12/2021

Jones, R. 2003, Managing Climate Change Risks, Working Party on Global and Structural Policies, OECD Workshop on the Benefits of Climate Policy: Improving Information for Policy Makers, <https://www.oecd.org/env/cc/19519189.pdf>

Kaluwin, C. & Samuel, P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.

NCCARF. 2017, How to conduct a climate change risk assessment, Coast Adapt, National Climate Change Adaptation Research Facility (NCCARF) <https://coastadapt.com.au/how-to-pages/how-to-conduct-a-climate-change-risk-assessment>

Reisinger, A., Howden, M., Vera, C. et al. (2020) The Concept of Risk in the IPCC Sixth Assessment Report: A Summary of Cross-Working Group Discussions. Intergovernmental Panel on Climate Change (IPCC), Geneva, Switzerland. pp15
https://www.ipcc.ch/site/assets/uploads/2021/02/Risk-guidance-FINAL_15Feb2021.pdf cited on 4/12/2021

Renn, O. 1991, Risk communication and the social amplification of risk. In: Kasperson, R.E., Stallen, P.J.M. (eds) Communicating Risks to the Public. Technology, Risk, and Society, vol 4. Springer, Dordrecht. https://doi.org/10.1007/978-94-009-1952-5_14

Science Direct. 2021, Risk communication, Science Direct, <https://www.sciencedirect.com/topics/medicine-and-dentistry/risk-communication> cited on 4/12/2021

UK Government. 2021, UK Climate Change Risk Assessment 2022, Climate Change Committee (CCC), UK Government, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1047003/climate-change-risk-assessment-2022.pdf cited on 4/12/2021

UNCC. 2021, Climate-related risks and extreme events, United Nations Framework Convention on Climate Change (UNFCCC), <https://unfccc.int/topics/resilience/resources/climate-related-risks-and-extreme-events> cited on 4/12/2021

TOPIC 5: CLIMATE CHANGE ADAPTATION AND RESILIENCE

Overview

It's more cost effective and less damaging to include adaptation at design and planning stages than to adjust to impacts afterwards. Adaptation is defined as the adjustment in ecological, social, or economic systems in response to the actual or expected climatic stimuli and their effects or impacts. Adaptation implies changes in processes, practices, and structures to moderate potential damages or to benefit from new opportunities emerging from climate change. It also means countries must develop adaptation solutions and take actions to respond to the impacts of climate change that already occurred as well as prepare for future.

On the other hand, resilience implies the condition or capacity that enables an individual, group, community, or society to bounce back to normal when affected by a devastating event.

This topic focuses on adaptation and resilience in the context of climate change. The key message is to understand these concepts and how you can apply it to your specific situation.

Aims of Topic 5

- ❖ To enable the participant to have the basic understanding of the concept of climate change adaptation
- ❖ To enable the participant to have the basic understanding of the concept of climate change resilience
- ❖ To enable participants, understand the climate change adaptation/resilience and their implications
- ❖ To enable the participants plan and develop adaptation/resilience activities to climate change

Objective

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the concept of adaptation and the climate change adaptation.
- ❖ Understand the concept of resilience and the climate change resilience.
- ❖ Identify the potential resilience and adaptation factors for each sector.
- ❖ Apply the resilience assessment techniques and tools to address climate change risks.
- ❖ Understand why resilience and adaptation valuation is critical in managing climate risks

Knowledge Base

5.1 Takeaways

The following are main points regarding the concepts of adaptation and resilience:

The complexity involved in defining rather simple concept like adaptation and resilience is widely recognized. Adaptation refers to adjustments in ecological, social or economic systems in response to actual or expected climatic stimuli and their effects or impacts. It refers to changes in processes, practices, and structures to moderate potential damages or to benefit from opportunities associated with climate change.

Adaptation solutions take many shapes and forms depending on the unique context of the place, business, organization, country, or region. There is no “one-size-fits-all-solution-adaptation can range from building flood defences, setting up early warning systems for cyclones and switching drought resistant crops, to redesigning communication systems, business operations and government policies.

Successful adaptation does not depend only on the government but also on the active and sustained engagement of stakeholders including national, regional, multilateral, international organizations, the public and private sectors, civil society, and other relevant stakeholders.

Climate resilience refers to the adaptive capacity for socioeconomic systems to absorb stresses and maintain function in the face of external stresses imposed upon them by climate change. Climate resilience is often linked to acute events like heat waves, heavy precipitation, tropical cyclone, or wildfire that will be more frequent or intense as climate change continues. Proactive resilience planning should account for chronic event like rising sea level, worsening air quality and massive population migration.

Climate change adaptation is defined as the actions that reduce the negative impacts of climate change while also taking advantage of the potential new opportunities. Climate change adaptation may involve adjusting the policies and actions to accommodate the changes from the actual or expected future climate.

The goal of adaptation is to reduce vulnerability to the adverse effects of climate change like rising sea level, more intense extreme weather events, diseases, and food security. Adaptation actions such as moving to higher ground to avoid rising sea levels, planting new crops that tolerate changing climate conditions, using new building technologies or creating climate resilient infrastructures.

Resilience is commonly defined as a process of effectively negotiating, adapting to, or managing significant sources of risks from a given hazardous situation or event. In other words, resilience or resiliency is our ability to adapt and bounce back positively when things do not go well as planned or we face unexpected issues. With strong resilience, people will not dwell on their failures, they will acknowledge the situation, learn from their mistakes, and then move forward with positive mindsets.

5.2 Climate change adaptation

The following summaries will provide some understanding of managing the impacts climate change and using the adaptation options to address the sectors and its communities:

Human beings have been adapting to climate variability and change over the centuries however today’s climate change is more frightening because human activities have released significant amount of greenhouse gases into the atmosphere that have trapped heat causing the planet to warm up.

Climate change has grossly affected many countries across the globe. Most of them have suffered from extreme weather events like floods, droughts, wildfires, wild storms, etc.

At a basic level, climate change adaptation implies what people/communities will do to avoid and recover from unusual or extreme climate events.

Climate change adaptation has however, different definitions of which the key words that express adaptation include “adjustments”, “practical steps”, “process” and “outcome”. This appears to be the major concerns amongst stakeholders.

Key resources particularly water will be the most affected, but it is important to view the resources from the system’s perspective (Table 7).

Table 7: Effects of Climate Change on Key Resource Systems

Systems	Description
Coastal	Coastal communities face many new risks due to warmer climate. Sea level rise will lead to submergence, sea water intrusion and inundation, coastal flooding, and erosion. Hundreds of millions of communities will be displaced by 2100 if no adaptation measures are undertaken.
Marine	There will be more suffering if we continue with <i>business-as-usual</i> scenario. High latitudes will experience more biodiversity while fish and other marine life will decline in the tropical region. There will be massive food insecurity as distribution of seafood shifts.
Land-based	This will also fluctuate under current emissions projections. Food insecurity will be worse in the rural area where most food originate. Food insecurity will rise due to weather events like food and droughts that affect conditions for sustainable food production. Food insecurity will also increase in urban area which may cause poverty to rise in many low and lower-middle income countries.

Adaptation planning is a process of adjustment to the impacts of climate change, including actions taken to reduce the negative impacts of climate change, or to take advantage of emerging opportunities. It is often a cycling planning process (Figure 15). Once climate change risks and vulnerabilities have been assessed and preferred adaptation options have been identified and

selected, a framework for implementation of adaptation action - strategy and action plan - can be established.



Figure 15: Adaptation planning cycle¹¹

Adaptation options and strategies will differ amongst the different countries around the world. An example of climate change adaptation planning in PNG is shown in Figure 16. The IPCC reports have identified three entry points to implement any adaptation projects that will apply across a range of locations and sectors (Table 8).



Figure 16: Climate change adaptation planning in PNG¹²

¹¹ Bharwani, S. 2022, C3D+Module: Adaptation planning, WeAdapt, <https://www.weadapt.org/knowledge-base/climate-adaptation-learning-resources/c3d-module-adaptation-planning>

¹² Participatory Avenues. 2022, Participatory 3D modelling for climate change adaptation and disaster risk reduction in Manus, PNG, <http://www.iapad.org/case-studies/climate-change-adaptation/manus-png/>

Table 8: IPCC’s Climate Change Entry Points

Entry point	Description
Vulnerability reduction through system-based planning	This will include addressing human development, poverty alleviation, livelihood security, disaster risk management, ecosystem management, and spatial or land-use planning.
	This includes creating weather-based insurance schemes, installing early warning systems for weather events and maintaining watersheds.
	This focuses on improving coping mechanisms and requires "no or low-regret" measures to improve human development.
Incremental adjustments to institutions, social systems and physical systems	This includes building sea walls (physical change), passing laws to aid disaster risk reduction (institutional change), or crop rotation due to climate change (social/behavioural change).
Transformational adaptation	Refers to changing fundamental attributes of a system in response to climate and its effects.
	This is a large scale change through social and technical innovations, political shifts to minimize risks and vulnerability or change in personal belief systems to support climate change responses.
	For example, the use of smart phones to access weather data to make informed risks decisions.

5.3 Climate change resilience

The definition of climate resilience is heavily debated, in both conceptual and practical terms. Some of the key issues include how resilience relates to climate change adaptation, the extent to which it should encompass actor-based verses system-based approaches to improve stability, and its relationship with the balance of nature theory or the homeostatic equilibrium view of ecological systems.

Climate resilience can commonly be described as the adaptive capacity for a system to a) absorb stresses and main function in the face of external stresses imposed upon it by climate change, and; b) adapt, reorganize, and evolve into more desirable configurations that improve the sustainability of the system, leaving it better prepared for future climate change impacts.

Climate resilience is the ability to anticipate, prepare for, and respond to hazardous events, trends, or disturbances related to climate or the ability to bounce back or return to normal functioning after climate induced adversity.

Improving climate resilience requires assessing how climate change will create new, or alter current, climate related risks, and taking proactive measures to better cope with these risks.

Even if we plan to avoid the worst potential impacts of climate change, we ought to be more resilient to those impacts that are now unavoidable. These impacts will disproportionately affect low-income communities and marginalized populations; hence the need for equitable and proactive resilience planning and resource allocation is crucial.

It is necessary and critical that both government departments and the private sector should integrate climate risks into their existing risk management framework to become climate resilient while the public sector should update infrastructure and help communities to cope with extreme weather, sea level rise and other climate change impacts.

Numerous frameworks have been used to address climate resilience. These frameworks would enable you to identify the climate hazard that has potential to cause you harm, deciding on which situation you must avoid and determining the workable solutions to reduce your climate related risk.

There are five basic steps involved when developing effective climate resilience framework as illustrated in Table 9.

Table 9: Steps for developing climate resilience framework

Step	Description
Step 1 Identify the Climate Hazard	Consider everything that is of value which will be exposed to potential harm from weather and climate related hazards <i>What could happen? What is exposed to climate hazard? What would be the consequences?</i>
Step 2 Assess Vulnerability and Risk	Vulnerability <i>Consider the sensitivity and adaptive capacity of the exposed asset to determine which one is vulnerable</i> Risk <i>To characterize the risk for the most vulnerable element, you have to develop risk matrix (Probability x Severity)</i>
Step 3 Investigate Options	Consider possible solutions for the highest risks. <i>Through brainstorming, build a list of potential options and refine your options to the actions that are feasible</i>
Step 4 Prioritize and Plan	Consolidate actions into cohesive plans <i>Combine similar actions and sequence them to reduce risk to the vulnerable elements The aim is to find series of actions that all stakeholders will agree upon and support</i>
Step 5 Take Action	Implement plan <i>Communicate the intended outcome of the actions taken and get started on your plan Support stakeholders that are stepping forward to build resilience Create more awareness to raise support from civic society</i> Monitor <i>Measure the effectiveness and modify approach as needed Continue checking the inputs and feedbacks to see if the actions taken are yielding benefits as anticipated Be aware of external factors beyond your control that may impact the outcomes</i>

There are basic Climate Resilience Principles, and they are divided into three parts:

Part 1: Framing principle: This part addresses the key preliminary aspects that need to be considered as they inform the risk and benefit assessments undertaken in the second part, namely determining the assets or project’s boundary and interdependencies with the systems of which it is a part.

Part 2: Design principles: This part addresses the climate risk assessment that needs to be undertaken in order to design, implement and operate assets and activities that appropriately address those risks. This includes understanding physical climate hazard, exposure and vulnerability, and potential trade-offs between climate resilience and climate mitigation impacts. For assets and activities focused on enhancing the resilience of the system, this also includes a resilience benefits assessment.

Part 3: On-going management principle: This part addresses the need for ongoing monitoring and evaluation by the issuer to enable assets and activities to remain in step with evolving climate hazards, exposures and vulnerabilities, and changing opportunities and needs for resilience benefits. As a bundle, the three-part Climate Resilience Principles form the framework for Climate Resilience Criteria to be applied to all assets and activities included in a bond seeking certification under the Climate Bonds Standard (Figure 17).

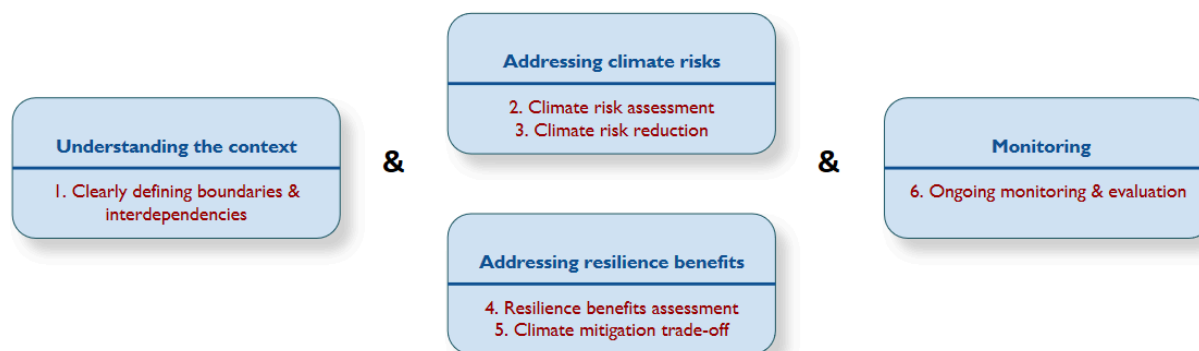


Figure 17: Overview of Climate Resilient Principles¹³

5.4 Resilience development framework

The “Resilience Development Framework” (RDF) is a modification of the risk framework approaches that have been used by many organizations in different places at different times. RDF is based on the risk models such as the ISO 31000 risk model, Australia-New Zealand Risk model, the SOPAC’s Comprehensive Hazard and Risk Management (CHARM) model. The CHARM framework has five main steps and includes; (1) establish the context, (2) identify the risks, (3) analyse the risks, (4) evaluate the risk, and (5) treat risks (Figure 18).

¹³Climate Bonds Initiative. 2019, Climate Resilience Principles: A framework for assessing climate resilience investments, Climate Resilience Consulting (CRC) and World Resources Institute (WRI), Adaptation and Resilience Working Group (AREG), September 2019, <https://www.climatebonds.net/files/page/files/climate-resilience-principles-climate-bonds-initiative-20190917-.pdf>

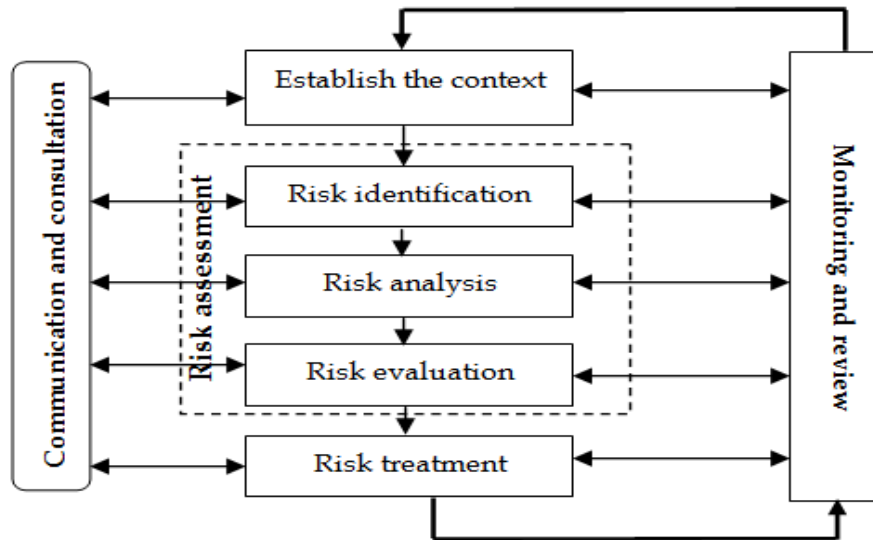


Figure 18: CHARM Framework¹⁴

Step	Description
Establish the context	Sensitize senior political and policy officials Identify strategic issues Identify existing framework for management of CHARM Identify national development priorities
Identify the risk	Develop risk evaluation criteria Identify and assess hazards Identify and assess vulnerability in key sectors
Analyse the risk	Identify risks Determine likelihood Determine consequences
Evaluate the risk	Assign risk levels Decide on the risk acceptability Set the risk priorities
Treat the risk	Manage the existing risks Manage the future risks

The RDF development framework has been adopted by the Asian Development Bank (ADB) in developing the Milne Bay Provincial Wharf. Using this framework, the climate risks assessment was conducted and later the resilience measures were identified and integrated in the design of the wharf to ensure that it is climate proof and continues to serve its purpose. To ensure development is climate proof and sustainable, climate resilient measures or options are crucial and need to be mainstreamed into the sector’s development plans (Figure 19).

¹⁴ Ciocoiu, C. N. , & Dobrea, R. C. (2010). The Role of Standardization in Improving the Effectiveness of Integrated Risk Management. In (Ed.), *Advances in Risk Management*. IntechOpen. <https://doi.org/10.5772/9893>

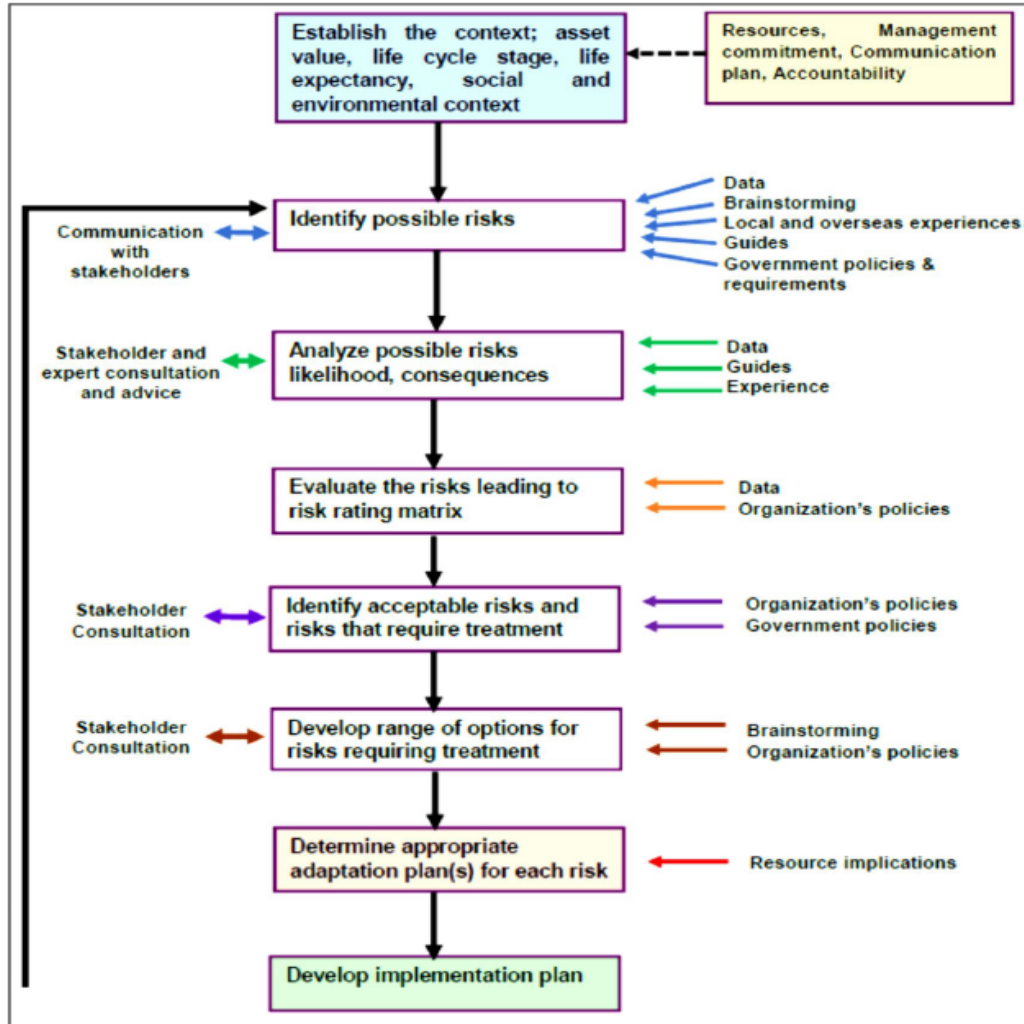


Figure 19: Resilient Development Framework¹⁵

5.5 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)
P.O. Box 4017
Boroko
National Capital District
Papua New Guinea Email: info@ccda.gov.pg
Website: www.ccda.gov.pg

¹⁵ Source: Authors

5.6 Activity: Resilient Development Framework approach

Assume you are now the climate change specialist tasked to help with the design of a climate smart development project using the Resilient Development Model (RDF).

In your group, identify the climate-related issue that is affecting one of the four sector and using the RDF approach develop the climate resilient development project.

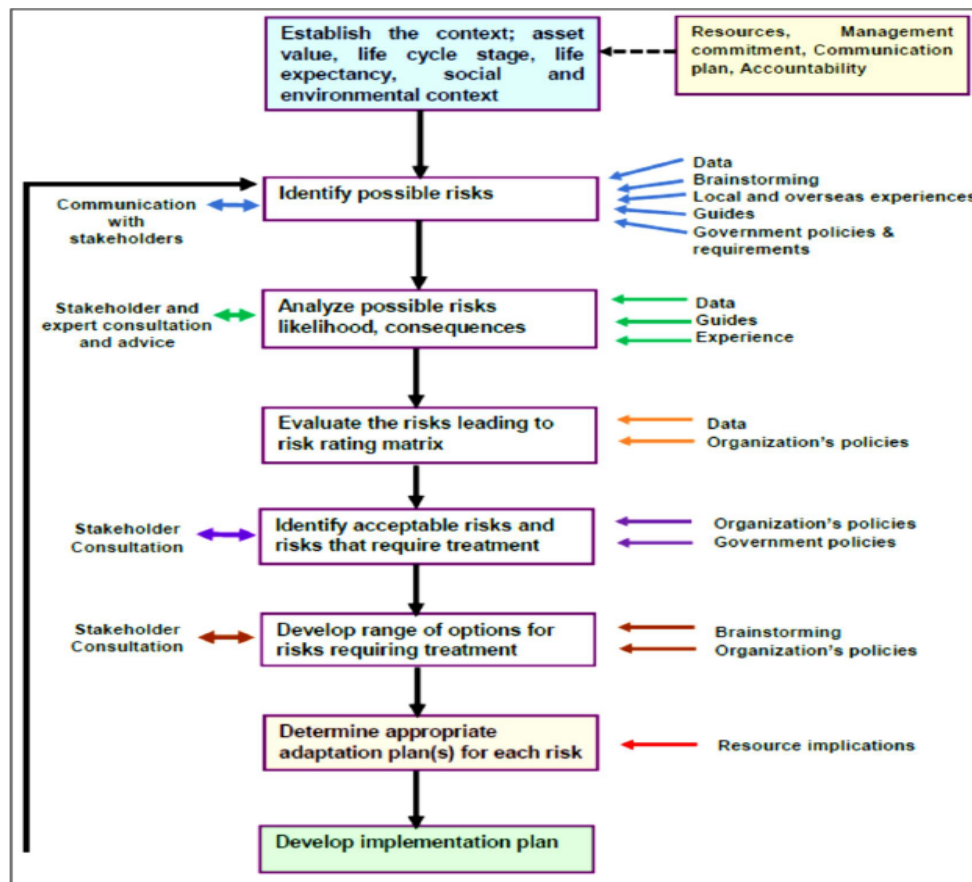


Figure 20: Resilient Development Framework¹⁶

The facilitator will ask each group to present their project using the RDF approach to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

5.7 Self-Evaluation

What did you acquire in this session which was beneficial?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

¹⁶ Source: Authors

5.8 References

- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop
- Aung.T; Kaluwin.C; Kilepak.M and Samuel.P: Book Title: Climate Change in the Pacific, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- CCDA. 2020, Report on Papua New Guinea's Sustainable Development Goal 13, Road map 30 by 30. Climate Change and Development Authority (CCDA)
- Ciocoiu, C. N., & Dobrea, R. C. (2010). The Role of Standardization in Improving the Effectiveness of Integrated Risk Management. In (Ed.), *Advances in Risk Management*. IntechOpen.
<https://doi.org/10.5772/9893>
- Climate Bonds Initiative. 2019, Climate Resilience Principles: A framework for assessing climate resilience investments, Climate Resilience Consulting (CRC) and World Resources Institute (WRI), Adaptation and Resilience Working Group (AREG), September 2019, <https://www.climatebonds.net/files/page/files/climate-resilience-principles-climate-bonds-initiative-20190917-.pdf> cited on 5/12/2021
- C2ES. 2019, What is climate resilience and why does it matter? Climate Essentials, Centre for Climate and Energy Solutions <https://www.c2es.org/wp-content/uploads/2019/04/what-is-climate-resilience.pdf> cited on 5/12/2021
- El-Ashry, M. 2016, Adaptation to climate change: Building resilience and reducing vulnerability, UN Foundation
https://www.brookings.edu/wp-content/uploads/2016/07/09_climate_change_poverty_el_ashry.pdf cited on 5/12/2021
- GEF. 2014, GEF Programming Strategy on Adaptation to Climate Change” Least Developed Countries Fund (LDCF) and Special Climate Change Fund (SCCF), the Global Environment Facility (GEF)
https://www.thegef.org/sites/default/files/publications/GEF_AdaptClimateChange_CRA_0.pdf cited on 5/12/2021
- Kaluwin.C and Samuel.P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- NOAA. 2021, Steps to Resilience Overview, yete Resilience Toolkit, United States Global Change Research Program, National Oceanic and Atmospheric Administration, <https://toolkit.climate.gov/steps-to-resilience/steps-resilience-overview> cited on 5/12/2021
- NOAA. 2021, Explore Hazards, US Climate Resilience Toolkit, United States Global Change Research Program, National Oceanic and Atmospheric Administration <https://toolkit.climate.gov/steps-to-resilience/explore-hazards> cited on 5/12/2021
- UNCC. 2021, Climate Action Pathway, Climate Resilience, Global Climate Action and Marrakech Partnership, United Nations Climate Change,
https://unfccc.int/sites/default/files/resource/ExecSumm_Resilience_0.pdf cited on 5/12/2021
- UN/DESA. 2016, UN/DESA Policy Brief #44: Building climate change resilience for sustainable development, Chapter 1: Climate change resilience for sustainable development, Department of Economic and Social Affairs, United Nations, https://www.un.org/development/desa/dpad/wp-content/uploads/sites/45/1_Chapter_WESS2016.pdf
- World Bank. 2019, The World Bank Group Action Plan on Climate Change Adaptation and Resilience: Managing Risks for a more Resilience Future, Washington, DC.
<https://documents1.worldbank.org/curated/en/519821547481031999/The-World-Bank-Groups-Action-Plan-on-Climate-Change-Adaptation-and-Resilience-Managing-Risks-for-a-More-Resilient-Future.pdf> cited on 5/12/2021

TOPIC 6: CLIMATE CHANGE ADAPTATION AND THE HEALTH SECTOR

Overview

Health sector is one of the sectors largely affected by climate change. According to IPCC the globally averaged combined land and ocean surface temperature is reaching about 1.5⁰C since 1880. This implies that changes in many extreme weather and climate events will emerge that will have dramatic impacts on the health sector. One category of healthcare affected by changing climatic conditions is that of the infectious and parasitic diseases. Different groups of infections, based on their mode of transmission, will be affected: vector borne, water-borne, airborne and zoonosis. The mechanisms involved in the influence of climate on infections range from the effects of temperature on the lifecycle of both pathogens and vectors to the increase in the concentration of pathogens in water due to alteration in the precipitation in human environment or in natural ecosystems.

On the other hand, the health sector is also a major contributor to the anthropogenic climate change. Many of the services that are associated with healthcare have contributed to the health carbon footprint.

This topic focuses on adaptation and health sector in the context of climate change. The key message is to understand how climate change impacts health sector but also to know how healthcare services contribute to climate change. Weighing out these options is crucial for you to best manage health sector situations.

Aims of Topic 6

- ❖ To enable the participant to have the basic understanding of the linkage between climate change adaptation and the health sector.
- ❖ To enable participants, understand the implications of climate change adaptation on the health sector.
- ❖ To enable the participants frame climate change adaptation activities to support health sector to adjust to the changing climatic conditions.

Objectives

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the linkage between climate change and health sector.
- ❖ Identify the climate change impacts and risks on the health sector.
- ❖ Apply the climate change resilience framework to identify the key adaption options.
- ❖ Understand the complexities in climate change adaptation for the health sector.

Knowledge Base

6.1 Takeaways

The following are key points in managing and designing adaptation strategy to accommodate these health issues:

The impacts of climate change are quite noticeable for all sectors across the globe and especially for health sector, it is a serious concern. In terms of health sector, climate change will affect both the social and environmental determinants of health such as clean air, safe drinking water, sufficient food, and secure shelter. It is estimated that between 2030 and 2050, climate change is expected to cause about 250,000 additional deaths per year from malnutrition, malaria, diarrhea, and health stress. In addition, the direct damage costs to health (i.e., excluding costs in health-determining sectors such as agriculture and water and sanitation) is estimated to be between US\$ 2 - 4 billion/year by 2030.

Compared to developed nations, developing countries are highly vulnerable and they will be exposed to an uncontrollable health risk. Many of these countries have weak health infrastructure and poor health workforces which make them least capable to cope and adapt. They will require additional assistance from outside to prepare and respond effectively. The choice of addressing climate change though mitigation is important, however, adaptation will be the most crucial issue. Designing practical adaptation options for health sector can result in improved health services for the vulnerable populations.

6.2 Climate change and health

The following summaries are indeed important to understand and develop adaptation options and include:

- Climate change is the single biggest health threat facing humanity and health workers are challenged to deal with the climate related health issues everywhere across the globe.
- It is not only a problem for future generations – it's already occurring. Higher mean temperatures are recorded yearly, and more people are affected by disasters, climate-sensitive diseases, and other health conditions.
- According to IPCC, to avert catastrophic health impacts and prevent climate change-related deaths, the world must limit temperature rise to 1.5⁰C. Evidence of past emissions showed that global temperature rise has caused many other changes to the climate to be unavoidable.
- Furthermore, global heating of even 1.5⁰C is considered not safe and any increase beyond 1.5⁰C will be excruciating for people's life and health.

Human beings are vulnerable especially those from low-income and disadvantaged countries and communities. They are being harmed first and they are people that contributed least to the cause and are unable to protect themselves against it.

The climate crisis has threatened to destroy the development progress, increase global health and poverty issues thus widen the gap of health inequalities between and within populations.

Many compounding health burdens will be exacerbated by climate change thus exert additional barriers to access better health services.

Health shocks and stressed will be more prevalent amongst the poorest people who are largely uninsured.

Climate change exacerbates some existing health threats and creates new public health challenges. Global health indicators show more deaths per year will occur in the next decades due to climate change (Figure 20).

The health sector can also assist in reducing greenhouse gas emissions through “greening” health facilities. For example, in the use of solar panels, energy efficient equipment and waste management, can help reduce greenhouse emissions.

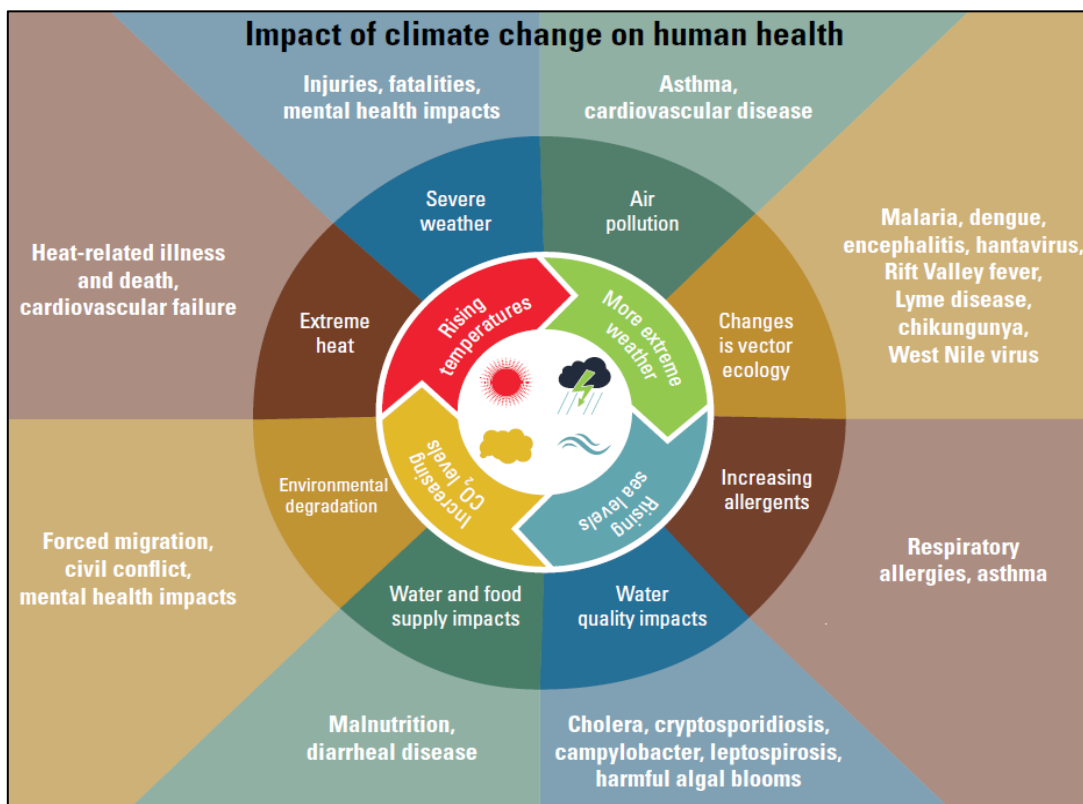


Figure 21: Impacts of climate change on health¹⁷

¹⁷ NOAA. 2021, Health, US Climate Resilience Toolkit, United States Global Change Research Program, National Oceanic and Atmospheric Administration <https://toolkit.climate.gov/topics/human-health> cited on 5/12/2021

6.3 Climate-sensitive health risks

Climate change has already affected health sector in numerous ways. Examples include deaths and illness from damaging extreme weather events, disruption to food systems, water and vector borne diseases and mental health issues. Additionally, climate change is destroying the social determinants for good health such as livelihoods, equity and access to proper health care and social support structures.

The climate-sensitive health risks are extremely felt by the most marginalized and vulnerable elements like women, children, older population, ethnic minorities, poor communities, and those with underlying health conditions. Climate change affects human health beyond imagination especially the scale and the impacts of climate-sensitive health risks (Figure 21).

In the short to medium term, health impacts of climate change can easily be determined by the vulnerability of population, their resilience to the current scenario and the pace of adaptation. In the long-term, it depends on the extent to which transformation actions is taken now to reduce emissions and avoid the breaching of dangerous temperature thresholds and potential irreversible tipping points.

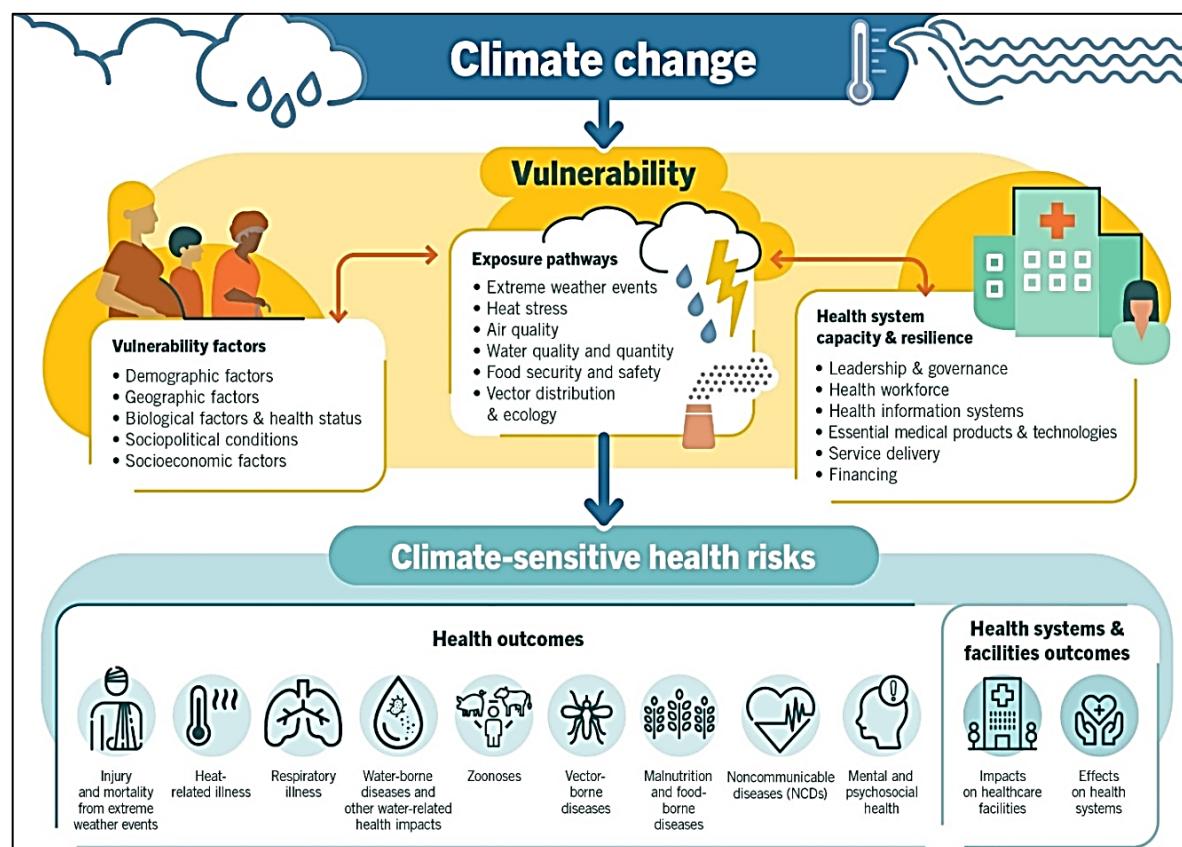


Figure 22: Climate-sensitive health risk, the exposure pathways and vulnerability factors¹⁸

¹⁸ WHO. 2021, Climate change and health, World Health Organisation (WHO), <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health>

6.4 Climate change adaptation and health sector

Apart from the direct effects of heat on humans, the major impact of climate on human health are through changes to human environment like storms, coastal inundation, changing weather patterns – increased flooding, humidity and stagnant water affecting disease vectors, food security and storage, and decreased availability of fresh water.

Adaptation simply implies actions that are taken to lessen the impact on health and the environment due to the changes that cannot be prevented through mitigation.

Identify appropriate adaptation strategies is crucial because they bring positive outcomes for climate and environment thus certainly affect human health. In addition, some of the adaptation activities that improve human health may come through changes in the public health and health care infrastructure. In developing adaptation plans or programs, much attention should be given to the assessment of climate change impacts, climate change risks and the climate change vulnerabilities. A WHO example is shown in Figure 22.

The Development Resilient Framework (Session 4) is an appropriate model to apply in assessing those key variables (impacts, risks, and vulnerabilities) and identify the most appropriate adaptation interventions or options to use in the health adaptation planning process.

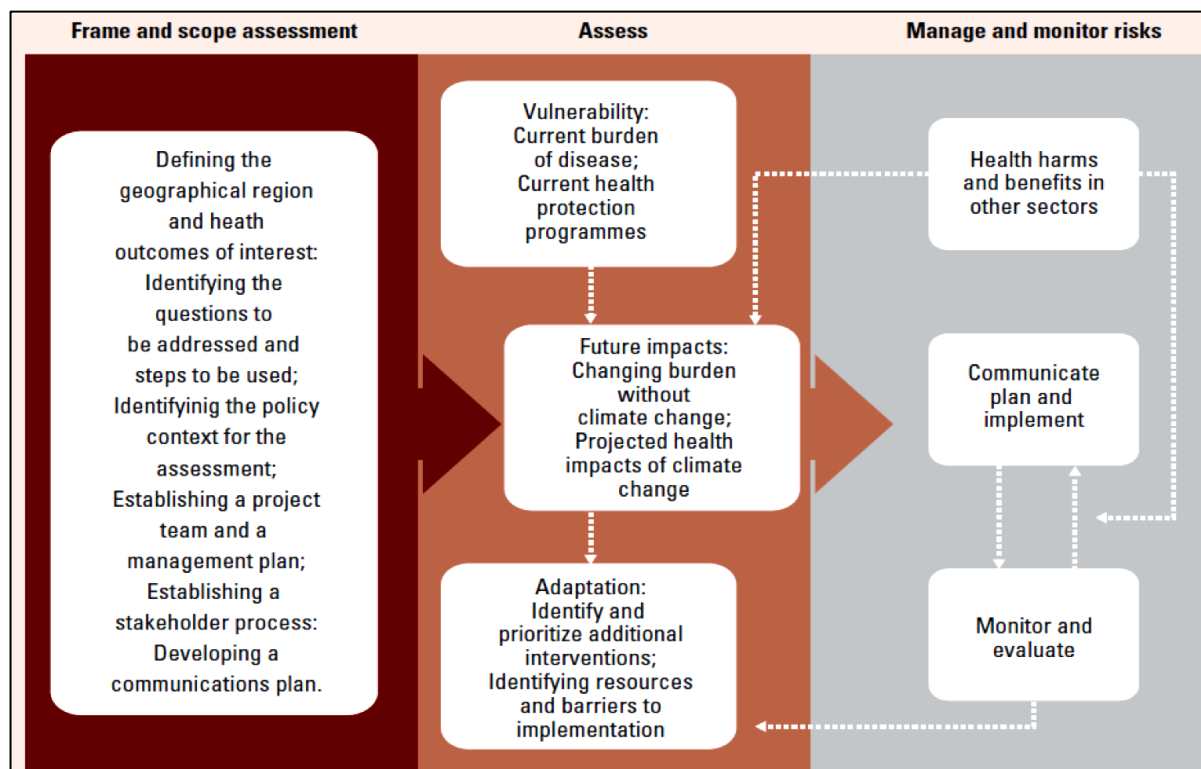


Figure 23: WHO guidance on climate change health issues within NAP process (HNAP)¹⁹

¹⁹ UNESCWA. 2017, Climate Change Adaptation in the Health Sector Using Integrated Water Resources Management Tools, United Nations Economic and Social Commission for Western Asia (UNESCWA), <https://www.unescwa.org/publications/climate-change-adaptation-health-sector-using-integrated-water-resources-management>

6.5 Climate change adaptation, health sector and gender

Climate change is known to exacerbate existing gender inequalities, and this has caused women to face larger negative impacts than men. But women are not just victims but agents of change and possess knowledge and skills that is vital for survival.

Integrating gender aspects is vital to achieve greater success of the policies, programmes and projects for adaptation to climate change such that human health is given better protection. Impacts and risks of climate change on women are more intense and increasing across the globe. For instance, pregnant women are at high risk of contracting malaria with other secondary risks such as maternal anaemia and miscarriage among others.

According to Article 4.f. of the UNFCCC, before a new adaptation initiative is proposed, the health benefits and negative impacts together with environmental and economic considerations must be addressed. This implies that the article recognizes the importance of health and other social implications including gender equality in the climate change impact or risk assessment processes

Gender should not be standalone, but instead be an integral part of policy making as well as reflected in the policies themselves. Presently women barely participate in developing policies.

Ensuring that women efficiently participate in all decision making related to climate change at all levels to build an effective alliance for community participation.

Integrating gender components should be approached through institutional mechanisms, active participation at all levels and decision-making while policies, programmes and projects facilitate women's access to and control over natural resources, knowledge, information, and credit (Figure 23).

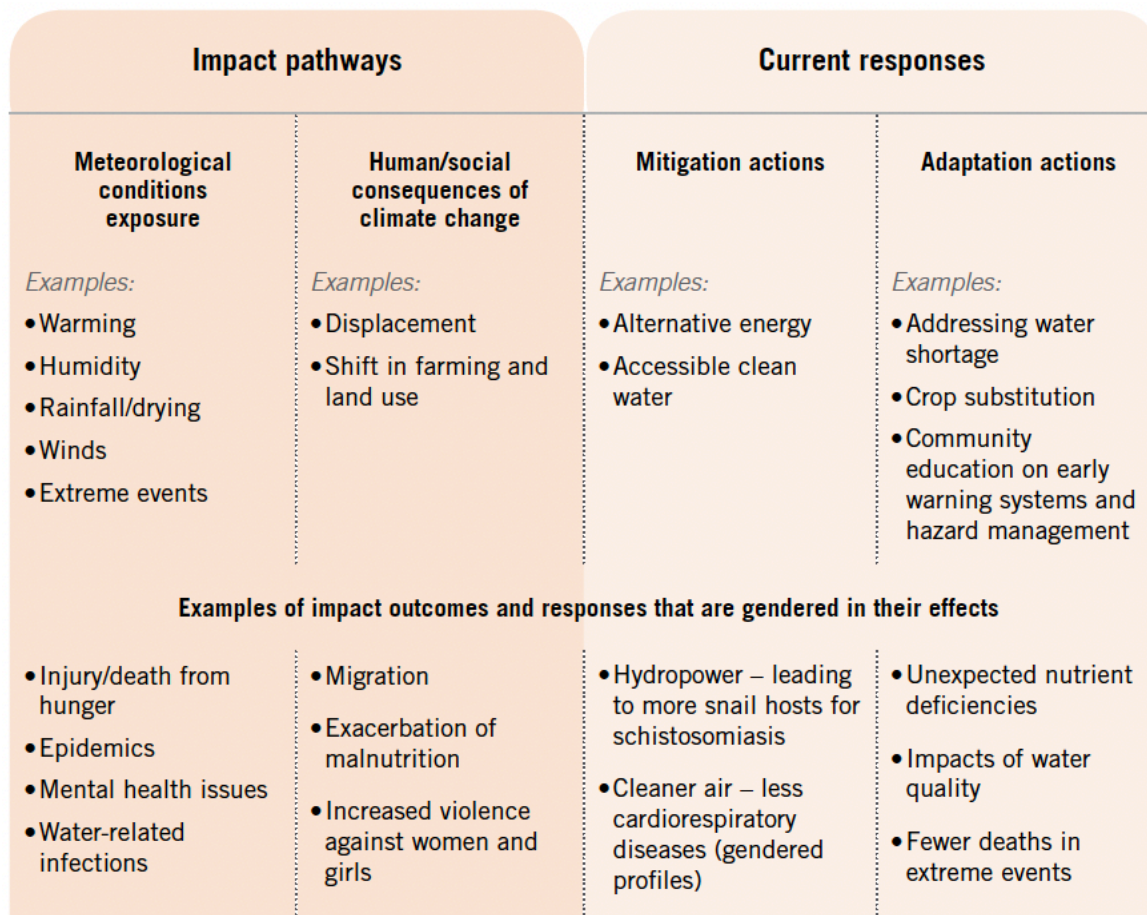


Figure 24: Effect of climate change on human health and current responses²⁰

6.6 Climate change adaptation framework for health

Climate change is a single most crucial environmental hazard that triggers all the other hazards causing havoc and even disastrous situations. Additionally, the impacts of climate change may adversely health and wellbeing, directly via extreme weather events such as heat waves, storms, and foods, and indirectly via impacts on food security, air and water quality, and other environmental amenities.

It is important that governments recognize this fact and find ways to reduce the effects of climate change on health and wellbeing. A conceptual framework is one way to support the aims and objectives of the policy framework by depicting the effects of climate change on health, and individual and social wellbeing, and areas for policy actions and responses. An example from New South Wales Australia is shown in Figure 24.

²⁰ WHO. 2014. Gender, Climate Change and Health, World Health Organisation (WHO), ISBN 9789241508186 <https://www.who.int/globalchange/GenderClimateChangeHealthfinal.pdf>; a gendered perspective (Adapted from McMichael & Bertollini, 2009)

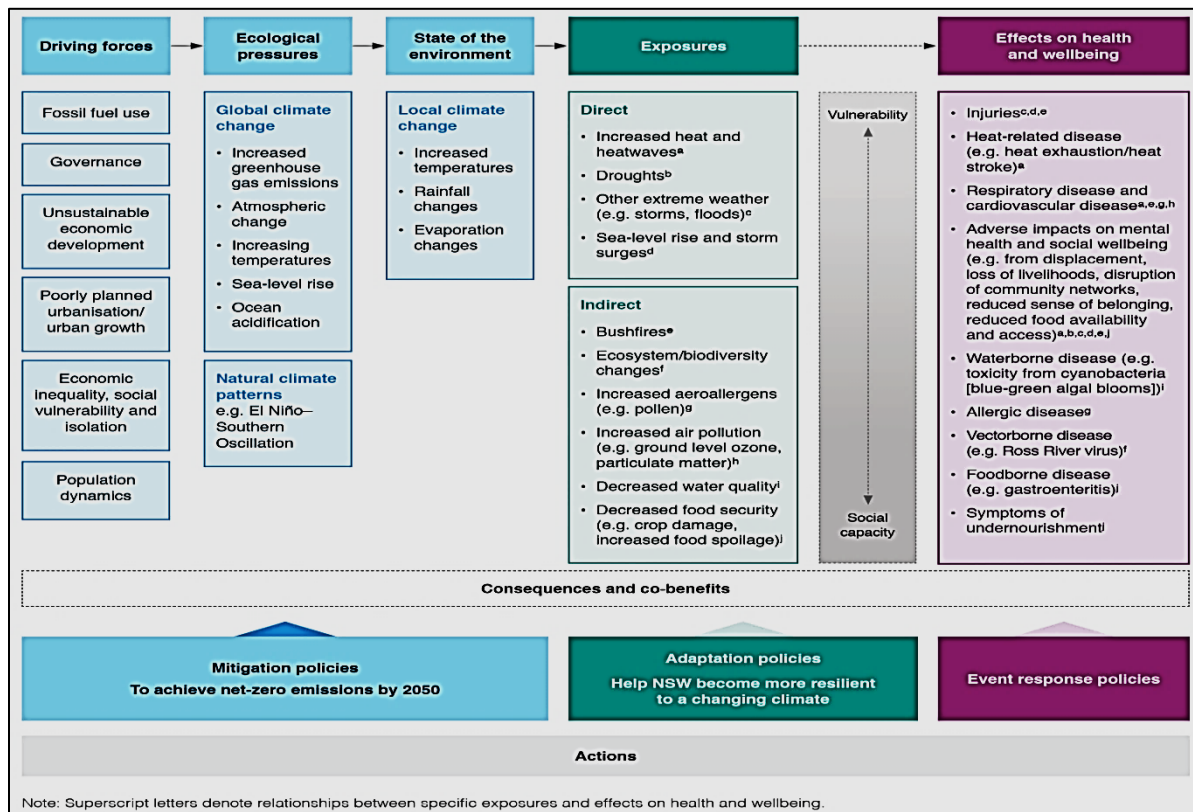


Figure 25: Framework for climate change impacts on human health and wellbeing in NSW²¹

The conceptual framework above is based on the Driving Force, Pressure, State, Exposure, Effect and Action (DPSEEA) framework of the World Health Organization. This framework shows the link between exposures and health effects as well as entry points for interventions. The conceptual framework shows the key processes as depicted in the Development Resilient Framework (Topic 4).

6.7 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information.

Climate Change & Development Authority (CCDA)
P.O. Box 4017
Boroko
National Capital District
Papua New Guinea Email: info@ccda.gov.pg
Website: www.ccda.gov.pg

²¹ Boylan S, Beyer K, Schlosberg D, Mortimer A, Hime N, Scalley B, Alders R, Corvalan C, Capon A. A conceptual framework for climate change, health and wellbeing in NSW, Australia. Public Health Res Pract. 2018;28(4):e2841826. <https://doi.org/10.17061/phrp2841826>

6.8 Activity: Climate change and malaria

Pacific: Malaria mosquitoes on increase in PNG's Highlands due to climate change, says hospital CEO.

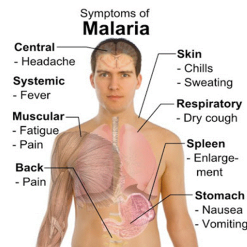
Joseph Apa, Goroka Hospital
30 April 2007



The Chief Executive Officer of Goroka Hospital in Papua New Guinea's Eastern Highlands province says malaria outbreaks in the area have increased in recent years

because of climate change.

Joseph Apa says the hospital has sent a medical team to the Lufa area to help treat those affected by a malaria outbreak which has claimed at least 10 lives and seen around 600 hospitalized for treatment. Health officials have suggested that the outbreak may have been caused due to the continuous rain in the region since last month.



Mr. Apa says malaria outbreaks hardly used to occur in the Highlands due to the altitude... "But these days in the last five to fifteen years, the

climate has changed and it's getting warmer up here in the Highlands and we are now experiencing mosquitos breeding in the Highlands and transmitting malaria pesticides. So we could say that global warming has contributed to this climate change in the Highlands and hence the malaria outbreak in the Highlands."

Source: Apa, J. 2007, Malaria mosquitoes on increase in PNG's Highlands due to climate change, says hospital CEO *Radio New Zealand (RNZ)* <https://www.rnz.co.nz/international/pacific-news/169518/malaria-mosquitoes-on-increase-in-png-s-highlands-due-to-climate-change,-says-hospital-ceo>

As an expert in public health and diseases outbreak, explain how malaria spreads and how does climate change influence the spread of this disease. Under this epidemic scenario, identify and discuss the adaptation and resilience strategies to reduce the extent of this outbreak.

The facilitator will ask each group to present their findings to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

6.9 Self-Evaluation

What did you acquire in this session which you were very impressed?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

6.10 References

- ADB. 2012, Sector Briefing on Climate Change Impacts and Adaptation: Health, Asia Development Bank (ADB) <https://www.adb.org/sites/default/files/publication/29553/cc-sector-brief-health.pdf> cited 14/12/2021
- Alston, M. (2013). Gender Mainstreaming and Climate Change. In Women's Studies International Forum. Pergamon.
- Annecke, W. 20016, Adaptation and Beyond: 04 Gender and climate change, Lessons Learnt from the Community Based Adaptation in Africa (CBAA) <https://assets.publishing.service.gov.uk/media/57a08adf40f0b6497400080a/Adaptationandbeyond04small.pdf> cited 15/12/2021
- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop
- Bäthge, S. 2010, 'Climate Change and Gender: Economic Empowerment of Women through Climate Mitigation and Adaptation?' GTZ Working Papers, GTZ, Eschborn.
- Boylan S, Beyer K, Schlosberg D, Mortimer A, Hime N, Scalley B, Alders R, Corvalan C, Capon A. A conceptual framework for climate change, health and wellbeing in NSW, Australia. Public Health Res Pract. 2018;28(4):e2841826. <https://doi.org/10.17061/phrp2841826>
- Cheong.B; Kaluwin.C and Samuel.P: Book on Tropical Climatology 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- Climate Change and Development Authority, 2020. Report on Papua New Guinea's Sustainable Development Goal 13, Road map 30 by 30.
- IUCN & UNDP. 2009, 'Training Manual on Gender and Climate Change', International Union for Conservation of Nature (IUCN) and the United Nations Development Programme (UNDP).
- Kaluwin.C and Samuel.P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- PAHO/WHO. 2021, Climate change and health, Pan American Health Organisation (PAHO) and the World Health Organisation (WHO) <https://www.paho.org/en/topics/climate-change-and-health> cited 14/12/2021
- Skinner, E., 2011, 'Gender and Climate Change: Overview Report', BRIDGE Cutting Edge Pack on Gender and Climate Change, Institute of Development Studies, Brighton.
- UNDP. 2012, Gender and climate change Africa: Policy Brief 1. United Nations Development Programme (UNDP) https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB1_Africa_Overview-Gender-Climate-Change.pdf cited 15/12/2021
- UNDP. 2010, 'Gender, Climate Change and Community-Based Adaptation', United Nations Development Programme (UNDP), New York
- UNDP. 2016, Overview of linkages between gender and climate change, Policy Brief 1, United Nations Development Programme (UNDP) <https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/UNDP%20Linkages%20Gender%20and%20CC%20Policy%20Brief%201-WEB.pdf> cited 15/12/2021
- UNESCWA. 2017, Climate Change Adaptation in the Health Sector Using Integrated Water Resources Management Tools, United Nations Economic and Social Commission for Western Asia <https://www.unescwa.org/publications/climate-change-adaptation-health-sector-using-integrated-water-resources-management> cited 14/12/2021
- WHO. 2020, WHO Global Strategy on Health, Environment and Climate Change: The transformation needed to improve lives and wellbeing sustainably through healthy environments, World Health Organisation (WHO), Switzerland, ISBN 978-92-4-000037-7

<https://apps.who.int/iris/bitstream/handle/10665/331959/9789240000377-eng.pdf?sequence=1&isAllowed=y>
cited 15/12/2021

WHO. 2017, Climate change and health: Framework for action 2017-2021, Regional Committee for the Eastern Mediterranean, 64th Session, Provisional Agenda Item 3(b), EM/RC64/4 , August 2017, World Health Organisation (WHO) https://applications.emro.who.int/docs/RC_technical_papers_2017_4_20040_en.pdf
20/01/2022

WHO. 2021, Climate change and health, World Health Organisation (WHO), <https://www.who.int/news-room/fact-sheets/detail/climate-change-and-health> cited 14/12/2021

WHO. 2014. Gender, Climate Change and Health, World Health Organisation (WHO), ISBN 9789241508186 <https://www.who.int/globalchange/GenderClimateChangeHealthfinal.pdf> cited 15/12/2021

TOPIC 7: CLIMATE CHANGE ADAPTATION AND THE AGRICULTURE SECTOR

Overview

Agricultural sector is one of the priority economic considerations for the PNG government and its communities. Climate change affects agriculture in a number of ways. Changes in temperature and precipitation as well as weather and climate extremes are already influencing crop yields and livestock productivity everywhere across the country and globally. Weather and climate conditions also affect the availability of water needed for irrigation, livestock watering practices, processing of agricultural products, and transport and storage conditions. Climate change is projected to adversely affect agriculture in future, and this will also affect human survival.

Conversely, agriculture is a major contributor to anthropogenic global warming through emission of greenhouse gases like methane, nitrous oxide and carbon dioxide, as well as through the loss of key carbon sinks via conversion of land uses for agricultural land (e.g., forest area conversions to agriculture). Agriculture and food production is associated with these three gases, but direct agricultural emissions are largely dominated by methane and nitrous oxide. Before we consume the food on our plate, our food is produced, stored, processed, packaged, transported, prepared, and served. At every stage, food provision releases greenhouse gases into the atmosphere.

This topic focuses on adaptation and agriculture sector in the context of climate change. The key message is to understand how climate change impacts agriculture sector, while also considering ways in which addressing climate change adaptation in agriculture can also improve or mitigate many of the emissions generated in producing food.

Aims of Topic 7

- ❖ To enable the participant to have the basic understanding of the linkage between climate change adaptation and the health sector
- ❖ To enable participants, understand the implications of climate change adaptation on the health sector
- ❖ To enable the participants frame climate change adaptation activities to support health sector to adjust to the changing climatic conditions.

Objectives

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the linkage between climate change and agriculture sector
- ❖ Identify the climate change impacts and risks on the agriculture sector
- ❖ Apply the climate change resilience framework to identify the key adaption options
- ❖ Understand the complexities in climate change adaptation for the agriculture sector

Knowledge Base

7.1 Takeaways

The following key points that can be summarized for this sector to increase your understanding in developing your adaptation strategies and in particular agriculture:

IPCC has issued its dreadful warning about the threats posed by a rapidly changing climate. The way we grow, distribute, consume, and dispose of food around the world both fuels climate change and will suffer tremendously as the world warms over the coming years.

According to IPCC and supported by the second PNG Greenhouse Inventory report 2017, agricultural emissions are increasingly driving the climate change, with agricultural and emissions from land use change one of the biggest contributors globally to climate change. Food systems may be responsible for a shocking one-third of global greenhouse gas emissions. They emit carbon dioxide and also generate other planet-warming gases like methane, etc.

According to IPCC, the intensifying climate impacts will harm global food production. Extreme weather events are becoming increasingly frequent and intense. Severe droughts are having devastating effects on food and agriculture. These impacts will increasingly threaten food security which in turn fuel malnutrition, conflict, and migration.

Given this situation, sustainable agricultural practices appear to be the most crucial climate solutions. To counter and adapt to climate change, solutions in agriculture can focus on resilient agricultural practices that have co-benefits of assisting to adapt and become more resilient to climate change, while also serving to mitigate the emissions from land and degradation in the agricultural sector. Approaches in agriculture range from climate smart agricultural practices, agroecology, regenerative agriculture, sustainable agroforestry, integrative management practices and diversification, and so on, to both fight climate change and become more resilient.

Both the international governance arrangement and national policy frameworks should provide the robust foundation for climate change adaptation in agriculture. Through the national planning process, prioritization tools be applied which can sustain efficient, effective, and equitable allocation of limited resources to benefit the most vulnerable farmers and systems.

Local planning is crucial to devolve decision making and participatory approaches to match the local contexts, capacities, and preferences.

Accessing adaptation finances remain critical and significant to achieving the local and the global goals for adaptation.

Effective research and knowledge systems is needed to connect farmers, policy makers, businesses, and researchers to accelerate sharing of new knowledge and information and help adapt to current climate and future scenarios for climate and development.

Promoting and enhancing traditional knowledge can strengthen effective adaptation measures through working closely with knowledge holders at both local and national levels.

Modernizing extension services, capacity building and technology transfer approaches are important to motivate people and their participation in the agricultural activities.

Gender equality and social inclusion can be strengthened if the adaptation approaches are well designed.

Appropriate and people-focused adaptation approaches in the agriculture sector have multiple co-benefits for environmental health and mitigation.

7.2 Climate change and agriculture

The ongoing changes in climate have substantially affected agriculture production across the globe. The effects and consequences of climate variability and changes are forcing the agricultural producers to search for new ways to sustain their agricultural activities.

These include:

Examples of direct effects of changing climate conditions on crops and livestock include: (a) increasing annual average and seasonal temperature, (b) seasons shifting, (c) increasing number of hot days and hot nights, (d) changing precipitation patterns, (e) drought periods. These factors are now threats to the agricultural producers (Figure 25). These effects have implications for agricultural planning, and the loss of agricultural systems and knowledge with the changes (e.g., changes in environmental signalling, seasons for planting, dealing with watering and pests).

Moreover, there are emerging hazardous risks that are now impinging on agricultural productivity due to changing weather and climate. These risks include: (a) increasing extreme weather events that are increasing the risk of damages to crops, soil and infrastructure, (b) rising flood risks to crops and livestock, (c) increasing severe wind and storm hazards, and (d) escalating warmer temperatures which have the potential to increase soil moisture stress and drought.

Agricultural producers are also constantly making adjustments to the changing conditions (i.e., market price fluctuations, increasing input costs, labour shortage, pest invasions, and adverse weather conditions).

The climate change impacts can be categorized into two groups as illustrated in Table 10.



Figure 26: Impacts of climate change on subsistence agriculture in PNG²²

Table 10: Impacts of climate change on agriculture

Biophysical impacts	Socio-economic impacts
Physiological effects on crops, pasture, forests and livestock (quantity and quality)	Decline in yields and production
Changes in land, soil, and water resources (quantity and quality)	Reduced marginal GDP from agriculture
Increased weeds and pest challenges	Fluctuation in world market prices
Shifts in spatial and temporal distribution of impacts	Changes in geographical distribution of trade regimes
Sea level rise	Increased number of people at risk of hunger and food security
Changes in ocean salinity	Poverty and unemployment
Sea temperature rise causing fish to inhabit different ranges	Migration and civil poverty

7.3 Climate change adaptation and agriculture sector

Undertaking agricultural adaptation is vital to manage potential climate risks over the coming decades as climate changes. Adaptation research can help inform decisions by farmers, agribusiness, and policy makers with implications over a range of timeframes (i.e., short-term to long-term).

²² Photographs taken by Peter Samuel 2021

Climate change adaptation can lessen the risks from climate variability and change yet also increase the resilience of the systems to potential disruptions and further alter systems to accommodate future climate conditions (Table 11).

More attention should be given to climate-smart land use approaches. It is central for food security and resilience, poverty reduction, agricultural emissions reduction, and natural resource protection

Climate-smart land uses includes different components: (a) climate-smart agriculture which focuses on better management of food and agriculture systems to simultaneously increase productivity and resilience while also co-benefiting to lower emissions produced by the sector (b) forestry, (c) land restoration, (d) Ecosystem-based Adaptation (EbA) and coastal area management, (e) improved water management including groundwater, and (f) Community-based Adaptation (CBA)/locally-led adaptation.

The above actions will enhance the ways that natural capital can protect people’s assets from climate change and enhance their incomes through ecosystem services, water supply, and flood protection.

Table 11: Key Areas for Agricultural Adaptation

Key areas	Explanation
Agricultural extension inclusions for climate smart agriculture	Extension services are vital for assisting and promoting climate smart agriculture (CSA) practices.
Keeping policy relevant	At present climate change adaptation is not reflected in the agricultural sector policy. Mainstreaming of climate change adaptation into the policy will enhance broad resilience to risks and promote sustainable development.
Demonstration of climate resilient practices, and farmer to farmer training	On-farm demonstrations facilitate out scaling of locally appropriate climate-smart agriculture (CSA) practices among farmers through “learning by doing”.
Informing mutually co-benefiting adaptation and mitigation targets	It is vital to identify and evaluate possible adaptation strategies that serve to mutually co-benefit adaptation, mitigate emissions, and enhance biodiversity component.

Informing investment	This is vital to both the public and private sectors in terms of investment or disinvestment decisions they need to make now or in the future regarding climate sensitive aspects of their portfolios.
Rewarding early adopters	Participatory research into climate change adaptation can aid agricultural decision makers the existing climatic trends and apply them to their own advantages. This involves meeting with decision makers through integrating their practical knowledge into the assessment have been fruitful compared to the ones explored by scientists.
Focusing on climate risk management	Adaptation is an ongoing process that integral part of good risk management as drivers of risk are constantly identified, likely impacts on the system and alternative management are also assessed.
Changing management unit decisions	Changes in practices at the management unit level is an important aspect for adapting agriculture to climate change. It will require a range of adaptation strategies for cropping, livestock, forestry and fisheries. Policy measures are crucial in these areas to encourage effective adaptation activities through investment in new technologies and infrastructure.
Changing the decision environment	Adaptation at the management unit level, based on current decision environment, may not fully cope with climate changes. This requires deliberate measures planned ahead of time at global, regional, national and local levels in order to facilitate broad range of adaptation responses. There are many options for policy-based adaptation to climate change that have been identified for agriculture, forests, fisheries, etc. The mainstreaming process of adaptation into policy planning in the face of risk and vulnerabilities is a crucial aspect of adaptation planning but may be constricted by economic, informational, social, attitudinal, and behavioural barriers.

7.4 Climate change adaptation, agriculture sector and gender

Women and men are experiencing climate change differently, as gender inequalities persist around the world affecting the ability of individuals and communities to adapt.

Little research has been undertaken to understand how men and women are adapting to climate change, mitigating emissions and maintaining food security.

Recognizing the important contributions of women as decision makers, stakeholders, educators, careers and experts across sectors and at all levels can lead to successful, long-term solutions to climate change.

Women have proven to be leading the way towards more equitable and sustainable solutions to climate change. Across sectors, women’s innovations and expertise have transformed lives and livelihoods, and increased climate resilience and overall well-being.

Global negotiations have increasingly reflected the growing understanding of gender considerations in climate decision making over the past years hence progress towards gender equality in the future can help achieve successful climate action.

Under the UNFCCC guidelines and requirements, countries should have developed climate change adaptation strategies and programs, National Climate Change Policies and Frameworks and National Determined Contributions highlighting the processes that they aim to achieve their national commitments related to climate change adaptation and mitigation in agriculture and allied sectors.

UNFCCC has ensured women’s equality is given prominence in implementing climate change mitigation and adaptation plans. In addition, the UN Millennium Development Goals (2008) and Sustainable Development Goals (2015) have been promoting gender equality and empowerment across sectors including agriculture. However, the inclusion of a gender component as part of policy document appears insufficient to reduce the gender gap in climate change adaptation.

In PNG, women play a significant role in agriculture production, the extent of gender inclusiveness of these policies have played vital role in determining the success of adaptation and mitigation actions in agriculture. Research institutions such as the National Agriculture Research Institute (NARI) has encouraged women in the country to take advisory role working with all communities to develop climate change resistant crops from the coastal areas into the highland provinces (Figure 26).



Figure 27: Women in Agriculture in PNG²³

²³ PNG National Agricultural Research Institute- Strategy and Results Framework 2011-2020 Corporate Document No.8 2011

Table 12 illustrates the key areas that can promote gender equality and social inclusiveness in agriculture.

Table 12: Key Areas for gender equality and social inclusiveness in agriculture

Key Area	Explanation
Reforming laws	Modernizing laws that restrict women’s ownership and access to productive resource will give women access to land, credit and other resources to increase productivity of land and support food security and overall well-being of the family and community.
Promote gender sensitive approaches	Adopt gender sensitive approaches in climate-smart agriculture initiatives. New ways to agriculture that employs policy and agro practices that enhance food security, promotes adaptation and resilience, and produces mitigation co-benefits.
New technologies and agricultural extension services to cater for women’s needs	Women supported with access to new technologies, agricultural extension services and climate information services to balance accessibility between gender.
Collect gender-disaggregated data in agriculture and food security	Gathering gender-disaggregated data especially access to land, land tenure security, resource use, finance and extension services and agriculture tools are crucial for supporting gender-responsive policy design and monitoring for the project cycle of the adaptation and mitigation actions in the agricultural sector.



Figure 28: Impacts of climate change on cash crops within the coastal areas of PNG²⁴

7.5 Climate change adaptation framework for agriculture

A key challenge for adapting agricultural systems to climate change relates to the translation of broad science-based concepts of climate adaptation into specific, tangible on-farm actions and can contribute to assisting the village-based cash cropping as shown in this coastal area of PNG (Figure 27). To elaborate further on this, a framework (Figure 28) describes a flexible five-step process to assist agriculture producers, service providers or educators consider the potential impacts of increasing climate variability and change and identify possible actions that facilitate adaptation to changing conditions.

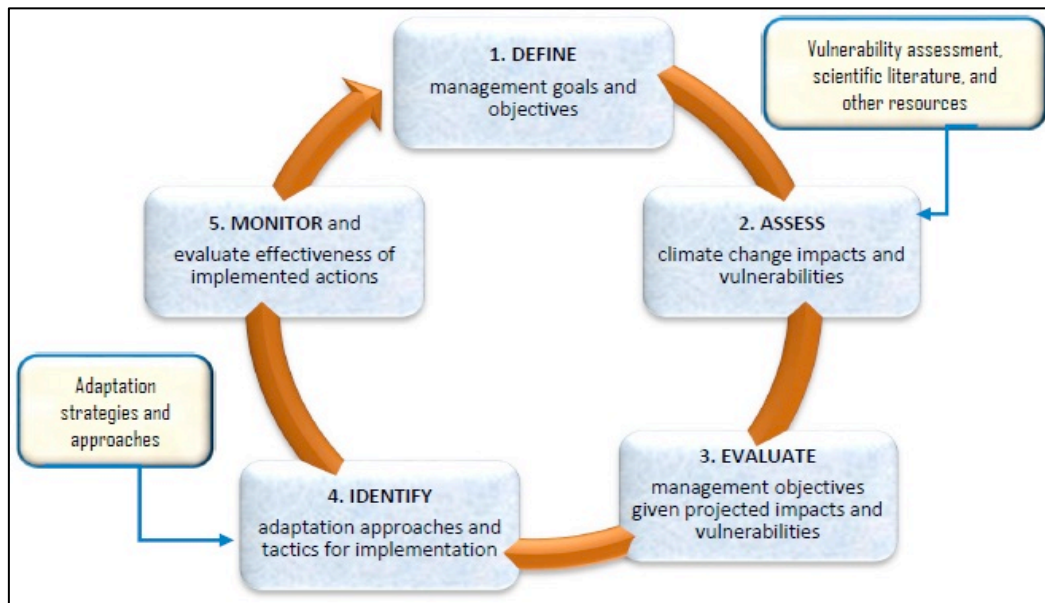


Figure 29: Five-step process of adapting to climate change²⁵

²⁴ Photographs taken by Peter Samuel

²⁵ Janowiak, M., D. Dostie, M. Wilson, M. Kucera, R. Howard Skinner, J. Hatfield, D. Hollinger, and C. Swanston. 2016. Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. Technical Bulletin 1944. Washington, DC: U.S. Department of Agriculture. <https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf>

The five-step process exemplifies the key processes in the Development Resilient Framework (Topic 4). It is a comprehensive model that assesses all the key variables (impacts, risks and vulnerabilities) and pinpoints the most applicable interventions (adaptation strategies and approaches) to use in the agricultural adaptation planning process.

7.6 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)
P.O. Box 4017
Boroko
National Capital District
Papua New Guinea Email: info@ccda.gov.pg
Website: www.ccda.gov.pg

7.7 Activity: Climate change and food security

Climate change threatens food security

Post Courier, 28th May 2021

By Patrick Tom

Climate change is posing a major threat to the food security and security in the country, say an expert. The Department of Agricultural and Livestock Regional Acting Director Chris Apisai highlighted the impacts and challenges bring about by the global climate change during the regional food system summit held in Port Moresby yesterday.

Mr Apisai in presenting the overview of the challenges and constraints facing the New Guinea Island region as far as food security is concerned highlighted that natural disasters and the raising sea level is one of the major concern and the greater risks it poses towards the region food system.

“There are many other food security related issues that are becoming common in the communities now days like insufficient land for gardening or farming due to the population increase which disturb the food system in the communities,” he said.

“Another issue that is affecting the food system is monoculture which means people are now growing cash crop in place of fresh garden food and this needs to be discuss in the summit going forward.”

Mr Apisai also elaborated that the main threat the region is facing is climate change and this pose enormous risks of destroying the entire food system in the region. “The government is not supportive of the different projects in the various provinces to counter on the emerging threats to the food security system and to safeguard sustain those food crops which is essential for the people’s livelihood,” he said

Source: Tom, P. 2021, Climate Change Threatens Food Security, *Post Courier*, May 28, 2021, <https://postcourier.com.pg/climate-change-threatens-food-security/>

Being an agricultural expert in the country but climate change has become the most challenging issue for the agriculture sector especially with food security. Answer the following questions:

1. What do you understand of food security and food insecurity?
2. How has climate change threatened food security?
3. What would be the likely consequences of food security on community’s livelihood?
4. How can you assess the potential impacts/risks of climate change on food systems?
5. How do the communities adapt to the changing condition as food security become a threat?

The facilitator will ask each group to present their results to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

7.8 Self-Evaluation

What did you acquire in this session which you greatly appreciated?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

7.9 References

- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop.
- Calmon, M. & Feltran-Barbieri, R. 2019, 4 Ways Farmers Can Adapt to Climate Change and Generate Income, World Resources Institute (WRI), <https://www.wri.org/insights/4-ways-farmers-can-adapt-climate-change-and-generate-income> cited 15/12/2021
- Climate Change and Development Authority, 2020. Report on Papua New Guinea’s Sustainable Development Goal 13, Road map 30 by 30.
- FAO. 2021. Climate-smart agriculture case studies 2021 – Projects from around the world. Rome. <https://doi.org/10.4060/cb5359en>
- FAO. 2021, Strategic Framework 2022-31, Food and Agriculture Organisation of the United Nations (FAO) <https://www.fao.org/3/ne577en/ne577en.pdf> cited 15/12/2021
- FAO. 2012, Training Guide: Gender and climate change research in agriculture and food security for rural development, The CGIAR Research Programme on Climate Change, Agriculture and Food Security (CCAFS), Food and Agriculture Organisation of the United Nations (FAO) <https://www.fao.org/3/md280e/md280e00.pdf> cited 15/12/2021
- Howden, M. Soussana, J-F. Tubiello, F.N., Chhetri, F.N, Dunlop, M. & Meinke, H. 2007, Adapting agriculture to climate change, Proceedings of the National Academy of Science of the United States (PNAS), December 11, 2007, Vol. 104, No.50, pp 19691-19696
<https://www.pnas.org/doi/pdf/10.1073/pnas.0701890104> cited 15/12/2021
- Janowiak, M., D. Dostie, M. Wilson, M. Kucera, R. Howard Skinner, J. Hatfield, D. Hollinger, and C. Swanston. 2016. Adaptation Resources for Agriculture: Responding to Climate Variability and Change in the Midwest and Northeast. Technical Bulletin 1944. Washington, DC: U.S. Department of Agriculture. <https://www.climatehubs.usda.gov/sites/default/files/AdaptationResourcesForAgriculture.pdf>
- Kaluwin.C and Samuel.P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- Paudyal, B., Chanana, N., Khatri-Chhetri, A., Sherpa, L. Kadariya, I & Aggarwal, P. 2019, Gender Integration in Climate Change and Agricultural Policies: The Case of Nepal, Front. Sustain. Food Syst., 23 August 2019, <https://doi.org/10.3389/fsufs.2019.00066>
- UNDP. 2017, Gender and Climate Change, Training Module 3: Gender, climate change and food security, Policy Brief 1, Overview of linkages between gender and climate change, United Nations Development Programme (UNDP), <https://www.undp.org/publications/gender-and-climate-change#modal-publication-download> cited 15/12/2021
- Vermeulen, S., Dinesh, D. Howden, M., Cramer, L. & Thornton, P. 2018, Transformation in Practice: A Review of Empirical Cases of Transformational Adaptation in Agriculture Under Climate Change, Front. Sustain. Food Syst., 10 October 2018, <https://doi.org/10.3389/fsufs.2018.00065>
- World Bank. 2021, Climate-Smart Agriculture, <https://www.worldbank.org/en/topic/climate-smart-agriculture> cited 15/12/2021
- World Bank, IFC, and MIGA. 2016. “World Bank Group Climate Change Action Plan 2016–2020.” World Bank, Washington DC. <https://openknowledge.worldbank.org/bitstream/handle/10986/24451/K8860.pdf> cited 15/12/2021
- World Bank. 2016. “World Bank Group Climate Change Action Plan 2021-2025: Supporting Green, Resilient, and Inclusive Development.” World Bank, Washington DC. <https://openknowledge.worldbank.org/bitstream/handle/10986/35799/CCAP-2021-25.pdf> cited 15/12/2021

TOPIC 8: CLIMATE CHANGE ADAPTATION AND THE TRANSPORT SECTOR

Overview

Transport is another important sector identified by the PNG government affected by climate change. With climate change, extreme weather and events like cyclones and floods continues to affect many transport routes both inland and on the coastal provinces. The main climate factors that may affect transportation sector includes climate-driven changes in temperature, humidity and precipitation. Coastal transport infrastructure, in particular seaports, airport runways, are now impacted by sea level rise which will exacerbate coastal flooding during extreme storm events. Roads and rail infrastructure, inland waterways and airports that are already prone to flooding continue to face more frequent inland flood events and deeper floodwaters under climate change and sea level changes.

This topic focuses on adaptation and transport sector in the context of climate change. The key message is to understand how climate change impacts transport sector but also to recognize how transport services contribute to present climate change. Weighing out these options is crucial for you to best manage transport sector situations.

It is important that this sector and especially provincial government and private sectors include climate change and sea level rise risks into all their design and building codes as a long-term strategy-Adaptation planning.

Aims of Topic 8

- ❖ To enable the participant to have the basic understanding of the linkage between climate change adaptation and the transport sector
- ❖ To enable participants to understand the implications of climate change adaptation on the transport sector
- ❖ To enable the participants frame climate change adaptation activities to support transport sector to adjust to the changing climatic conditions.
- ❖ Discuss and include all climate change and sea level rise into all design and building codes of transport sector

Objectives

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the linkage between climate change and transport sector
- ❖ Identify the climate change impacts and risks on the transport sector
- ❖ Apply the climate change resilience framework to identify the key adaption options
- ❖ Understand the complexities in climate change adaptation for the transport sector
- ❖ Knowledge Base

8.1 Takeaways

The following are key points in developing adaptation options for transport:

The transport sector is an important adaptation measure in achieving sustainable development outcomes and especially address issues of economic activity and social outcomes in the PNG. It supports both international and national trade with ever-increasing industry evolving around it.

The development of adaptation systems such as inventing new technology is important in reducing transport emission is a challenge given the inevitable increases in demand hence if no mitigation options are implemented to minimize these barriers, the current transport sector's GHG emission could rise by 50% by 2030 at the current rate thus double by 2050.

Decoupling transport from current GDP growth is possible yet requires the development and deployment of appropriate measures, advanced technologies, and improved infrastructures. The cost-effectiveness of these opportunities varies from region and over time.

The recent development of low-carbon transport systems is also an important adaptation option and will require behavioural changes and infrastructural investments together with the development of efficient vehicle technologies and the use of low-carbon fuels.

8.2 Climate change and transport

Climate change will impact transport in myriad ways, depending on the model and location-specific characteristics. At the same time, it is estimated that transport contributes about 23 percent of global CO₂ emission, therefore this sector holds the key to reducing the emission trajectory. Many nations are tasked today to invest in low carbon solutions which imply that they should increase the sustainability of existing and new transport systems.

There is evidence and high confidence indicating coastal systems and infrastructure especially in low-lying areas that will be adversely affected by climate change including submergence, coastal flooding and erosion due to rising sea level.

The IPCC (2022) estimated that the mean sea-level would increase anywhere from 0.44 meters (RCP 2.6) to 0.74 meters (RPC 8.5) by 2100. Data and information from PNG Weather Service (2021) concludes that sea level rise will continue to occur in the country and impact on coastal provinces. This could lead to more devastating impacts hence more unavoidable risks.

Presently, all transportation infrastructures are constructed under design standards that have not considered climate change effects (high temperature and high precipitation ranges, increased storm and cyclone incidence, floods, and coastal inundation) and return intervals for extreme events like floods and extreme heats. For example, paved roads are highly vulnerable to extreme heat while unpaved roads, bridges, and culverts are very sensitive to precipitation extremes.

Additionally, indirect effects of climate change can also impact transportation. Increased magnitude of natural disaster and heat waves can lead to mass transit, service disruptions, changes in passenger demand, reduced passenger health and comfort or high operational costs (e.g., cooling costs and peak electricity pricing).

Transport emissions contribute immensely to climate change while transport systems are highly vulnerable to damaging impacts of climate change hence result in access restrictions to dock and marinas, deteriorating conditions and structural integrity of road payments, bridges, airports and railway tracks (Table 13). As well as contributing to air, water (inland and marine) and noise pollution plus the land use changes for transport infrastructure which endanger other critical infrastructure.

Table 13: Climate change impacts and transport sector

Climate change factor	Potential impacts
Rising temperatures	<ul style="list-style-type: none"> • Longer shipping season and new sea routes.
High temperatures	<ul style="list-style-type: none"> • Additional support services and navigational aids.
Melting ice	<ul style="list-style-type: none"> • New trade, diversion of existing trade, structure and direction of trade (indirectly through impact on agriculture, fishing & energy).
Large variation (spatial/temporal)	<ul style="list-style-type: none"> • Damages to infrastructure, equipment and cargo. • Increased construction and maintenance costs.
Frequent freeze-thaw cycles)	<ul style="list-style-type: none"> • New ship design and strengthening hulls. • Environment, social, ecosystem related and political considerations. • Higher energy consumption in ports. • Variation in demand and supply of shipping and port services. • Challenges to shipping reliability.
Rising sea levels	<ul style="list-style-type: none"> • Damages to infrastructure, equipment and cargo (coastal infrastructure, port-related structure, hinterland connections).
Flooding & inundation	
Erosion of coastal areas	<ul style="list-style-type: none"> • Increased construction and maintenance costs, erosion and sedimentation. • Relocation and migration of people and business, labour shortage and shipyard closure. • Variation in demand and supply of shipping and port services and modal shift. • Structure and direction of trade (indirectly through impact on agriculture, fishing & energy). • Challenges to service reliability and reduced dredging, reduced safety and sailing conditions.

Extreme weather conditions	• Damages to infrastructure, equipment and cargo (coastal infrastructure, port-related structure, hinterland connections).
Tropical cyclones	• Erosion and sedimentation, subsidence and landslides.
Storms	• Relocation and migration of people and business, labour shortage and shipyard closure.
Floods	• Reduced safety and sailing conditions.
Increase precipitation	• Challenge to service reliability.
Wind	• Modal shift, variation in demand and supply of shipping and port services.
	• Changes in trade

8.3 Climate change adaptation and transport sector

The following are some of the important summaries on the impacts of climate change and adaptation options for consideration:

Adaptation in the transport sector is essential for both developed and developing countries, as global transport systems are vulnerable to the increasing impacts of extreme weather and that rapid motorization is increasing the potential for disastrous impacts.

Importantly, sustainable transport systems are crucial to adapt to climate change and maintain reliability to enable transport's role in socioeconomic development. By investing in equitable and climate-forward transportation infrastructure, the world can rebuild the global economy.

8.4 Climate change, transport sector and gender

The following are some considerations and options in adaptation for gender and in transport sector:

Despite decades of discussions between gender and transport, progress has been very slow in implementing a gender perspective in transport policies. For example, in urban planning, gender is less recognized hence it has become problematic to identify different travel patterns between different genders which have adversely affected the mobility of women.

In addition, the power-structures in the transport sector are far from equal such that male decision makers and male norms still dominate.

Promoting equality, diversity and inclusiveness in the transport sector is vital to achieving sustainable development. Planning travel and transport with women in mind, requires that women should be part of the whole spectrum of transport workforce. Actions from both public and private sectors are vital to attain the policy objective of a diverse and inclusive transport workforce.

Advancing adaptation planning and low carbon transport infrastructure and services, can incorporate a complete understanding of the factors influencing individual travel behaviour to reveal different preferences and attitudes by gender. Thereby, providing insights into existing travel patterns, improving transport planning, preparing for future infrastructure needs and services, and assisting better design and implementation of climate and risk-reduction alongside low-carbon transport policies that improve gender equality and safety.

Gender mainstreaming for the transport sector is crucial as it ensures that projects are designed and built to maximize positive and equitable benefits (e.g., income generating opportunities and access) while mitigating risks and threats from climate change.

Transport development must be driven by a human-centered approach which translates to gender-responsive projects. This will allow participation of all stakeholders affected by transport systems and not only the financiers, engineers, environmentalists but also the gender experts, social inclusion experts, women, and all members of the society.

We should develop transport systems and facilities that promotes sustainable development, foster innovation and build our society that is inclusive, safe, and resilient.

8.5 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)
P.O. Box 4017
Boroko
National Capital District
Papua New Guinea Email: info@ccda.gov.pg
Website: www.ccda.gov.pg

8.6 Activity

Impacts of climate change increasing

Post Courier, December 8th, 2017

By Nellie Setepano

The impacts of climate change-related hazards in Papua New Guinea have been increasing in intensity and frequency, a climate change meeting in Port Moresby heard. Most coastal and riverine areas are prone to extensive flooding which is one of the most devastating impacts observed to date.

The country's economy, environment and people are vulnerable and at risk of not meeting basic human development needs due to drastic onset and multitude of this climate change impacts. As a results-five community resilience projects funded by Climate Change Adaptation Fund has seen the five-year projects underway in five provinces. These projects are as follows: early warning system and mangrove rehabilitation and reforestation program, and climate change

training and livelihood protection in Madang, Morobe, Northern, and New Ireland and East Sepik provinces.

The meeting by project stakeholders heard that the five-year projects have reached its completion and there was a need for their sustainability. Inputs from stakeholders such as National Weather Services, Climate Change, and Development Authority, Conservation and Environment Authority and civil society organizations have come together in Port Moresby this week to present the project and identify lessons look for a way forward to sustain the projects. The United Nations Development Program has supported the projects with funding from the Adaptation Fund and the Australian Department of Foreign Affairs and Trade.

Source: Setepano, N. 2017, Impacts of Climate Change Increasing, *Post Courier*, December 9, 2017:

<https://postcourier.com.pg/impacts-climate-change-increasing/>

The article highlights critical issues concerning the transport sector in the country. As development experts, discuss the key issues affecting the transport sector as a direct consequence of the adverse impacts of climate change. Under each issue, identify activities that must be undertaken to lessen these issues.

The facilitator will ask each group to present their outcomes to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

8.7 Self-Evaluation

What did you acquire in this session which has broaden your perspective?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

8.8 References

- CCDA. 2020, Report on Papua New Guinea's Sustainable Development Goal 13, Road map 30 by 30, Climate Change and Development Authority (CCDA)
- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop
- UNCTAD. 2019, Why the transport sector needs to adapt to climate change, United Nations Conference on Trade and Development (UNCTAD), <https://unctad.org/news/why-transport-sector-needs-adapt-climate-change> cited 19/12/2021
- Sims R., R. Schaeffer, F. Creutzig, X. Cruz-Núñez, M. D'Agosto, D. Dimitriu, M.J. Figueroa Meza, L. Fulton, S. Kobayashi, O. Lah, A. McKinnon, P. Newman, M. Ouyang, J.J. Schauer, D. Sperling, and G. Tiwari, 2014: Transport. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer, O., R. Pichs-Madruga, Y. Sokona, E. Farahani, S. Kadner, K. Seyboth, A. Adler, I. Baum, S. Brunner, P. Eickemeier, B. Kriemann, J. Savolainen, S. Schlömer, C. von Stechow, T. Zwickel and J.C. Minx (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter8.pdf
- Comité 21 & Climate Chance. 2019, Synthesis Report on Adaptation Actions, Global Observatory on Non-State Climate Action, Climate Chance 2019, <https://www.climate-chance.org/wp-content/uploads/2020/03/climate-chance-comite21-2019-adaptation-book-2019-synthesis-report-on-adaptation-action.pdf> cited 19/12/2021
- OECD. 2010, Reducing transport GHG emissions: Opportunities and Costs, Preliminary Findings, International Transport Forum, <https://www.internationaltransportforum.org/Pub/pdf/09GHGsum.pdf> cited 19/12/2021
- UNSDSDG. 2021, Concept Note: Thematic Session 4: Sustainable transport and green development: climate change mitigation, adaptation and resilience, Second United Nations Global Sustainable Transport Conference, 14-16 October 2021, Beijing, China, 1 September 2021, United Nations Division for Sustainable Development, https://sdgs.un.org/sites/default/files/2021-10/GSTC-2_Session%204_Climate_Concept%20note_1%20Sept%202021_rev2.pdf cited 19/12/2021
- OECD. 2009, Integrating Climate Change Adaptation into Development Co-operation, Policy Guidance, <https://www.oecd.org/env/cc/44887764.pdf> cited 19/12/2021
- Finley, T. & Schuchard, R. 2009, Adapting to Climate Change: A Guide for the Transportation Industry, Business for Social Responsibility (BSR) https://www.bsr.org/reports/BSR_Climate_Adaptation_Issue_Brief_Transportation.pdf cited 19/12/2021
- UNESD, Joint Workshop "Climate Change Impacts on International Transport Networks", Economic Commission for Europe, Inland Transport Committee, Working Party on Transport Trends and Economics, 23rd Session, Geneva 7-8 September 2010. ECE/TRANS/WP.5/2010/3, United Nations Economic Commission for Europe and United Nations Conference on Trade and Development secretariats <https://unece.org/DAM/trans/doc/2010/wp5/ECE-TRANS-WP5-2010-03e.pdf> cited 22/12/2021
- ADB. 2012, Urban Transport Strategy to Combat Climate Change in the People's Republic of China, Asian Development Bank (ADB), ISBN 978-92-9092-572-9 (Print), 978-92-9092-573-6 <https://www.adb.org/sites/default/files/publication/29675/urban-transport-strategy-cc-prc.pdf> cited 22/12/2021
- Leather, J. 2009, ADB Sustainable Development Working Paper Series, No.10, December 2009, Clean Air Initiative for Asian Cities Centre Team, Asian Development Bank (ADB), <https://www.adb.org/sites/default/files/publication/28489/adb-wp10-rethinking-transport-climate-change.pdf> cited 22/12/2021
- CCC. 2021, ClimateSmart Cities Self Assessment Tool, ClimateSMART Cities Assessment Framework, Climate Centre for Cities, <https://niua.org/c-cube/csc-sat/about-csc> cited 22/12/2021

SLOCAT. 2021, Transport and Climate Change Global Status Report, 2nd Edition, Tracking Trends in a Time of Change: The need for Radical Action Towards Sustainable Transport Decarbonisation, https://tcc-gsr.com/wp-content/uploads/2021/06/Slocat-Global-Status-Report-2nd-edition_high-res.pdf cited 22/12/2021

Patterson, R. 2021, Gender, Climate and Transport in the United States, Policy Brief on Transport, Women's Environment and Development Organization (WEDO), https://wedo.org/wp-content/uploads/2021/07/WEDO_PolicyBriefonTransport_July15.pdf cited 23/12/2021

ADB. 2019, Gender in Infrastructure: Lessons from Central and West Asia, December 2019, Asian Development Bank (ADB) <https://www.adb.org/sites/default/files/publication/545006/gender-infrastructure-central-west-asia.pdf> cited 23/12/2021

ADB. 2020, How to use gender approaches to build climate resilience: Tips for designing ADB projects based on experiences in the Pacific, Asian Development Bank (ADB) <https://www.adb.org/sites/default/files/publication/616101/gender-approaches-climate-resilience-pacific.pdf> cited 23/12/2021

Menon, J. 2019, Guide on Integrating Gender throughout Infrastructure Project Phases in Asia and the Pacific, UN Women, https://www2.unwomen.org/-/media/field%20office%20eseasia/docs/publications/2019/03/ap-bls19062_gpp_web.pdf?la=en&vs=5727 cited 23/12/2021

Kaluwin.C and Samuel.P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.

TOPIC 9: CLIMATE CHANGE ADAPTATION AND THE INFRASTRUCTURE SECTOR

Overview

PNG government considers infrastructure sector as one of the major sectors affected by climate change. Infrastructure is the backbone of the global economy, connecting people, enhancing quality of life, and promoting health and safety. However, with climate change, it is revealing a lot of infrastructure vulnerabilities. Hence, the central question is not whether we need infrastructure, but how it can be provided in ways that is sustainable, resilient, and compatible with a net zero future. This demands a myriad of choices, from its inception as an infrastructure project to the end of its life when it is decommissioned

This topic focuses on adaptation and infrastructure sector in the context of climate change. The key message is to understand how climate change impacts infrastructure sector.

Aims of Topic 9

- ❖ To enable the participant to have the basic understanding of the linkage between climate change adaptation and the infrastructure sector
- ❖ To enable participants to understand the implications of climate change adaptation on the infrastructure sector
- ❖ To enable the participants frame climate change adaptation activities to support infrastructure sector to adjust to the changing climatic conditions.

Objectives

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the linkage between climate change and infrastructure sector.
- ❖ Identify the climate change impacts and risks on the infrastructure sector.
- ❖ Apply the climate change resilience framework to identify the key adaptation options.
- ❖ Understand the complexities in climate change adaptation for the infrastructure sector.

Knowledge Base

9.1 Takeaways

The following are key points in developing and designing adaptation options for infrastructure:

Infrastructure policy makers and practitioners have a vital role to play in meeting the challenges of climate change impacts in the developing world. This applies to mitigation (i.e., reducing GHG emissions in ways that sustain growth and reduces poverty) and adaptation (i.e., protecting the vulnerable elements from the impacts and risks of climate change).

Three key challenges are faced by the infrastructure sector, and they are (a) raising the necessary finance, (b) developing and transferring technology, and (c) developing the capacity of governments to formulate and implement climate change adaptation planning and resilience in the infrastructure sector.

However, climate change has also created development opportunities in the infrastructure sector like access to new sources of finance, the potential for green job creation, and profiting from synergies between climate change initiatives and development priorities.

9.2 Climate change and infrastructure

The existing infrastructure like water infrastructure (drainage network, irrigation network, reservoirs, dams, dikes water supply network, etc.), transportation infrastructure (highways, airports, seaports, etc.), energy supply infrastructure, telecommunication infrastructure, and buildings of public facilities (hospitals, government buildings, schools, etc.) of different places and times differ.

Infrastructure is usually planned with certain design life; hence it is expected to be useful and sustainable during the design life. In reality, many infrastructures show substandard performances due to many factors, both technical and non-technical factors. For example, many urban drainages cannot function well because they are full of waste, and therefore cannot accommodate surface runoffs due to heavy rainfalls generated in a changing climate. The APEC Building in Port Moresby (cover page) and Figure 29 is an example of a building that has not properly considered climate change impacts. Figure 30 is another example showing rock walls which will be impacted by climate change.

These underlying conditions are further escalated by extreme weather events due to climate change hence when infrastructure of a region becomes disrupted, it can negatively impact other sectors like economy, public health, etc.

Sufficient provision of infrastructure and administration will enhance economic growth, competitiveness and improve quality of life. Sustainable development requires sustainable infrastructure which is the main pillar of modern society.

Climate change means that the increasing temperature of land and sea during the last three decades is expected to continue. The rise in temperature has also affected precipitation and atmospheric moisture leading to more intense rainfall, more storms and rising sea level. The cumulative impact of climate change on these vital infrastructures for energy supply, water supply, and transport systems are likely to bring forth additional new risks.

Transportation system and its infrastructure are crucial for efficient distribution of food, energy, and trade as well as facilitating accessibility to jobs and market for the workers and consumers. Physical damages and disruptions caused by climate change to such infrastructure will have significant socioeconomic and human losses (Table 14).

Table 14: Potential impacts of climate change on transport infrastructure

Climate change	Roads	Ports & waterways	Airports
Temperature change	Rapid asphalt deterioration. Substructure damage. Increase O&M costs.	Thermal expansion of bridge joints, paved surfaces.	Rapid asphalt deterioration on runway
Precipitation change	Increase flooding of roadways Increase erosion. Construction damages.	Channel closure due to increased silt deposition from constant flooding Reduced navigability.	Travel disruption due to heavy flooding Damages to airport infrastructure due to inundation.
Sea level rise	Permanent inundation of roads, seaports and airport infrastructure.		



Figure 30: APEC Building - example of infrastructure built without climate change influences²⁶

²⁶ Photograph taken by Chalapan Kaluwin 2021



Figure 31: Modern coastal infrastructure without consideration of climate change influences²⁷

9.3 Coastal Protection

Figure 31 shows an example of the rapid coastal erosion along the coastal shorelines in PNG.



Figure 32: Rapid coastal erosion along the coastlines in PNG²⁸

The IPCC Reports (2007 and 2021-2022) working group on Impacts and Adaptation stress that the cost of Adaptation strategies in the world will be economically taxing to all countries including small island states like PNG. Adaptation policies for PNG need to be developed very soon to address the impacts of climate change and variability and sea level rise. The landform of PNG and most little islands of the Pacific and their coastlines are general quite different to those of Australia, New Zealand, Europe, US and Asia. Most coastal defence systems have been developed for these regions and then adapted for use elsewhere, including PNG.

²⁷ Photograph taken by Chalapan Kaluwin 2021

²⁸ Photograph taken by Peter Samuel 2021

The conditions that tend to differentiate the PNG are as follows:

- Fringing coral reefs, barrier reefs and atolls provide partial natural barriers against large ocean swells, winds, and storm surges.
- Cyclone impact by creating large ocean swells that travel long distance with little reduction in wave heights.
- Wave action on reefs results in sand production and rubble that act as a source to build beaches and size of islands (See Figure 32).

Islands are often narrow and low lying so that a strategy of setting back development from the shoreline is difficult to implement. Erosion problems are now confronting PNG and the coastal communities. Materials for constructing sea defences are often limited to coral rubbles, boulders and sand. Where hard rock occurs the maximum size rocks are usually less than 5 tons. Budgets for constructing coastal defence are limited if construction have been justified in terms of economic returns.

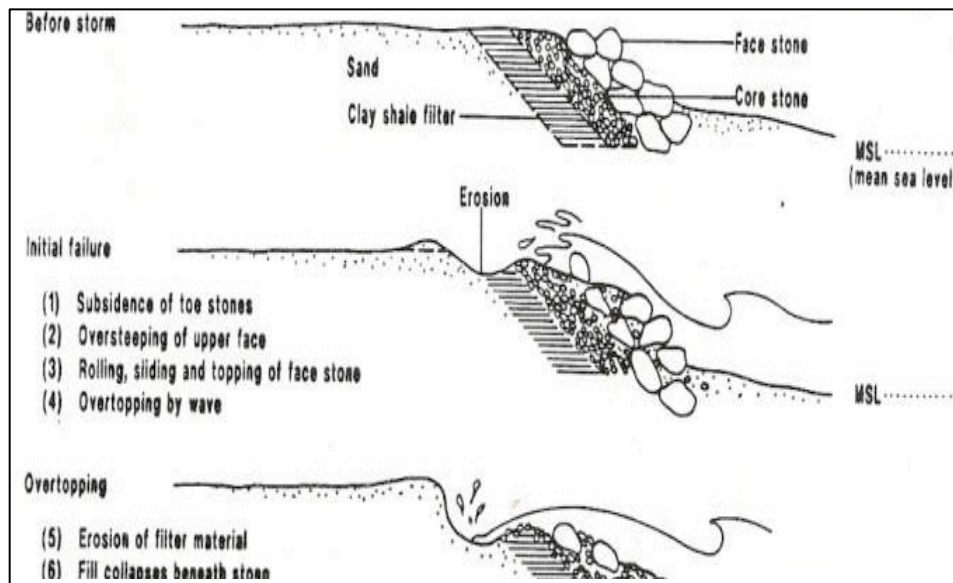


Figure 33: Adaptation systems for Coastal Defence

All these adaptation systems or coastal protection systems used elsewhere are not directly applicable to PNG environment and shorelines. The drivers or factors that cause erosion along the coastlines and communities including the following (Table 15).

Table 15: Drivers and Effects of Coastal Erosion

Drivers	Effect
<i>Storms</i>	Storm surges and waves are common cause of erosion by moving sand offshore and damage to infrastructure.
<i>Cyclical weather patterns</i>	Repeated patterns over a long period of time.
<i>Sea level rise</i>	The increase of relative sea level rise occurring due to warming of oceans, winds, waves and ENSO contribute to sea level changes.
<i>Sand extraction</i>	Sand has been extracted for social and economic develop
<i>Reclamation</i>	Repossession of shorefront land.
<i>Seawalls</i>	This is subjected to the wave actions.
<i>Sand trapping structures</i>	This includes traditional method of stabilizing a segment of the coast and been the construction of groynes or other barriers that prevent sand being moved along the beach by waves.



Figure 34: Coastal protection systems²⁹

²⁹ Photograph: Chalapan Kaluwin 2021

PNG experiences on coastal protection methods

Much of the coastal protection works in PNG and within the Pacific islands have been funded by either foreign aid or developers. This has resulted in the use of the following coastal protection systems (Figure 33):

- Rubble mound coastal revetments or breakwaters constructed of hard rocks (basalt or granite).
- Vertical walls a common method in PNG.
- Gabion revetment and mattresses use small size rocks and usually short life (7 years).
- Beach or foreshore replenishment has only recently used in the country. Use of sand and corals.

The development of adaptation strategies and especially coastal protection systems such as traditional and modern protection systems are available, but the traditional systems are generally ignored. The constructions of conventional effective coastal defence works are expensive and costly in the order of K1200.00 to K15, 000.00 per meter length (See Figure 34).

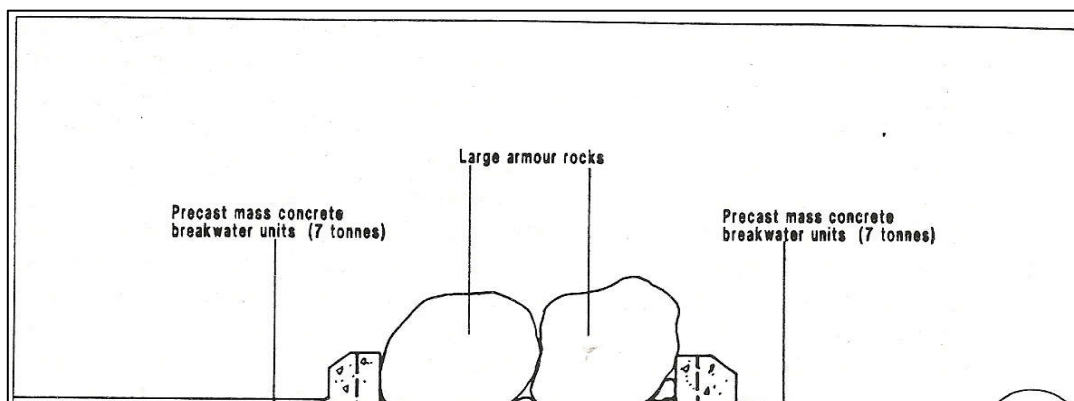


Figure 35: PNG's Experiences in Coastal Protection

9.4 Climate change adaptation, infrastructure sector and gender

Climate change is already affecting every region on Earth in multiple ways. Women have long faced a greater burden from a changing climate compared to men which exacerbates many other inequalities.

In line with 2030 Agenda, good access to quality and sustainable infrastructure is an important determinant of people's wellbeing. Moreover, high quality infrastructure from digital, transport, energy and water to public areas and facilities underpin inclusive growth and support sustainable development. Both sustainable and quality infrastructure is vital to foster equal opportunities, to connect left-behind areas, ensure easy access to public amenities for everyone to improve their welfare.

Though there is an assumption that women will spontaneously benefit from new infrastructure projects in the same way as men do, it is not true since there is still distinct difference based on their needs and social roles. For example, improving urban amenities may improve people’s life in the city but the risk of unmanaged urbanization poses greater threat for women.

Additionally, contrary to popular belief, infrastructure is not gender neutral. Women and girls worldwide remain disproportionately burdened by a lack of access to basic infrastructure services like clean water, sanitation, and safe public transport. Barriers often apply in infrastructure development (Table 16).

In support of SDG5 (Gender Equality), improving urban/rural infrastructure with a gender perspective should reduce human-related risks. Considering needs of women, girls and children in infrastructure planning also improves distributional effects of infrastructure projects (e.g., equality in accessibility) and harnesses sound business decision that prevent wrong planning decisions.

Table 16: Barriers to gender-responsive infrastructure development

Barriers	Descriptions
Inadequate knowledge and awareness	Infrastructure sector is still male dominated, and knowledge of gender as vital aspect of sustainable development is still lacking amongst policy makers.
Lack of capacity building and training	Lack of overall lack of awareness limits opportunities for training and capacity building in the infrastructure cycle.
Lack of gender disaggregated data	Lack of systematic collection of gender disaggregated data at both project and aggregate level limits provision of reliable information on differentiated needs of women as infrastructure end-users.
False perception of costs	Gender-responsive infrastructure is seen as time consuming and expensive. However, it is not true because inadequate design and planning that constraint the accessibility of infrastructure services negatively impacts overall business.
Unfavourable enabling environment	Lack of proper policy and legal framework limits mainstreaming process to cater for gender in infrastructure project development.

By identifying the challenges women and girls face in terms of infrastructure development, we can increase resilience, provide equal opportunities and, in the long-term, create a world where gender equality will not be the norm but also upheld during times of crisis and beyond.

9.5 Climate change adaptation framework for infrastructure sector

Many strategies have been developed to reduce negative impacts of climate change on infrastructure. The adaptation framework (Figure 35) depicts the key processes involved in identifying the climate change impacts and threats and the possible adaptation options.

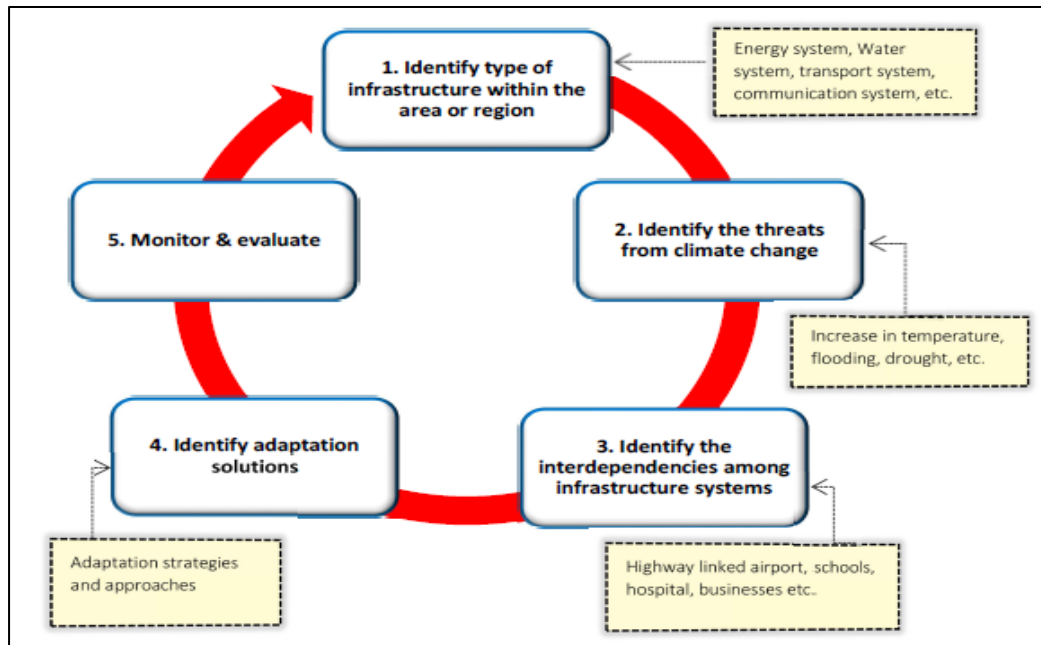


Figure 36: Climate change adaptation framework for infrastructure

The framework has five simple steps. These steps firstly identify the type of infrastructures, followed by the identification of the climate risks that relates to other infrastructure systems and then the identification of the appropriate strategies that creates win-win gain for all and finally the monitoring and evaluation of this approach. The adaptation framework shown above can be better completed using the Development Resilient Framework (Topic 4). The Development Resilient Framework is a suitable model to apply in assessing those key variables (impacts, risks, and vulnerabilities) and identify the most appropriate adaptation interventions or options to use in the infrastructure planning process.

9.6 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)
P.O. Box 4017
Boroko
National Capital District
Papua New Guinea Email: info@ccda.gov.pg
Website: www.ccda.gov.pg

9.7 Activity: Field excursion to the beachfront

This activity will involve a field trip to observe the various coastal protection systems (if possible), from natural to modern coastal systems from beach replenishment, coastal protection systems and its design.

Old Ela Beach



New Ela Beach



This will be followed by a group discussion to allow every participant to discuss the nature of these coastal protection systems.

The facilitator will ask each group to present their results to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

9.8 Self-Evaluation

What did you acquire in this session which are you most proud of?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

9.9 References

- AIP Conference Proceedings 1977, 040030 (2018); <https://doi.org/10.1063/1.5043000> Published Online: 26 June 2018, [Climate change risks to infrastructures: A general perspective \(scitation.org\)](https://doi.org/10.1063/1.5043000) cited 22/12/2021
- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop
- Baker, A. & Week, D. 2011, Infrastructure and Climate Change in the Pacific, Pacific Australia Climate Change Science and Adaptation Planning (PACCSAP) program
<https://www.awe.gov.au/sites/default/files/documents/infrastructure-report.pdf> cited 22/12/2021
- CCDA. 2020, Report on Papua New Guinea's Sustainable Development Goal 13, Road map 30 by 30 Climate Change and Development Authority (CCDA)
- IPCC, 2018: Summary for Policymakers. In: Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, and T. Waterfield (eds.)]. In Press.
https://www.ipcc.ch/site/assets/uploads/sites/2/2019/05/SR15_SPM_version_report_LR.pdf cited 22/12/2021
- Kaluwin.C and Samuel.P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- Morgan G, Bajpai A, Ceppi P, Al-Hinai A, Christensen T, Kumar S, Crosskey S & O'Regan N. Infrastructure for gender equality and the empowerment of women. UNOPS, Copenhagen, Denmark.
<https://content.unops.org/publications/UNOPS-Infrastructure-for-Gender-Equality-and-the-Empowerment-of-women.pdf> cited 22/12/2021
- OECD. 2018, Climate-resilient Infrastructure, Policy Perspectives, OECD Environment Policy Paper No.14,
<https://www.oecd.org/environment/cc/policy-perspectives-climate-resilient-infrastructure.pdf> cited 22/12/2021
- OECD. 2019, Gender Equality and Sustainable Infrastructure, OECD Council on SDGs: Side Event, 7 March 2019
<https://www.oecd.org/gov/gender-mainstreaming/gender-equality-and-sustainable-infrastructure-7-march-2019.pdf> cited 22/12/2021
- Ramos, J. 2021, Climate-smart infrastructure: Principles and technology, <https://tomorrow.city/a/climate-smart-infrastructures-principles-and-technology>
- Ryan-Collins, L. Ellis, K & Lemma, A. 2011, Climate Compatible Development in the Infrastructure Sector: An overview of the opportunities and challenges at the nexus of climate change, infrastructure and development, Engineers Against Poverty
<https://cdn.odi.org/media/documents/7142.pdf> cited 22/12/2021
- Rydge, J., Jacobs, M. and Granoff, I., 2015. Ensuring New Infrastructure is Climate-Smart. Contributing paper for Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate. New Climate Economy, London and Washington, DC. Available at: <http://newclimateeconomy.report/misc/working-papers/>.
- Schweikert, A., Chinowsky, P., Espinet, X., & Tarbert, M. (2014). Climate Change and Infrastructure Impacts: Comparing the Impact on Roads in ten Countries through 2100. Procedia Engineering, 78, 306–316.
<https://doi.org/10.1016/j.proeng.2014.07.072>
- Thacker S, Adshead D, Fantini C, Palmer R, Ghosal R, Adeoti T, Morgan G, Stratton-Short S. 2021. Infrastructure for climate action. UNOPS, Copenhagen, Denmark.
https://content.unops.org/publications/Infrastructure-for-climate-action_EN.pdf cited 22/12/2021
- The Solutions Lab. 2020, Gender-Responsive Infrastructure, Thematic Brief, The Solutions Lab
https://emsdialogues.org/wp-content/uploads/2020/11/The-Solutions-Lab_Gender-responsive-Infrastructure_Thematic-Brief.pdf cited 23/12/2021

UCS. 2021, Principles for Climate-Smart Infrastructure, Union of Concerned Scientists
<https://www.ucsusa.org/sites/default/files/attach/gw-smart-infrastructure-principals.pdf> cited 22/12/2021

UNEP. 2021, Infrastructure for Climate Action, United Nations Environment Programme (UNEP)
<https://www.unep.org/resources/report/infrastructure-climate-action> cited 22/12/2021

USAID. 2015, A methodology for Practitioners: Overarching Guide: Incorporating climate change adaptation in infrastructure planning and design, USAID,
https://www.climatelinks.org/sites/default/files/asset/document/OVERARCHING_METHODODOLOGY_CCA_ENGINEERING_DESIGN.pdf cited 22/12/2021

Wei, J & DeRidder, K. 2021, Mobilising climate-resilient infrastructure in Asia, DevPolicy Blog,
<https://devpolicy.org/mobilising-climate-resilient-infrastructure-in-asia-20211029/> cited 22/12/2021

TOPIC 10: POLICY DEVELOPMENT AND GOVERNANCE

Overview

Climate change poses greater risks to human health, ecosystems, social and cultural systems, and economic development. Climate change policy is mandatory for government to develop. The goals of climate policy should be to reduce the risks and take advantage of opportunities. Climate change is a complex and ongoing process which requires actions by individuals, communities, governments, and international organizations. To make informed decisions, policy makers need timely and useful information about the consequences of climate change, people perceptions of whether these impacts are negative or positive, available adaptation options and the benefits of slowing the rate of climate change. The challenge is for communities to provide the factual information for policy makers to make informed decisions to adapt to these untimely and adverse consequences of climate change.

Climate governance, on the other hand, is the diplomacy mechanisms and response aimed at steering social systems towards preventing, mitigating, or adapting to the risks posed by climate change. Climate change is a threat to humanity at global and local scale thus for it to be tackled holistically, its governance is an important issue need scientific and practical considerations. The contemporary political/administrative systems have evolved to solve other issues and must now be adapted to handle emerging issues of climate change adaptation and mitigation.

This topic focuses on policy development and governance in the context of climate change. The key message is to understand the policy development process and the governance of the policy to ensure climate change is effectively managed. Evaluating these options is crucial in order for you to best implement the policy thus ensure decision are made fairly and on timely basis to adapt these changing climatic situations.

Aims of Topic 10

- ❖ To enable the participant to have the basic understanding of the concept of policy development and governance.
- ❖ To enable participants, understand the implications of climate change adaptation on the policy development and governance sector.
- ❖ To enable the participants frame climate change adaptation activities to support policy and governance to adjust to the changing climatic conditions.

Objectives

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the linkage between policy development and governance.
- ❖ Understand the climate change issues and processes at global and national scale.
- ❖ Applying PNG laws in PNG, its appropriateness or relevance, especially in sectors and provinces.

- ❖ Understand the complexities in policy implementation and governance.

Knowledge Base

10.1 Takeaways

The following are key points:

- A policy is a deliberate system of guidelines to guide decisions and achieve rational outcomes. It is a statement of intent and is implemented as a procedure or protocol.
- A policy is usually adopted by a governance body within an organization and also a policy differs from rules and laws.
- A policy should be integrated which infers that it should not be created in isolation but be threaded across all sectors, departments, and ministries.
- A policy should be informed which implies that it should be created with substance, or it must have strong science or be evidence based.
- A policy should be inclusive which means that it should involve wider representations and participations rather than only the politically powerful or wealthy.

10.2 Policy development cycle

A policy comes in different forms and includes public policies, organizational policies, sectoral policies, department policies, and so on.

A public policy is developed and implemented by the government for its citizens. Policy development has several key stages and steps, and they are listed and shown in Figure 36.



Figure 37: Policy Making Cycle

Stage 1- Issue identification and agenda building

The first step of policy process involves turning issues identified into agenda items for policymaking bodies. Note that many problems exist but only those that become policy agendas are identified as the most significant issues.

The key points to recognize are:

An issue becomes agenda item if it is initiated by a major political group compared to a small interest group without great political clout.

An issue becomes agenda item if it hits public spotlight (the amount of attention and public outcry) for it.

An issue becomes agenda item if it's given much publicity through media or if there's strong campaign from certain powerful groups for it.

More importantly, not all issues that become agendas complete the policy cycle become laws. Furthermore, the agenda items are subjected to timing thus are easily displaced by other issues when crisis occurs.

Stage 2 - Policy formulation

The second step of policy process is referred to as policy formulation and involves the proposal of solutions to the agenda issues. In this step, policymakers discuss and suggest approaches to correct problems that have occurred as part of the agenda. At times, it is necessary to choose from among multiple potential paths to move forward.

The key points to consider are:

Formulation step often provides policymakers with several choices or options for resolving agenda items.

Effective policy formulation is comprised of analysis that identifies the most effective policies and political authorizations.

Stage 3- Policy adoption

The third step of policy process is known as policy adoption and infers that the formulated policies are widely and readily accepted by government bodies for future implementation.

During the adoption phase, similar factors that influence issues when moving into the phase of agenda building also act as disrupting forces. Examples include powerful political groups, media or other interested groups also affect how policies are adopted.

Politicians especially governors can adopt the policies and bring about changes in their provinces however it depends on the executive arm of the government to determine which are adoptable at the national level.

The key points to recognize for stage 3 include:

The Executive branch of which the Prime Minister is the chair has the authoritative powers to determine which policies are best adopted for implementation at national level.

The Legislative branch which is the parliament passes the bill which becomes the law or regulation that is ready for implementation.

Stage 4 - Policy implementation

The fourth step of the policy process is referred to as policy implementation and implies that the adopted policies are to be put into effect.

Policy implementation means the actual rollout of the proposed solutions. Whether the policies are successfully implemented depend on the following conditions:

A policy needs to be communicated from the creator (e.g., national government) to the relevant governing bodies within the bureaucracy that has the mandate to implement it. For example, the Pandemic Act gives the Police Department the power to take charge of every situation even when its staff do not have the capacity to deal with the scientific (medical) aspects of any pandemic outbreak in the country.

A policy needs to be communicated clearly and easy to interpret if it is to be implemented effectively. Too much ambiguity in this stage can lead to the involvement of the judiciary that forces legislators to clarify their ends and means for policy implementation. The judiciary may overrule the implementation of such policies.

The resources applied to the implementation of such policy must accommodate or integrate existing processes and agencies without extensive disruption, duplication, competition, or conflict.

Apart from the points highlighted, policy implementation can further be complicated when policies are passed down to agencies without a great deal of direction. Policy formulation is a result of compromise and represents the nature of politics hence implementation imposes greater amount of discretion and confusion in agencies administering the policies. Moreover, bureaucratic incompetency, ineptitude and corruptions may complicate the policy implementation process.

Stage 5 - Policy evaluation

The fifth step of policy process is known as policy evaluation and implies that the implemented policy should be inspected to ensure it fulfils its mandated objectives.

Policies can be evaluated using several standards. They can be informally evaluated based on uncritical analysis like anecdotes, substantially evaluated through careful, honest feedbacks from those affected by the policies or formally evaluated through research that provide empirical evidence regarding the effectiveness of the policies.

Scientific research is vital as it provides both comparative and statistical evaluations of whether policies have clear casual results

Policy evaluation can occur at different times. For example, administrators may want to improve operations may assess policies as they are being implemented. After policies been implemented, they can be further evaluated to understand their overall effectiveness.

A number of ways are used to assess policy implementation; however, evaluation have not been regularly done. Formal and scientific research appear time consuming, complicated to design and implement and costly while informal evaluation which are mainly anecdote or storytelling are commonly used, they tend to contain a lot of biases.

Policies are difficult to assess where some aim to achieve broad conceptual goals that require different interpretations while other have multiple objectives that may not be compatible.

Stage 6 - Policy termination

The sixth step of policy process is known as policy termination and implies the deliberate cessation or conclusion of government functions, organizations, policies, or programs. In other words, it is gratitude that a policy or program need not live forever once its objectives are achieved.

From historical perspective, once policies are implemented, they are difficult to terminate. When they are terminated, it is usually because the policy has become obsolete, clearly did not work, or lost its support among the interest groups and elected official that earlier endorsed it.

From a legal perspective, a policy termination is crucial for protecting the government, organization from liability and risks associated with it.

From an ethical perspective, a policy termination policy is vital as it details how affected organization and its staff subject to involuntary termination can be effectively managed with respect.

10.3 Papua New Guinea Climate Change (Management) Act

Presented at the COP 26 Meeting in Glasgow, the Climate Change (Management) Amendment Bill 2021 was passed in late 2021. This Amendment updates the Papua New Guinea Climate Change (Management) Act 2015 which was developed in 2015 and approved by the PNG Government before the Paris Agreement was concluded in December 2015.

Scientists globally (e.g., IPCC amongst others), the PNG Government and the Alliance of Small Island States believe that the Paris commitment will not be achieved as the climate change emissions continue to increase in the Pacific Ocean and their countries. Even the maintaining of 1.5°C degree of warming at the global level until 2030 will not be achieved.

10.4 Governance

Governance refers to all the processes of interactions, be they be laws, norms, power, or language, of an organized society over a social system. It is usually performed by the government of a state, by a market, or by a network. Governance involves system by which an organization is controlled and operates, and the mechanisms by which it, and its people, are held to account. Ethics, risk management, compliance and administration are all elements of governance.

Governance reflects the structures and processes that are designed to ensure accountability, transparency, responsiveness, rule of law, stability, equity and inclusiveness, empowerment, and brad-based participation. Governance represents the norms, values, and rules of the game through which public affairs are managed in manner that is transparent, participatory, inclusive, and responsive. Governance therefore can be subtle and may not be easily observable.

In a broad sense, governance is about the culture and institutional environment in which citizens and stakeholders interact among themselves and participate in public affairs. It is more than the organs of the government. Governance is about how power is distributed and shared, how policies are formulated, priorities set, and stakeholders made accountable.

10.5 Good Governance

Governance is the process of decision-making and the process by which decisions are implemented (not implemented). In this context, governance applies to corporate, international, national, or local governance and the interactions between other sectors of the society.

Good governance, however, is the process of measuring how public institutions conduct public affairs and manage public resources and guarantee the realization of human rights in a manner essentially free of abuse and corruption and with due regard for the rule of the law.

Good governance emerged as a model to compare ineffective economies or political bodies with viable economies and political bodies. It focuses on the responsibility of governments and governing bodies to meet the needs of the masses as opposed to selected groups in the society.

Good governance is an approach to government and governing bodies that are committed to creating a system based on justice and peace that protects individual’s human rights and civil liberties. According to the United Nations, good governance is measured using eight principles (factors) and they include: participation, rule of law, transparency, responsiveness, consensus oriented, equity and inclusiveness, effectiveness and efficiency and accountability (Figure 37).

The primary use of these principles is to serve as a guide for bureaucrats, managers, directors, and legislators. If the principles are fundamentally true and the rule of law is executed, this is invaluable in assisting decision-makers and implementers make their organizations, departments, and sectors effective in meeting the socioeconomic needs of their constituents and the country at large.



Figure 38: Eight good governance principle

10.6 Climate change governance

Climate change governance requires governments to take an active role in bringing about shifts in interest perceptions so that stable societal majorities in favour of deploying an active mitigation and adaptation policy can be maintained.

Climate change governance is posing difficult challenges for contemporary political/administrative systems. These systems evolved to handle other sorts of problems and most now be adapted to handle emerging issues of climate change mitigation and adaptation. Due to the “institutional inertia”, long-term climate change governance faces daunting challenge in terms of its development and implementation across the globe to reduce the adverse impacts of climate change. When the powerful influence of groups combined scientific uncertainty, there is high complexity in terms of reaching global agreements and long-time frame thus the only option is for the governments to delay action, avoid irritating influential groups, and adopt less ambitious climate program. The conflict of power and interest are unavoidable in relation to long-term climate change policy.

To address long term climate change policy, it requires alteration of the ways things are currently done especially in relation to production and consumption practices in key sector namely energy, agriculture, infrastructure, health, and transportation.

In addition, to create an effective governance regime; we need to know how different elements interact with each other. The combination of top-down and bottom-up actions may differ in every case and are negotiated between actors in a polycentric setting with stakeholders whose capacities, areas of influence and interests form a particular governance model (Figure 38).

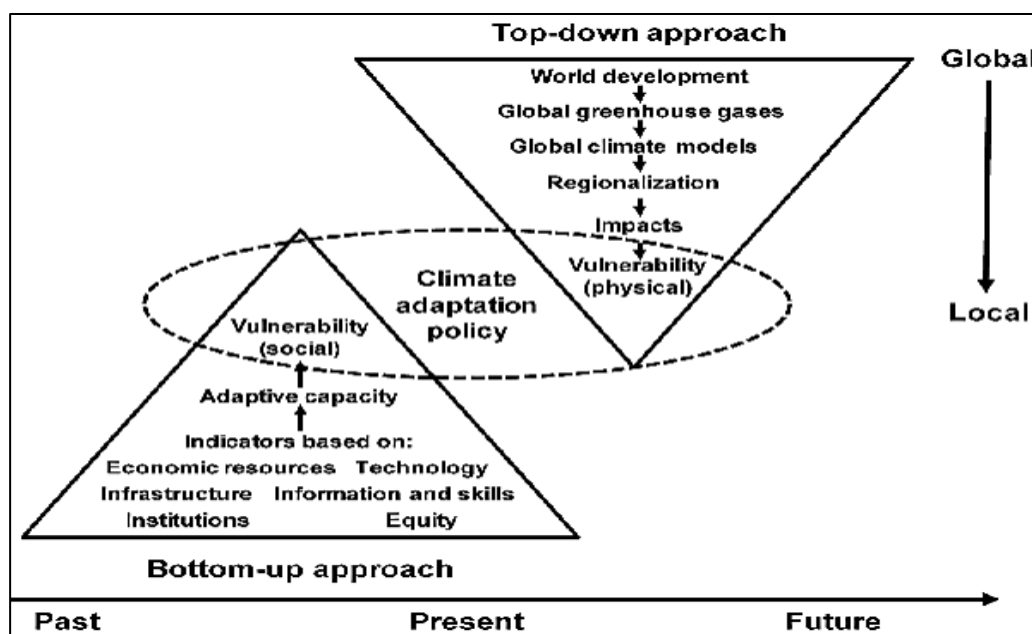


Figure 39: Top-down and bottom-up approaches to inform climate adaptation policy³⁰

³⁰Dessai, S., & Hulme, M. (2004). Does climate adaptation policy need probabilities? *Climate Policy*, 4, 107 - 128.

Top-down governance approach

The main focus is to integrate climate change adaptation into development process at regional, national, sectoral and project levels so that sub-national actors can understand the changing risks and take action to reduce their vulnerabilities (physical) to these risks.

The range of adaptation options are usually framed for local levels at this level, but local actors are ideally, but not always, consulted during these processes. Consequently, vulnerability assessments at the regional, or national level do not appropriately portray the variations in vulnerability at local levels.

Bottom-up governance approach

The key focus is to assess the climate change impacts within the local setting so as to show areas that are highly vulnerable (social) or at highest risks thus guide targeted actions in these areas.

Lessons and experiences with adaptation at the local level provide valuable operational knowledge at higher decision-making levels. Local adaptations are effective, suitable, and sustainable when there is high level of interaction, participation and cooperation with the higher levels.

Climate change governance, therefore, necessitates governments to take an active role in coordination by bringing about shifts in interest perceptions so that communities can moving forward in deploying active adaptation (and mitigation) policy regime that effectively addresses changing climate change impacts and risks.

10.7 Further Resources

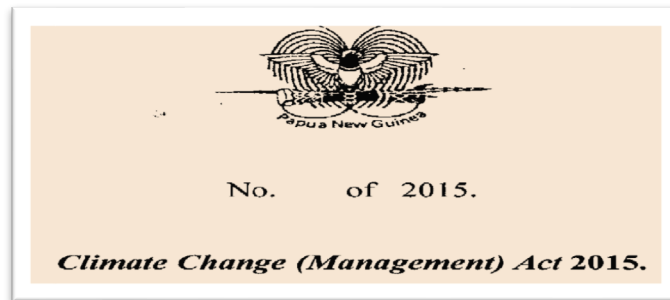
Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)
P.O. Box 4017
Boroko
National Capital District
Papua New Guinea Email: info@ccda.gov.pg
Website: www.ccda.gov.pg

10.8 Activity: PNG Climate Change (Management) Act

The negotiations in November-December 2015 culminated in the adoption by parties to the United Nations Framework Convention on Climate Change of a conference decision and Paris Agreement to address climate change. The combined Paris Outcome commits parties to limit global temperature rise to ‘well below 2°C’ with an aspirational target of a 1.5°C limit. A number of UPNG Staff provided advice to the PNG Government and Pacific Island States (who attended COP21 and COP26) provided initial comments on the Paris Outcome below and attached Paris Agreement.

A copy of the PNG Climate Change (Management) Act will be provided, and you have to read the appropriate chapters/paragraphs to answer the questions below and particularly how this Bill will contribute to the Paris Agreement in a meaningful way in the long term for PNG.



The questions are as follows:

- *What is the overall objective of the PNG Climate Change (Management) Act?*
- *Comment on the Part III- Administration in allowing all partners and communities achieve the objective of the Act and its application?*
- *Appointment of overseas attachee in Paragraph 52*
- *Do you believe the Part V –Mitigation and Part VI – Adaptation measure will be achieved for PNG?*
- *Explain how your project outputs can contribute to this PNG Bill.*

Answer these questions individually first and then in your group, write the final summary. The facilitator will ask each group to present their results to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

10.9 Self-Evaluation

What did you acquire in this session which you really understood?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

10.10 References

- Aung T and Kaluwin C, 2017. Book-Fundamental of Climate Change and Sea Level Rise; Published by University of PNG Bookshop.
- CCDA. 2020, Report on Papua New Guinea's Sustainable Development Goal 13, Road map 30 by 30. Climate Change and Development Authority (CCDA)
- Chapman, Andrew & Mclellan, Benjamin & Tezuka, Tetsuo. (2016). Strengthening the Energy Policy Making Process and Sustainability Outcomes in the OECD through Policy Design. Administrative Sciences. 6. 9. 10.3390/admsci6030009. https://www.researchgate.net/figure/OECD-governance-and-policy-making-process-sub-steps-in-parentheses_fig3_305639737 cited 25/12/2021
- Fozzard, A. 2019, Climate Change and Governance: Opportunities and Responsibilities, Governance Notes, April 2019, No.14, <https://documents1.worldbank.org/curated/en/711501555389933326/pdf/Climate-Change-and-Governance-Opportunities-and-Responsibilities.pdf> cited 24/12/2021
- GIZ. 2011, Integrating climate change adaptation into development planning: A practice training based on an OECD Policy Guidance, Training Manual <https://www.oecd.org/dac/environment-development/45856020.pdf> cited 24/12/2021
- Gonzalez, S. & Numer, E. . 2020, What is climate governance, United Nations Children Fund (UNICEF), Panama <https://www.unicef.org/lac/media/19651/file/what-is-climate-governance.pdf> cited 26/12/2021
- Hill, M.H., & Engle, N.L. (2013). Adaptive Capacity: Tensions across Scales. Environmental Policy and Governance, 23, 177-192.
- IKI. 2018, Climate governance integrity- A Handbook for getting Started, International Climate Initiative (IKI) https://www.international-climate-initiative.com/fileadmin/Dokumente/2018/20181119_2015_14_II_115_TI_Climate_Governance_Handbook.pdf cited 24/12/2021
- Kaluwin.C and Samuel.P: Book on Hazard and Risk Management, 2012. Published by Centre for Climate Change and Sustainable Development, University of PNG, Bookshop.
- Lumen. 2021, The Policy-Making Process: Issue Identification and Agenda Building, <https://courses.lumenlearning.com/boundless-politicalscience/chapter/the-policy-making-process/> cited 25/12/2021
- Meaowcroft, J. 2009, Background Paper to the 2010 World Development Report, Policy Research Working Paper 4941, https://openknowledge.worldbank.org/bitstream/handle/10986/9063/WPS4941_WDR2010_0015.pdf
- Pozarny, P. (2016). Climate change and social development: Topic guide. Birmingham, UK: GSDRC, University of Birmingham. https://gsdrc.org/wp-content/uploads/2016/07/GSDRC_CC_SocDev.pdf cited 24/12/2021
- Sheridan College. 2021, The Ten Principles of Policy Governance <https://www.sheridan.edu/wp-content/uploads/2018/11/Ten-Principles-of-Policy-Governance.pdf> cited 26/12/2021
- SOAS. 2021, Climate Change and Development, Unit 1, Centre for Development, Environment and Policy, SOAS, https://www.soas.ac.uk/cedep-demos/000_P524_CCD_K3736-Demo/module/pdfs/p524_unit_01.pdf cited 24/12/2021
- UNHABITAT. 2014, Planning for Climate Change, A strategic, Values Based Approach for Urban Planners, https://www.unclearn.org/wp-content/uploads/library/planning_for_climate_change.pdf cited 24/12/2021
- UNDP. 2021, Module 5: Governance, coordination, finance, National Adaptation Plans Climate Resilience in Agriculture Building Climate Resilience in Agriculture, Lecture Notes of the Massive Open Online Course, https://www.adaptation-undp.org/sites/default/files/uploaded-images/module_5.pdf cited 24/12/2021

WCDI. 2020, Local seed business management, Module: Governance and leadership of SPCs; December 2020. Commissioned by the programme on Integrated Seed Sector Development in Ethiopia (ISSD Ethiopia). Wageningen Centre for Development Innovation, Wageningen University & Research.

TOPIC 11: CLIMATE CHANGE ADAPTATION AND PARTNERSHIP

Overview

Climate change is the single most challenging issue for humanity at the present time. In order to respond favourably to mitigate and adapt to its negative consequences, funding is a necessary ingredient to swiftly facilitate these actions. Climate finance refers to local, national, or transnational financing that is drawn from the public, private and alternative sources of financing that aims to support mitigation and adaptation actions to address climate change.

The Paris Agreement splits climate finance allocations between mitigation and adaptation, as well as stipulating financial assistance should be given by those countries with more financial resources to those that are less endowed and more vulnerable. Climate finance is needed for mitigation because of large-scale investment needed to reduce emission however it is equally important for adaptation since significant financial resources are required to adapt to the adverse effects and reduce the risks of climate change.

This topic focuses on partnership in the context of climate change adaptation. The key message is to understand the concept of partnership especially how to develop a climate change adaptation funding proposal. Assessing different ways of writing and designing proposals is crucial in order for you to develop climate change funding proposal that meets the funding organization's criteria for the proposal to be effectively funded.

Aims of Topic 11

- ❖ To enable the participant to have the basic understanding of the concept of partnership in the context of climate change.
- ❖ To enable participants to understand the implications of climate change adaptation and partnership especially how to access the climate finance.
- ❖ To enable the participants to develop climate change funding proposals to obtain funds from climate change funding sources.

Objectives

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- Understand the linkage between climate change adaptation and partnership.
- Increase awareness and understanding of how to propose, frame and cost adaptation into internal budgeting.
- Increase awareness and understanding of the critical role of the private sector in climate.
- Increase awareness of the opportunities to engage with other bilateral and multilateral funding.
- Understand the complexities in partnership.

Knowledge Base

11.1 Takeaways

The following are key points:

According to UNFCCC, climate finance is defined as the finance that aims at reducing emissions and enhancing sinks of greenhouse gases and aims at reducing vulnerability and maintaining and increasing the resilience of human and ecological systems to negative climate change impacts.

Climate finance is mobilized by industrialized country governments and private entities that support climate change mitigation and adaptation in developing countries to make the transition to zero-carbon and climate-resilient development while also fostering equitable social policy, including gender equality and women's empowerment.

Beyond ensuring access, issues of accountability, efficiency and good governance need to be addressed so that funding for adaptation and mitigation activities is used fairly and transparently.

11.2 Climate change and partnership

In addressing climate change while fostering sustainable development agendas are two mutual reinforcing sides of the same coin. Climate change exacerbates threats and makes delivery of sustainable development agenda more challenging, as it reverses the positive trends, creates new uncertainties, and raises the costs of adaptation and building resilience.

The global perspective of these challenges calls for the widest possible cooperation or partnership aimed at reducing global greenhouse gas emission and adapting to the adverse impacts of climate change within the context of sustainable development.

The scenarios projecting emissions growth reveal a substantial gap between global maximum emissions that will occur and those that must be achieved to keep to the 1.5°C and 2°C pathway under the Paris Agreement unless much greater levels of emissions reductions are undertaken.

The Paris Agreement supports the significance of cooperation and partnership at all levels and encourages greater levels of international cooperation on climate change by designing a plan of action that progresses over time and recognizes the need to support developing country Parties to implement the objectives of the UNFCCC.

The Public-Private-Partnership (PPPs) is a promising avenue that offers both practical and conceptual solutions to ensuring productive interaction of public and private finance organization. PPPs promote public service delivery and provide frameworks to ensure public leadership and accountability while enabling the ownership of certain components of climate finance to be transferred to private hands.

PNG continues to work with bilateral partners such as Australia, New Zealand, France, Japan, US and multilaterals including EU, including UN agencies (UNDP, FAO, UNEP) to implement its climate change policies.

11.3 Climate finance

In the broadest perspective, climate finance refers to the flow of funds towards activities that reduces greenhouse emissions or help society adapt to the climate change impacts (Figure 39).

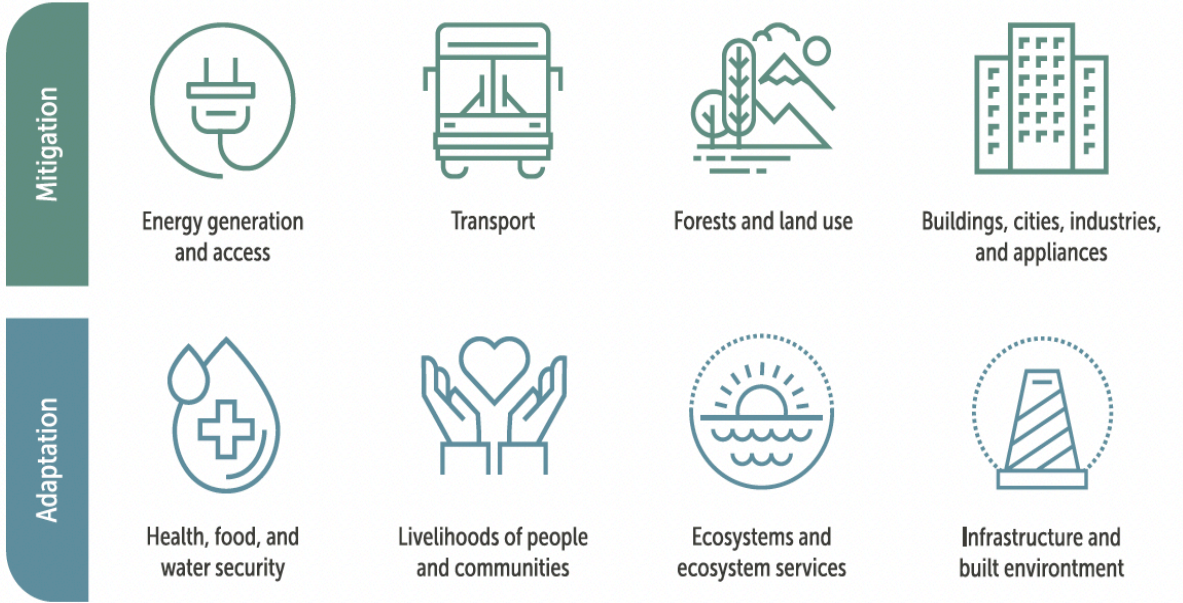


Figure 40: Programmatic areas for the Green Climate Fund (GCF)

The term is used in the context of international political negotiations on climate change which infers the financial flows from developed countries to developing countries for climate change mitigation and adaptation activities like building solar power plants or walls to protect from sea level rise.

Additionally, other definition of climate finance tends to be narrowly defined thus includes the notion of “incrementally” or “additionally”. This means that only those financial commitments that truly represent investments beyond a business as-usual case would qualify to be categorized as climate finance.

Both mitigation and adaptation efforts globally will require mobilization of significant resources to cover the cost of the goods, services, and technologies that communities need to deal with the adverse impacts of climate change. Financing climate change responses encompasses the role and actors of financial institutions and decision makers thus include range of actors, funds, and mechanisms.

The key actors include governments, international quasi-governmental institutions (e.g., UN agencies and multilateral development banks) and private sector actors like investors,

corporations, and hedge funds. The mechanisms include a mix of market and non-market-based mechanisms, and they have complex governance structures (Figure 40).

The Article 2 of the Paris Climate Agreement calls for “making finance flows consistent with pathways towards low greenhouse gas emissions and climate-resilient development” while the Article 9 emphasises on the equity aspects of the climate debate. This implies that developed countries shall provide financial resources to assist developing countries to help reduce climate emissions and adapt to the adverse effects of climate change.

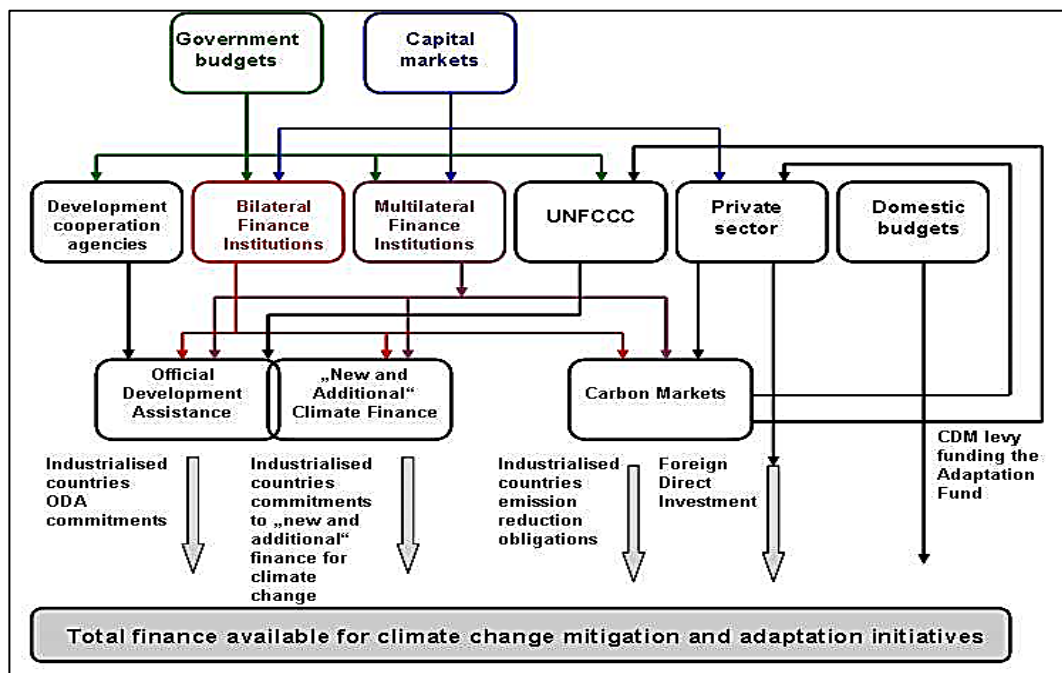


Figure 41: Financial flows for climate change mitigation & adaptation in developing countries

Note: The UNFCCC mechanism include various funds - Green Climate Fund (GCF) and the Global Environment Fund (the GEF), the Adaptation Fund.

11.4 Climate finance and gender

In climate finance, gender is considered an important subject for two key reasons. Firstly, women are agents of positive change as recognised by the PNG government and financial institutions. Recognizing their concerns, needs, unique experiences and contributions in the design and operationalization of climate finance mechanisms adds more value and return on adaptation and mitigation investments. Secondly, despite efforts to reduce gender inequalities over the years, women are still among the most disadvantaged group of the society and mostly vulnerable to severe impacts of climate change. Gender-blind climate finance can inadvertently underpin these vulnerabilities.

Concrete evidence from studies indicates that counties that have higher representation of women in politics (congress/parliament) tend to set aside protected land areas and ratify multilateral environment agreements.

As primary users and managers of biomass products in many communities, women play a significant role in natural resource management and also in other productive and reproductive activities at the household and community levels (Figure 41).

Targeted investment in gender equality and women’s empowerment would also yield favourable returns in environmental conservation, achievement of the sustainable development goals and poverty alleviation.

The nature and scope of socioeconomic empowerment processes must be broadened to address the socioeconomic costs of climate change. There needs to be better understanding of the relationships amongst the various forms of finance and their actual impact on social policy and ease of access to them.



Figure 42: Climate finance enhancing women empowerment³¹

11.5 Accessing climate finance

Climate finance works to provide the necessary monetary backing to fight the adverse impacts of climate change. It connects government intervention with the private sector to develop innovative climate change solutions.

PNG and many small island states continue to access climate finance either directly through bilateral development partners (Australia, USA) and multilateral development banks or through multilateral Climate Funds (CFs) such as the Global Climate Fund (GCF) (Table 17).

Presently, multilateral CFs are a major source of finance for large adaptation projects which requires working within a system of accredited and implementing entities or the “climate finance

³¹ UNDP. 2016, Gender and Climate Change: Gender and Climate Finance, Policy Brief 5, United Nations Development Programme (UNDP) <https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/UNDP%20Gender%20and%20Climate%20Finance%20Policy%20Brief%205-WEB.pdf>

architecture”. Climate finance architecture refers to the system of public funds and institutions that help countries implement climate mitigation and adaptation projects.

Table 17: Main Climate Funds Available to PICs and Their Financial Instrument

Facility	Concessional			
	Grant	Loan	Equity	Guarantee
Green Climate Fund (GCF)	✓	✓	✓	✓
Pilot Program for Climate Resilience (PPCR)	✓	✓	✓	✓
Global Environment Facility (GEF)	✓	✓	✓	✓
Abu Dhabi Fund for Development (ADFD)	✓	✓		
NAMA Facility	✓	✓		✓
Asia-Pacific Climate Finance Fund (APCLIF)	✓	✓	✓	
Adaptation Fund (AF)	✓			
Least Developed Countries Fund (LDCF)	✓			
Global Climate Change Alliance (GCCA)	✓			
Special Climate Change Fund (SCCF)	✓			
Climate Change Fund (CCF)	✓			
Asian Development Fund (ADF)	✓			
Adaptation for Smallholder Agriculture Programme (ASAP)	✓			
Canadian Climate Fund for Private Sector in Asia II (CCFP II)		✓		

Note on eligibility: LDCF-only least developed PICs are eligible; ADF-Fiji, Palau, and Papua New Guinea are not eligible; ASAP—Marshall Islands, Micronesia, Nauru, Palau, and Tuvalu are not eligible.³²

For the Green Climate Fund (GCF), ten-step process is required in developing and submitting a proposal to have access to the fund (Figure 42).

³² Fouad, M., Novta, N., Preston, G., Schneider, T., & Weerathunga, S. (2021). Unlocking Access to Climate Finance for Pacific Island Countries, *Departmental Papers, 2021(020)*, A001. Retrieved Apr 11, 2022, from <https://www.elibrary.imf.org/view/journals/087/2021/020/article-A001-en.xml>

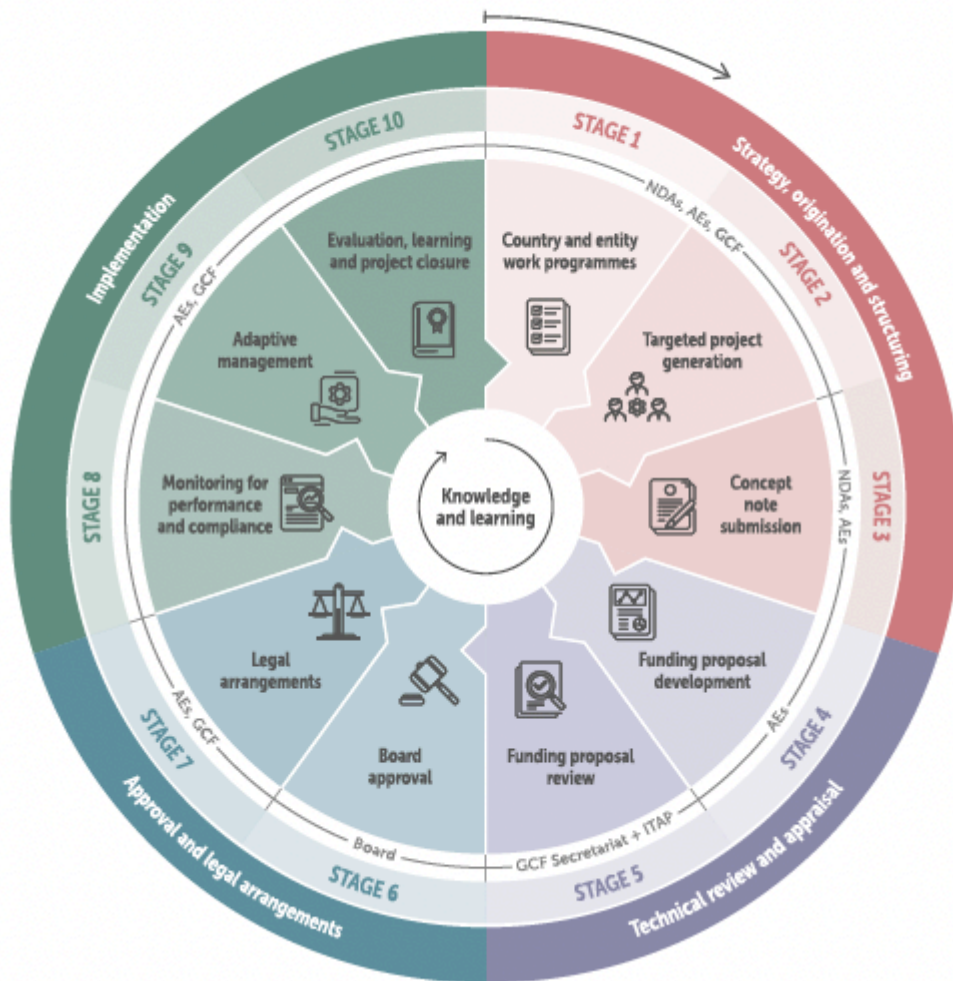


Figure 43: How to access Green Climate Fund³³

To develop and submit a funding proposal, both the Accredited Entity (AE) and the Nationally Designated Authority (NDA) are jointly involved.

For a full proposal to be submitted, it is recommended that the AE develops a concept note so as to seek feedback from the GCF Secretariat about whether the proposal matches the Fund's objectives and mandate. Any proposal needs approval in the form of a letter by the NDA. They are then assessed by the GCF Secretariat and an independent Technical Advisory Panel and finally approved by the GCF Board.

There are a number of actions where climate finance will cover and there are, i) Renewable Energy, ii) Sustainable Agriculture, iii) Energy Efficiency, iv) Climate change resilience, v) Conservation

³³ SDC. 2021, How to access the Green Climate Fund, SDC Global Programme Climate Change and Environment <https://www.shareweb.ch/site/Climate-Change-and-Environment/Documents/How%20to%20access%20the%20Green%20Climate%20Fund-2021.pdf>

of Biodiversity, vi) Climate change migration, vii) Sustainable transport, and viii) Adaptation to climate change (Figure 43).

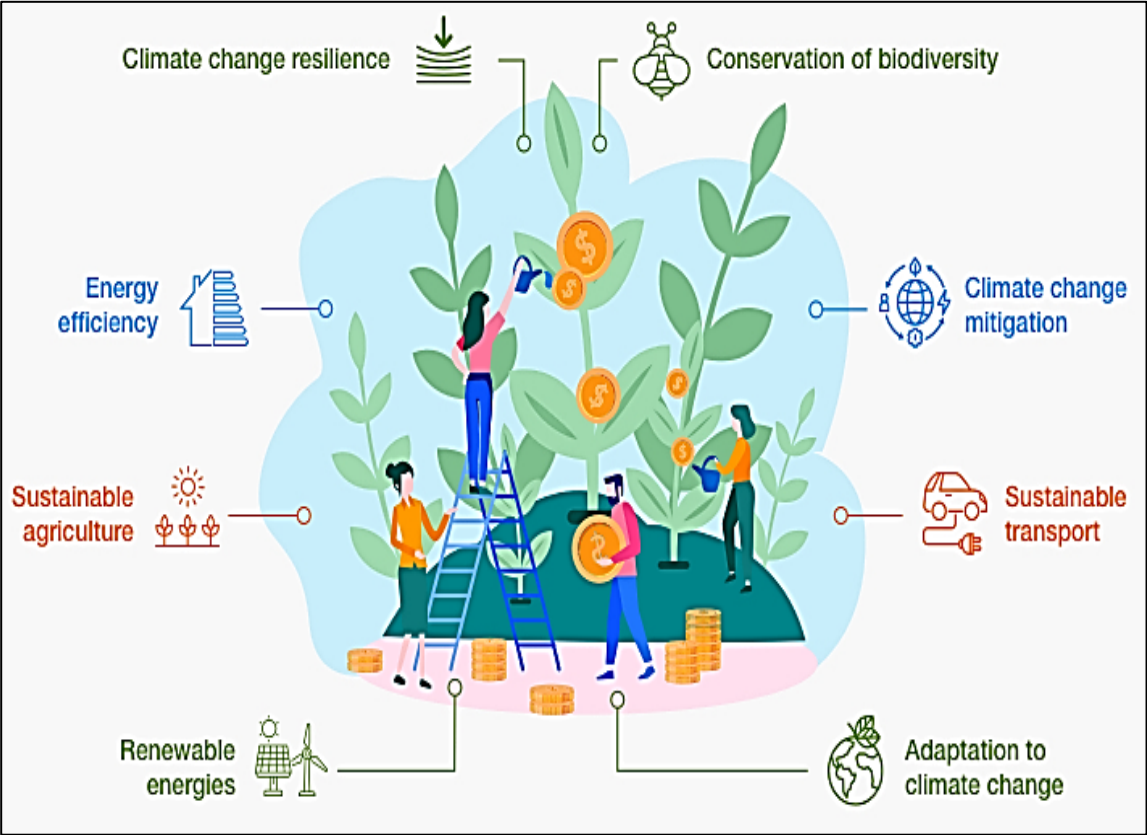


Figure 44: Actions under Climate Finance³⁴

An example of a concept paper is provided in the following pages.

³⁴ Iberdrola 2022, Climate finance, essential for mitigating and adapting to climate change <https://www.iberdrola.com/sustainability/what-is-climate-finance>



CONCEPT PAPER

Instruction: Please make sure that your Concept Paper is clear and concise, preferably between 2-3 pages, excluding all attachments such as the organizational profile. Ensure that your submission is complete and received by the SGP Secretariat on or before the scheduled deadline for applications as contained on the Call for Proposal:

Signed cover letter addressed to the SGP National Coordinator

Completed concept paper. Note that submission which has not used the prescribed template will not be included in the review process.

Other attachments such as:

Photocopy of the organization's Certification of Incorporation

Organizational profile or background information about the organization

Map of proposed project site in relation to the nearest provincial capital or town area

Section I. General Information			
Date of Submission:			
Project Title:			
Project Site/s (specify province/LLG, if applicable):		Project Duration (e.g. June 2011-Dec 2012):	
GEF Focal Area: <input type="checkbox"/> Biodiversity Conservation <input type="checkbox"/> Climate Change <input type="checkbox"/> Land Degradation and Sustainable Forestry Mgt. <input type="checkbox"/> International Waters <input type="checkbox"/> Multi-focal area (specify): _____		Other Considerations for your Project: <input type="checkbox"/> Introduce innovation(s) in terms of approach or technology <input type="checkbox"/> Expand to new areas or scaling-up the existing initiative <input type="checkbox"/> Support to develop livelihoods for communities <input type="checkbox"/> Leverage additional support to complement this project <input type="checkbox"/> Linkage with other GEF project/s	
Requested Amount (in PGK):		Amount of Local Counterpart and non-SGP Funding for this Project, if any:	
Section II. The Proposal			
Brief summary of your Project (less than 500 words) <i>What do you want to do and how?</i> <i>What is/are the problem/s your project seeks to address?</i>			
Project objectives (200 words only) <i>What would the Project intends to target or accomplish?</i>			
Contribution to SGP development results (maximum of 200 words) <i>How will the Project contribute to SGP development results and priorities in the country</i>			
Section III. Contact Details			
Name of Organization:			
Address:			
Telephone:		Fax:	
Focal Person (Name & designation):		Mobile:	Email:

Section IV. Project Budget

Provide a summary on the sources of funding including the detailed budget for activities/inputs and other information using the matrix provided below

Expected Output/s	Main activities	Responsible Partner/s*	Target Completion Date	Project Budget		
				Requested Amount	Local contribution or other sources	Total
Output 1						
Output 2						
Total Project Budget						

* Note: Responsible Partners refers to groups, entities or institutions chosen by your organization to carry out specific activities due to their mandate, expertise or value added they can bring to the Project. Your organization may opt to partner with community-based organizations, research institution, media, foundations, national or local government bodies/agencies, and other non-government organizations.

Attachment A. Organizational Profile

Name of Organization:	
Type of Organization (<i>Tick appropriate box</i>):	<input type="checkbox"/> National or local NGO organization <input type="checkbox"/> Academic or research institution <input type="checkbox"/> Faith-based organization <input type="checkbox"/> Community-based organization <input type="checkbox"/> Other (please specify): <input type="checkbox"/> Local government body or unit
Registration Number and Date, if available	
Mandate or vision/mission/ goal of your Organization in relation to this Project	
Experience of your Organization in the management and implementation of similar initiative	
Capacity of your organization to also include number of full-time staff	
Assistance previously received from SGP or other development partner/s?	No Yes (Please provide year & amount received or attach a separate list as may be necessary): _____

List of Key Officials in your Organization including the Board of Directors and Project Team

Name	Job title	Field of expertise	On board since

11.7 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)

P.O. Box 4017

Boroko

National Capital District

Papua New Guinea Email: info@ccda.gov.pg

Website: www.ccda.gov.pg

11.8 Activity: Writing a logical framework of a funding proposal

You were tasked to develop a climate change funding proposal for a specific sector. In writing such funding proposal, the most important thing is to use a Logical Framework Approach (LFA) (Figure 44). The LFA is an analytical process and set of tools used to support project planning and management.

Project Description		Objectively verifiable indicators of achievement	Sources and means of verification	Assumptions
Goal	What is the overall broader impact to which the action will contribute?	What are the key indicators related to the overall goal?	What are the sources of information for these indicators?	What are the external factors necessary to sustain objectives in the long term?
Purpose	What is the immediate development outcome at the end of the project?	Which indicators clearly show that the objective of the action has been achieved?	What are the sources of information that exist or can be collected? What are the methods required to get this information?	Which factors and conditions are necessary to achieve that objective? (external conditions)
Outputs	What are the specifically deliverable results envisaged to achieve the specific objectives?	What are the indicators to measure whether and to what extent the action achieves the expected results?	What are the sources of information for these indicators?	What external conditions must be met to obtain the expected results on schedule?
Activities	What are the key activities to be carried out and in what sequence in order to produce the expected results?	Means:	What are the sources of information about action progress?	What pre-conditions are required before the action starts?
		What are the means required to implement these activities, e. g. personnel, equipment, supplies, etc.	Costs	
			What are the action costs?	

Figure 45: Logical Framework Matrix (log frame)³⁵

The logical framework has the power to communicate the essential elements of a complex project clearly and concisely throughout the project cycle. It is used to develop the overall design of the project, to improve the project implementation monitoring and to strengthen periodic project evaluation.

You will be provided copies of proposal templates that tell you about how to access the climate finance from a climate funding source. You will develop a climate finance proposal for a given sector using a specific template.

³⁵ Dillon, L.B. 2020, Logical Framework Approach, <https://sswm.info/planning-and-programming/decision-making/planning-community/logical-framework-approach>

The facilitator will assist each group to develop the proposal and later present their results to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

11.9 Self-Evaluation

What did you acquire in this session which you appreciate?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

11.10 References

- ARCIS. 2006, Project Design and Proposal Writing Guide, Integrated Planning Process, American Red Cross International Services (ARCIS), January 2006
http://www.mfem.gov.ck/images/documents/DCD_Docs/Development-Resources/Project-Logical_Framework_Approaches/2006-RedCross_project_design_proposal_writing.pdf cited 18/01/2022
- DFID. 2011, Guidance on using the revised Logical Framework, A DFID Practice Paper, Department for International Development, January 2011
http://www.mfem.gov.ck/images/documents/DCD_Docs/Development-Resources/Project-Logical_Framework_Approaches/2011-DFID_how-to-guideline_logical_framework.pdf cited 18/01/2022
- EU-GCCA. 2013, Logical Framework Approach – Training Material and Resources, Ministry of Finance and Economic Management, Government of the Cook Islands, European Union – Global Climate Change Alliance (EU-GCCA) http://www.mfem.gov.ck/images/documents/DCD_Docs/Development-Resources/Project-Logical_Framework_Approaches/Project-Proposal-Guidelines_Final.pdf cited 18/01/2022
- Habtezion, S. 2013, Gender and climate finance, Asia and the Pacific, Policy Brief 5, United Nations Development Programme (UNDP),
<https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/PB5-AP-Gender-and-Climate-Finance.pdf> cited 18/01/2022
- Hirsch, T. & Mandal, T. 2018, A Resource Guide to Climate Finance: An orientation to sources of funds for climate change programmes and action, ACT Alliance Global Climate Change Project, Act Alliance Secretariat <https://reliefweb.int/sites/reliefweb.int/files/resources/ENGLISH-quick-guide-climate-finance.pdf> cited 18/01/2022
- IFRC. 2019, Climate Training Kit Module 3a: Advocacy, policy dialogues and funding, Climate finance and the IFRC
https://ctk.climatecentre.org/downloads/modules/training_downloads/3a%20FAQ%20Climate%20finance%20and%20the%20Red%20Cross%20Red%20Crescent.pdf cited 18/01/2022
- IUCN. 2016, Module 3: Project Development, IUCN Project Guidelines and Standards, Version 2.2, International Union for Conservation of Nature (IUCN)
https://www.iucn.org/sites/dev/files/module_3_proposal-development_v2.2.pdf cited 18/01/2022
- Örtengren, K. 2003, The Logical Framework Approach, A summary of the theory behind the LFA method, Sida, http://www.mfem.gov.ck/images/documents/DCD_Docs/Development-Resources/Project-Logical_Framework_Approaches/2004-SIDA_Logical_framework_approach_guideline.pdf cited 18/01/2022
- SPC. 2013, Logical Framework Approach – Learner Guide, The Pacific Guide to Project Proposal Preparation using the Logical Framework Approach, Secretariat of the Pacific Community (SPC)
http://www.mfem.gov.ck/images/documents/DCD_Docs/Development-Resources/Project-Logical_Framework_Approaches/Learner-Guide_LFA_FINAL_070513.pdf cited 18/01/2022
- SPC. 2013, Donors for Climate Change Adaptation in the Pacific, Version 3.0, Secretariat of the Pacific Community (SPC) http://www.mfem.gov.ck/images/documents/DCD_Docs/Development-Resources/Project-Logical_Framework_Approaches/Donor-Directory_v3.pdf cited 18/01/2022
- UNDP. 2016, Training Module 5: Gender and Climate Finance, United Nations Development Programme (UNDP)
https://www.undp.org/sites/g/files/zskgke326/files/publications/Gender_Climate_Change_Training%20Module%205%20Finance.pdf cited 18/01/2022
- UNDP. 2016, Gender and Climate Change: Gender and Climate Finance, Policy Brief 5, United Nations Development Programme (UNDP)
<https://www.undp.org/content/dam/undp/library/gender/Gender%20and%20Environment/UNDP%20Gender%20and%20Climate%20Finance%20Policy%20Brief%205-WEB.pdf> cited 18/01/2022

World Bank. 2022, Climate-Smart PPPs: Further Reading and Resources, the Public-Private-Partnership Legal Resource Centre, World Bank <https://ppp.worldbank.org/public-private-partnership/climate-smart-ppps-further-reading-and-resources> cited 18/012022

TOPIC 12: CLIMATE CHANGE ADAPTATION, COMMUNICATION, AND INFORMATION

Overview

Climate change risks and impacts and how to undertake planning and strategies to adapt to these, require information to be transmitted in a way that people understand for them to respond favourably. On the surface, climate change communication is about educating, informing, warning, persuading, mobilizing, and solving this critical issue. However, at a much deeper level, climate change communication is shaped by our different experiences, mental and cultural models, and underlying values and worldviews.

This topic focuses on communication and information in the context of climate change. The key message is to understand how communication and information are important enablers for climate change adaptation. Developing effective climate change communication platform and making information available to those who need it most will help make our communities safe, resilient, and responsive to the adverse impacts of climate change.

Aims of Topic 12

- ❖ To enable the participants to have the basic understanding of the linkage between climate change adaptation and communication/information.
- ❖ To enable participants to understand the how communication/information are important for climate change.
- ❖ To enable the participants to develop climate change fact sheets as a way to communicate climate change information to the communities.

Objectives

Knowledge and Understanding:

By the end of this topic, the participants should be able to:

- ❖ Understand the linkage between climate change adaptation, communication, and information.
- ❖ Identify the key components of communication and information strategy.
- ❖ Apply climate change within the communication and information strategy.
- ❖ Understand the complexities in communication and information service and delivery.

Knowledge Base

12.1 Takeaways

The following are key points:

Climate change communication and information is about educating, informing, warning, and persuading, mobilizing and solving critical climate change issues. However, at the deeper level, it is greatly influenced by our different experiences, mental and cultural environment and the underlying values and worldviews.

Individuals, communities, and societies tend to understand, care, and act on climate change through communicating with other people. Understanding of the communication processes and actors are very crucial for climate change adaptation and mitigation efforts at all levels

Through diverse communication methods, the world has already known more about climate change, its impacts, and its risks. However, climate change communication continues to fall short of accomplishing particularly the critical goal of raising public concern and driving people to action.

12.2 Climate change and communication/information

The public understanding and concern for climate change is crucial for policy makers given the desire for public acceptance of policies and risk management procedures. It is a challenge to find effective ways to communicate the science as evidence of anthropogenic climate change and mobilizing public support for action and solutions.

Globally, there is a widespread concern for climate change especially in the developing countries, yet it remains a lower priority compared to other social, economic, and environmental issues. This implies that communication and information is very poor resulting in the communities being unable to effectively convert the climate change concerns into actions.

There are numerous gaps and misperceptions about climate change amongst individuals, communities, and the country at large which need to be identified and solved. This implies more refined approaches to communication rather than providing only the information is highly desirable.

The media sources and their coverage are crucial for the public awareness and understanding of climate change. There is a dose-response relationship in which media coverage of climate change is more focused on awareness while the public is still unaware of vital climate-related issues that are not covered in the media.

Public engagement and participation including civic engagement are critical in addressing climate change issues. A wide range of engagement from different actors (e.g., scholars, government, non-government organizations, industry, etc.) is vital to address climate change; however, they are vague and implicit in relation to which actions are crucial and what role the public plays in addressing climate change.

The industry sector is also an important actor in addressing climate change. Industry actors have continually promoted scientific uncertainty about climate change through manipulating the

language used to describe climate change and science. This is done purposely to prevent the policy makers and public address climate change by avoiding ways that might reduce the industry profits.

There are many other factors such as demographic, psychographic, and political that affects public’s perceptions about climate change. For example, gender affects climate change engagement as climate change impacts typically impact females disproportionately. Additionally, political ideology, values and worldviews, and personal experiences also play dominant roles in public understanding of climate change.

12.3 Climate Change Communication Strategy

There are several approaches that is used to deal with climate change, but the most effective management strategy is communication. Concentrating on how we communicate information and to who is the first step to become more effective.

There is no right or wrong way to communicate, as long as the information in the message meets its target audience or the vulnerable populations.

Communicating the ecological and socioeconomic impacts of climate change is crucial as it raises awareness, impacts decision-makers, changes behaviour and raises funds for future research. Moreover, managing for resilience requires more than just traditional management hence communication is important.

There are key principles for good communication. These principles can be represented by an acronym of six features that spell “SUCCES” (Table 18).

Table 18: Key principles for good communication

Principles	Explanation
S	Keep it simple
U	Make your point in an unexpected way. Preferably not use more detailed data in complex tables or graphs that people might expect
C	Give concrete examples. Use example that people can relate to than to allow them to use their own imagination
C	Use credibility to your advantage. Using examples like 97% of climate scientists agree on the climate sciences
E	Allow emotions to accentuate the message. This is how humans feel but overuse of emotions can be scary, counterproductive and people may disengage
S	Use a story to bring the message to life. Use an example of a successful adaptation by local community to convince others. This is more inspiring and empowering than just the theory

A communication strategy for climate change may have the following objectives:

- Gain support from the superiors and constituencies to respond positively to climate change in the short and long term.
- Engage stakeholders in a two-way communication about the extent and severity of climate change and actions required to build climate change resilience.
- Work with the media to raise awareness of climate change events and their impacts among the general public.

In addition, the roles played by the managers in the communication strategy are also important. The following key points need much attention:

- Managers must take an approach that is clear and well-articulated, proactive, solution-oriented, balanced, and respectful of the political constraints.
- Managers should uphold the trust of their superiors and the credibility of their reputations.
- Managers must be aware of political and social sensitivities and operate within the organizational constraints.
- Managers need to resist temptations to over-dramatize issues or events in order to meet the expectations of the media or press.

There are many methods that can be used for communication and include books, posters, participatory workshops, drama productions, video, television, events, songs, and message boards. Table 19 gives series of guidelines to help develop your messages.

Table 19: Methods for communication

To Whom	What	How	Possible methods
1 National Government / development partners	Official advocacy documents and policy briefs on the need for assisting vulnerable populations to adapt to a changing climate	The science and predictions associated with climate change gained through met offices, universities in your country - and the Movement's positions and experiences in using forecast information and other adaptation efforts.	Stakeholder meeting, background publication, policy briefs
2 Sectors	Impact of climate variability & change on sectors work and programs	The trends associated with climate change gained through met offices, universities, etc. in your country.	Climate assessment, brochures, events, games, exercises

3	NGOs/FBOs	Impact of climate variability & change on NGOs/FBOs work and programs	Extracting simple messages from the more complicated knowledge derived from met offices, universities, etc. in your country.	Participatory workshops, games, videos, posters
4	Communities/ wider public	Awareness raising, introducing the concept and challenges of climate change and what can be done to address the impacts	Extracting simple messages from the more complicated knowledge derived from met offices, universities, etc. in your country. Combining it with risk reduction messages.	Brochures, videos, radio commercials drama / plays, posters.
5	Youth groups	Awareness raising, introducing the idea of climate change	Extracting simple messages from the more complicated knowledge deriving from met offices, universities, etc. in your country.	Participatory workshops, games, comic books, puppet show, quiz.

12.4 Further Resources

Further resources can be found on the CCDA website or contact CCDA for further information:

Climate Change & Development Authority (CCDA)

P.O. Box 4017

Boroko

National Capital District

Papua New Guinea Email: info@ccda.gov.pg

Website: www.ccda.gov.pg

12.5 Activity: Developing a fact sheet

Imagine you are a communication specialist, and your task is to write a climate change fact sheet. A fact sheet is a short, typed, or hand-written document that contains the most relevant information about a specific subject in the least amount of space (Figure 45). The aim is to provide facts and key points about the topic in a clear, concise, and easy-to-understand way.

Tipping points in the climate system

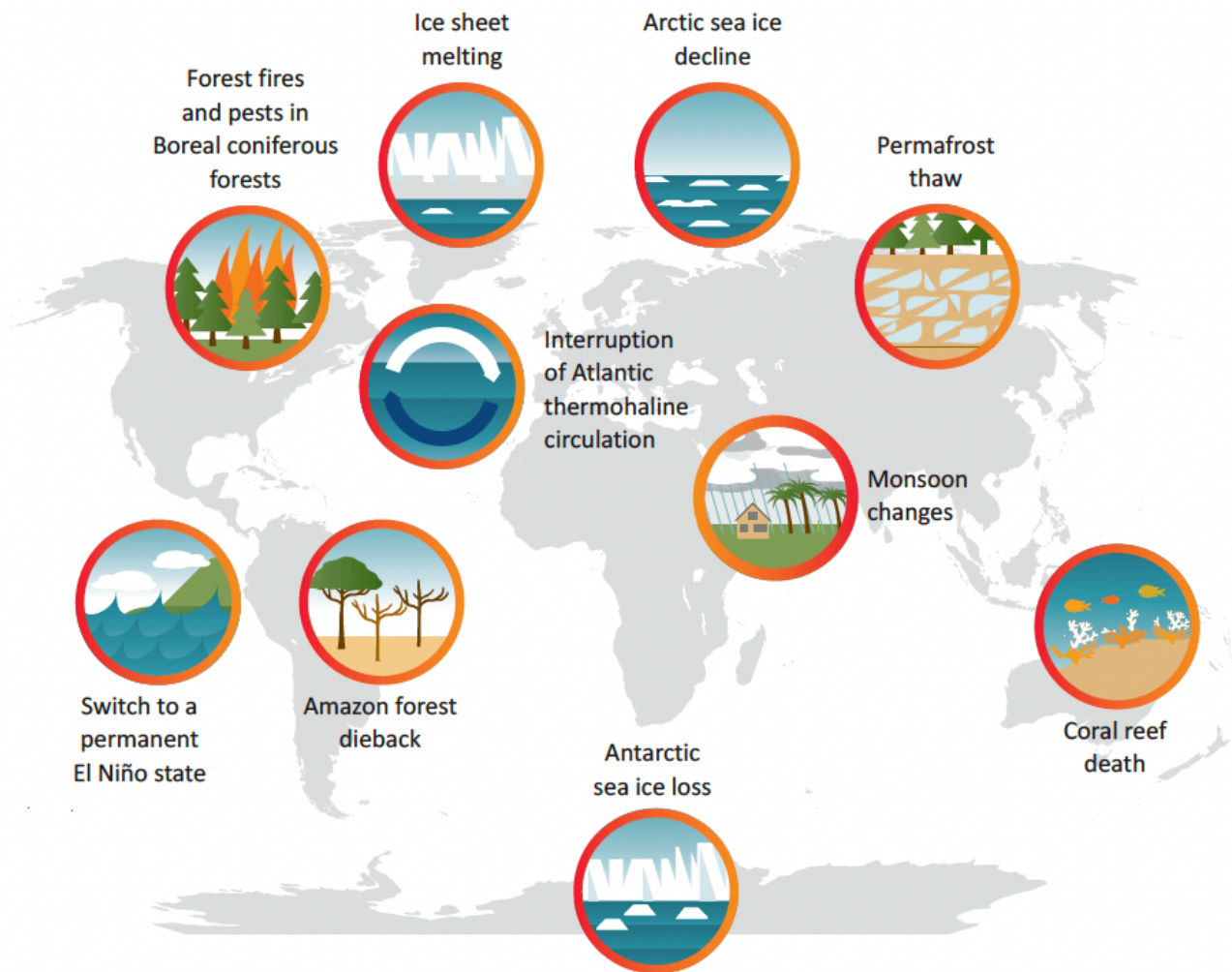


Figure 46: Tipping points in the climate system: Example of developing a Fact Sheet³⁶

In developing a fact sheet, you must decide what is most important, organize it, and communicate it in their own words. All three of these practices relate to how people learn and are linked to increased retention of information. In one of the four sectors, identify the significant climate change issue, organize it and communicate it in your own words. The facilitator will ask each

³⁶ Anton, C.A., Mengel, J. & Witt, E. (Eds.) 2021, Climate change: causes, consequences and possible actions, Factsheet, Version 1.1, Germany National Academy of Sciences Leopoldina, Halle, Germany, https://www.leopoldina.org/fileadmin/redaktion/Publikationen/Infomaterial/13-Graphics-Factsheet-Climate_Change-tipping_points.png

person/group to present their work to the audiences. After the group presentations, an open 10-minute discussion follows afterwards.

12.6 Self-Evaluation

What did you acquire in this session which are you most appreciate?

Which objective(s) for this session was achieved?

Which objective(s) fell short for this session?

What has motivated you in this session and why?

What can be done to make this session more enjoyable and productive?

12.7 References

- Depoux, A., Hémono, M., Puig-Malet, S. Pédrón, R. & Flahault, A. 2017, Communicating climate change and health in the media, *Public Health Reviews*, 38:7
<https://publichealthreviews.biomedcentral.com/track/pdf/10.1186/s40985-016-0044-1.pdf> 28/12/2021
- DSD. 2018, Saint Lucia's Climate Change Communication Strategy: Under the National Adaptation Planning Process, Department of Sustainable Development Saint Lucia, NAP Global Network
<https://www4.unfccc.int/sites/NAPC/Documents/Parties/Saint%20Lucia%20Climate%20Change%20Communications%20Strategy.pdf> 28/12/2021
- Gálvez, R.O. & Casanova, J.V. 2019, Voices with Purpose: A Manual on Communication Strategies for Development and Social Change, Participant's Moule, Friedrich-Ebert-Stiftung (FES),
<https://library.fes.de/pdf-files/bueros/africa-media/15542.pdf> 28/12/2021
- IFRC. 2019, Climate Training Kit Module 3b: Communication, International Federation of the Red Cross (IFRC),
https://www.climatecentre.org/downloads/modules/training_downloads/3b%20A%20how%20to%20guide%20on%20communicating%20climate%20change.pdf 28/12/2021
- MNREM. 2019, National Environment and Climate Change Management Communication Strategy 2019-2023, Ministry of Natural Resources, Energy and Mining, Environmental Affairs Department, Malawi,
http://www.ead.gov.mw/storage/app/media/Resources/Miscellaneous/MALAWI-National_Environment_and_Climate_Change_Management_communication_Strategy.pdf 28/12/2021
- NOAA. 2009, Module 7: Communications, Reef Resilience and Climate Change: A workshop for Coral Reef Managers, Coral Reef Watch, NOAA Satellite and Information Service,
https://coralreefwatch.noaa.gov/satellite/education/workshop/docs/workbook_module7_communications.pdf 28/12/2021
- Treut, L.; Somerville, H. R.; Cubasch, U.; Ding, Y.; Mauritzen, C.; Mokssit, A.; Peterson T.; Prather, M. Historical Overview of Climate Change. In *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller Eds. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 2007; pp. 104-105.
- UNDP. 2021, Module 6: Communications, monitoring and evaluation, National Adaptation Plans Climate Resilience in Agriculture Building Climate Resilience in Agriculture, Lecture Notes of the Massive Open Online Course, https://www.adaptation-undp.org/sites/default/files/uploaded-images/module_6_0.pdf 28/12/2021

GLOSSARY OF TERMS

The list of the terms that is applicable for this training and the meaning for each.

Terms	Definition
Adaptation	Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.
Adaptive capacity	The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences
Anthropogenic emission	Emissions of greenhouse gases, greenhouse-gas precursors, and aerosols associated with human activities. These include the burning of fossil fuels, deforestation, land-use changes, livestock, fertilization, etc. that result in a net increase in emissions.
Capacity building	In the context of climate change, the process of developing the technical skills and institutional capability in developing countries and economies in transition to enable them to effectively address the causes and results of climate change
Carbon cycle	The term used to describe the flow of carbon (in various forms, e.g., carbon dioxide) through the atmosphere, ocean, terrestrial biosphere, and lithosphere.
Carbon sequestration	The process of removing carbon from the atmosphere and depositing it in a reservoir.
Climate	Climate in a narrow sense is usually defined as the ‘average weather’, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period of time is 30 years, as defined by the WMO. These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.
Climate change	A change of climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.
Climate system	The climate system is defined by the dynamics and interactions of five major components: atmosphere, hydrosphere, cryosphere, land surface, and biosphere. Climate system dynamics are driven by both internal and external forcing, such as volcanic eruptions, solar variations, or human-induced modifications to the planetary radiative balance, for instance via anthropogenic emissions of greenhouse gases and/or land-use changes.
Climate variability	Climate variability refers to variations in the mean state and other statistics (such as standard deviations, statistics of extremes, etc.) of the climate on all temporal and spatial scales beyond that of individual

	weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).
Community-based Adaptation	Community-based adaptation to climate change is a community-led process, based on communities' priorities, needs, knowledge, and capacities, which should empower people to plan for and cope with the impacts of climate change.
Coping capacity	The means by which people or organizations use available resources and abilities to face adverse consequences that could lead to a disaster. In general, this involves managing resources, both in normal times as well as during crises or adverse conditions. The strengthening of coping capacities usually builds resilience to withstand the effects of natural and human-induced hazards.
Ecosystem-based Adaptation	Ecosystem-based adaptation is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people to adapt to the adverse effects of climate change.
Evaluation	Evaluation is the structured interpretation and giving of meaning to predicted or actual impacts of proposals or results. It looks at original objectives, and at what is either predicted or what was accomplished and how it was accomplished. So, evaluation can be formative, which is taking place during the development of a concept or proposal, project or organization, with the intention of improving the value or effectiveness of the proposal, project, or organisation. It can also be summative, drawing lessons from a completed action or project or an organisation at a later point in time or circumstance
Exposure (climate related)	The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected by a climate induced hazard
Gender	Either of the two sexes (male and female), especially when considered with reference to social and cultural differences rather than biological ones. The term is also used more broadly to denote a range of identities that do not correspond to established ideas of male and female.
Global warming	It refers to the gradual increase, observed or projected, in global surface temperature, as one of the consequences of radiative forcing caused by anthropogenic emissions.
Greenhouse effect	The process in which the absorption of infrared radiation by the atmosphere warms the Earth. In common parlance, the term 'greenhouse effect' may be used to refer either to the natural greenhouse effect, due to naturally occurring greenhouse gases, or to the enhanced (anthropogenic) greenhouse effect, which results from gases emitted as a result of human activities.
Greenhouse gases	The atmospheric gases responsible for causing global warming and climate change. The major GHGs are carbon dioxide (CO ₂), methane (CH ₄) and nitrous oxide (N ₂ O). Less prevalent –but very powerful –

	greenhouse gases are hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and Sulphur hexafluoride (SF6).
Hazard	A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage.
Impacts (climate related)	Consequences of climate change on natural and human systems. Depending on the consideration of adaptation, one can distinguish between potential impacts and residual impacts.
Maladaptation	Any changes in natural or human systems that inadvertently increase vulnerability to climatic stimuli; an adaptation that does not succeed in reducing vulnerability but increases it instead.
Mitigation	In the context of climate change, a human intervention to reduce the sources or enhance the sinks of greenhouse gases. Examples include using fossil fuels more efficiently for industrial processes or electricity generation, switching to solar energy or wind power, improving the insulation of buildings, and expanding forests and other “sinks” to remove greater amounts of carbon dioxide from the atmosphere.
Monitoring	A system for observing, measuring and recording information about specific aspects of a project. In climate monitoring, it provides users with the information they need for effective planning and operations to respond to climate variations in the frequency, intensity and location of extreme weather and climate events.
National adaptation plan	A national document outlining plan of action to address problems and issues faced by a particular human, economic development, and environment system.
Resilience	The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.
Risk (climate related)	The potential for adverse consequences for human and ecological systems, recognizing the diversity of values and objectives associated with such systems. In the context of climate change, risks can arise from potential impacts of climate change as well as human responses
Risk Assessment	The systematic process of identifying hazards and evaluating any associated risks within a workplace, then implementing reasonable control measures to remove or reduce them.
Risk Management	The implementation of strategies to avoid unacceptable consequences. In the context of climate change adaptation and mitigation are the two broad categories of action that might be taken to avoid unacceptable consequences.
Sea level rise	Sea level can change, both globally and locally, due to (i) changes in the shape of the ocean basins, (ii) changes in the total mass of water and (iii) changes in water density. Factors leading to sea level rise under global warming include both increases in the total mass of water from the melting of land-based snow and ice, and changes in water density from an increase in ocean water temperatures and salinity changes.

	Relative sea-level rise occurs where there is a local increase in the level of the ocean relative to the land, which might be due to ocean rise and/or land level subsidence.
Sensitivity	It is the degree to which a system is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).
Sink	Any process, activity, or mechanism that removes a greenhouse gas, an aerosol, or a precursor of a greenhouse gas or aerosol from the atmosphere
Socio-economic scenario	Scenarios concerning future conditions in terms of population, Gross Domestic Product and other socio-economic factors relevant to understanding the implications of climate change. See SRES.
Solar radiation	Electromagnetic radiation emitted by the Sun. It is also referred to as shortwave radiation. Solar radiation has a distinctive range of wavelengths (spectrum) determined by the temperature of the Sun, peaking in visible wavelengths.
Thermal expansion	In connection with sea level rise, this refers to the increase in volume (and decrease in density) that result from warming water. A warming of the ocean leads to an expansion of the ocean volume and hence an increase in sea level.
Uncertainty	An expression of the degree to which a value (e.g., the future state of the climate system) is unknown. Uncertainty can result from lack of information or from disagreement about what is known or even knowable. It may have many types of sources, from quantifiable errors in the data to ambiguously defined concepts or terminology, or uncertain projections of human behavior. Uncertainty can therefore be represented by quantitative measures (e.g., a range of values calculated by various models) or by qualitative statements (e.g., reflecting the judgment of a team of experts).
Vulnerability	The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.
Vulnerability assessment	Vulnerability assessment identifies who and what is exposed and sensitive to change. A vulnerability assessment starts by considering the factors that make people or the environment susceptible to harm, i.e., access to natural and financial resources; ability to self-protect; support networks and so on.
Weather	Atmospheric condition at any given time or place. Weather is measured in terms of such things as wind, temperature, humidity, atmospheric pressure, cloudiness, and precipitation. In most places, weather can change from hour-to hour, day-to-day, and season-to-season. Weather should be clearly distinct from climate, which is usually defined as the

“average weather”, or in wider sense is the state of the climate system. A simple way of remembering the difference is that climate is what you expect (e.g., cold winters) and ‘weather’ is what you get (e.g., a blizzard).
