Manual on Assessing Risk and Vulnerability to climate change

Vientiane Capital, 2025

Department of Environment
Ministry of Agriculture and Environment

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I. Overview

1.1 Background

The National Adaptation Plan (NAP) of Lao PDR is a strategic framework designed to address the impacts of climate change and enhance resilience in vulnerable communities and ecosystems. It adopts a comprehensive and integrated approach by identifying priority areas for adaptation, setting goals and targets, and outlining strategies and actions to achieve them. Developing a NAP involves a wide range of stakeholders, including national and local governments, civil society organizations, academic and research institutions, and the private sector. The process is based on a thorough analysis of the country's vulnerability to climate change, considering both current and projected impacts on key sectors such as agriculture, health, infrastructure, energy, education, water, forestry, conservation, and transport. Overall, the NAP is a vital tool for countries to strengthen resilience to climate change and safeguard the well-being of citizens and ecosystems.

The Government of Laos (GOL) has committed to completing the NAP process by the end of 2023, with the goal of preparing a robust NAP for formal submission (or at least presentation) ahead of the COP28 event in the UAE, scheduled for mid-November 2023. To fulfill this commitment, the GOL applied for funding to implement the project titled “Building the Capacity of the Lao PDR Government to Advance the National Adaptation Planning Process” from the Global Environment Fund (GEF), which was approved in December 2020.

The objective of the project is to enhance the institutional and technical capacity of stakeholders and the government to advance the NAP process. This goal will be achieved through four components: i) strengthening institutional and technical capacity for the NAP process in Lao PDR; ii) developing climate information systems for prioritizing adaptation needs; iii) integrating climate change adaptation into social and economic development in Lao PDR; and iv) establishing systems for monitoring, reviewing, and reporting on the NAP process. The Department of Climate Change (DCC) within the Ministry of Natural Resources and Environment (MoNRE) serves as the Executing Agency, with support from the United Nations Environment Programme (UNEP), to ensure the successful implementation of the project.

As part of the project, support is needed to integrate Climate Vulnerability and Risk Assessment (CRVA) and climate change adaptation measures into medium- and long-term socio-economic development planning in Lao PDR. Deliverables include a series of final Situational Sector Statements to support the parallel CRVA, revisions to national, sectoral, and provincial strategies and development plans to incorporate climate change adaptation priorities, and contributions to the final NAP report submission

1.2 Objective of the training

- To provide participants with a thorough understanding of climate change fundamentals to support the development of the NAP.
- To teach participants how to identify and assess potential climate-related risks and vulnerabilities using risk and vulnerability indices, and encourage the use of stakeholder consultations and scenario analysis.

- To guide participants in developing and implementing adaptation plans tailored to specific risks and vulnerabilities.
- To advise participants on integrating adaptation measures into plans and policies.

1.3 Target participants

Participants in the training program include experts and officials involved in the planning and implementation of the NAP process across various sectors, representing 18 provinces at both provincial and central levels. This group includes officials from

- Provincial Department of Natural Resource and Environment (PONRE).
- Provincial Department of Agriculture and Forestry (PAFO).
- Provincial Department of Public Work and Transportation.
- Provincial Department of Public Health.
- Provincial Department of Energy and Mine.
- Provincial Department of Labor and Social Welfare.
- Provincial Department of Information, Culture, and Tourism.
- Provincial Department of Industry and Commerce.
- Provincial Department of Education and Sports.
- Provincial Department of Planning and Investment.
- Provincial Department of Finance.
- Provincial Lao Women's Union.
- Provincial Lao Youth Unio

1.4 Structure of the training course

To enhance capacity in climate risk and vulnerability assessment (CRVA) and adaptation measures, a capacity needs assessment at the central and provincial levels is essential. Fortunately, the Department of Climate Change conducted this assessment in 2022. The findings revealed that officials at both levels require a solid understanding of climate change, climate risk and vulnerability assessment, and adaptation measures. The training course is structured into four modules, as follows:

1) Module1: Climate change and its impacts

The aim of this module is to pave the basic knowledge of climate change and its impacts to the participants. In order to make sure that the participants have common understanding about climate change prior to be trained for climate risk and vulnerability assessment (CRVA).

Chapter 1: Basic knowledge of climate change

- Climate and weather
- The world climate
- Climate in the Lower Mekong Basin
- Climate in Lao PDR

Chapter 2: Introduction to climate change

- Green house effects
- GHG emission, green house effects, and climate change
- The impacts of climate change
- Climate change mitigation and adaptation
- Climate change policies in Lao PDR

Chapter 3: Introduction to climate risk and vulnerability assessment (CRVA)

- Terminology
- Component and process of vulnerability assessment based on IPCC's Fourth Assessment Report (AR4)
- Component and process of climate risk and vulnerability assessment based on IPCC's Fifth Assessment Report (AR5)

2) Module 2: Training on climate risk and vulnerability assessment (CRVA)

For this training course, three modules have to be developed to fulfill the capacity needs, including climate risk and vulnerability assessment (CRVA), developing disaster risk index and mapping risky areas, and climate change projection. The contents of the training materials are outlined as follow:

Chapter 1: Climate risk and vulnerability assessment (CRVA)

- Introduction to climate risk and vulnerability assessment
- Development of vulnerability assessment framework using AR5 methodology
- Risk and vulnerability assessment and adaptation measure development procedure
- Required information and data sources

Chapter 2: Developing disaster risk index and mapping risky areas

- Identifying and analyzing observed climate changes across provinces in Lao PDR
- Creating hazard map, vulnerability map, exposure map, and adaptive capacity map
- Developing disaster risk profile (risk index) and disaster risk maps for provinces

Chapter 3: Climate projection

- Introduction to climate projection
- Examining and downloading projected climate scenarios from the World Bank website.
- Identifying potential impacts of climate change and assessing future risk based on projected climate scenarios.

3) Module 3: Training on climate change adaptation

Chapter 1: Reviewing and verifying disaster risk profile and disaster risk maps

- Reviewing disaster risk profile and disaster risk maps of provinces.
- Verifying disaster risk profile and disaster risk maps of provinces and relevant sectors.

Chapter 2: Reviewing adaptation measures and plan of provinces

- Reviewing adaptation measures of each province
- Reviewing adaptation plan and policy of each province

Chapter 3: Climate change adaptation

- Reviewing natural resource management and land use plan of each province
- Identifying adaptation options (with special emphasize on ecosystem-based adaptation)
- Applying multicriteria analysis to prioritize and choose the most suitable options.
- Developing adaptation measures and plan

4) Module 4: Training on integrating climate change and adaptation into policies, strategies, and plans

Chapter 1: Reviewing risk profile and existing strategies, plans, and policies

- Situational analysis
- Reviewing disaster risk profile and disaster risk maps
- Reviewing existing strategies, plans and policies.

Chapter 2: Integrating climate change and adaptation into policies, strategies, and plans

- Synchronizing strategies, plans and policies of sectors and provinces
- Integrating climate change and adaptation into policies, strategies, and plans.

II. Training modules

2.1 Module 1: Climate change and its impacts

2.1.1 Chapter 1: Basic knowledge of climate change

a) Weather and climate

Weather

The weather is the state of the atmosphere at a particular time or place with specific characteristics such as temperature, air pressure, humidity, wind speed and precipitation. The elements are in a complex relationship with each other, which is mainly caused by solar energy and the rotation of the earth. The weather changes constantly within a short period of seconds, hours, days or weeks and also changes considerably depending on the geographical location.

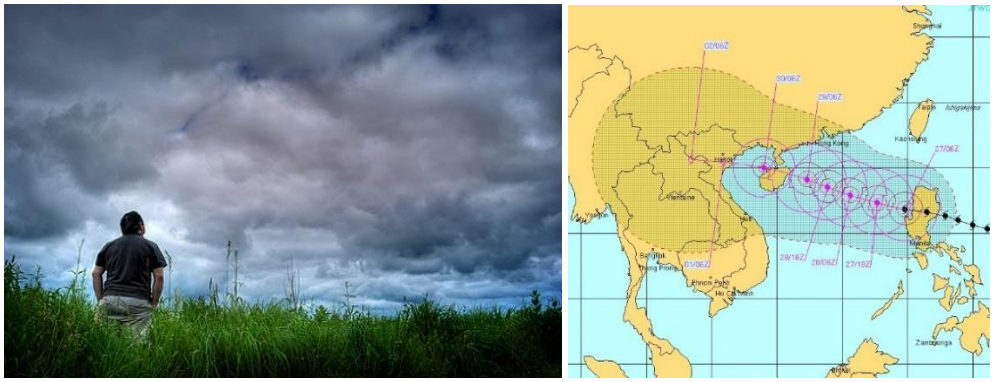

Figure 1 weather and weather forecast

Climate

Climate refers to the characteristics observed in the air or weather that are averaged to know the characteristics of the climate in different regions. Thus, the characteristics of climate on the earth's surface are one of the characteristics of weather that are continuously observed over a long period of time, such as temperature values or precipitation values that occur over a long period of time. Climate change can be said to be a change in the average value of the climate over a long period of time.

- The technical regulations of the World Meteorological Organization (WMO) have defined "normal values, standard climate" by specifying the average value of climate data calculated for a period of 30 years.

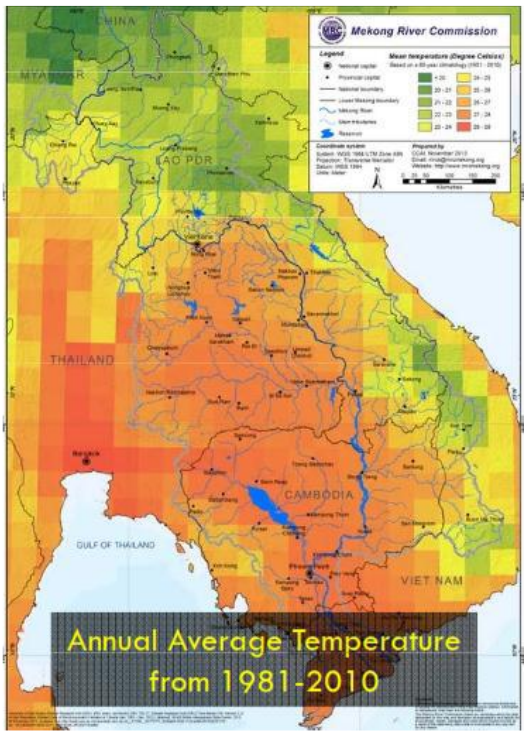

Figure 2 Average temperature

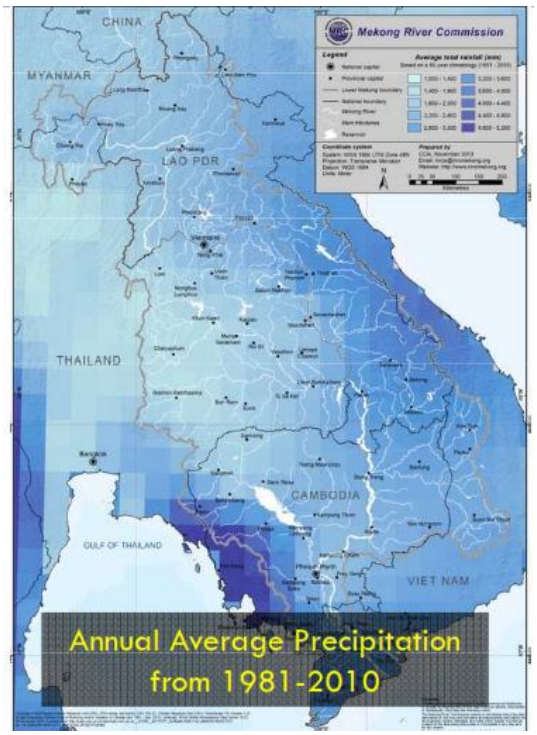

Figure 3 Average rainfall

However, the most important thing now is the phenomenon of climate change or mean changes in the average climate, which is mainly caused by human activities, e.g. combustion with the release of greenhouse gases that trap heat in the atmosphere and cause gradual global warming.

Understanding the difference between weather and climate is critical to addressing the challenges facing our world. By learning to engage with these concepts, we can explore possible solutions and move towards a sustainable future.

b) World Climate

The classification of the world climate using temperature as a criterion can be divided into 3 major groups: the cold climate zone (Frigid Zone), the warm climate zone (Temperate Zone) and the hot zone (Torrid Zone) with the temperature line (Isotherm) from the map showing the average temperature of the world. In addition, there is a classification of the climate according to latitude, which shows the following differences:

1. Tropical climate zone 0°-30° N or S:

- Hot (dry or humid all year round)
- The average temperature is above 20°C
- Location: located in the area between the hot zones of the line or dividing line
- Important features: the warmest climate in the world with high average temperatures all year round. Receives the most direct sunlight throughout the year. High humidity and high rainfall. There are two seasons: Rainy season and dry season. Lush rainforests and coral reefs are common life forms.

2. Temperate 30°- 60° N or S:

- Cold winters and mild summers
- The average temperature is 0-20°C
- Location: between the polar and tropical zones, in the middle latitudes.
- Important characteristics: moderate temperatures with warm summers and very cold winters. There are four distinct seasons: spring, summer, fall and winter. The country receives more direct sunlight than the polar regions, but less than the tropics. It rains in varying amounts throughout the year. There is great biodiversity, with deciduous forests, grasslands and deserts.

3. Polar climate zone 60°-90° N or S:

- Cold winter
- The average temperature is 0°C
- Location: Found at the highest and lowest latitudes, at the North and South Poles.
- Important features: The coldest climate in the world with an average temperature below freezing above 0°C all year round. receives the least amount of sunlight due to the curvature of the earth. There is limited precipitation, mostly in the form of snow covered

by ice sheets and glaciers in some areas such as Antarctica and Greenland, with grasslands and short-lived vegetation in summer.

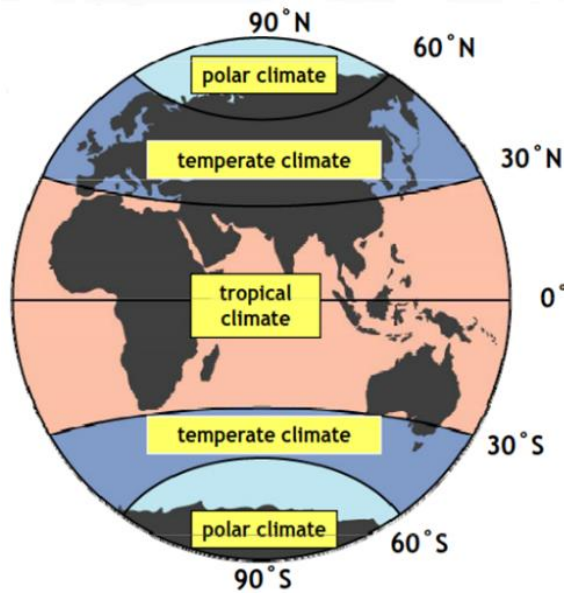

Figure 4 Three climate zones

c) Climate in the Mekong River basin.

The climate in the Lower Mekong Basin is characterized by a tropical monsoon, a monsoon that blows seasonally from the northeast and from the southwest with different rainy and dry seasons. The reservoir covers a large area in Southeast Asia, including parts of China, Myanmar, Laos, Thailand, Cambodia and Vietnam.

The rainy season is usually the monsoon, which flows in from the northwest from May to October, with the heaviest rainfall from June to September. During this time, the Mekong River and its tributaries have higher water levels, leading to flooding in some areas.

The dry season is usually the monsoon, which blows in from the northeast from November to March, with lower humidity and cooler temperatures. During this time, the water level of the Mekong drops and some areas may experience drought. Average temperatures in the dry season are between 25-30°C (77-86°F). April and October are transitional months and winds blow from many directions

Table 1 Monsoon season

cool		hot			rain					cool	
Jan	Feb	Mar	April	May	June	July	August	Sep	Oct	Nov	Dec
Northeast Monsoon		Change of season			Southeast Monsoon					Northeast Monsoon	

The climate of the Mekong River Basin is influenced by the Asian monsoon system, which brings in moisture from the Indian Ocean during the rainy season, causing heavy rainfall and flooding in many areas. The region is also prone to extreme weather events such as typhoons and cyclones, which can cause flooding and further damage.

Overall, the climate in the Mekong catchment area is hot and humid with different rainy and dry seasons. This has a major impact on the local ecosystem, agriculture and the livelihoods of people in the region. Furthermore, climate change is expected to have additional impacts on the Mekong River Basin, leading to more severe weather events and changing rainfall patterns.

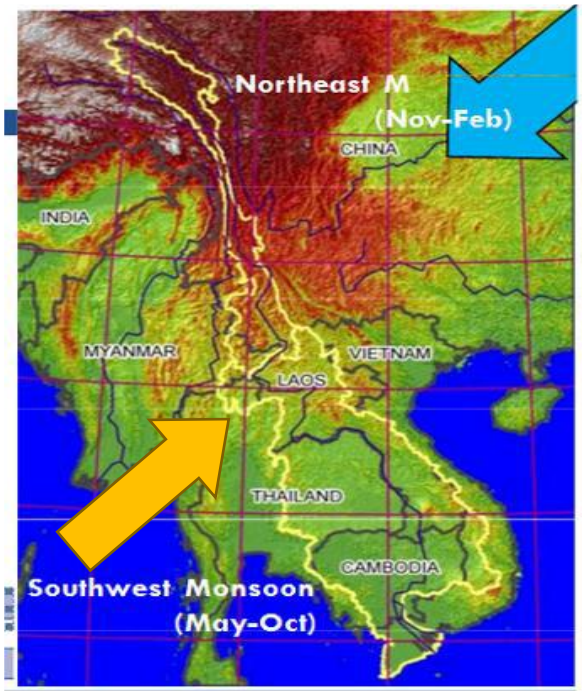

Figure 5 Monsoon

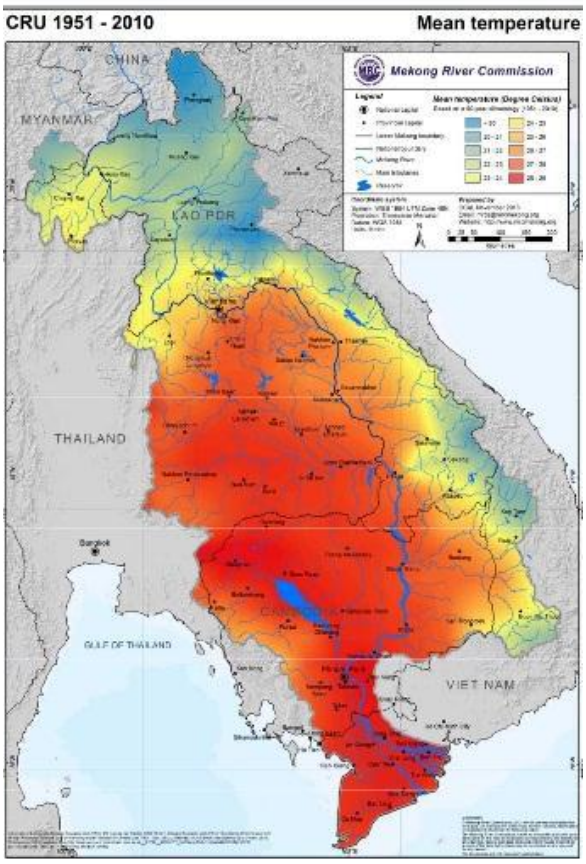

Figure 6 Average Temperature

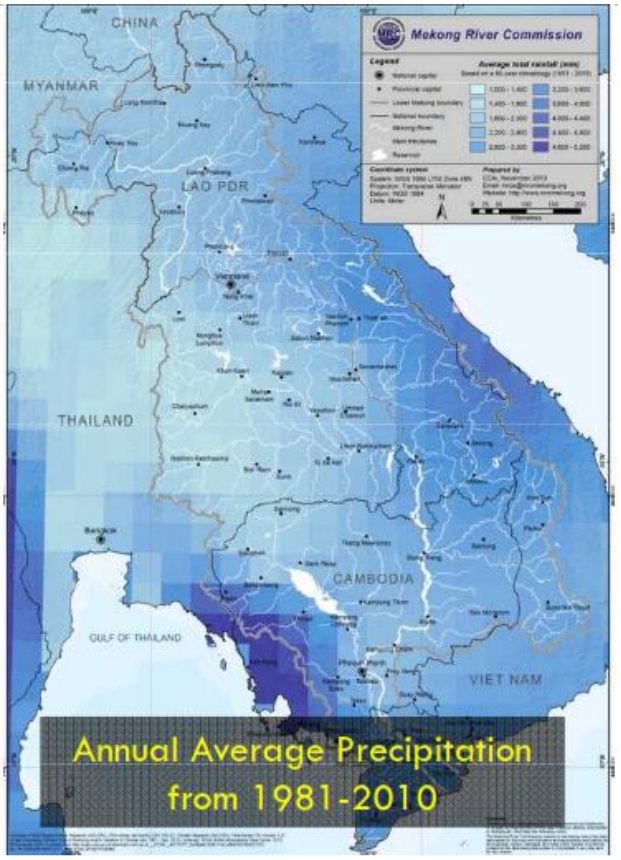

Figure 7 Average rainfall

d) Lao PDR Climate

Lao PDR has a tropical monsoon climate, characterized by a rainy and a dry season and influenced by the southeast monsoon.

- Rainy season (May to mid-October): This is the monsoon season, which brings a lot of rain with high humidity and lush greenery. The average rainfall can be up to 3,000 millimeters per year. The heaviest rainfall occurs in July and August.
- Dry season (mid-October to April): The monsoon subsides during this time, resulting in drier air, less humidity and more sunshine. Temperatures rise and it is the hottest time of the year.
- Changes in temperature: Due to the different altitudes in the Lao People's Democratic Republic, there are different temperature ranges throughout the country:
  - Northern mountainous region: these regions with an altitude of more than 1,000 meters have a warm climate like the mountains and a subtropical climate that is hilly. The temperature is expected to be cooler throughout the year than in the plains.
  - Central mountain area: Located in the Annamai region at an altitude between 500 and 1,000 meters, this area has a tropical monsoon climate with high temperatures and moderate rainfall with a rainfall of 2,500 to 3,500 mm.

- Lowlands: More than half of the population lives in the areas along the Mekong River and these tributaries have the hottest temperatures. With an average temperature of 25-27°C (77-81°F), rainfall here averages 1,500-2,000 mm.

2.1.2 Climate change

a) Greenhouse gases

The word greenhouse here has the same characteristics as a house built with glass to store heat so that plants that need heat to grow can grow, and the greenhouse phenomenon is a phenomenon in which the earth's atmosphere is covered by greenhouse gases so that the sun's heat cannot be released from the earth. The greenhouse phenomenon is caused by human development and lifestyles that release greenhouse gases. Greenhouse gases include: CO2, CH4, N2O and others. The occurrence of the greenhouse effect leads to an increase in the world's temperature, i.e. global warming, which will result in changes in the world's weather and climate.

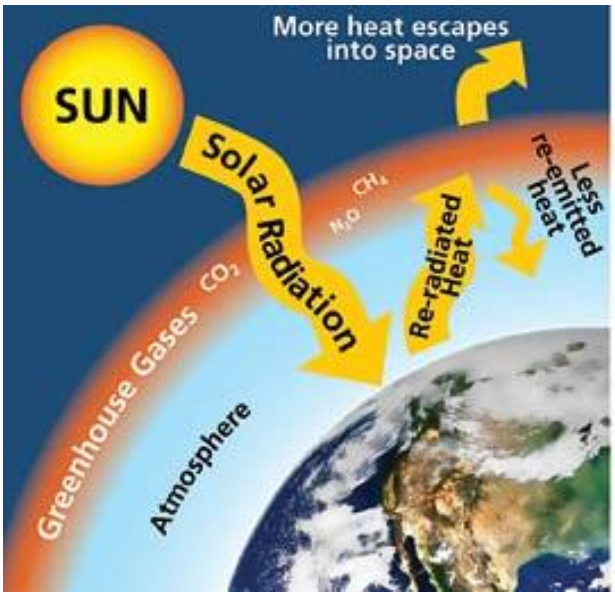

Figure 8 Natural greenhouse phenomenon

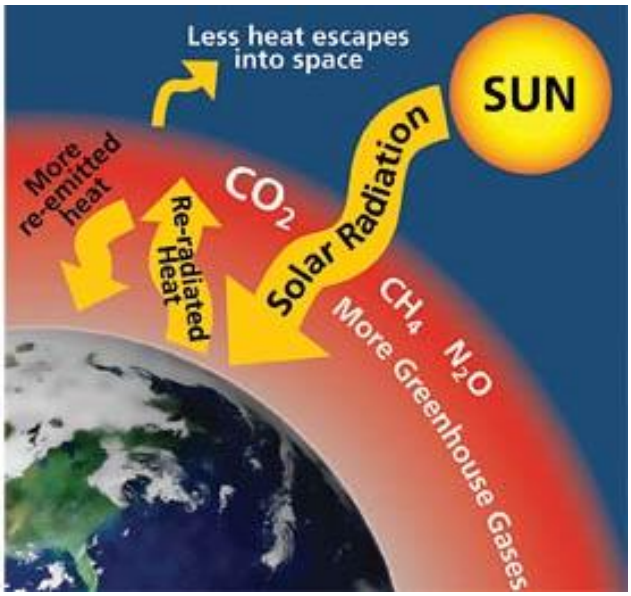

Figure 9 Greenhouse phenomenon from human activity

b) Important greenhouse gases

The important greenhouse gases (GHGs) that contribute to global warming and climate change include:

1. Carbon Dioxide (CO_2) – The most significant greenhouse gas produced by human activities, primarily from the burning of fossil fuels (coal, oil, and natural gas) for energy and transportation, as well as deforestation.
2. Methane (CH_4) – A potent greenhouse gas released during the production and transport of coal, oil, and natural gas, as well as from livestock, landfills, and rice paddies.

3. Nitrous Oxide (N_2O) – Produced by agricultural and industrial activities, particularly from the use of fertilizers, and also emitted by burning fossil fuels and biomass.
4. Fluorinated Gases – A group of synthetic gases used in industrial applications, including refrigerants (HFCs, PFCs, SF_6), which have a much higher global warming potential than CO_2 but are typically present in smaller quantities.
5. Water Vapor (H_2O) – While naturally occurring, water vapor is also influenced by human activities, particularly through the warming effect of other greenhouse gases. It plays a significant role in the Earth's climate system as a feedback mechanism, amplifying the effects of other GHGs

When these substances are released, they gradually enter the atmosphere and remain in the troposphere and do not change state. These synthetic chemicals then migrate into the stratosphere. In this layer, ultraviolet radiation from the sun breaks down the chlorofluorocarbon or CFC atoms, which are released and combine with the ozone molecule in the stratosphere. At both the North and South Poles, without ozone gas in the stratosphere, ultraviolet radiation can reach the Earth's surface in large quantities, which is an important cause of damage to living things and natural systems on Earth. When the ozone in the Earth's atmosphere is destroyed, more gaps are created through which more ultraviolet radiation can reach the Earth's surface, leading to a rapid rise in the Earth's temperature and causing global warming.

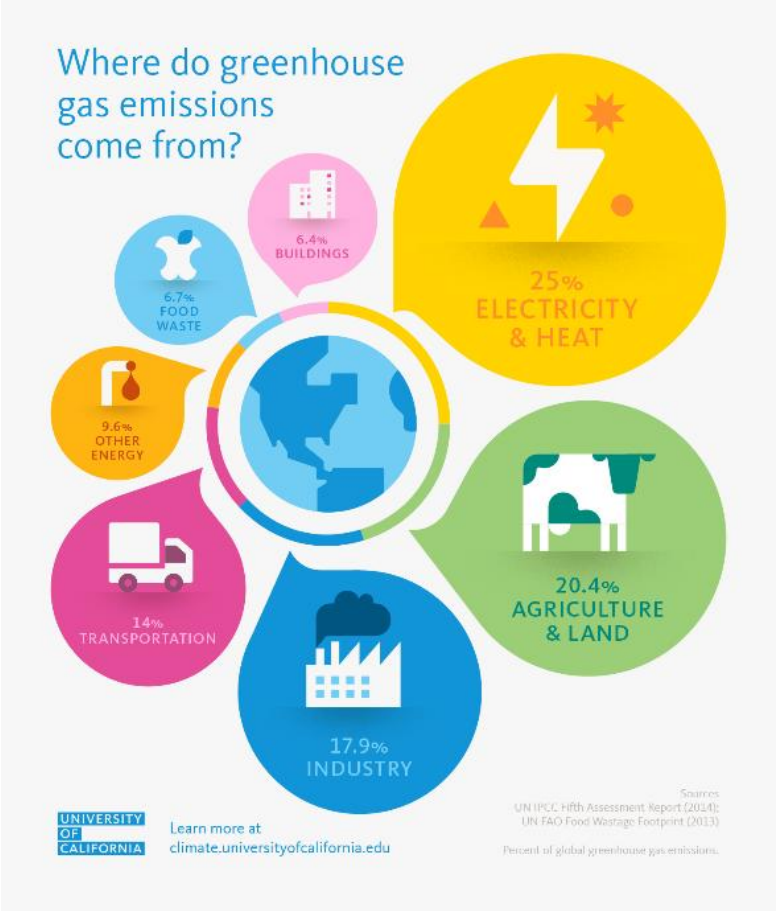

Figure 10 Examples of sources that emit greenhouse gases

c) Greenhouse gas and climate change

Scientists today assume that the current climate change is due to changes in atmospheric gases. The main cause lies in human activity, and it is believed that the temperature in the world is higher due to the effect of greenhouse gases, which is a phenomenon that occurs more than usual due to the accumulation of greenhouse gases in the atmosphere. Due to the increase in greenhouse gases, the earth's atmosphere absorbs more heat energy, which leads to a change in the energy balance and has a lasting effect. It is established that the climate changes in the long term (30 years or more).

Greenhouse gases in nature include water vapor (H2O), carbon dioxide (CO2), ozone (O3), methane (CH4) and nitrous oxide (N2O). These gases naturally make up less than 1 percent of the atmosphere, leading to global warming to a level suitable for humans.

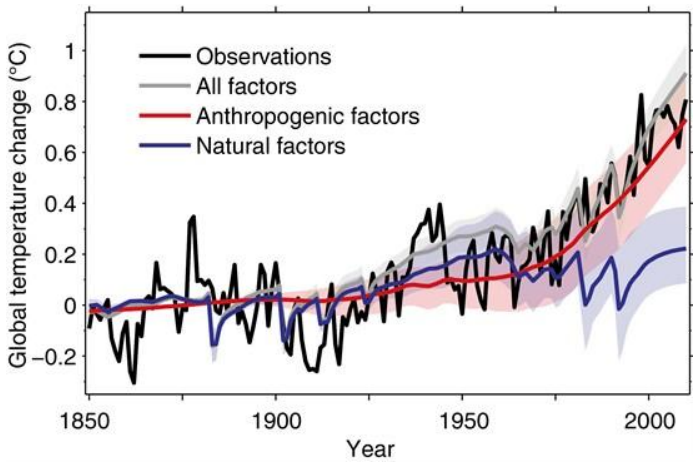

Figure 11 Global temperature variations between 1850 and 2000

d) Climate change's impacts

Although the average global temperature has not risen significantly, this is having an impact on ecosystems and climate change everywhere. A clear example is the melting of ice at the poles, both glaciers and unstable weather patterns around the world, the severity of storms and the damage that has led to unprecedented droughts in some areas of the world. Today, people around the world are facing climate change issues such as:

- The temperature is getting hotter, causing the planet's glaciers and snow to melt and sea levels to rise.
- The result is a change of seasons.
- Severe cold weather (or snowfall) occurs in areas where this has never happened.
- In the rainy season, there are heavy storms that bring more rain than usual and cause flooding and landslides.
- In the dry season, there is drought that lasts longer than usual.
- Temperatures that are higher than normal and last longer affect the lives of people and animals (heat stroke).

Figure 12 Climate change's impacts

e) The impact of climate change on Lao PDR

Climate change in Lao PDR can be seen in various ways:

- *Unpredictable rainfall patterns*: The distinction between the traditional rainy and dry seasons is becoming less clear, leading to more frequent and severe droughts and floods, which disrupt agriculture and local livelihoods.
- *Rising temperatures*: Increased average temperatures are affecting crop yields, particularly in temperature-sensitive sectors like rice farming, and putting strain on water resources, making them less reliable for both irrigation and drinking.
- *Shifting seasons*: Changes in the timing and intensity of seasons may disrupt planting and harvesting cycles, further impacting food security and agricultural productivity.

Climate change poses several significant impacts on the Lao People's Democratic Republic (Lao PDR), affecting various sectors of the economy and the livelihoods of its population. Some key impacts include:

1. Increased Flooding and Droughts: Climate change is leading to unpredictable rainfall patterns, with more frequent and severe floods during the rainy season and prolonged droughts during the dry season. These extreme weather events disrupt agricultural production, particularly rice farming, and threaten water availability for both irrigation and drinking.
2. Rising Temperatures: Higher temperatures are affecting agricultural productivity, especially for crops that are sensitive to heat. This can lead to reduced crop yields, particularly for rice, a staple crop in Laos. The warming climate also exacerbates the risk of forest fires and challenges in managing water resources.
3. Changes in Agriculture and Food Security: The shifting rainfall patterns and temperature changes affect crop planting and harvesting schedules, leading to lower agricultural

yields. This, in turn, threatens food security and may increase dependence on imported food.

4. Water Scarcity: Altered rainfall patterns and reduced snowmelt in upstream areas of the Mekong River could result in diminished water availability. This is critical for both agriculture, which relies heavily on irrigation, and for the provision of drinking water to communities.
5. Impacts on Biodiversity and Ecosystems: The changing climate affects Laos' rich biodiversity, including forests, wetlands, and wildlife. Higher temperatures and extreme weather events can disrupt ecosystems, making it harder for species to adapt or survive. Forests, which are vital for the country's economy and biodiversity, are particularly at risk.
6. Health Risks: The increase in temperatures and extreme weather events also brings health challenges, including heat-related illnesses, the spread of waterborne diseases, and an increased risk of vector-borne diseases like malaria and dengue fever, particularly as changing rainfall patterns affect the breeding grounds of disease-carrying mosquitoes.
7. Impact on Hydropower: Laos depends heavily on hydropower for its energy needs and exports. Changes in water availability due to shifting rainfall patterns and reduced river flow threaten the stability and productivity of hydropower plants.
8. Impact on Livelihoods and Rural Communities: Many rural communities in Laos depend on agriculture, forestry, and natural resources for their livelihoods. Climate change affects these sectors, leading to a decline in income, increased poverty, and displacement as communities are forced to migrate in search of better living conditions.

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Figure 13 Some impacts of climate change on Lao PDR

f. Mitigation and Adaptation

To protect the global population, including those in Laos, from the severe impacts of climate change, it is essential to actively participate in preserving the natural balance through both mitigation and adaptation efforts. Climate change is a global challenge that requires coordinated action at all levels, from international agreements to local initiatives, to minimize its harmful effects and safeguard future generations.

Mitigation focuses on reducing or preventing the factors that contribute to climate change, primarily by lowering greenhouse gas emissions. This can be achieved through a variety of measures, such as transitioning to renewable energy sources like solar and wind power, improving energy efficiency in buildings and industries, promoting sustainable transportation (e.g., electric vehicles and public transit), and implementing policies that reduce deforestation and promote large-scale reforestation efforts. Mitigation is crucial for slowing the pace of climate change and preventing even more severe and irreversible damage in the future. By addressing the root causes, mitigation helps to reduce the overall carbon footprint and contributes to achieving long-term climate goals.

Adaptation, on the other hand, focuses on adjusting to the current and predicted impacts of climate change. While mitigation works to prevent further damage, adaptation addresses the effects that are already being felt and those anticipated in the future. This includes measures to protect infrastructure from extreme weather events, such as floods and storms, developing drought-resistant crops to secure food production, improving water management systems to ensure access to clean water, and creating early warning systems for natural disasters like typhoons and heatwaves. Adaptation efforts are essential to reducing the vulnerability of communities and ecosystems, ensuring that people can cope with the changes brought on by climate change and continue to thrive.

Both **mitigation** and **adaptation** are essential for effectively managing climate change. Mitigation tackles the underlying drivers of climate change, while adaptation addresses the immediate and future consequences. Together, they form a comprehensive strategy for protecting both the environment and human societies. Effective mitigation can slow down the rate of climate change, while robust adaptation measures help communities adjust to its impacts, making them more resilient to future challenges.

Governments, organizations, and communities worldwide are working on strategies to mitigate and adapt to climate change. International agreements like the **Paris Agreement** set binding targets for reducing greenhouse gas emissions and aim to limit global temperature rise to below 2°C. On the local and regional levels, initiatives focus on building resilience, improving infrastructure, and implementing sustainable practices to help communities adapt to the changing climate. These collective efforts are crucial for the protection of our planet, and they ensure the well-being of current and future generations. By combining both mitigation and adaptation strategies, we can foster a more sustainable, resilient world in the face of climate change.

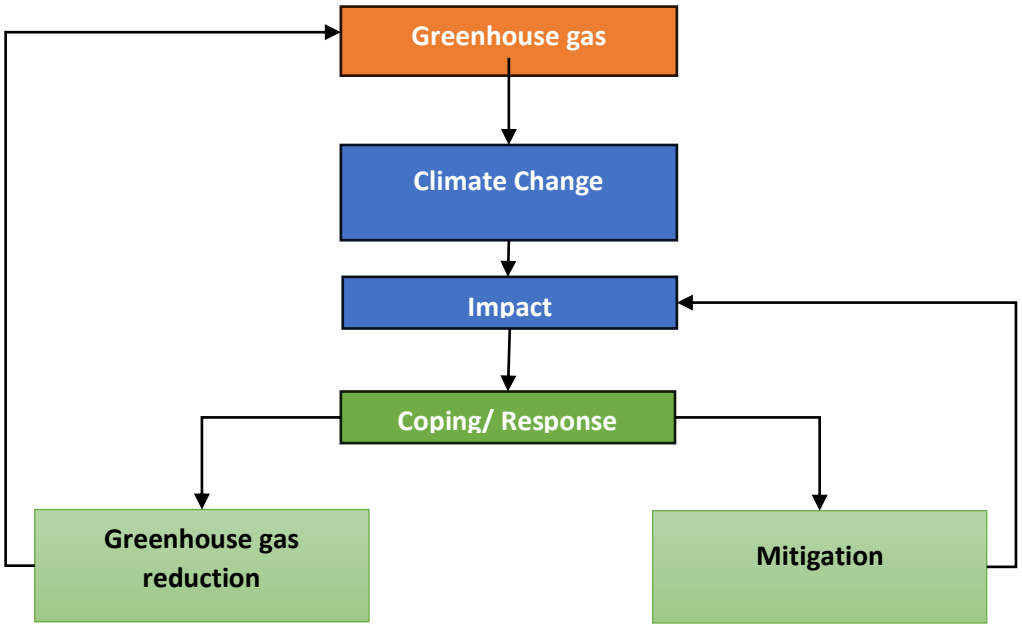


Figure 14 The connection between adaptability, climatic change, and greenhouse gas mitigation

g) Reasons for adaptation

- To mitigate the impact of violence, including loss of life, property, and damage to ecosystems.
- Planning and defining suitable adaptation measures can help minimize unnecessary costs.
- To ensure effective and efficient integration with other development plans, such as economic development and planning using GIS.
- To address future challenges and produce outcomes that reflect the current situation.
- However, the ideal solution is to prevent the issue from occurring in the first place.

h) Adaptation planning

- Establish boundaries: Define the geographical, temporal, and sectoral limits for the adaptation planning process. This step involves identifying the scope of the assessment, such as specific regions, sectors (e.g., agriculture, water resources, health), and timeframes (short-term, medium-term, long-term) to ensure that the adaptation measures are relevant and achievable.
- Assess vulnerability: Conduct a comprehensive assessment of the vulnerabilities to climate change within the defined boundaries. This includes analyzing how climate change impacts key sectors, communities, and ecosystems, taking into account factors such as exposure to climate hazards, sensitivity to these changes, and the capacity to adapt. The assessment should involve data collection, stakeholder input, and vulnerability mapping.
- Define adaptation options and strategies:

a) Analyze the benefits and losses: Evaluate different adaptation options by considering the potential benefits they offer in reducing vulnerabilities, enhancing resilience, and supporting sustainable development. Also, assess the potential losses or trade-offs associated with each option, such as economic costs, social equity concerns, or environmental impacts.

b) Evaluate using multiple criteria: Consider a range of criteria when selecting adaptation strategies, such as cost-effectiveness, feasibility, equity, social acceptability, and potential for long-term sustainability. This ensures that chosen strategies are not only practical but also inclusive and robust against future uncertainties.

- Develop an action plan for adaptation: Create a detailed action plan that outlines specific measures, timeframes, responsible actors, resources, and financing mechanisms for implementing the selected adaptation strategies. The action plan should prioritize actions based on urgency, feasibility, and the potential to reduce vulnerability, and include monitoring and evaluation systems to track progress and adjust strategies as needed.

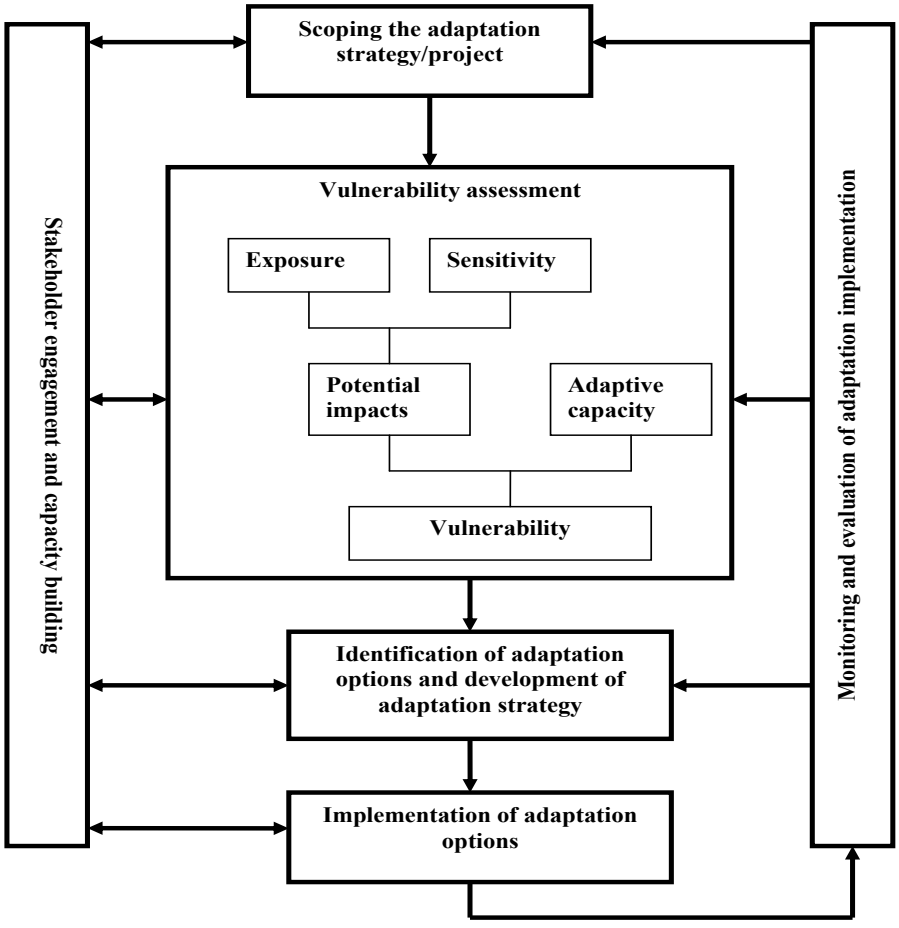


Figure 15 Action plan for adaptation

i) Climate change policies in Lao PDR

Lao People's Democratic Republic (Lao PDR) has developed several climate change policies and strategies to address the challenges posed by climate change and to promote sustainable development. These policies aim to reduce greenhouse gas emissions, enhance resilience to climate impacts, and integrate climate change considerations into national development plans. Some key climate change policies and initiatives in Lao PDR include:

1. **The National Adaptation Programme of Action (NAPA)**:

   NAPA is a framework that identifies urgent and immediate adaptation needs in response to climate change impacts, particularly in vulnerable sectors such as agriculture, water resources, and rural livelihoods. The NAPA outlines priority adaptation actions and provides a foundation for developing more comprehensive climate change strategies.

2. **The Nationally Determined Contributions (NDCs)**:

   As part of the Paris Agreement, Lao PDR has submitted its NDC, which outlines the country's commitments to reducing greenhouse gas emissions and enhancing climate resilience. The NDC includes both mitigation and adaptation measures, focusing on energy efficiency, renewable energy development, sustainable agriculture, and forest management.

3. **The Lao PDR National Sustainable Development Strategy**:

   This strategy incorporates climate change considerations into the broader context of sustainable development. It emphasizes the importance of aligning climate action with the country's development goals, particularly in the context of poverty reduction, economic growth, and environmental protection.

4. **The National Biodiversity Strategy and Action Plan (NBSAP)**:

   Climate change and its impacts on biodiversity are addressed in this plan, which seeks to conserve Laos' rich biodiversity while adapting to climate change. The NBSAP highlights the need for integrated approaches to biodiversity conservation and climate change adaptation.

5. **The Low Carbon Development Strategy (LCDS)**:

   This strategy outlines Laos' approach to reducing carbon emissions while promoting economic development. It focuses on promoting low-carbon technologies, improving energy efficiency, and shifting toward renewable energy sources, with particular emphasis on hydropower and biomass.

6. **The Forest Strategy 2020**:

   Laos' Forest Strategy aims to improve forest management and enhance forest carbon sinks to combat climate change. The strategy includes measures for afforestation, reforestation, and sustainable forest management practices to reduce emissions from deforestation and forest degradation (REDD+).

7. **The Green Growth Strategy**:

   The Lao Green Growth Strategy focuses on promoting environmentally sustainable development by improving energy efficiency, fostering green technologies, and reducing the carbon footprint of key sectors. It is aligned with the country's long-term development goals and international climate commitments.

Box 1: Training guide for Module 1

Objective: To disseminate knowledge of climate change, its sources, and its impacts to participants

Training content and methods:

The trainer presents Chapters 1, 2, and 3, allowing participants to ask questions at the end of each chapter. Afterward, the trainer asks participants to work in groups to identify and present the situation of climate change and its impacts on their respective provinces.

Content	Methods
<u>Presentation</u>: Chapter 1: Basic knowledge of climate change Chapter 2: Introduction to climate change Chapter 3: Introduction to climate risk and vulnerability assessment (CRVA)	- The trainer gives presentation relevant to the content of chapter 1, chapter 2, and chapter 3. - A VDO about climate change in the globe is also displayed. - Q&A following the presentation of each chapter.
<u>Group work</u>: Presentation of climate change and its impacts in each province	Representatives from the provincial departments of each province shall work in group and present their work relating to the status of climate change and its impacts of their province.

2.2 Module 2: climate risk and vulnerability assessment (CRVA)

2.2.1 Chapter 1: Climate risk and vulnerability assessment (CRVA)

a) Introduction to climate risk and vulnerability assessment

The Climate Risk and Vulnerability Assessment (CRVA) is important for the preparation of a National Adaptation Plan to Climate Change (NAP), because the assessment helps us to determine areas that are vulnerable to natural hazards and can identify areas and sectors that are vulnerable to natural hazards in the future, or we can say that the vulnerability assessment is an assessment of the degree of fragility based on the concept of vulnerability and exposure assessment to climate change, to predict the impact of trends in temperature, rainfall and events or effects of climate change, such as storms, floods, droughts, colds, based on the data collected in each period and the results of future prediction, to use the assessment results as basic information for policy making, strategies and programs to prepare for climate change. The fact that we can determine the vulnerability and risk will help us to determine the appropriate measures to cope with possible natural disasters.

In 2020, the Department of Climate Change, Ministry of Natural Resources and Environment of Lao PDR, released a report on the Climate Risk and Vulnerability Assessment (CRVA) of Lao PDR. The report applied the concept of vulnerability assessment based on the 4th Assessment Report (AR4) from 2007.

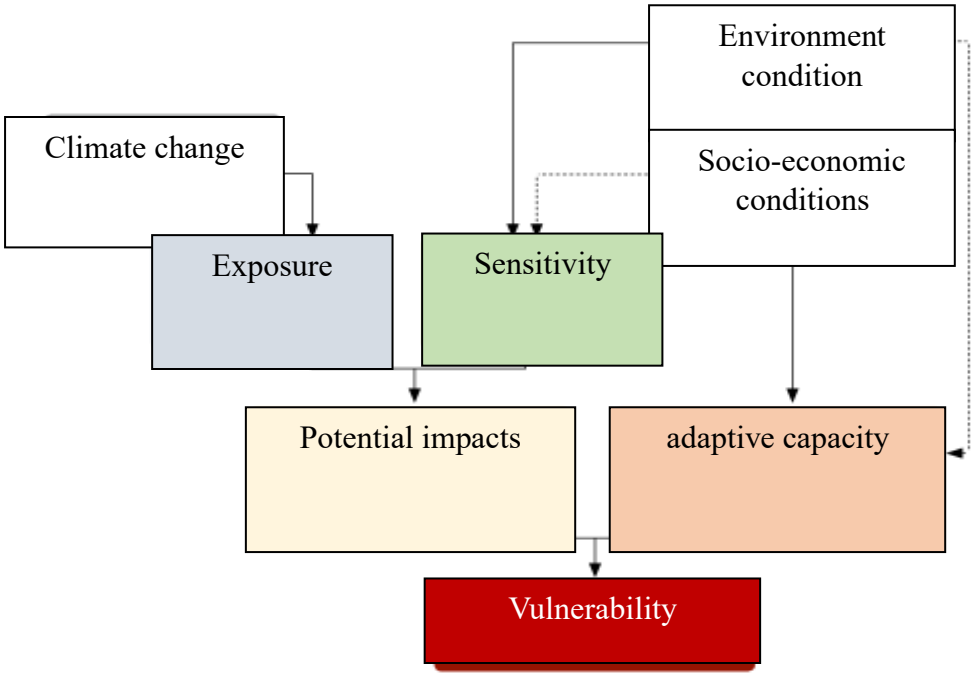


Figure 16 The concept of assessing vulnerability and risk to climate change

Nevertheless, for the development of the NAP in 2024, the concept of climate change vulnerability and risk assessment has evolved and is defined as follows in the 5th Assessment Report (AR5), published in 2014.

The IPCC Fifth Assessment Report (AR5) provides a robust, comprehensive framework for assessing climate-related risks, which is vital for understanding the complex and dynamic impacts of climate change. It helps guide decision-making by identifying risks and opportunities for adaptation and mitigation strategies. This framework reflects a shift towards a more integrated and holistic approach to understanding climate impacts across various sectors and regions, and emphasizes the need for assessing both current and future risks. Below is an expanded explanation of the Risk Assessment Framework in the IPCC AR5:

Defining Climate Risk in AR5:

In AR5, climate risk is seen as the combination of:

- **Hazard**: A climate event or trend, such as rising temperatures, extreme weather events (e.g., floods, droughts, storms), or sea-level rise.
- **Exposure**: The degree to which a system, community, or region comes into contact with a climate hazard. This includes people, infrastructure, ecosystems, and economic assets that are located in areas where hazards are likely to occur.
- **Vulnerability**: The susceptibility of a system or population to harm from the hazards. Vulnerability is influenced by the **sensitivity** (the degree to which a system is affected by a hazard) and the **adaptive capacity** (the ability of a system to cope with, respond to, and recover from climate impacts).

The AR5 expresses this relationship as:

$$Risk = Hazard \times Exposure \times Vulnerability$$

It highlights that risk is not a static concept; it evolves with changes in climate patterns, societal development, and adaptive capacity. Understanding how hazards interact with exposure and vulnerability over time is crucial for effective risk management.

The Process of Risk Assessment:

Risk assessment in AR5 is a structured process that involves multiple stages:

- **Identifying and Analyzing Hazards**: The first step involves identifying the potential climate hazards that could affect a given region or sector. These include both current climate variability (e.g., rainfall patterns) and projected climate changes (e.g., global warming, changes in extreme weather events). This stage also involves evaluating the timing, intensity, and spatial distribution of these hazards, often using climate models to project future conditions under different emission scenarios.
- **Assessing Exposure**: Exposure refers to the extent to which a system is likely to come into contact with these hazards. This can include the physical location of people and assets (e.g., coastal areas vulnerable to sea-level rise), or sectors such as agriculture that depend on certain climate conditions. Assessing exposure requires identifying vulnerable regions and sectors and considering the spatial and temporal distribution of climate hazards.

- **Evaluating Vulnerability**: Vulnerability is evaluated by looking at both the *sensitivity* of a system to climate impacts and its *adaptive capacity*. Sensitivity refers to the degree to which a system or population will be affected by climate hazards (e.g., crop yields may decline with changing rainfall patterns). Adaptive capacity refers to the ability to cope with or adjust to these changes, including the availability of resources, technologies, governance structures, and social systems that can facilitate adaptation.
- **Risk Evaluation**: Once hazards, exposure, and vulnerability have been assessed, the next step is to evaluate the *risk* of climate change impacts. This involves estimating the likelihood and severity of potential outcomes and considering different future scenarios based on climate projections. These projections take into account the uncertainty in climate models, emission scenarios, and socio-economic factors. Various methods are used to quantify risk, from qualitative approaches (e.g., expert judgment) to quantitative models (e.g., probabilistic risk assessments).

Uncertainty in Climate Risk Assessments:

AR5 highlights that uncertainty is an inherent part of risk assessments, especially when projecting future climate impacts. Uncertainty stems from several factors:

- **Climate models**: While climate models provide important projections of future climate, they inherently have some degree of uncertainty, especially in terms of regional predictions and extreme events.
- **Socio-economic scenarios**: Future emissions depend on various socio-economic drivers, such as population growth, technology development, and economic trends, all of which involve uncertainty.
- **Natural variability**: Natural climate variability adds another layer of unpredictability, especially in the short term.

Despite these uncertainties, AR5 stresses that it is still possible to make informed decisions about climate risk, particularly through the use of scenarios. Scenarios present different possible futures based on different assumptions, helping policymakers prepare for a range of potential outcomes.

Sectoral and Regional Risk Assessments:

The AR5 framework underscores that risk assessments need to be tailored to specific sectors and regions, as climate change impacts vary widely depending on local conditions and sectoral vulnerabilities. For example:

- **Agriculture**: The risks in agriculture may include reduced crop yields due to changing precipitation patterns, temperature extremes, or the spread of pests and diseases. These risks vary by crop type, region, and farming practices.
- **Water Resources**: Climate impacts on water resources include changes in rainfall patterns, snowmelt, and river flow, which can lead to floods or droughts. Vulnerable regions may include areas dependent on seasonal water availability, such as river basins.

- **Health**: Climate change poses risks to human health through the spread of diseases, heat stress, and malnutrition. Regions with poor healthcare infrastructure or high vulnerability to vector-borne diseases are at greater risk.
- **Coastal Zones and Urban Areas**: Sea-level rise and storm surges threaten coastal infrastructure and communities. Urban areas, especially those in low-lying regions, are vulnerable to flooding, heatwaves, and water scarcity.

By considering sector-specific risks, adaptation strategies can be more targeted and effective.

Integrating Mitigation and Adaptation:

AR5 emphasizes that mitigation (reducing greenhouse gas emissions) and adaptation (adjusting to climate impacts) are both critical to managing climate risks. The report advocates for an integrated approach, where both mitigation and adaptation measures are considered together. For instance:

- Mitigation efforts, such as shifting to renewable energy, improving energy efficiency, and promoting sustainable land-use practices, can reduce the overall risk of climate change by limiting future climate impacts.
- Adaptation strategies, such as improving water management, developing drought-resistant crops, or enhancing disaster preparedness, help reduce vulnerability to existing climate impacts.

AR5 suggests that combining these strategies will provide a more holistic solution to managing climate risks.

Building Resilience:

One of the key takeaways from the AR5 risk assessment framework is the importance of building resilience to climate risks. Resilience involves the capacity of systems, communities, and ecosystems to absorb and recover from the impacts of climate change. This includes enhancing adaptive capacity, strengthening governance and institutions, diversifying livelihoods, and promoting sustainable development practices.

The report also emphasizes that addressing climate risks requires a long-term perspective. Climate change will continue to affect future generations, and risk assessments must account for long-term impacts, not just immediate or short-term hazards.

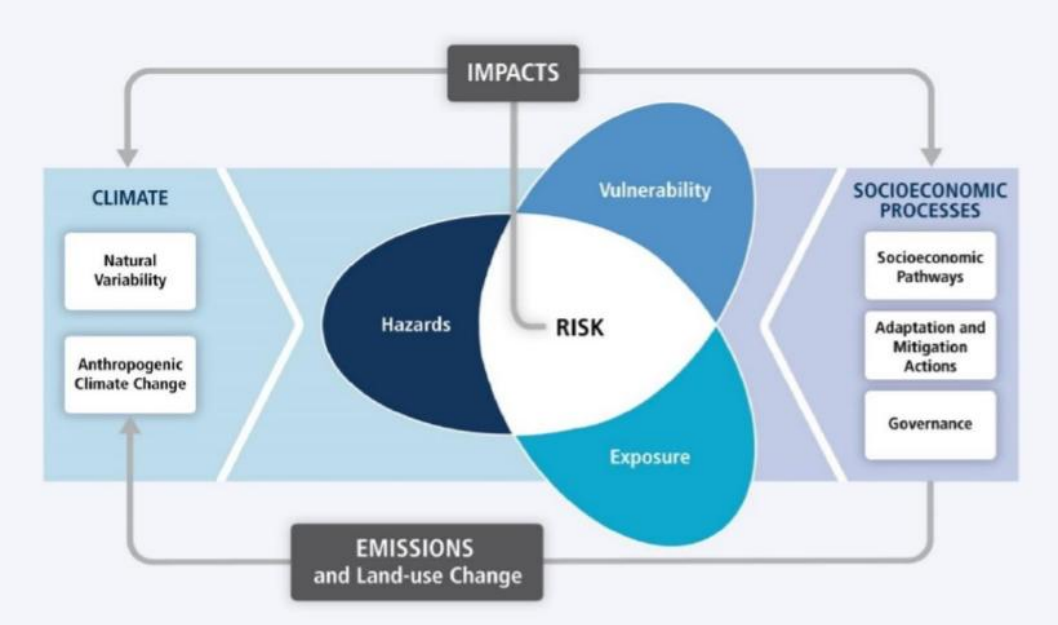


Figure 17 Concept of risk assessment of IPCC AR5

b) Development of vulnerability assessment framework using AR5 methodology

The IPCC AR5-based vulnerability assessment framework is a comprehensive approach designed to assess the potential impacts of climate change on various systems and sectors. It integrates the concepts of exposure, sensitivity, and adaptive capacity to evaluate how vulnerable different regions, communities, or sectors are to climate risks. The framework is structured to guide the identification of vulnerabilities and the development of appropriate adaptation strategies.

Key Steps in the Framework:

1. Defining Scope and Context:

The first step involves clearly defining the scope of the assessment. This includes identifying the geographical regions, sectors (e.g., agriculture, water, infrastructure, health), and timeframes for the study. It also involves engaging stakeholders and considering local contexts in the assessment process.

2. Identifying Climate Hazards:

The next step is identifying potential climate hazards, such as changes in temperature, rainfall patterns, and extreme weather events like floods or droughts. Climate models and projections are used to anticipate how these hazards may evolve in the future under different emission scenarios.

3. Exposure Assessment:

Exposure refers to the degree to which a system or sector is subjected to the identified climate hazards. It involves evaluating the spatial (geographical) and temporal (time-based) aspects of exposure. For example, a region may be exposed to increased temperatures or rising sea levels, which could impact agricultural productivity or infrastructure.

4. Sensitivity Evaluation:

Sensitivity refers to how susceptible a system is to the impacts of climate hazards. This step assesses the extent to which sectors or communities might be affected by climate changes. For example, agriculture in drought-prone areas may be highly sensitive to reduced rainfall, while coastal infrastructure may be sensitive to sea-level rise.

5. Assessing Adaptive Capacity:

Adaptive capacity is the ability of a system to cope with and adjust to the impacts of climate change. It includes factors such as governance, financial resources, technological capabilities, and community resilience. Assessing adaptive capacity helps to identify where interventions are needed to enhance resilience, whether through infrastructure improvements, policy development, or capacity-building efforts.

6. Integrating Vulnerability with Risk:

The vulnerability assessment framework integrates the three components—exposure, sensitivity, and adaptive capacity—to assess the overall risk posed by climate change. This step helps to prioritize areas and sectors that are most at risk based on their exposure, sensitivity, and ability to adapt.

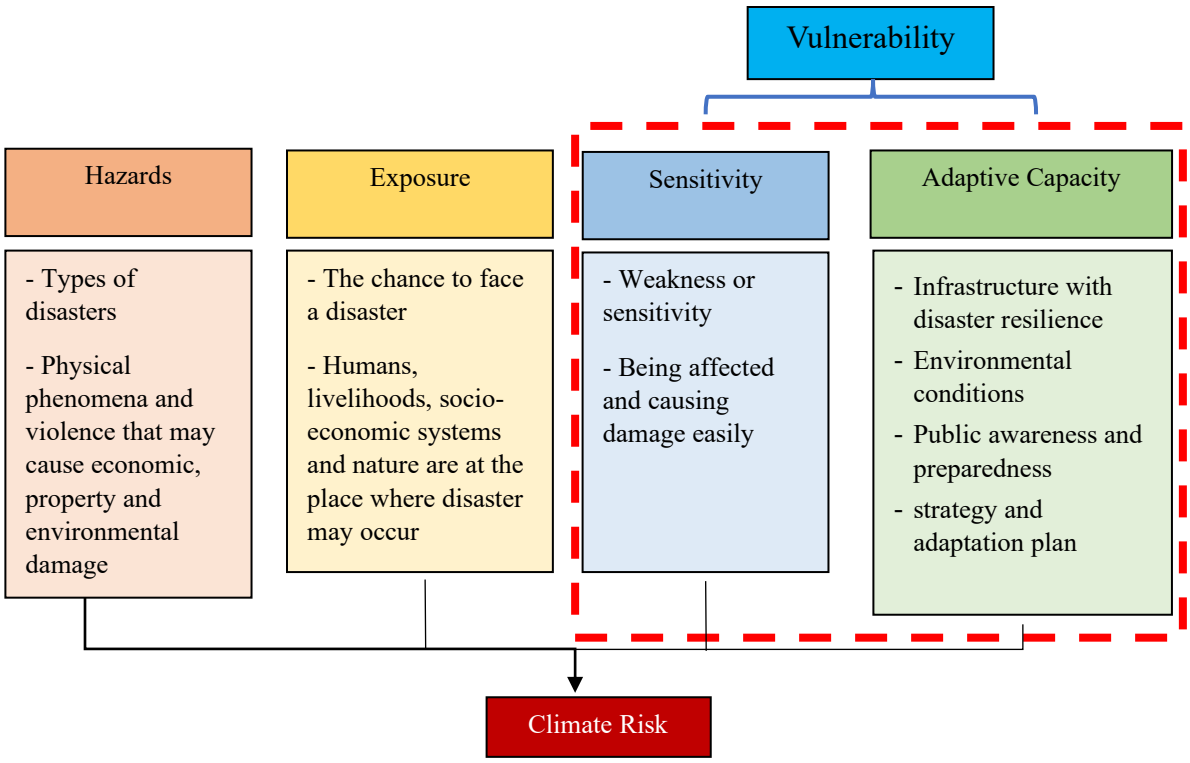


Figure 18 Principles of risk assessment in social ecological systems

c) Risk assessment and adaptation measure development procedure

Collect data:

The first essential step in the risk and vulnerability assessment process is to collect comprehensive data. This involves gathering a variety of data points across multiple sectors to develop an accurate understanding of current conditions and potential future climate impacts. This data includes:

- Strategies and plans: Review of national, provincial, and sectoral policies, strategies, and climate action plans that guide responses to climate change, to ensure that the adaptation measures align with existing frameworks.
- Socio-economic data: Information about population size, density, socio-economic conditions, income levels, livelihoods, and employment sectors. This data is crucial to understand how vulnerable different population groups are to climate impacts, particularly marginalized or high-risk communities.
- Ecosystem data: Data on land use, biodiversity, soil health, water quality, and other key ecosystem indicators that help evaluate the health and vulnerability of natural resources. This also includes data on ecosystems that provide essential services such as water filtration, flood protection, and carbon sequestration.
- Livelihood data: Information about the income sources and livelihood strategies of local communities, which highlights how people depend on natural resources, agriculture, fisheries, or other sectors that may be directly affected by climate change.

- Infrastructure data: Details on critical infrastructure such as roads, bridges, schools, hospitals, energy grids, and water supply systems. The resilience of these infrastructures is key to assessing vulnerability and planning for their protection against climate-related hazards. By synthesizing this data, a risk index is created to assess the relative risks across different regions, sectors, and communities.

Assess the risk:

Once the data is collected, the next step is to assess the risk by developing a risk index. This involves evaluating the key components of climate risk:

- Hazards: Identification of climate hazards, including extreme weather events like storms, droughts, heatwaves, and flooding, and longer-term changes such as sea-level rise and shifting precipitation patterns. Understanding the specific hazards that each region faces is crucial to developing localized adaptation strategies.
- Exposure: Assessment of how vulnerable each sector, region, or community is to these hazards. Exposure is not only about geographical location but also includes the frequency, severity, and timing of climate hazards. For example, coastal communities may face high exposure to rising sea levels, while rural areas may be more vulnerable to droughts.
- Vulnerability: This includes evaluating both sensitivity and adaptive capacity:
    - Sensitivity refers to how susceptible a system (whether a community, sector, or ecosystem) is to the negative impacts of climate change. For instance, an agricultural system in an area with limited water resources would be more sensitive to drought conditions.
    - Adaptive capacity is the ability of a system to adjust, cope, and recover from climate impacts. This includes factors such as available financial resources, governance structures, infrastructure resilience, access to technology, and knowledge. The combined factors of exposure, sensitivity, and adaptive capacity are used to create risk and vulnerability maps, which visually show the areas or sectors most at risk. These maps serve as critical tools for decision-makers, highlighting where climate impacts are most likely to occur and the intensity of those impacts.

Study the current ecosystem services of each province and sector:

A crucial aspect of adaptation planning is understanding the current ecosystem services and the role they play in supporting communities. Ecosystem services refer to the benefits humans derive from natural ecosystems, such as:

- Provisioning services: Food, water, fuel, and raw materials.
- Regulating services: Climate regulation, water purification, flood control, and disease regulation.
- Cultural services: Recreational, aesthetic, and spiritual benefits.
- Supporting services: Soil formation, nutrient cycling, and pollination. In each province, it's essential to assess which ecosystems provide critical services and how these services

are being affected by current and future climate change. For example, forests may provide important flood regulation services, while wetlands may filter water. Understanding the social context of each province is equally important. This includes looking at the economic dependency of local communities on these services, particularly in rural areas where livelihoods may be tied directly to natural resources. This step helps to identify areas where ecosystems are under threat and ensures that adaptation measures account for the ecological and social context.

Develop adaptation measures:

With a thorough understanding of risks, vulnerabilities, and ecosystem services, the next step is to develop adaptation measures. Adaptation measures can be categorized into two main types:

- Sector-specific measures: These adaptation strategies focus on reducing vulnerability within specific sectors, such as agriculture, health, or infrastructure. For example, in agriculture, adaptation measures might include developing drought-resistant crop varieties, changing farming techniques, or improving irrigation systems. For health, measures may involve strengthening health infrastructure to cope with climate-induced diseases.
- Ecosystem-based adaptation (EbA): This approach focuses on utilizing ecosystem services to help communities adapt to climate change. For instance, restoring mangroves to protect coastal areas from storm surges or promoting sustainable forest management to improve water retention and reduce flood risks. Ecosystem-based solutions are often cost-effective, provide co-benefits (such as biodiversity protection), and help maintain or enhance the resilience of both natural and human systems. In developing these measures, it's essential to incorporate local knowledge and previous adaptation experiences. Each sector and region have valuable insights from past actions and community-led solutions. Therefore, stakeholder participation from various sectors is crucial. This can include workshops, focus groups, and consultations with local communities, experts, and government agencies to identify feasible and locally appropriate measures. Additionally, adaptation measures should be integrated into the broader development planning process, ensuring that they align with existing policies, strategies, and local priorities. This can involve revising or updating existing sectoral plans and policies to incorporate climate adaptation measures. Finally, the development of adaptation measures should be accompanied by a monitoring and evaluation framework to track their effectiveness and make necessary adjustments over time.

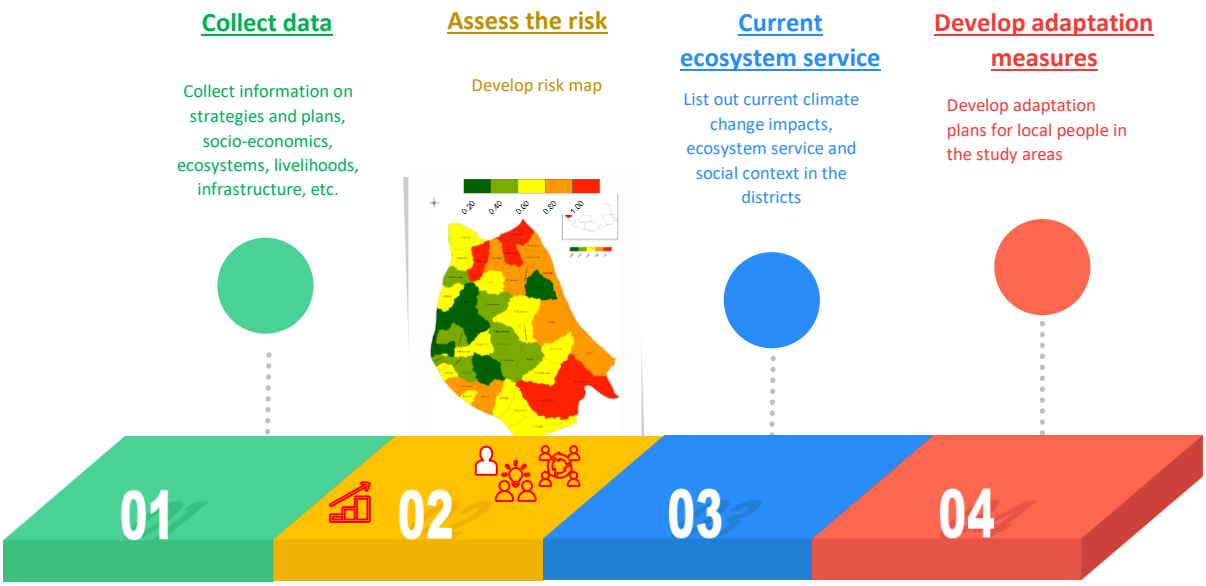


Figure 19 the risk assessment and adaptation process

e) Required data and information

The data and information required for a comprehensive climate change risk and vulnerability assessment are crucial for understanding the current and projected impacts of climate change. These data types help evaluate how vulnerable specific sectors, communities, and ecosystems are to climate risks. The four main types of data used in the assessment include: secondary, statistical, geospatial, and climate data. These four types of data—secondary, statistical, geospatial, and climate data—are essential for creating a comprehensive climate change risk and vulnerability assessment. They provide the necessary foundation for identifying risks, assessing vulnerabilities, and developing adaptation strategies to protect vulnerable communities, ecosystems, and sectors from the impacts of climate change.

Secondary data:

Secondary data refers to data that has already been collected and documented by other sources, such as government agencies, research institutions, and international organizations. This data can include:

- **Reports and policy documents**: National or regional climate change adaptation and mitigation plans, environmental assessments, sectoral reports, and policy frameworks.
- **Studies and research papers**: Existing research that analyzes climate change impacts, vulnerability assessments, or sector-specific challenges and solutions.
- **Historical data**: Past studies or reports that provide context on long-term trends and changes related to climate impacts, such as shifts in rainfall patterns, temperature trends, or the frequency of extreme weather events.

Secondary data serves as the foundation for understanding the broader context of climate risks, often providing a starting point for more detailed primary data collection.

Statistical data:

Statistical data is critical for understanding the socio-economic dynamics of regions or sectors and how they intersect with climate risks. This data includes:

- **Demographic information**: Population size, density, age distribution, gender, and migration patterns. These statistics help identify which communities are more vulnerable to climate change due to factors like population concentration, income inequality, or dependence on climate-sensitive livelihoods.
- **Economic data**: Economic indicators, such as income levels, employment patterns, and industry outputs. This can include sector-specific data on agriculture, energy, health, and infrastructure, showing how sectors might be impacted by climate change.
- **Health data**: Information about public health issues related to climate impacts, such as the prevalence of heat-related illnesses, vector-borne diseases, or malnutrition in areas prone to droughts and floods.

Statistical data is essential for assessing the socio-economic vulnerabilities of populations and for identifying which sectors and communities may require targeted adaptation measures.

2. **Geospatial data**:

Geospatial data refers to data that is geographically referenced and is used to map out spatial relationships, locations, and patterns relevant to climate change impacts. This includes:

- **Land-use data**: Information about how land is used in different regions, including urban areas, agriculture, forests, wetlands, and protected areas. This data helps assess which areas may be vulnerable to climate impacts like flooding, soil erosion, or deforestation.
- **Topographic data**: Elevation, slope, and terrain data, which are crucial for understanding flood risks, the potential for landslides, and other geography-dependent impacts.
- **Infrastructure data**: Maps and information about the locations and conditions of key infrastructure such as roads, bridges, buildings, water supply systems, and energy infrastructure. This helps in assessing which critical infrastructures are most exposed to climate risks.
- **Ecosystem mapping**: Identifying ecosystems and biodiversity hotspots that provide vital services such as water filtration, flood control, and carbon sequestration. These maps help in assessing the potential impacts of climate change on these services and identifying areas for ecosystem-based adaptation.

Geospatial data is critical for visualizing climate risks and vulnerability, allowing for the creation of detailed risk maps that can be used for planning and decision-making.

3. **Climate data**:

   Climate data is the most direct and essential source of information for understanding the potential impacts of climate change. It includes both historical and future projections of climate conditions, such as:

   - **Historical climate data**: Records of past climate conditions, such as temperature, precipitation, humidity, and extreme weather events. These data sets help identify trends, such as increasing temperatures or changing rainfall patterns, and are used to detect long-term shifts in the climate.
   - **Climate projections**: Forecasts of future climate conditions based on different emission scenarios. These projections, typically produced by climate models, include future temperature changes, altered precipitation patterns, and the occurrence of extreme weather events like droughts, floods, and heatwaves. Climate projections provide insight into potential future risks and guide the development of long-term adaptation strategies.
   - **Extreme weather events data**: Data on the frequency, intensity, and duration of extreme weather events such as storms, heatwaves, heavy rainfall, and floods. This data is crucial for understanding the potential for these events to increase due to climate change and for identifying vulnerable regions or sectors.

2.2.2 Chapter 2: Developing risk index and mapping risky areas

Based on the definition of climate risk outlined in Section 2.2 of the IPCC AR5, climate risk is described as the potential for harm or damage to human systems, ecosystems, or infrastructure, resulting from the interactions between **climate hazards, exposure, and vulnerability**. In this context, the components of climate risk and their respective indicators can be defined as follows:

a) Identifying and analyzing indicators of climate risks

Climate hazards

These are physical events or trends such as extreme weather events (e.g., storms, floods, heatwaves) or longer-term climatic shifts (e.g., rising temperatures, increasing precipitation). Indicators include changes in precipitation patterns, temperature anomalies, storm intensity, or drought frequency.

$$\boldsymbol{Flooding} = f(\boldsymbol{frequencies\ of\ floods, magnitudes\ of\ floods, etc} \dots)$$

$$\boldsymbol{drought} = f(\boldsymbol{frequencies\ of\ droughts, magnitudes\ of\ droughts, etc, etc} \dots)$$

$$\boldsymbol{Landslide} = f(\boldsymbol{frequencies\ of\ landslides, magnitudes\ of\ landslides, etc} \dots)$$

$$\boldsymbol{Storm} = f(\boldsymbol{frequencies\ of\ storms, magnitudes\ of\ storms, etc} \dots)$$

Table 2 List of indicators of climate hazards

1. Floods

- Rainfall intensity and duration
- Water level measurements in rivers, lakes, and reservoirs
- Frequency and duration of heavy rainfall events
- Presence of floodplains and low-lying areas
- Land use changes (e.g., urbanization or deforestation)
- Flood history (previous occurrences and severity)

2. Droughts

- Precipitation levels and trends over time
- Temperature anomalies
- Evapotranspiration rates
- Vegetation health and growth (e.g., through remote sensing data)
- Agricultural yield reductions

3. Landslides

- Slope steepness and terrain instability
- Rainfall intensity and duration
- Land use changes (e.g., deforestation or construction)
- Geological and soil composition
- Historical landslide events (frequency and magnitude)

4. Storms

- Wind speed
- Storm frequency and intensity
- Temperature and humidity patterns
- Historical storm data (e.g., typhoons, hurricanes, cyclones)
- Lightning frequency and distribution

Exposure indicators

This refers to the presence of people, assets, ecosystems, or infrastructure in areas that are subject to climate hazards. Indicators include population density in hazard-prone areas, the location of critical infrastructure, and the spatial distribution of vulnerable ecosystems.

$$\boldsymbol{Expose\ to\ floods} = f(\boldsymbol{population\ density\ in\ flood\ prone\ areas, etc} \ldots)$$

$$\boldsymbol{Expose\ to\ droughts} = f(\boldsymbol{population\ in\ water\ scarce\ area, etc})$$

$$\boldsymbol{Expose\ to\ landslides} = f(\boldsymbol{population\ density\ in\ steep, etc} \ldots)$$

$$\boldsymbol{Expose\ to\ storms} = f(\boldsymbol{population\ in\ storm\ surge\ area, etc} \ldots)$$

Table 3 List of indicators of exposure to climate hazards

1. Exposure to floods

- Population density in flood-prone areas
- Location of critical infrastructure (e.g., roads, bridges, hospitals) in flood zones
- Area of agricultural land in floodplains
- Urbanization in flood-prone areas
- Proximity to rivers, lakes, and reservoirs
- Floodplain development (e.g., residential or commercial buildings)
- Access to early warning systems and flood protection measures

2. Exposure to droughts

- Agricultural land dependent on rainfall in drought-prone areas
- Water supply infrastructure (e.g., reservoirs, irrigation systems)
- Population in water-scarce regions
- Dependency on rain-fed agriculture for livelihoods
- Groundwater levels and availability for irrigation or drinking
- Livelihoods dependent on water-intensive sectors (e.g., agriculture, livestock)
- Location of water resources (rivers, lakes, reservoirs)
- Access to water storage and management systems

3. Exposure to landslides

- Population density in steep, unstable areas
- Location of infrastructure (e.g., roads, buildings) on or near slopes
- Land use changes (e.g., deforestation, construction) in landslide-prone areas
- Proximity to slopes or hilly terrain
- Agricultural land on steep slopes
- Historical landslide events in the area
- Soil erosion levels in mountainous or hilly regions
- Vulnerability of settlements built in or near landslide-prone zones

4. Exposure to storms

- Population density in storm-prone areas
- Location of critical infrastructure (e.g., schools, hospitals) in storm-prone regions
- Proximity to storm-prone areas (e.g., typhoons)
- Housing and settlement patterns in high-wind areas
- Agricultural land in storm-prone areas
- Height above sea level in flood-prone or storm surge areas

- Early warning systems and storm preparedness infrastructure

Vulnerability

This is the degree to which a system or community is susceptible to harm when exposed to climate hazards. Indicators include adaptive capacity, social resilience, poverty levels, governance structures, and ecosystem health, which determine how well a system can withstand and recover from climate impacts. It comprises two main components, including sensitivity and adaptive capacity.

Sensitivity

The degree to which a system or community is affected by climate hazards. This includes the extent to which a system or sector (e.g., agriculture, health, or infrastructure) is exposed to and impacted by changes in climate variables like temperature, precipitation, or extreme events.

$$\boldsymbol{Sensitivity} = f(\boldsymbol{vulnerable\ populations}, \boldsymbol{dependency\ on\ agriculture}, \boldsymbol{etc}\ \ldots)$$

Adaptive Capacity

The ability of a system or community to adjust to climate change, moderate potential damages, or take advantage of opportunities. This includes factors such as access to resources, technology, infrastructure, social networks, governance, and the overall ability to implement effective adaptation measures.

$$\boldsymbol{Adaptive\ capacity} = f(\boldsymbol{education}, \boldsymbol{infrastructure}, \boldsymbol{etc}\ \ldots)$$

Table 4 List of indicators of sensitivity to climate hazards

1. Sensitivity to floods

- Proximity to flood-prone areas (e.g., rivers, lakes, coastal zones)
- Dependence on flood-prone agricultural land
- Age and health of infrastructure (e.g., bridges, roads, drainage systems)
- Quality of flood protection systems (e.g., levees, dams)
- Health infrastructure (e.g., hospitals and clinics vulnerable to flooding)
- Housing quality (e.g., housing in flood zones, poorly constructed buildings)
- Socioeconomic dependency on flood-sensitive sectors (e.g., agriculture, tourism)
- Vulnerable populations (e.g., elderly, disabled, low-income communities)

2. Sensitivity to droughts

- Dependence on rain-fed agriculture for food and livelihoods
- Water demand in agriculture, industry, and domestic sectors
- Access to water resources (e.g., rivers, lakes, groundwater)
- Soil fertility and irrigation capacity
- Vulnerable crop and livestock species to water stress
- Water consumption patterns (e.g., over-extraction or inefficient use)
- Dependency on water for energy production (e.g., hydroelectric power)
- Availability of drought-resistant crops and technologies

3. Sensitivity to landslides

- Steepness and instability of terrain in the area
- Land use patterns (e.g., deforestation, urbanization, agriculture on slopes)
- Soil composition and erosion rates
- Degree of slope modification (e.g., construction, mining)
- Absence or degradation of natural barriers (e.g., vegetation, rock formations)
- Presence of vulnerable infrastructure (e.g., roads, buildings, bridges on slopes)
- Population density in landslide-prone areas
- Level of awareness and preparedness for landslide risks

4. Sensitivity to storms

- Geographical location (e.g., proximity to coastal areas, tropical zones)
- Structural integrity of buildings (e.g., vulnerability to wind and water damage)
- Type of vegetation and natural barriers (e.g., absence of mangroves or forests)
- Vulnerable infrastructure (e.g., power lines, communication towers)
- Socioeconomic dependence on sectors vulnerable to storms (e.g., tourism, agriculture)
- Local response capacity and disaster preparedness (e.g., early warning systems, evacuation plans)
- Previous exposure to storms (e.g., history of storm damage and recovery)
- Access to resources for storm resilience (e.g., building materials, financial resources)

Table 5 List of indicators of adaptive capacity to climate hazards

1. Adaptive capacity to floods

- Access to early warning systems for floods
- Availability of flood protection infrastructure (e.g., dams, levees, flood barriers)
- Quality of emergency response systems (e.g., rescue teams, evacuation plans)
- Government policies and regulations for flood management and land use planning
- Public awareness and education on flood risks and preparedness
- Economic resources to rebuild after floods (e.g., insurance, government support)
- Diversification of livelihoods to reduce dependence on flood-sensitive sectors (e.g.,

agriculture)
- Community social capital (e.g., cohesion, networks for mutual support in emergencies)

2. Adaptive capacity to droughts

- Availability of alternative water sources (e.g., groundwater, reservoirs, desalination)
- Access to drought-resistant crops and agricultural techniques
- Water management infrastructure (e.g., irrigation systems, water storage facilities)
- Government policies and programs for water conservation and drought preparedness
- Technological innovations for efficient water use (e.g., drip irrigation, water recycling)
- Access to financial resources (e.g., loans, insurance for farmers)
- Research and development capacity for drought resilience (e.g., drought forecasting)
- Community involvement in water conservation and sustainable land management practices

3. Adaptive capacity to landslides

- Availability of landslide risk monitoring systems (e.g., early warning systems, land movement sensors)
- Strength of building codes and regulations for construction in landslide-prone areas
- Government disaster response planning and land-use planning for vulnerable areas
- Public education and awareness about landslide risks and prevention measures
- Reforestation and soil conservation programs to stabilize slopes
- Access to financial resources for disaster preparedness and reconstruction
- Community capacity to implement landslide mitigation measures (e.g., drainage systems, terracing)
- Availability of technical expertise for landslide risk assessment and mitigation

4. Adaptive capacity to storms

- Early warning systems and preparedness plans for storm events
- Quality of storm-resistant infrastructure (e.g., reinforced buildings, flood-proof roads)
- Availability of emergency relief resources (e.g., shelters, food, medical supplies)
- Government policies and regulations to reduce storm vulnerability (e.g., zoning laws, infrastructure standards)
- Community participation in storm resilience programs and training
- Access to insurance and financial assistance for storm recovery
- Public education and awareness of storm risks and safety measures
- Access to alternative livelihood options during storm damage recovery (e.g., financial aid, diverse industries)

b) Creating hazard index, exposure index, vulnerability index, and risk index

Creating a hazard index**,** exposure index**,** vulnerability index, and risk index involves a systematic approach to understanding and quantifying the potential impacts of climate hazards, how exposed systems are to those hazards, and the inherent vulnerabilities that determine their susceptibility. Below is a general framework for creating each of these indices.

Normalization:

Prior to creating indices, it is necessary to normalize all data (representing various indicators) to the same standard. The normalization formular in this manual follows statistical normalization (Jolliffe, 2002; Sheskin, 2011):

$$x_i = \frac{X_i - Min\{X_i\}}{Max\{X_i\} - Min\{X_i\}} \times 100 \qquad \text{Eq. (1)}$$

1. Hazard Index

The hazard index quantifies the frequency, magnitude, and severity of climate hazards (e.g., floods, droughts, landslides, and storms). This index focuses on the occurrence of extreme climate events.

- Indicators: Frequency of occurrence, intensity, and duration of hazard events in a specific area (village, district, or province)
- Calculation Method:
  - Normalize all data using the formula representing in Eq. (1).
  - Combine the normalized variables by using weighted average as presented in Eq. (2).
  - Assign a score based on the intensity, frequency, and magnitude of past events (e.g., 1 to 5, where 1 represents low intensity and 5 represents high intensity).

$$\text{Hazard Index} = \sum \text{w}_\text{i} \times \text{normalized hazard indicators} \qquad \text{Eq. (2)}$$

Where:

w_i: is the weight of each hazard indicators (which $\sum w_i = 1$)

2. Exposure Index

The exposure index measures the degree to which people, infrastructure, or ecosystems are exposed to climate hazards. It reflects the extent of the system or community that is vulnerable to these hazards.

- Indicators: Population density, infrastructure quality, proximity to hazard-prone areas, land use, and critical assets (e.g., agricultural land, health facilities, water sources).
- Calculation Method:
  - Normalize all data using the formula representing in Eq. (1).
  - Combine the normalized variables by using weighted average as presented in Eq. (3).
  - Assign a score based on the intensity, frequency, and magnitude of past events (e.g., 1 to 5, where 1 represents low intensity and 5 represents high intensity).

$$\text{Exposure Index} = \sum w_i \times \text{normalize exposure indicators} \quad \text{Eq. (3)}$$

Where:

w_i: is the weight of each exposure indicators (which $\sum w_i = 1$)

3. Vulnerability Index

The vulnerability index measures the susceptibility of a system to harm from climate hazards, based on its sensitivity and adaptive capacity.

- Indicators: Social resilience, poverty levels, adaptive capacity (e.g., governance, infrastructure resilience, economic resources), and ecosystem health
- The calculation of Vulnerability Index takes into account the Sensitivity Index and Adaptive Capacity Index

$$\text{Vulnerability Index} = \text{Sensitivity Index} - \text{Adaptive Capacity Index} \quad \text{Eq. (4)}$$

Sensitivity Index

The sensitivity index is often used to evaluate how vulnerable a system (e.g., an ecosystem, infrastructure, or economy) is to climate-related changes or hazards.

- Indicators: Social resilience, poverty levels
- Calculation Method:

- Normalize all data using the formula representing in Eq. (1).
- Combine the normalized variables by using weighted average as presented in Eq. (5).
- Assign a score based on the intensity, frequency, and magnitude of past events (e.g., 1 to 5, where 1 represents low intensity and 5 represents high intensity).

$$\text{Exposure Index} = \sum w_i \times \text{normalize exposure indicators} \quad \text{Eq. (5)}$$

Where:

w_i: is the weight of each exposure indicators (which $\sum w_i = 1$)

Adaptive Capacity Index

An Adaptive Capacity Index is a measure used to evaluate the ability of a system, community, or ecosystem to adjust to climate change impacts, cope with the consequences, and recover from climate-induced stressors. It helps identify areas that have the resources, capabilities, and strategies to manage and respond effectively to climate risks

- Indicators: Adaptive capacity (e.g., governance, infrastructure resilience, economic resources), and ecosystem health
- Calculation Method:
  - Normalize all data using the formula representing in Eq. (1).
  - Combine the normalized variables by using weighted average as presented in Eq. (6).
  - Assign a score based on the intensity, frequency, and magnitude of past events (e.g., 1 to 5, where 1 represents low intensity and 5 represents high intensity).

$$\text{Exposure Index} = \sum w_i \times \text{normalize exposure indicators} \quad \text{Eq. (6)}$$

Where:

w_i: is the weight of each exposure indicators (which $\sum w_i = 1$)

4. Risk Index

The risk index combines the hazard, exposure, and vulnerability indices to assess the overall climate risk faced by a system or community. It represents the potential for damage or harm from climate change impacts.

- Indicators: Hazard, exposure, and vulnerability scores.
- Calculation Method: Average between the hazard index, the exposure index, and the vulnerability index (See Eq. (7)).
- Interpret the averaged value using the score range in Table XX
- Higher scores represent areas or systems with higher risk, requiring more urgent attention and adaptation measures.

$$Risk\ Index = \frac{1}{3}(Hazard\ Index) + \frac{1}{3}(Exposure\ Index) + \frac{1}{3}(Vulnerability\ Index)$$

Table 6 Score range for Risk Index

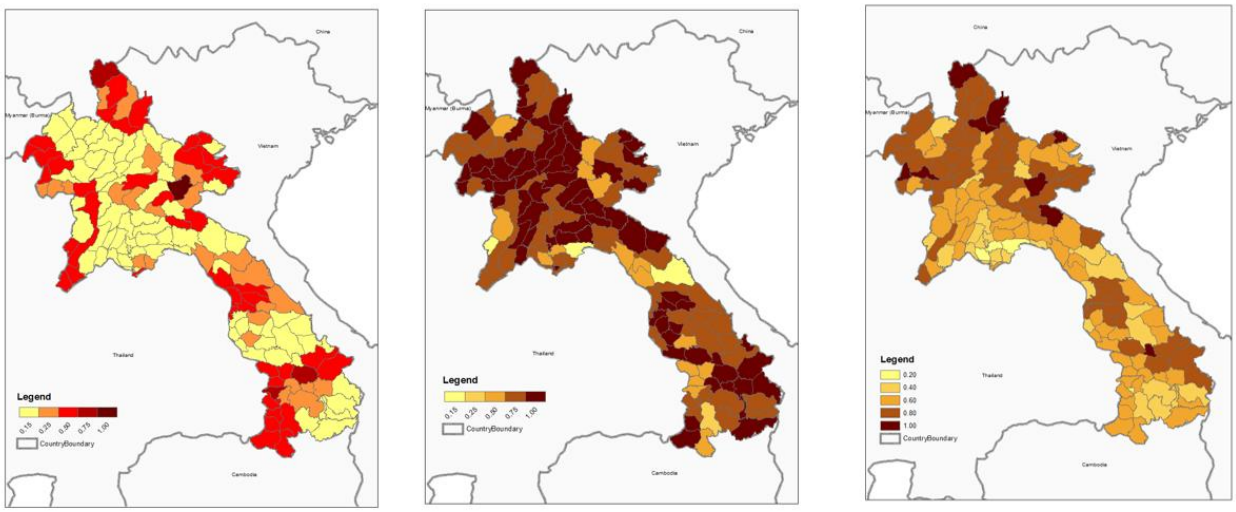
Score range for Risk Index	Level	Meaning
4.21 – 5.00	5	Very high risk
3.41 – 4.20	4	high
2.61 – 3.40	3	moderate
1.81– 2.60	2	low
1.00 – 1.80	1	negligible

c) Developing hazard map, exposure map, vulnerability map, and climate risk map

After creating the Hazard Index, Exposure Index, Vulnerability Index, and Risk Index, the score representing level of impacts can be translated into color code (See Table 7) for each specific area and put in the map to generate hazard map, exposure map, vulnerability map, and climate risk map. See Figure 20 and 21 as examples.

Table 7 Score range for Risk Index

Level	Meaning	Color representing level of risk
5	Very high risk	
4	high	
3	moderate	
2	low	
1	negligible	



Hazard Exposure Vulnerability

Figure 20 Hazard map, exposure map, and vulnerability map

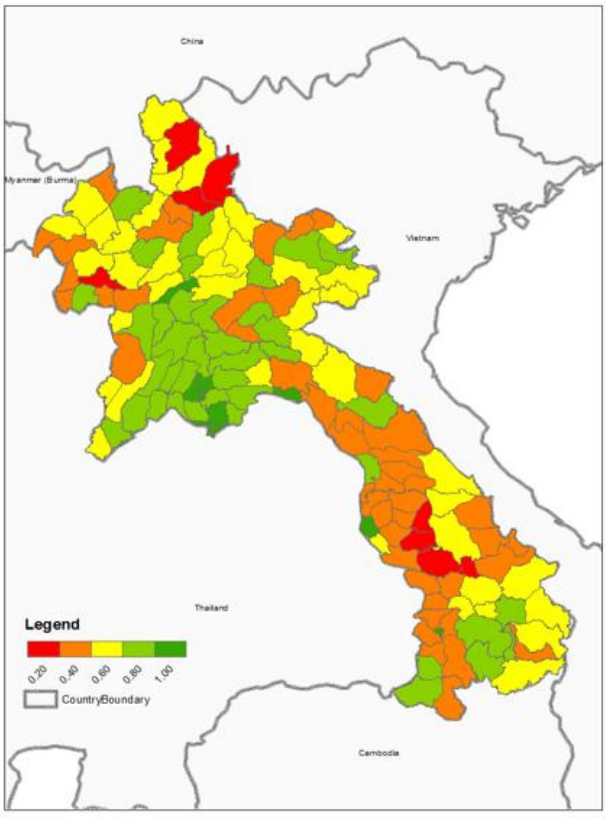


Figure 21 Risk and vulnerability map

2.2.3 Chapter 3: Climate projection

The aim of this chapter is to familiarize participants with climate projections, which are crucial tools for anticipating future climate conditions and informing long-term adaptation planning. Climate projections are forecasts based on different greenhouse gas emission scenarios, using climate models to estimate future climatic conditions. These projections help decision-makers understand potential changes in temperature, precipitation, and extreme weather events, such as floods and droughts, enabling them to plan accordingly. It is important to emphasize that while predictions can offer specific outcomes, projections focus on a range of possible future conditions under various scenarios, thus offering flexibility in planning for future uncertainties.

a) Introduction to The World Bank's Climate Change Knowledge Portal (CCKP)

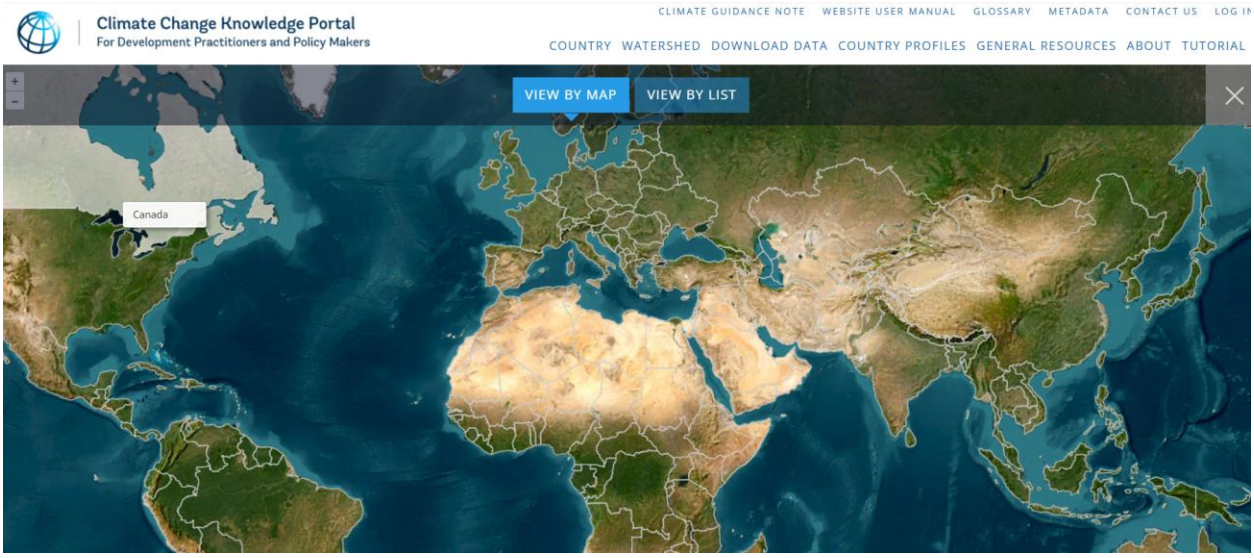
The World Bank's Climate Change Knowledge Portal is an essential online platform that provides climate data, analysis, and tools to help governments, businesses, and individuals understand and respond to the challenges posed by climate change. The portal offers access to a wide range of climate projections, historical data, and future scenarios, which can be used for climate risk assessments and adaptation planning.

The portal serves as a valuable resource for users seeking to access high-quality climate data, especially for regions such as Southeast Asia, including Laos. It provides information on climate trends, extreme weather events, and projected climate changes, including changes in temperature, precipitation, and other variables over various timeframes. These projections are based on different greenhouse gas emission scenarios, enabling users to explore various possible futures depending on global emission trajectories.

Through the Climate Knowledge Portal, users can download datasets, explore visualizations, and conduct in-depth analyses of climate risks in their region. These insights can be used for developing climate resilience strategies, integrating climate change considerations into development planning, and informing policy-making to enhance climate adaptation efforts.

b) Entering the portal

To get started, go to the homepage of the CCKP at climateknowledgeportal.worldbank.org. From there, you can explore the interactive data visualization pages by selecting a view that interests you, such as a specific country or watershed. Additionally, you can directly access the Download Data, Climate Risk Country Profiles, General Resources, and Tutorial tabs.



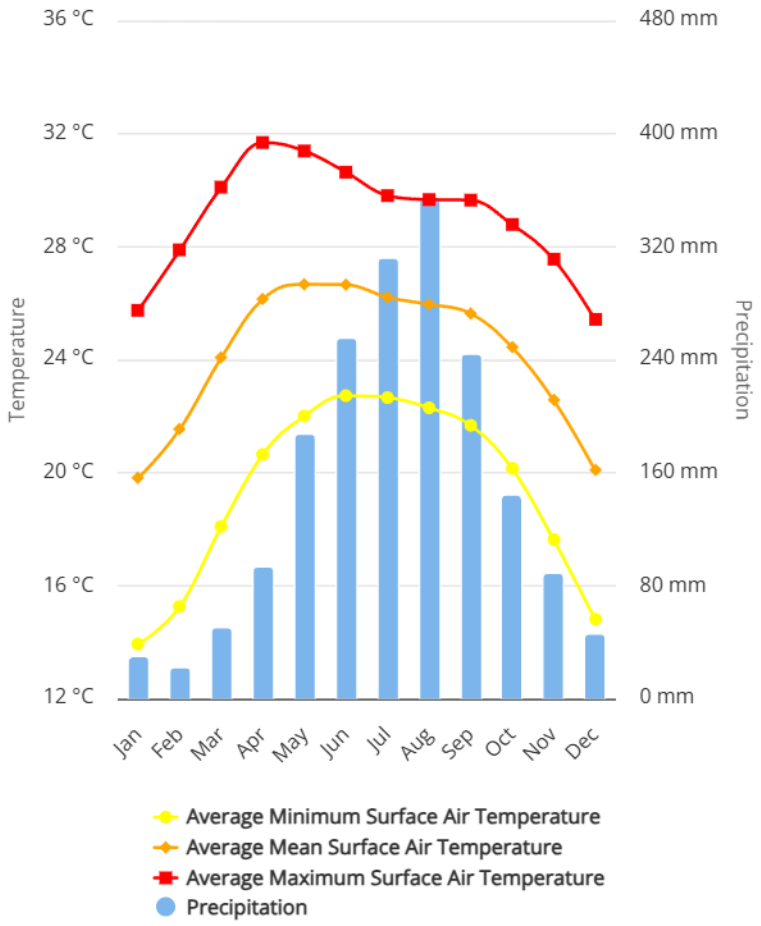
c) Select a country (Lao PDR)

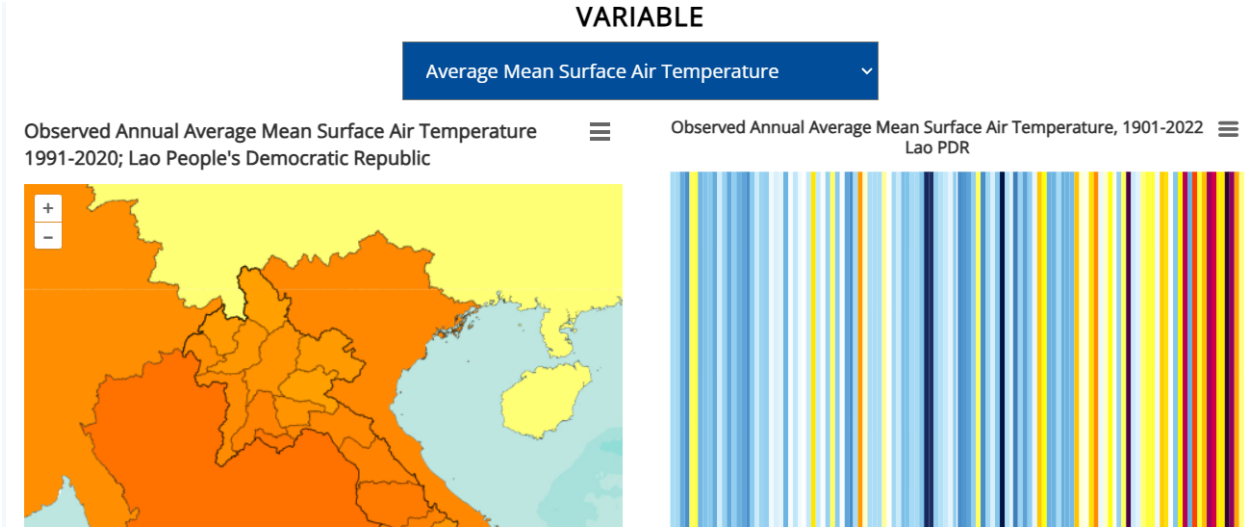
To select a specific country or watershed, click directly on the map or select view by the alphabetized list

d) Climate change overview

This page presents high-level information for Lao PDR's climate zones and its seasonal cycle for mean temperature and precipitation for the latest climatology, 1991-2020. Climate zone classifications are derived from the Köppen-Geiger climate classification system, which divides climates into five main climate groups divided based on seasonal precipitation and temperature patterns. The five main groups are A (tropical), B (dry), C (temperate), D (continental), and E (polar). All climates except for those in the E group are assigned a seasonal precipitation sub-

group (second letter). Climate classifications are identified by hovering your mouse over the legend. A narrative overview of Lao PDR's country context and climate is provided following the visualizations.



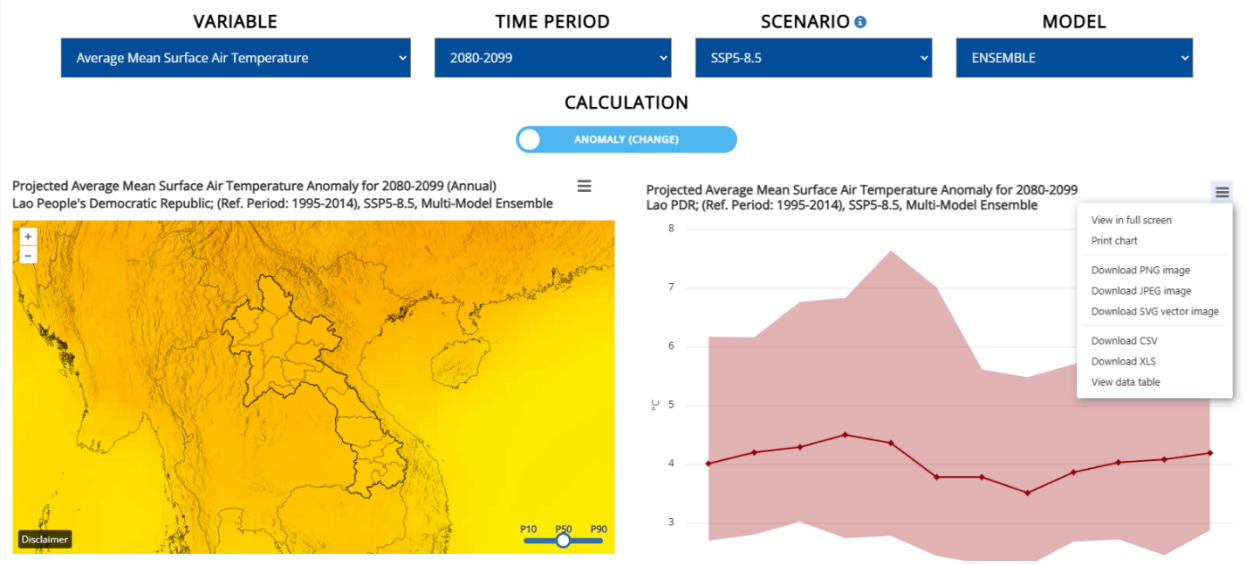


e) Climate projection

This page provides projected climate data for Lao PDR. The "Mean Projections" section offers a comprehensive set of indicators from the CCKP, allowing for an in-depth analysis of future climate scenarios and potential risks due to climate change. The data can be explored as either projected means or anomalies (changes), and is presented spatially in various formats, including seasonal cycles, time series, or heat plots, which illustrate seasonal variations over long-term periods. You can analyze the data on an annual, seasonal, or monthly basis and further refine your analysis by selecting different time periods and Shared Socioeconomic Pathways (SSPs). SSPs offer insights into future climates based on defined emissions, mitigation efforts, and development pathways.

The indicators are presented as a multi-model ensemble, which reflects the range and distribution of the most likely projected climate outcomes for a given SSP. Individual model data will be available soon.

The climate projection data is derived from global climate models compiled in the Coupled Model Inter-comparison Projects (CMIPs), managed by the World Climate Research Program. The data presented here comes from CMIP6, which supports the IPCC's Sixth Assessment Report. This data is available at a resolution of 0.25º x 0.25º (25km x 25km).



Temperatures

Projected Maximum of Daily Max Temperatures, by season - This represents the projected average single-day maximum value of the daily maximum temperatures over the data aggregation period, shown below by season. It is necessary in understanding heat risks and needs for the hottest part of the day and gives insight into extreme heat conditions. The identified sub-national units with the highest and lowest values reflect the projected time period, 2040-2059.

Units:°C	2020-2039				2040-2059				2060-2079				2080-2099			
Scenario	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
SSP1-1.9	34.31 (33.16, 35.39)	36.87 (35.84, 38.02)	34.53 (33.26, 36.15)	33.09 (32.31, 34.07)	34.64 (33.33, 35.78)	37.18 (36.13, 38.23)	34.71 (33.47, 36.46)	33.3 (32.45, 34.28)	34.55 (33.31, 35.72)	37.14 (36.09, 38.2)	34.61 (33.4, 36.11)	33.22 (32.41, 34.16)	34.39 (33.23, 35.55)	37 (35.99, 38.05)	34.41 (33.24, 35.89)	33.1 (32.29, 34.06)
SSP1-2.6	34.58 (33.49, 35.51)	37.01 (36.05, 38.26)	34.81 (33.47, 36.58)	33.34 (32.44, 34.48)	35.05 (33.66, 36.16)	37.44 (36.32, 38.64)	34.96 (33.57, 36.64)	33.52 (32.63, 34.51)	35.36 (33.79, 36.57)	37.78 (36.42, 39.05)	35.47 (33.77, 37.55)	33.81 (32.72, 35.05)	35.05 (33.68, 36.53)	37.62 (36.35, 39.13)	35.31 (33.39, 38.03)	33.71 (32.57, 35.17)
SSP2-4.5	34.32 (33.19, 35.28)	37.05 (35.98, 38.11)	34.66 (33.44, 36.51)	33.11 (32.38, 34.14)	35.15 (33.94, 36.1)	37.63 (36.5, 38.71)	35.5 (33.59, 37.42)	33.84 (32.79, 34.86)	35.72 (34.29, 36.82)	38.27 (36.93, 39.48)	35.97 (34.4, 38.28)	34.23 (33.2, 35.2)	35.89 (34.23, 37.25)	38.71 (37.07, 40.21)	36.39 (34.41, 39)	34.54 (33.33, 35.94)
SSP3-7.0	34.31 (33.01, 35.7)	36.83 (35.73, 38.29)	34.65 (33.13, 36.14)	33.11 (32.29, 34.3)	34.94 (33.09, 36.45)	37.69 (36.35, 39.07)	35.25 (33.89, 38.13)	33.76 (32.7, 35.31)	35.77 (33.4, 37.52)	38.62 (36.94, 40.55)	36.6 (34.48, 39.17)	34.67 (33.24, 36.57)	36.79 (34.82, 38.55)	39.83 (37.68, 42.01)	37.7 (35.28, 40.77)	35.45 (33.78, 37.75)

Precipitation

Projected Change in Seasonal Precipitation as Percentage - Projected percent change in total precipitation for the data aggregation period, shown below by season. This is a useful indicator for contextualizing projected precipitation anomalies, or changes. Percent change should be compared with precipitation anomalies to understand absolute values of precipitation (mm) to gain a more complete understanding of projected changes in precipitation dynamics. The identified sub-national units with the highest and lowest values reflect the projected time period, 2040-2059.

Units:%	2020-2039				2040-2059				2060-2079				2080-2099			
Scenario	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON	DJF	MAM	JJA	SON
SSP1-1.9	97.63 (66.24, 141.23)	98.82 (82.37, 115.18)	99.19 (87.94, 111.7)	103.43 (82.72, 125.37)	97.47 (69.74, 136.04)	99.57 (84.6, 114.75)	100.8 (89.96, 113.16)	105.01 (84.88, 128.3)	98.89 (74.21, 136.05)	101.91 (87.85, 116.26)	101.52 (91.47, 113.09)	104.82 (87.45, 126.58)	98.6 (75.55, 134.22)	102.33 (89.49, 116.48)	101.67 (91.88, 112.95)	104.86 (88.21, 125.83)
SSP1-2.6	100.35 (65.84, 144.81)	99.75 (80.76, 116.46)	99.67 (88.65, 113.17)	101.1 (80.93, 124.18)	97.21 (66.05, 147.2)	103.15 (85.48, 119.98)	101.26 (90.13, 114.2)	103.81 (80.79, 132.45)	106.67 (71.18, 155.89)	104.18 (84.88, 122.98)	102.94 (90.75, 116.45)	108.42 (85.15, 138.41)	105.13 (72.16, 155.03)	103.5 (85.33, 123.47)	102.73 (90.15, 116.85)	109.59 (85.88, 137.84)
SSP2-4.5	94.07 (67.25, 138.41)	98.66 (81.68, 115.67)	99.22 (88.69, 111.6)	103.61 (82.94, 124.96)	94.52 (62.87, 142.19)	97.66 (80.75, 114.8)	102.09 (90.02, 115.28)	107.47 (83.06, 132.97)	96.18 (66.92, 148.2)	98.51 (81.4, 117.19)	102.84 (89.8, 119.44)	105.78 (81.99, 134.36)	101.57 (68.67, 149.02)	99.3 (78.39, 121.74)	103.28 (88.29, 121.26)	109.22 (83.44, 140.14)
SSP3-7.0	91.16 (57.76, 142.6)	95.35 (77.04, 114.33)	96.95 (84.14, 111.63)	101.26 (76.76, 125.61)	91.42 (60.83, 131.7)	90.92 (70.89, 110.25)	98.09 (83.1, 115.87)	103.42 (77.72, 130.67)	91.89 (62.47, 133.66)	89.21 (67.48, 112.61)	97.75 (81.77, 118.36)	103.54 (80.47, 134.54)	92.61 (60.24, 143.64)	88.97 (67.89, 114.46)	100.73 (79.48, 124.95)	106.66 (78.14, 145.2)

Overall, the World Bank's Climate Knowledge Portal is a key tool for those working on climate change adaptation, providing essential data to support informed decision-making and actions that reduce vulnerability to climate impacts.

Box 2 Training guide for Module 2: Climate risk and vulnerability assessment

Objective: To disseminate knowledge of climate risk and vulnerability assessment and to ensure that the provincial officers could perform CRVA for their provinces

Training content and methods:

The trainer presents Chapters 1, 2, and 3, allowing participants to ask questions at the end of each chapter. Afterward, the trainer asks participants to work in groups to calculate hazard, exposure, vulnerability, and risk indices and develop maps for their respective districts or provinces (using the form in the Appendix M2).

Content	Methods
Presentation: Chapter 1: Climate risk and vulnerability assessment (CRVA) Chapter 2: Developing disaster risk index and mapping risky areas Chapter 3: Climate projection	- The trainer gives presentation relevant to the content of chapter 1, chapter 2, and chapter 3. - Q&A following the presentation of each chapter.
Group work 1: - Gathering district-level data relating to hazards, exposure, vulnerability, and adaptive capacity. - Calculating risk index - Producing provincial risk map - Presenting their risk map to others.	- Representatives from each province work in group to gather district-level data relating to hazards, exposure, vulnerability, and adaptive capacity in Excel sheet. - Each group learn how to calculate risk index from their gather data in Excel sheet. - Each group produces their provincial risk map. - Each group present the results of their risk map.
Group work 2: Downloading climate projection data of each province	Each provincial group practice downloading climate projection data from Climate Portal of the World Bank

2.3 Module 3: Climate change adaptation

2.3.1 Chapter 1: Reviewing and verifying disaster risk profile and disaster risk maps

This chapter focuses on the essential task of reviewing and verifying the disaster risk profile and corresponding disaster risk maps of provinces to ensure the accurate representation of the risks and vulnerabilities that communities face. The process involves a thorough analysis of existing risk assessments, which includes understanding the various disaster scenarios, identifying potential hazards, and evaluating the impacts on different sectors and populations. Here's a detailed breakdown of the key activities:

a) Reviewing Disaster Risk Profile and Disaster Risk Maps of Provinces

- Assess Existing Risk Profiles: The first step in the process is to review the current disaster risk profiles for each province. This involves analyzing the available data on natural hazards such as floods, droughts, storms, and landslides, and understanding their historical occurrence, frequency, and severity.
- Examine Hazard-Specific Data: Evaluate the hazard-specific data available for each province to ensure that the information is up-to-date and reflective of the most recent disaster events and trends. This might include reviewing historical records of hazards, impacts on local populations, and previous risk assessments conducted at the national or provincial level.
- Sectoral Risks: Ensure that the disaster risk profile covers all relevant sectors, such as agriculture, infrastructure, health, water resources, and human settlements, to understand how each sector is vulnerable to different hazards.
- Integrating Vulnerability Data: Cross-reference the disaster risk profile with data on the vulnerability of various populations, including marginalized groups, and their exposure to potential hazards. This helps in understanding the broader picture of disaster risk in each province.
- Interpreting Risk Maps: Interpreting the disaster risk maps to assess their accuracy and relevance. Risk maps provide visual representations of hazard zones, vulnerable areas, and key infrastructure at risk. Ensure that they include updated information on population distribution, critical infrastructure, and natural features that can influence the spread or mitigation of hazards.

b) Verifying Disaster Risk Profile and Disaster Risk Maps of Provinces and Relevant Sectors

- Cross-check with Local Authorities and Stakeholders: Collaborate with local authorities, provincial government officials, sector experts, and other stakeholders to verify the disaster risk profiles and maps. Local knowledge is vital for ensuring the accuracy of the risk data, especially for less-documented or emerging risks. Engaging with experts from various sectors (e.g., agriculture, water, health) ensures that the data is relevant and applicable to the specific conditions in each province.

- Identify Data Gaps and Update Information: During the verification process, identify any gaps in the available data or inconsistencies between the profile and maps. Update the risk profiles and maps to reflect new information, such as recent climate change projections or updated vulnerability assessments.
- Field Validation: Where possible, conduct field assessments to validate the information on the ground. This could include site visits to affected areas, consultations with local communities, and interviews with disaster response agencies to assess the accuracy of previous assessments.
- Cross-Sectoral Risk Assessment: Examine how different sectors are interconnected and affected by disaster risks. For example, the impact of flooding on agriculture, infrastructure, and health services can be assessed in a combined manner to understand the cascading effects of a single disaster event. Verifying this aspect ensures that no sector or vulnerability is overlooked in the risk profile and maps.
- Assess Adaptation and Mitigation Efforts: While verifying disaster risk profiles and maps, also assess the effectiveness of previous adaptation and mitigation measures in reducing disaster risk. This can help identify strengths and areas where further efforts are needed to improve resilience.

2.3.2 Chapter 2: Reviewing adaptation measures and plans of provinces

This chapter focuses on the critical process of reviewing the adaptation measures and plans that each province has developed to address climate change impacts. The objective is to evaluate the effectiveness, relevance, and comprehensiveness of existing adaptation strategies, ensuring they align with the needs of vulnerable sectors and communities while identifying gaps and areas for improvement. This process will help identify opportunities for strengthening adaptation efforts and ensure that provinces are better equipped to manage future climate risks.

a) Reviewing Adaptation Measures of Each Province

- Assessment of Existing Adaptation Measures: The first step in this process is to systematically review the adaptation measures that have already been implemented by each province. This includes evaluating the specific actions taken to address climate-related risks such as flooding, drought, storms, and temperature rise. The review will assess whether these measures are effectively reducing vulnerability and improving resilience at the provincial level.
- Sector-Specific Measures: Adaptation measures often vary by sector, so it is essential to examine how different sectors such as agriculture, water resources, infrastructure, and health are integrating climate adaptation. For example, drought-resistant crops or improved irrigation systems might be key measures for agriculture, while flood defense infrastructure and early warning systems may be central for reducing risks from floods.
- Evaluating the Implementation of Nature-Based Solutions: Nature-based solutions, such as reforestation, wetland restoration, and the conservation of ecosystems, have gained attention for their ability to build resilience to climate change while providing co-benefits for biodiversity and human well-being. The review should examine how these solutions are being incorporated into adaptation efforts in each province.

- Engagement with Local Communities: Adaptation measures are often more successful when they are developed in collaboration with local communities. The review should assess how community involvement is being integrated into the design and implementation of adaptation measures. This includes evaluating participatory approaches, local knowledge, and feedback mechanisms.
- Monitoring and Evaluation (M&E) of Adaptation Measures: Effective adaptation measures require robust monitoring and evaluation to assess progress and effectiveness. The review should identify whether provinces have established mechanisms for tracking the outcomes of adaptation initiatives, identifying challenges, and making adjustments when necessary.

b) Reviewing Adaptation Plans and Policies of Each Province

- Evaluating Adaptation Plans: The next critical step is to review the adaptation plans developed by each province. These plans should outline the province's long-term strategy for adapting to climate change, detailing specific actions, timelines, budgets, and responsibilities. The review will assess whether these plans are comprehensive, evidence-based, and aligned with national and international climate change policies and frameworks.
- Alignment with National and Global Policies: It is essential to assess how well provincial adaptation plans align with national climate change strategies, such as the National Adaptation Plan (NAP), and international frameworks, including the Paris Agreement. The review should ensure that the adaptation plans reflect a coordinated approach that integrates both local and global climate change priorities.
- Policy Integration: Effective adaptation requires the integration of climate considerations across all sectors of development. The review will evaluate whether the provincial adaptation plans incorporate climate adaptation into broader policy areas, such as urban planning, infrastructure development, and disaster risk management. This includes examining whether climate adaptation is embedded in sectoral policies and if it aligns with sustainable development goals (SDGs).
- Financial and Institutional Support: The success of adaptation plans depends largely on adequate financial resources and institutional capacity. The review will analyze whether each province has identified sources of funding (e.g., government budgets, climate finance, international assistance) to implement their adaptation strategies. It will also assess the institutional arrangements in place to manage and oversee adaptation efforts, ensuring that provincial governments, local authorities, and other stakeholders have the capacity to carry out the plans effectively.
- Stakeholder Involvement: An essential aspect of adaptation planning is the involvement of a broad range of stakeholders, including government agencies, private sector actors, NGOs, and local communities. The review should assess how inclusive the planning process has been, ensuring that all relevant stakeholders have been engaged in the development and implementation of adaptation strategies.
- Risk Assessment and Prioritization: Adaptation planning requires understanding the risks and vulnerabilities that each province faces. The review should examine how adaptation plans incorporate comprehensive risk assessments and prioritize actions based on the level of risk, cost-effectiveness, and potential benefits. This may involve identifying

"low-hanging fruit" solutions that can be implemented quickly and more costly, long-term projects that require substantial investment.

c) Identifying Gaps and Opportunities for Improvement

- Gap Analysis: As part of the review, it is essential to identify any gaps in the current adaptation measures and plans. These could include missing actions, insufficient resources, or areas where existing measures are inadequate to address the full spectrum of climate risks. The review will also identify gaps in knowledge, data, or capacity that may hinder effective adaptation planning.
- Recommendations for Strengthening Adaptation Plans: Based on the review, recommendations will be provided to enhance the effectiveness and comprehensiveness of the adaptation measures and plans. These may include suggestions for improving coordination, increasing stakeholder engagement, updating risk assessments, and securing additional funding. Furthermore, the review will propose ways to integrate emerging climate risks and new scientific findings into adaptation strategies.
- Enhancing Policy Coherence and Synergy: The review will explore ways to improve policy coherence and synergy across different levels of governance and sectors. This may involve recommending stronger alignment between provincial and national policies, ensuring that adaptation strategies are implemented in a manner that maximizes benefits and minimizes contradictions.

2.3.3 Chapter 3: Climate change adaptation

Chapter 3 focuses on the critical process of identifying, prioritizing, and developing climate change adaptation strategies tailored to the unique needs and vulnerabilities of each province. This chapter emphasizes the integration of ecosystem-based approaches into adaptation planning, considering the role of natural resources, land use, and local ecosystems in building resilience against climate impacts. By systematically evaluating different adaptation options, applying multicriteria analysis, and developing actionable plans, this chapter aims to provide provinces with effective tools and strategies for addressing climate change risks and improving long-term sustainability.

a) Reviewing Natural Resource Management and Land Use Plans of Each Province

- Assessing Current Natural Resource Management Practices: The first step in this process is to review the existing natural resource management (NRM) practices in each province. This includes evaluating how forests, water resources, agricultural land, and other natural assets are being managed to ensure sustainability in the face of climate change. Special attention should be given to the integration of climate change considerations into NRM strategies.
- Examining Land Use Plans: A thorough review of each province's land use plan is essential to understanding how land resources are allocated, zoned, and managed for various uses, such as agriculture, urban development, and conservation. The review will

assess whether these plans incorporate climate resilience principles, such as sustainable land management practices, the prevention of land degradation, and the integration of climate risk reduction strategies.

- Identifying Vulnerable Areas and Resources: As part of the review, vulnerable areas—such as floodplains, drought-prone regions, and areas at risk of desertification—will be identified. These areas may require more focused adaptation efforts to preserve critical resources and maintain ecosystem services that are crucial for local communities.

b) Identifying Adaptation Options (with Special Emphasis on Ecosystem-Based Adaptation)

- Exploring Various Adaptation Options: Once the vulnerabilities and resource management strategies are reviewed, the next step is to identify potential adaptation options. These options may range from engineering solutions (e.g., building flood defenses) to nature-based solutions (e.g., restoring wetlands to reduce flood risk). Adaptation options must be context-specific and tailored to the unique challenges faced by each province.
- Focusing on Ecosystem-Based Adaptation (EbA): Ecosystem-based adaptation emphasizes the use of biodiversity and ecosystem services to reduce climate risks. This could include reforestation, wetland restoration, sustainable forest management, and the conservation of key ecosystems such as mangroves, forests, and watersheds. EbA provides multiple benefits, including enhancing biodiversity, protecting water sources, improving soil fertility, and reducing the impacts of extreme weather events. This approach will be prioritized, as it aligns with both climate change mitigation and long-term resilience-building.
- Climate-Smart Agriculture: A critical component of adaptation options is the incorporation of climate-smart agricultural practices, such as crop diversification, soil conservation techniques, improved irrigation methods, and the use of drought-resistant or flood-resistant crops. These practices help farmers adapt to changing climate conditions while maintaining food security.
- Infrastructure Adaptation: In addition to natural resource management and agricultural adaptation, infrastructure resilience will be a key focus. Identifying adaptation options for critical infrastructure—such as roads, bridges, water supply systems, and health facilities—will ensure that these systems can withstand climate change impacts, including extreme weather events, rising sea levels, and temperature fluctuations.

c) Applying Multicriteria Analysis to Prioritize and Choose the Most Suitable Options

- Understanding Multicriteria Analysis (MCA): Multicriteria analysis is a decision-support tool used to evaluate and prioritize adaptation options based on multiple criteria. These criteria may include factors such as cost-effectiveness, feasibility, environmental impact, social benefits, and alignment with local priorities. The MCA process helps decision-makers compare different adaptation options and select the most suitable solutions for each province.

- Establishing Evaluation Criteria: The first step in the MCA process is to establish clear criteria for evaluating adaptation options. These may include technical feasibility, economic costs, environmental sustainability, equity considerations, and long-term impacts on resilience. The criteria should reflect both the local context and broader national and global climate goals.
- Evaluating Adaptation Options: Once the criteria are defined, the different adaptation options identified in the previous step are assessed against these criteria. This involves gathering data, consulting stakeholders, and using qualitative and quantitative methods to score and rank the options. The MCA process will provide a transparent, evidence-based approach to prioritizing adaptation measures.
- Balancing Trade-offs: In many cases, there will be trade-offs between different adaptation options. For example, one option might be highly effective in reducing flood risk but could have significant environmental or social costs. MCA helps to balance these trade-offs and choose options that provide the best overall benefits to the province.

d) Developing Adaptation Measures and Plans

- Designing Specific Adaptation Measures: Based on the results of the MCA, specific adaptation measures are developed for each province. These measures should be practical, scalable, and tailored to the unique needs and vulnerabilities of the region. They may include the implementation of nature-based solutions, infrastructure improvements, policy adjustments, or community-based actions.
- Creating Action Plans: Adaptation measures are then incorporated into detailed action plans that outline how the measures will be implemented, who will be responsible, and the timeline and resources required for each measure. The action plans should also identify indicators and mechanisms for monitoring progress and ensuring that adaptation efforts are on track.
- Engaging Stakeholders in Plan Development: It is essential that the development of adaptation measures and plans involves all relevant stakeholders, including local communities, government agencies, NGOs, the private sector, and other groups. Stakeholder consultations should be held at various stages of the planning process to ensure that the plans reflect local knowledge, needs, and priorities.
- Integrating Adaptation into Long-Term Development Plans: Adaptation measures should be integrated into broader development plans, ensuring that they contribute to sustainable development goals (SDGs) and complement other sectors such as health, education, energy, and economic development. This integration will ensure that climate adaptation becomes part of the province's long-term growth strategy

Box 3 Training guide for Module 3: Climate change adaptation

Objective: To ensure that the participants equipped with a strong understanding of climate change adaptation, enabling them to apply it into their work.

Training content and methods:

The trainer presents Chapters 1, 2, and 3, allowing participants to ask questions at the end of each chapter. Afterward, the trainer asks participants to work in groups to determine adaptation measures options (using the form in the Appendix M3).

Content	Methods
Presentation: Chapter 1: Reviewing and verifying disaster risk profile and disaster risk maps Chapter 2: Reviewing adaptation measures and plan of provinces Chapter 3: Climate change adaptation (with the emphasis on EbA)	- The trainer gives presentation relevant to the content of chapter 1, chapter 2, and chapter 3. - Q&A following the presentation of each chapter.
Group work: - Review provincial risk profile and risk map. - Gather existing adaptation options. - Considering EbA adaptation options. - Applying Multi-Criteria Analysis (MCA) to should the most suitable option. - Presenting the group work.	- Representatives from each province work in group to review provincial risk profile and risk map. - Each group gather existing adaptation options in their province. - Each group make a list of adaptation options including the existing ones and the EbA options. - Each group learn to apply MCA to decide the most suitable option of their province. - Each group present their work.

2.4 Module 4: Training on integrating climate change and adaptation into policies, strategies, and plans

2.4.1 Chapter 1: Reviewing Risk Profile and Existing Strategies, Plans, and Policies

Chapter 1 focuses on a comprehensive review of the disaster risk profile and the existing strategies, plans, and policies that address climate change impacts and disaster risk management. This review is essential for identifying the current strengths, weaknesses, and gaps in the current systems and approaches. By conducting a situational analysis and evaluating existing disaster risk profiles, maps, and policies, this chapter sets the foundation for developing more effective and targeted climate change adaptation strategies.

a) Situational Analysis

- Understanding Local Context and Challenges: The situational analysis begins by examining the local context in which climate risks and vulnerabilities are situated. This involves identifying the socio-economic conditions, environmental characteristics, and existing vulnerabilities of the region. Factors such as population density, urbanization trends, agricultural dependence, infrastructure resilience, and public health issues are all considered to understand the full scope of potential climate impacts.
- Analyzing Key Vulnerabilities: This part of the analysis identifies the key sectors and areas that are most vulnerable to climate change. This includes understanding how climate risks such as extreme weather events, temperature changes, flooding, and droughts affect agriculture, water resources, infrastructure, human health, and ecosystems. By identifying these vulnerabilities, the analysis provides a basis for determining where adaptation measures will be most effective.
- Stakeholder Mapping: Identifying key stakeholders, including government agencies, local authorities, civil society organizations, and the private sector, is also an important component of situational analysis. Understanding their roles, capacities, and influence will help ensure that all relevant parties are involved in the adaptation planning process.
- Assessment of Current Capacities: An important part of the situational analysis is to assess the current institutional, technical, and financial capacities of stakeholders involved in disaster risk management and climate adaptation. This includes evaluating the effectiveness of local governance structures, resource availability, and the level of knowledge and skills within different sectors related to climate adaptation.

b) Reviewing Disaster Risk Profile and Disaster Risk Maps

- Disaster Risk Profile: This step involves reviewing the disaster risk profile of the province, which includes a detailed assessment of the types, frequency, and intensity of disasters that are most likely to affect the area. The risk profile should outline the historical and projected impacts of disasters, including floods, storms, landslides, droughts, and other extreme weather events. It should also highlight the distribution of risk, specifying which regions, sectors, and communities are most vulnerable.

- Disaster Risk Maps: An integral part of disaster risk management is the use of disaster risk maps. These maps provide a visual representation of the areas most exposed to various hazards, such as flooding, landslides, and storms. By reviewing existing disaster risk maps, it becomes possible to identify areas that are at high risk and where early warning systems and emergency preparedness measures are needed. These maps should be updated regularly to reflect the changing nature of disaster risks due to climate change.
- Historical Data Analysis: The review of historical data on past disasters is crucial for understanding the frequency and severity of past events. This analysis helps to identify patterns and trends that can inform future risk assessments and adaptation strategies. Information about past losses in terms of lives, livelihoods, and infrastructure can provide critical insights for improving future resilience.
- Climate Hazard Mapping: In addition to disaster risk maps, climate hazard maps help identify areas prone to climate change-induced hazards such as temperature rise, sea-level rise, and changes in precipitation patterns. These maps can be used in conjunction with disaster risk maps to assess potential future risks under different climate scenarios.

c) Reviewing Existing Strategies, Plans, and Policies

- Assessment of Current Strategies: This section involves a thorough review of the existing climate change adaptation strategies and disaster risk reduction (DRR) plans in place. It aims to identify how well these strategies address the current and anticipated risks associated with climate change. Special attention is given to how the existing strategies incorporate principles of resilience, disaster risk reduction, and long-term sustainability.
- Policy and Regulatory Framework: Existing policies and regulations related to climate change adaptation, disaster risk management, land use planning, and natural resource management are reviewed to ensure that they align with national goals and international frameworks. Gaps in policies or contradictions between policies can be identified and addressed to create a more coherent and effective approach to disaster and climate risk management.
- Sectoral Plans: The review also includes analyzing sectoral plans (agriculture, water, health, urban development, etc.) to ensure that these plans are in line with climate resilience objectives. Many sectors are impacted by climate change, and adaptation measures need to be integrated into each sector's planning to ensure a comprehensive and multi-sectoral approach.
- Evaluation of Past Initiatives: Reviewing previous adaptation projects, programs, and disaster risk management interventions helps to evaluate the effectiveness of past efforts. This review identifies lessons learned, including successes and challenges, and provides insight into areas where improvements are needed.
- Aligning with International Frameworks: In this review, it is also important to assess how well existing plans and policies align with international frameworks, such as the Sendai Framework for Disaster Risk Reduction, the Paris Agreement, and the Sustainable Development Goals (SDGs). These global frameworks provide key principles and goals for building resilience to climate change and managing disaster risk, and aligning national policies with them ensures that the country remains on track with international commitments.

2.4.2 Chapter 2: Integrating climate change and adaptation into policies, strategies, and plans

Chapter 2 focuses on the critical process of embedding climate change considerations and adaptation measures into the existing policies, strategies, and development plans across different sectors and provinces. This integration is essential for ensuring that climate risks are adequately addressed and that the long-term resilience of both communities and ecosystems is prioritized. By aligning climate change adaptation with broader development goals, this chapter aims to promote sustainable and climate-resilient growth across the country.

a) Synchronizing Strategies, Plans, and Policies of Sectors and Provinces

- Aligning sectoral goals with climate adaptation objectives: This step involves ensuring that the goals of various sectors, such as agriculture, water resources, energy, health, infrastructure, and urban planning, align with the overarching climate adaptation objectives. By doing so, each sector's plans and actions can contribute to a unified national effort to address climate change. It requires identifying synergies between sectoral strategies and climate adaptation policies to ensure that actions are complementary rather than contradictory.
- Ensuring provincial alignment with national goals: Provinces have specific local conditions and vulnerabilities, and their plans and strategies must be aligned with national climate adaptation and disaster risk reduction frameworks. This alignment ensures that local-level adaptation plans contribute to the broader goals of the country's climate resilience. It is crucial that provincial governments incorporate climate risks into their development planning, ensuring consistency and coherence with national climate strategies.
- Cross-sectoral coordination: Effective climate adaptation requires collaboration across multiple sectors, and this section emphasizes the importance of synchronizing plans and strategies between different sectors (e.g., agriculture, health, infrastructure, and natural resources). This will help prevent conflicts and ensure that climate adaptation is tackled in a holistic manner. For example, integrating water management strategies into agricultural planning can enhance resilience against both droughts and floods.
- Stakeholder involvement and collaboration: Synchronization also involves engaging various stakeholders, including government agencies, local communities, civil society organizations, and the private sector, in the planning and decision-making process. By bringing together these diverse perspectives, it is possible to ensure that plans and policies reflect local needs and priorities, while also being aligned with national objectives.

f) Integrating Climate Change and Adaptation into Policies, Strategies, and Plans

- Policy reform and adaptation mainstreaming: One of the key steps in this process is the review and reform of existing policies to explicitly integrate climate change adaptation

measures. Climate change must be incorporated into the development of new policies and the revision of existing ones. This could involve introducing climate adaptation goals into national development plans, sectoral policies (e.g., agriculture, energy, and health), and disaster management policies. The aim is to ensure that climate change adaptation is not treated as a separate issue, but rather as a central consideration in all planning and policy-making processes.

- Sector-specific climate adaptation strategies: Different sectors are impacted by climate change in unique ways, and therefore, each sector requires specific strategies to address its vulnerabilities. This section involves the development of tailored adaptation strategies for key sectors. For example, the agricultural sector may need strategies to cope with changing precipitation patterns and temperature rise, while the health sector may need to prepare for the spread of climate-sensitive diseases. These sector-specific strategies should outline clear adaptation goals, actions, and timelines.
- Mainstreaming adaptation into local development plans: It is important to ensure that local governments and communities integrate climate change considerations into their development plans. This includes aligning local policies with national climate adaptation strategies and encouraging local-level actions to reduce vulnerabilities. Local governments can help translate national adaptation goals into concrete actions on the ground, taking into account the specific needs and risks of local populations and ecosystems.
- Strengthening the policy framework: In some cases, new policies or regulations may be needed to fill gaps in the current framework and to better address climate risks. This could involve introducing policies that incentivize climate-resilient investments, promote sustainable land use practices, or regulate activities that exacerbate climate vulnerability, such as deforestation or unsustainable water use. Strengthening the policy framework ensures that climate adaptation is comprehensively addressed at all levels of governance.
- Financial mechanisms for adaptation: Integrating climate change and adaptation into policies and plans also involves identifying and developing financial mechanisms that support climate adaptation actions. This could include establishing dedicated climate adaptation funds, leveraging international climate finance, or creating financial incentives for the private sector to invest in climate-resilient infrastructure. Financial mechanisms are crucial for ensuring that adaptation measures can be effectively implemented and sustained over time.
- Climate-sensitive monitoring and evaluation systems: To ensure that adaptation efforts are on track, it is essential to integrate climate change considerations into monitoring and evaluation systems. This could involve establishing indicators to track progress on climate adaptation at both the national and local levels. By systematically monitoring the effectiveness of adaptation measures, governments can adjust strategies as needed and ensure that resources are being used efficiently.

g) Procedure to mainstream climate change adaptation into plans and policies

Mainstreaming climate change adaptation into plans is a critical step in ensuring that development objectives consider climate risks and build resilience in the face of climate change. The process involves integrating climate change adaptation into policies, strategies, and

development plans across various sectors and at all levels of governance. Below is a structured approach to mainstreaming climate change adaptation into plans:

1. Conduct a Climate Risk and Vulnerability Assessment

- Identify key climate risks: Assess the potential impacts of climate change on sectors such as agriculture, water, health, infrastructure, and energy. Use climate projections and data to identify specific hazards (e.g., floods, droughts, storms) and vulnerable regions or communities.
- Assess vulnerability: Understand the sensitivity of different sectors and regions to climate change impacts and assess the adaptive capacity to handle these impacts.
- Prioritize risks: Based on the vulnerability and risk assessment, prioritize the sectors or regions that are most at risk and where adaptation efforts are most needed.

2. Integrate Climate Change into Existing Policies and Strategies

- Review existing development plans: Review current development plans, strategies, and sectoral policies to identify how climate change is currently addressed, if at all. This includes national, regional, and sector-specific plans.
- Identify gaps and opportunities: Identify gaps where climate adaptation is not yet considered or where current policies are inadequate to address emerging climate risks. Look for opportunities to introduce climate adaptation into ongoing or future policies and plans.
- Revise and update policies: Based on the findings, revise policies and strategies to explicitly incorporate climate change adaptation. This could involve updating national climate change strategies, disaster risk management plans, water management plans, and land-use policies.

3. Set Clear Goals, Targets, and Objectives

- Define adaptation goals: Establish clear, measurable goals for climate adaptation, ensuring they align with national development objectives and broader global goals (such as the Paris Agreement and the Sustainable Development Goals).
- Set targets and indicators: Develop specific, time-bound targets for implementing adaptation actions, and set indicators to measure progress. For example, setting targets to reduce vulnerability in key sectors or regions over a set period.

4. Incorporate Climate Change into Sectoral Plans

- Align sectoral plans with climate resilience: Ensure that sectoral plans (e.g., for agriculture, water, energy, infrastructure, and health) are aligned with climate adaptation priorities. This could include adjusting agricultural policies to account for changing weather patterns, updating infrastructure planning to accommodate extreme weather events, or revising health strategies to deal with climate-induced health risks.

- Mainstream climate adaptation in planning tools: Use planning tools such as Environmental Impact Assessments (EIAs) and Strategic Environmental Assessments (SEAs) to incorporate climate resilience into projects and initiatives across sectors.

5. Ensure Stakeholder Engagement and Participation

- Involve diverse stakeholders: Engage stakeholders from government agencies, local authorities, civil society organizations, communities, and the private sector in the planning process. This ensures that all relevant actors contribute to the adaptation process and that plans are inclusive and reflective of local needs and priorities.
- Consult with vulnerable groups: Ensure that the voices of vulnerable communities (e.g., farmers, coastal populations, marginalized groups) are heard and incorporated into the adaptation planning process.

6. Strengthen Institutional Capacity and Coordination

- Establish a coordinating body: Create or strengthen institutions responsible for coordinating climate adaptation efforts. This could be a dedicated climate change unit or a multi-stakeholder body.
- Build institutional capacity: Train government staff, local authorities, and key stakeholders in climate change adaptation to ensure they have the skills and knowledge to integrate adaptation into planning and decision-making processes.
- Promote cross-sectoral collaboration: Ensure that climate adaptation is not seen as the responsibility of one sector but is integrated across various sectors (e.g., water, agriculture, health, urban planning). Create mechanisms for coordination between different government ministries and local governments.

7. Mobilize Climate Finance

- Secure funding for adaptation: Ensure that adequate resources are allocated for climate adaptation actions. Explore domestic funding options, international climate finance (e.g., Green Climate Fund, Global Environment Facility), and private sector investments.
- Allocate climate finance in national budgets: Integrate climate adaptation funding into national budgets to ensure that resources are available for adaptation initiatives. This could include adjusting public financing mechanisms to prioritize climate-resilient projects.

8. Develop and Implement Adaptation Actions

- Design and implement adaptation projects: Based on the mainstreamed adaptation priorities, design and implement specific adaptation projects across sectors and regions.

For example, building climate-resilient infrastructure, promoting drought-resistant crops, or enhancing early warning systems for extreme weather events.

- Use ecosystem-based approaches: Prioritize nature-based solutions, such as restoring ecosystems or enhancing biodiversity, which can provide both adaptation benefits and contribute to environmental sustainability.

9. Monitor, Evaluate, and Review Progress

- Set up monitoring and evaluation (M&E) systems: Develop robust M&E frameworks to track the progress of climate adaptation actions and assess their effectiveness. This should include both short-term outputs (e.g., number of projects implemented) and long-term outcomes (e.g., reduced vulnerability to climate hazards).
- Conduct periodic reviews: Regularly review and update adaptation plans and strategies to reflect changing climate risks, new knowledge, and lessons learned from implementation.
- Accountability and transparency: Ensure that progress is regularly reported to stakeholders and the public, promoting transparency and accountability.

10. Raise Public Awareness and Build Capacity

- Conduct awareness campaigns: Raise awareness about the importance of climate adaptation among policymakers, stakeholders, and the general public. This helps build public support and ensures that adaptation is a priority for all sectors.
- Promote capacity-building programs: Provide training and capacity-building programs for local governments, communities, and other stakeholders to enable them to implement and monitor adaptation actions effectively

Box 4 Training guide for Module 42: Mainstreaming climate change adaptation into plans and policies

Objective: To ensure that the provincial officers equipped with a strong understanding of climate change adaptation, enabling them to apply it into their work.

Training content and methods:

The trainer presents Chapters 1 and 2, allowing participants to ask questions at the end of each chapter. Afterward, the trainer asks participants to work in groups to mainstream climate change adaption options into their selected plans and policies (using the form in the Appendix M4).

Content	Methods
Presentation: Chapter 1: Reviewing risk profile and existing strategies, plans, and policies Chapter 2: Mainstreaming climate change and adaptation into policies, strategies, and plans	- The trainer gives presentation of Chapter 1 and Chapter 2. - Q&A following the presentation of each chapter.
Group work: - Review provincial risk profile and risk map. - Reviewing existing provincial strategies, plans, and policies. - Integrating climate change and adaptation options into provincial policies, strategies, and plans.	- Representatives from each province work in group to review provincial risk profile and risk map. - Each group reviews and gathers existing provincial strategies, plans, and policies. - Each group integrates climate change and adaptation options into provincial policies, strategies, and plans.

References

Sheskin, D. J. (2011). *Handbook of Parametric and Nonparametric Statistical Procedures (5th Ed.).* New York: Chapman and Hall/CRC.

Appendices

Appendix M1: Climate change, climate hazards and their impacts

Instructions: Participants to identify climate hazards and their impacts in the following matrix

Impacts of climate change on	Climate hazards			
	Flooding	Drought	Landslide	Storm
Agriculture and Food Security				
Water Resources				
Health				
Ecosystems and Biodiversity				
Urban Areas and Infrastructure				
Energy				
Transport				
Forestry and Land Use				
Education				
Gender				
Others				

Appendix M2: Calculating hazards, exposure, vulnerability, and risk indices and developing risk maps

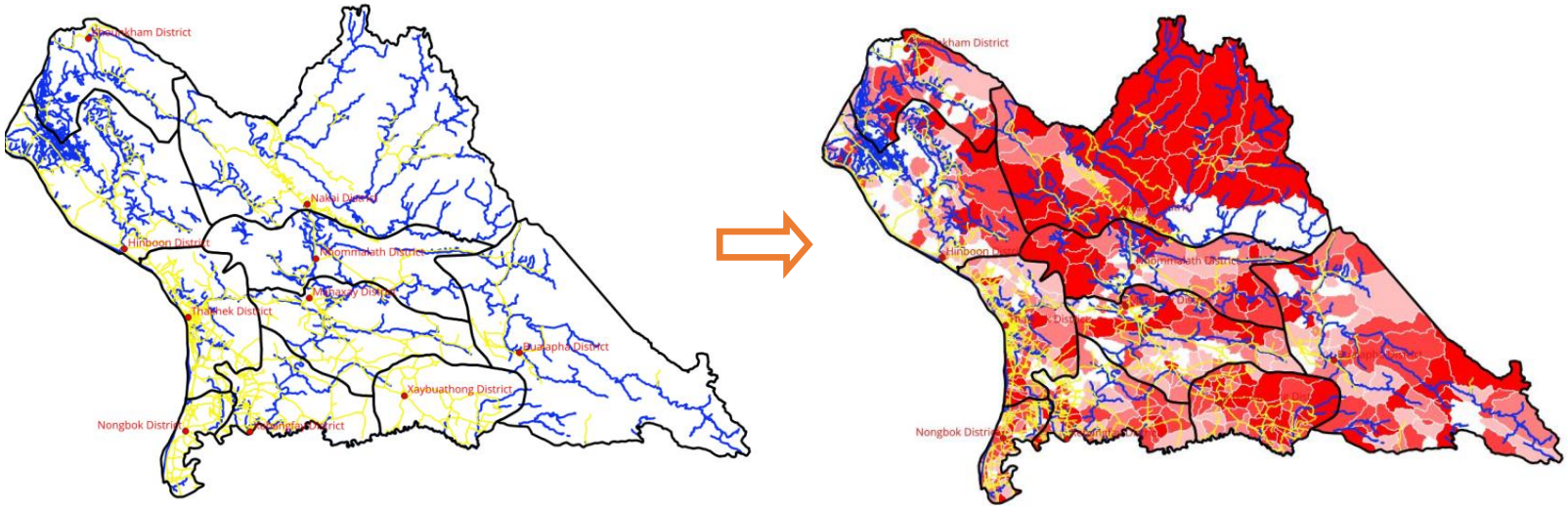
Exercise 1: Calculating hazards, exposure, vulnerability, and risk indices using Excel

		Exposure					Hazard										
Provinces	District	Number of villages affected by flash floods in the last 20 years	Number of villages affected by pluvial floods in the last 20 years	Number of villages affected by storms in the last 20 years	Number of villages that landslides occured in the last 20 years	Number of villages affected by drought in the last 20 years	Maximum temperature (Celcius)	Minimum temperature (Celcius)	Average temperature (Celcius)	Precipitation (mm/year)	Frequency of flash floods in the last 20 years	Frequency of pluvial floods in the last 20 years	Frequency of storms in the last 20 years	Frequency of landslides in the last 20 years	Frequency of drought events in the last 20 years	Population (persons)	Land area (Square Km)
Khammuan																	
	Thakhek																
	Nongbok																
	Xebang Fai																
	Hinboun																
	Mahaxay																
	Nakai																
	Boualapha																
	Yommalard																
	Xaybouathong																
	Khounkham																

	Vulnerability								Adaptive Capacity							
Provinces	District	Women	Ratio of women to total population	Number of poor people	Ratio of poor people to total population	Number of farmers	Ratio of farmers to total population	Area of agricultural land (Square Km) Literacy rate	Number of health centers, clinics and hospitals	Accessible road length (in rainy season and dry season)	Accessible road length (in rainy season)	Total number of households	Number of households accessible to tap water	Number of household accessible to elelectricity	Existing of strategies and adaptation plan	Forest cover
Khammuan									100							
	Thakhek															
	Nongbok															
	Xebang Fai															
	Hinboun															
	Mahaxay															
	Nakai															
	Boualapha															
	Yommalard															
	Xaybouathong															
	Khounkham															

Exercise 2: Producing hazards, exposure, vulnerability, and risk maps

- Trainer provides a map with village, district and provincial boundaries.
- Participants colour each area with colour corresponding to level of severity and risks



Appendix M3: Determining adaptation measures corresponding to climate hazards and their impacts

Instructions: Participants to identify adaptation measures corresponding to climate hazards and their impacts in the following matrix

Sector	Adaptation measures corresponding to			
	Flooding	Drought	Landslide	Storm
Agriculture and Food Security				
Water Resources				
Health				
Ecosystems and Biodiversity				
Urban Areas and Infrastructure				
Energy				
Transport				
Forestry and Land Use				
Education				
Gender				
Others				

Appendix M4: Mainstreaming climate change adaptation into plans and policies

Exercise on Mainstreaming Climate Change Adaptation into Plans and Policies

Objective:

To guide participants through the process of integrating climate change adaptation into existing and future policies and plans, ensuring that climate risks are considered and addressed across sectors.

Step 1: Review Existing Policies and Plans

1. Activity: Review current policies, plans, and strategies (e.g., national development plans, sectoral policies) to identify whether and how climate change is addressed.
    - Outcome: List of existing policies, strategies, and plans that mention climate change (e.g., agriculture, water, infrastructure).
2. Discussion: Analyze any gaps where climate change adaptation is not considered or where integration is weak.
    - Outcome: Identification of gaps or opportunities for adaptation integration

Step 2: Stakeholder Identification and Engagement

1. Activity: Identify key stakeholders involved in climate change adaptation and sectoral planning (e.g., local government, ministries, civil society, community representatives, businesses).
    - Outcome: List of stakeholders with clear roles and responsibilities.
2. Discussion: Organize a stakeholder consultation workshop where each group shares its perspectives on how climate change impacts their sector or region.
    - Outcome: Understanding of sectoral concerns, climate risks, and adaptation priorities

Step 3: Risk and Vulnerability Assessment

1. Activity: Conduct a risk and vulnerability assessment for key sectors to understand how they will be impacted by climate change.
    - Considerations: Use existing data and climate projections to assess risks in agriculture, water, infrastructure, health, and other relevant sectors.
    - Outcome: List of sector-specific climate risks and vulnerabilities.
2. Discussion: Present findings to stakeholders and discuss how these risks could be mitigated or adapted to in future planning processes.
    - Outcome: Shared understanding of sector-specific climate impacts.

Step 4: Define Adaptation Goals and Priorities

1. Activity: Work with stakeholders to define clear adaptation goals for each sector, based on identified risks and vulnerabilities.

    - Outcome: List of clear, sector-specific adaptation goals (e.g., increase drought resilience in agriculture, strengthen flood defenses in coastal areas).
2. Discussion: Prioritize the adaptation goals based on urgency, cost-effectiveness, and available resources.
    - Outcome: Ranked adaptation priorities.

Step 5: Integrating Adaptation into Sectoral Plans

1. Activity: Review existing sectoral plans and policies to identify opportunities for integrating climate change adaptation.
    - Outcome: Proposed changes or additions to sectoral plans to include climate change adaptation actions.
2. Discussion: Use a participatory approach to involve stakeholders in the revision process. Focus on developing specific adaptation actions that can be incorporated into existing policies (e.g., incorporating flood management measures into urban planning).
    - Outcome: Draft version of sector-specific plans with integrated climate adaptation actions

Step 6: Mainstreaming in the Budgeting Process

1. Activity: Review the current budgeting process and identify how climate change adaptation can be incorporated into national, regional, and local budgets.
    - Outcome: Identification of potential financial mechanisms or budgets for adaptation initiatives.
2. Discussion: Develop a financial plan for climate adaptation, ensuring that funds are allocated to priority adaptation measures.
    - Outcome: A climate adaptation budget integrated into national and local financial planning.