Brunei Darussalam
National Adaptation Plan

2025

**Kebawah Duli Yang Maha Mulia Paduka Seri Baginda
Sultan Haji Hassanal Bolkiah Mu'izzaddin Waddaulah
ibni Al-Marhum Sultan Haji Omar 'Ali Saifuddien Sa'adul Khairi Waddien,
Sultan dan Yang Di-Pertuan Negara Brunei Darussalam**

Petikan Titah

"

Mengenai komitmen negara ke arah Perubahan Iklim, Beta telah memperkenankan Negara Brunei Darussalam untuk menjadi Tuan Rumah bagi Pusat Perubahan Iklim ASEAN (ASEAN Centre for Climate Change) yang akan menempatkan pakar-pakar dari dalam dan luar negara untuk menjalankan kegiatan penyelidikan, berkaitan dengan perubahan iklim.

Ini selaras dengan Dasar Perubahan Iklim Negara, pada mana satu direktif, Inventori Karbon menggunakan Centralised Inventory System, yang akan diperkenalkan dalam usaha negara melaksanakan pemantauan dan mengesahkan data gas rumah hijau secara telus, konsisten dan tepat.

Dengan maklumat tersebut, pada penghujung tahun 2023, pelan kebangsaan adaptasi perubahan iklim akan dirangka sebagai usaha penyelarasan dan penyesuaian dengan perubahan iklim.

"

**KEBAWAH DULI YANG MAHA MULIA PADUKA SERI BAGINDA
SULTAN HAJI HASSANAL BOLKIAH MU'IZZADIN WADDAULAH
IBNI AL-MARHUM SULTAN HAJI OMAR 'ALI SAIFUDDIEN SA'ADUL KHAIRI WADDIEN,
SULTAN DAN YANG DI-PERTUAN NEGARA BRUNEI DARUSSALAM**

**Titah KDYMM Sempena Majlis Pembukaan Rasmi Mesyuarat Pertama
Dari Musim Permesyuaratan ke-19 Majlis Mesyuarat Negara (MMN)
Bagi Tahun 1444H/2023M**

11 Sya'ban 1444 bersamaan dengan 4 Mac 2023

**The Honourable Dato Seri Setia
Dr. Awang Haji Mohd Amin Liew
bin Abdullah,**
*Minister at the Prime Minister's Office
and Minister of Finance and Economy II*

**The Honourable Dato Seri Setia
Awang Haji Muhammad Juanda
bin Haji Abdul Rashid,**
Minister of Development

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

Brunei Darussalam contributes less than 0.02% of global greenhouse gas emissions. However, given the rise in temperature, increase in sea levels and more intense weather events that we have seen globally, Brunei Darussalam can also be threatened by these events that will affect our people, environment, infrastructure, resources, and livelihoods. It is therefore imperative for Brunei Darussalam to safeguard the well-being of its citizens and protect the country's future prosperity.

Recognising the urgency of climate change, Brunei Darussalam is proud to launch its first National Adaptation Plan (NAP), marking a pivotal step forward in our efforts to combat and adapt to climate challenges. Building on the Brunei Darussalam National Climate Change Policy, our Nationally Determined Contribution under the Paris Agreement, and the Biennial Transparency Report, the NAP reflects our shared vision of a low-carbon, climate-resilient and sustainable Brunei Darussalam.

The NAP will strengthen our capacity to safeguard communities, reinforce infrastructure and secure the nation's environmental and economic assets. It provides a strategic framework for action across all sectors, enabling innovation, investment and partnerships. **With this document, Brunei Darussalam takes a proactive stance to ensure that our development remains competitive, inclusive and environmentally sound for the benefit of present and future generation.**

Message from the Co-Chairs of the Adaptation & Resilience Working Group

Sr. Dayang Hajah Norhayati binti Haji Mohd Yaakub,
Deputy Permanent Secretary (Construction Industry and Development),
Ministry of Development

Dayang Nor Hamidah binti Haji Hamidon,
Deputy Permanent Secretary (Safety and Welfare),
Ministry of Home Affairs

بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِيْمِ

Brunei Darussalam is proud to present its first National Adaptation Plan (NAP), a document designed to address the potential impacts of climate change, especially given its position as a sovereign state located on an island, such as damage to critical infrastructure and biodiversity loss and impacts on agriculture sector, food security, marine and water resources. Furthermore, the health sector will also face with new challenges, such as the potential spread of infectious diseases linked to environmental changes.

Despite the uncertainties surrounding the future scale of climate change, its impacts can present a significant, cross-cutting threat to Brunei Darussalam's long-term sustainable development, encompassing its economy, society, and environment.

To address this challenge, the Adaptation and Resilience Working Group has tirelessly dedicated their time and commitment to conduct the necessary research for the foundational development of the NAP. Developed through a multi-year, inclusive process that began in 2023, the NAP is a dynamic, living policy document. It provides essential guidance and a clear roadmap for navigating an unpredictable future by using data and projections to build resilience and protect our nation's most valuable assets: its people and its environment.

Acknowledgements

The successful completion of the National Adaptation Plan (NAP) was made possible through the extensive participation and comprehensive contributions from the Adaptation and Resilience Working Group members, comprising representatives from the government, academia, non-governmental organisations, and the private sector.

Additionally, this achievement was propelled by the steadfast leadership of the esteemed Co-Chairs — the Deputy Permanent Secretary (Construction Industry and Development) of the Ministry of Development and the Deputy Permanent Secretary (Security and Welfare) of the Ministry of Home Affairs — whose timely supervision and guidance were instrumental throughout the process.

Sincere gratitude is extended to Brunei Shell Petroleum for their facilitative support during the Opportunity Framing Workshop held in 2023, which laid the critical groundwork for the NAP. Deep appreciation is also expressed to UN4NAPs for their invaluable technical expertise in reviewing the first iteration of the NAP and providing advice, wherever needed.

Lastly, heartfelt gratitude is due to the Brunei Darussalam National Council on Climate Change for their unwavering support and for providing strategic guidance during the NAP development. The collective efforts of all stakeholders have been the cornerstone of this NAP, and will significantly contribute to advancing Brunei Darussalam's climate adaptation and resilience strategies in the years ahead.

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Abbreviation

ABCi	Authority for Building Control and Construction Industry
AR5	Fifth Assessment Report
AR6	Sixth Assessment Report
ARWG	Adaptation and Resilience Working Group
BAGUS	Brunei Accredited Green Unified Seal
BCG	Boston Consulting Group
BCCO	Brunei Climate Change Office
BDMD	Brunei Darussalam Meteorological Department
BFRD	Brunei Fire and Rescue Department
BIA	Brunei International Airport
B.I.G.	Brunei Institution of Geomatics
BNCCC	Brunei Darussalam National Council on Climate Change
BNCCP	Brunei Darussalam National Climate Change Policy
BruWILD	Biodiversity and Natural History Society
CDD	Consecutive Dry Days
CFC	Chlorofluorocarbon
CH$_4$	Methane
CO$_2$	Carbon dioxide
COP	Conference of the Parties
CORDEX	Coordinated Regional Climate Downscaling Experiment
CORDEX-SEA	Coordinated Regional Climate Downscaling Experiment-Southeast Asia
CRED	Centre for Research on the Epidemiology of Disasters
CWD	Consecutive Wet Days
DDMC	District Disaster Management Committee
DDS	Department of Drainage and Sewerage

DLOGS	Disaster Logistic Storage
DEHS	Department of Environmental Health Services
DES	Department of Electrical Services
DEPS	Department of Economic Planning and Statistics
DEPR	Department of Environment, Parks and Recreation
DoAA	Department of Agriculture and Agrifoods
DTS	Department of Technical Services
DWS	Department of Water Services
EHW	Excessive Hot Weather
EIA	Environmental Impact Assessment
EMAS	Emergency Medical Ambulance Service
EMR	Emergency Medical Response
ENSO	El Niño Southern Oscillation
ERP	Emergency Response Plan
EVWG	Electric Vehicle Working Group
ExComm	Executive Committee on Climate Change
FWI	Fire Weather Index
GGA	Global Goal on Adaptation
GHGs	Greenhouse gases
H$_2$O	Water vapour
HER	Hazards and Effects Register
HFC	Hydrofluorocarbon
HSE	Health, Safety and Environment
ICP	Incident Command Post
IEWG	Industrial Emissions Working Group
IPCC	Intergovernmental Panel on Climate Change
JAPEM	Jabatan Pembangunan Masyarakat
LEG	Least Developed Countries Expert Group

MEL	Monitoring, Evaluation and Learning
MIB	Melayu Islam Beraja
MOFE	Ministry of Finance and Economy
MOH	Ministry of Health
MOI	Means of Implementation
MPRT	Ministry of Primary Resources and Tourism
MSME	Micro, Small, and Medium Entreprise
N_2O	Nitrous oxide
NAP	National Adaptation Plan
NaSOP	National Standard Operating Procedures
NCVA	National Climate Vulnerability Assessment
NDC	Nationally Determined Contribution
NDMC	National Disaster Management Centre
NGOs	Non-governmental organisations
NLUMP	National Land Use Master Plan
O_3	Ozone
PEARL	People, Environment, Asset, Reputation and Legal
PFC	Perfluorocarbon
PSI	Pollutant Standards Index
PUJA	Institutions of Surveyors, Engineers & Architects Brunei
PWD	Persons with Disabilities
RAM	Risk Assessment Matrix
RBAF	Royal Brunei Armed Forces
RCP	Representative Concentration Pathway
SDG	Sustainable Development Goals
SF_6	Sulphur hexafluoride
SOP	Standard Operating Procedure
SSP	Shared Socioeconomic Pathway

TCP	Department of Town and Country Planning
TPOR	Tekad Pemedulian Orang Ramai
UBD	Universiti Brunei Darussalam
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
UNISSA	Universiti Islam Sultan Sharif Ali
UTB	Universiti Teknologi Brunei
WCRP	World Climate Research Programme
WEF	World Economic Forum
WSDI	Warm Spell Duration Index
WMO	World Meteorological Organization

Measurements

°C	Degree Celsius
$GtCO_2e$	Gigatonnes of carbon dioxide equivalent
ha	Hectare
km	Kilometre
km^2	Square kilometres
m	Metre
mm	Millimetre
MW	Megawatt

Glossary

Most definitions under this section are derived from the Sixth Assessment Report of the Intergovernmental Panel on Climate Change. Some definitions have been shortened for brevity, but the original meanings are still retained.

Adaptation

In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate and its effects.

Adaptive capacity

The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities respond to consequences.

Cascading impact

Cascading impacts from extreme weather/climate events occur when an extreme hazard generates a sequence of secondary events in natural and human systems that result in physical, natural, social or economic disruption, whereby the resulting impact is significantly larger than the initial impact.

Climate

In a narrow sense, climate is usually defined at the average weather – or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities – over a period of time ranging from months to thousands or millions of years.

Climate change

A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcing such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.

Exposure

The presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure; or economic, social, or cultural assets in places and settings that could be adversely affected.

Greenhouse gases

Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of radiation emitted by the Earth's Ocean and land surface, by the atmosphere itself and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary GHGs in the Earth's atmosphere.

Human-made GHGs include sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs), chlorofluorocarbons (CFCs) and perfluorocarbons (PFCs); several of these are also O_3-depleting (and are regulated under the Montreal Protocol).

Hazard	The potential occurrence of a natural or human-induced physical event or trend that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems and environmental resources.
Impacts	The consequences of realised risks on natural and human systems, where risks result from the interactions of climate-related hazards (including extreme weather/climate events), exposure, and vulnerability. Impacts generally refer to effects on lives, livelihoods, health and well-being, ecosystems and species, economic, social and cultural assets, services (including ecosystem services) and infrastructure. Impacts may be referred to as consequences or outcomes, and can be adverse or beneficial.
Rainday	A rainday is defined as a day with at least 0.1mm rainfall recorded at the station.
Resilience	The capacity of interconnected social, economic and ecological systems to cope with a hazardous event, trend or disturbance, responding or reorganising in ways that maintain their essential function.
Risk	In the context of climate change, risks can arise from potential impacts of climate change as well as human responses to climate change. Relevant adverse consequences include those on lives, livelihoods, health and well-being, economic, social and cultural assets and investments, infrastructure, services (including ecosystem services), ecosystems and species.
Sendai Framework for Disaster Risk Reduction	The Sendai Framework for Disaster Risk Reduction 2015–2030 outlines 7 clear targets and 4 priorities for action to prevent new, and to reduce existing, disaster risks. Its aim is to achieve 'substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries'.
Sensitivity	The degree to which a system or species is affected, either adversely or beneficially, by climate variability or change. The effect may be direct (e.g., a change in crop yield in response to a change in the mean, range, or variability of temperature) or indirect (e.g., damages caused by an increase in the frequency of coastal flooding due to sea level rise).

Sustainable Development Goals

The 17 global goals for development for all countries established by the United Nations through a participatory process and elaborated in the 2030 Agenda for Sustainable Development, including ending poverty and hunger; ensuring health and well-being, education, gender equality, clean water and energy, and decent work; building and ensuring resilient and sustainable infrastructure, cities and consumption; reducing inequalities; protecting land and water ecosystems; promoting peace, justice and partnerships; and taking urgent action on climate change.

Vulnerability

The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements, including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Executive Summary

The Case for Climate Action Is Undeniable

As the planet is overheating and extreme weather events are becoming more frequent and severe, Brunei Darussalam has no choice but to adapt to the changing climate, despite contributing only a small share of global greenhouse gas emissions (less than 0.02%).

Given the Sultanate's geographic location, high concentration of urban population, and economic resilience on fossil fuels, concerted efforts must be channelled towards adaptation and resilience measures to safeguard its well-being against the challenges posed by climate change. This can be done through enhancing adaptive capacity, strengthening resilience and reducing vulnerability.

Paving a Climate-Resilient Future

In 2023, Brunei Darussalam initiated its National Adaptation Plan (NAP) process through a "Whole-of-Nation" approach to ensure a holistic and coordinated response to climate change. The NAP document serves as guidance in deciding the country's adaptation priorities, planning and implementation, which will be informed by the best available data and science. It is hoped that the NAP will aid in formulating more robust adaptation strategies that are best suited to the country's national circumstances, while fostering an enabling environment that advances the adaptation agenda across 6 key sectors: Agriculture and Food Security, Biodiversity and Environment, Health and Livelihoods, Infrastructure and Urban Resilience, Marine Protection and Coastal Resilience, and Water Resources.

This is concurrently reflected in the NAP's vision to "build a climate-resilient and adaptive strategies where communities, ecosystems and the economy still thrive despite the challenges posed by climate change."

The NAP has 3 objectives:

1. Outline the key priority climate hazards, their impacts, and existing strategies;
2. Facilitate the integration of climate adaptation considerations into national planning, coordination, and implementation processes; and;
3. Align adaptation strategies, plans and projects with both national and international commitments.

Unveiling the Country's Climate Impacts: Key Messages

- Both temperature and rainfall indicate an upward trend, with El Niño Southern Oscillation (ENSO) as the primary climate driver.
- Annual mean temperature has increased by 0.24°C/decade (1971–2024).
- Annual rainfall has increased by 110mm/decade (1966–2024).
- Sea level rise is occurring in the Sultanate, aggravated by other factors such as land subsidence. But, more research is needed to validate their rates.
- The leading climate-induced disasters in Brunei Darussalam are forest and bush fires, flash floods and flooding, landslides, and strong winds.

Comprehending Risks and Adaptation Information Starts the Process

Several preliminary risk assessments were carried out to support the formulation of NAP such as Hazards and Effects Register, Risk Assessment Matrix, and Barriers Assessment and Bowtie Analysis (also known as Swiss Cheese Model). These assessments clarified the impacts from rapid and slow on-set climate events on communities, the environment and infrastructure, as well as their severity and likelihood of happening. At the moment, the NAP focuses on frequently recurring hazards such as forest and bush fires, as well as flash floods and flooding, which are frequently recurring hazards, with assessments conducted to evaluate existing efforts to address them.

But since these preliminary risk assessments provide only a surface-level understanding, the Sultanate has embarked on the National Climate Vulnerability Assessment (NCVA) to comprehensively evaluate the "actual" climate risks facing the country. It will consider the interactions between hazards, exposure and vulnerability (sensitivity and adaptive capacity) and will focus in depth on sectoral impacts. The insights gained, especially in establishing a baseline, are expected to aid sectors to develop more targeted, feasible, and coherent adaptation strategies.

While adaptation progress faces challenges from a weak institutional framework, limited access to funding, insufficient inclusivity and participation across all stakeholder levels, a shortage of skills and capacity, data deficiencies – issues that also plague the development of an effective Monitoring, Evaluation and Learning (MEL) system – Brunei Darussalam embraces this phase as a valuable learning curve toward developing an improved NAP in the future.

The Path Forward is Clear: Adaptation Action Requires Strong Ambition and Unity on Both National and International Arenas

The successful implementation of Brunei Darussalam's NAP hinges on 2 critical and interconnected efforts.

Domestically, it is essential to prioritise the strengthening of coordination and the development of adaptation capacity within existing institutional arrangements. This localised resilience-building, integrated alongside climate mitigation efforts, must be achieved without compromising the nation's core economic stability and its long-term diversification goals. By enhancing inter-agency collaboration and embedding climate resilience into national planning and procurement, Brunei Darussalam will be better equipped to manage mounting risks.

However, as the world still remains distant from achieving the Paris Agreement goal to limit warming to well below 2°C while pursuing efforts to stay below 1.5°C, this action alone will not be sufficient.

Recognising that combating climate change is a collective global effort, the country requires strong international and regional support, including resources, expertise, and funding to further the national adaptation agenda. With ambition and unity, it is possible to close the adaptation gap, build resilience, and set a regional example in safeguarding people, ecosystems, and long-term prosperity.

Introduction

Climate risks are no longer distant threats; in fact, they are now a lived reality for most nations.

The Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR6) highlighted that global anthropogenic greenhouse gas (GHG) emissions have steadily climbed over the past decade, reaching 59 gigatonnes of carbon dioxide equivalent (GtCO$_2$e) in 2019 — **marking a 12% increase since 2010 and 54% surge since 1990**. As a result, global surface temperatures have already risen by 1.09°C compared to pre-industrial levels.[1]

To underscore the severity of this situation, the World Meteorological Organization (WMO) reported that **2024 swiftly surpassed 2023 as the hottest year on record, with a global mean temperature rising at 1.55°C above pre-industrial levels and the first to breach the 1.5°C threshold**. Moreover, this alarming upward trend is expected to continue and likely to exacerbate the frequency of natural disasters such as extreme heat, floods, droughts, storms, and wildfires, which have already increased fivefold over the past 50 years.[2] In fact, extreme weather events have been consistently ranked among the top global risks, with it being ranked second in 2025.[3]

Inevitably, both the impacts of climate change and the responses to address them have caused profound consequences for communities and significant economic damage. For instance, it was estimated that more than 765,000 lives were lost and nearly USD 4.2 trillion in direct economic losses were incurred due to over 9,400 extreme weather events that happened between 1993 to 2022.[4] In 2024 alone, the year was struck by 393 climate disasters, ranging from extreme heat waves to severe droughts, flooding, tropical storms, and cyclones. These events caused 16,753 fatalities and affected 167.2 million people, while inflicting an economic loss of USD 241.95 billion.[5] However, taking ambitious adaptation measures now can help reduce many of these expenses, both present and future.

With growing evidence of rising global temperatures, accelerated melting of glaciers, and sea level rise, it is apparent that we can no longer operate on a business-as-usual approach without compounding existing climate vulnerabilities and jeopardising the well-being of both current and future generations.

Brunei Darussalam is not exempt from the adverse impacts of climate change despite contributing only less than 0.02% of global GHG emissions. The country frequently faces hazards such as extreme weather events, forest and bush fires, as well as flash floods and flooding.

Prioritising adaptation, henceforth, is imperative to safeguard the nation's well-being through enhancing its adaptive capacity, strengthening resilience and reducing vulnerability against climate change. It can no longer be seen as a future option or a distant concern, but as one of the greatest priorities for nations and communities worldwide today, alongside efforts to abate GHG emissions.

Coastal Protection, Pantai Danau, Tutong

500 Kapur Paya Trees planted in Anduki Forest Reserve,
Photo by Green Brunei

Consequently, the National Adaptation Plan (NAP) for Brunei Darussalam was developed to advance the climate adaptation to defend the nation, while fulfilling its international commitments under the United Nations Framework Convention on Climate Change (UNFCCC) and its Paris Agreement. After all, adaptation transcends national interests— it is a vital global imperative that embodies a collective responsibility.

This document serves a vital role in **providing valuable insights and strategically guiding the country's adaptation planning, through outlining its adaptation priorities and a pipeline of projects for implementation**. The NAP adopts a "Whole-of-Nation" approach, uniting stakeholders across various sectors to ensure a coordinated response to the challenges posed by climate change.

1.1 National Context

1.1.1 Geographical Location

Brunei Darussalam is located on the northern coast of Borneo Island, surrounded by the Malaysian states of Sabah and Sarawak. With a total land area of 5,765 km², Brunei Darussalam is one of the

smaller nations in Southeast Asia. It comprises of four main districts, namely; Brunei Muara, Tutong, Belait and Temburong.

1.1.2 Significance of each district and the population distribution

The capital city of Brunei Darussalam is Bandar Seri Begawan. Despite its small area size of 571 km², the Brunei Muara district is the main government and commercial hub, and holds the most population of 329,900 people. Located at the westernmost side is the Belait district, characterised as the largest district at 2,727 km² and the second heavily populated district at 67,500 people. It is significantly known as a critical economic hub for the oil and gas industry, which serves as the largest contributor to the nation's Gross Domestic Product.

Connecting the Brunei Muara and Belait districts, the Tutong district holds all the major roads. It has an area size of 1,166 km² and accommodates a population size of about 48,500.

The Temburong district is the smallest district, with an area size of 1,306 km² and houses the least population of around 9,600 people. The district is connected to the rest of Brunei Darussalam through the Sultan Haji Omar 'Ali Saifuddien bridge, which enables the facilitation of inter-district communication and brought various development to the previously cut off district by the Brunei Bay. It is rich in tropical rainforest and mainly known for its gravel reserves.

All in all, the country population stands at 455,500 people and consists mostly of Malays at 335,500. This is further categorised into 7 'puaks' or ethnic groups, which are Melayu Brunei, Tutong, Murut, Bisaya, Belait, Kedayan and Dusun. The remaining existing races in Brunei Darussalam are Chinese at 43,800 people and other races at 76,200.[6]

1.1.3 Vulnerable group distribution

The population exhibits a male majority, with males constituting 52.8% compared to 47.2% for females. Concurrently, the age distribution reveals that 19.9% of the population is below 15 years of age, while a significant proportion of 72.8% falls within the 15 to 64 age brackets, indicative of the working-age or economically active population, with the remaining 7.3% comprising individuals aged 65 years and above, who are typically classified as old dependents.

Currently, 2,756 individuals have been officially registered as Persons with Disabilities (PWDs) in Brunei Darussalam's national registration.[7] This initiative is instrumental in elevating the visibility and inclusion of this vulnerable group within mainstream society.

It is important to note that within Brunei Darussalam's context, the definition of gender is aligned with national principles and legal frameworks, whereby gender is recognised strictly as male and female.

1.2 National Philosophy and Vision

The '*Melayu Islam Beraja*' (MIB) philosophy is a unique, dynamic, progressive, and integrated national aspirational concept adopted by Brunei Darussalam. It sets the national foundation in thinking, acting, evaluating, and planning the entire life of the nation, state, and religion[8], which is employed greatly in *Wawasan Brunei 2035*. **Wawasan Brunei 2035 represents the nation's vision to ensure that the people are educated, highly skilled and accomplished, enjoy a high quality of life, and strive towards a dynamic and sustainable economy by 2035** (*Figure 1*).

WAWASAN 2035

By 2035, Brunei Darussalam aspires to achieve international recognition through the successful realisation of these three strategic goals:

GOAL 1:
Educated, Highly Skilled & Accomplished People

1 First Class Education

2 Equal Educational Opportunities

3 Human Resource Development

GOAL 2:
High Quality of Life

4 High Standard of Living

5 Upholding Sovereignty & Stability

6 Sustainable Environment

7 Resilient & Cohesive Society

8 World Class Health & Safety

GOAL 3:
Dynamic & Sustainable Economy

9 High Sustainable Growth

10 Diversified Economy
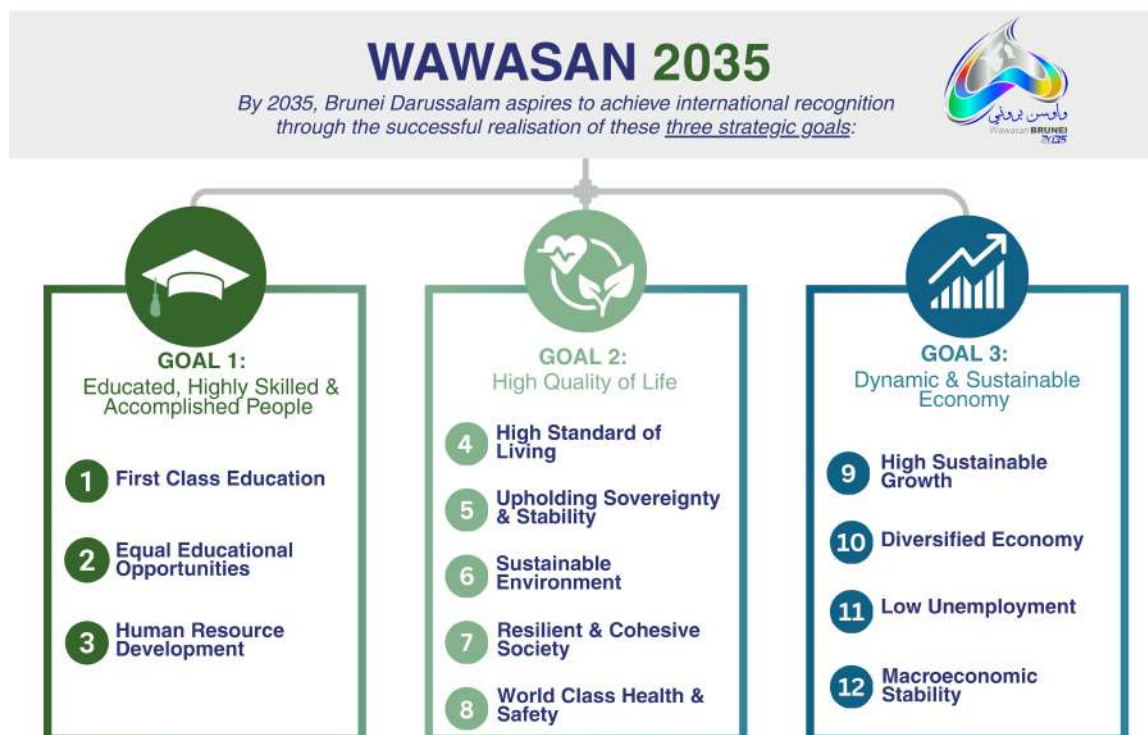
11 Low Unemployment

12 Macroeconomic Stability

Figure 1: Brunei Darussalam's *Wawasan 2035*

1.3 Brunei Darussalam's Climate Change Governance and Policies

1.3.1 Institutional Governance

BRUNEI DARUSSALAM NATIONAL COUNCIL ON CLIMATE CHANGE
The highest level of strategic direction in addressing climate change.
Co-chaired by the Minister at the Prime Minister's Office & the Minister of Finance and Economy II and the Minister of Development

EXECUTIVE COMMITTEE ON CLIMATE CHANGE
Chaired by the Deputy Minister (Energy), Prime Minister's Office, the ExComm consists of Permanent Secretaries, Chief Executive Officers and Managing Directors from relevant public, private, and NGOs.

BRUNEI CLIMATE CHANGE OFFICE
Secretariat to the BNCCC and ExComm

INDUSTRIAL EMISSIONS WORKING GROUP

ELECTRIC VEHICLE WORKING GROUP

ADAPTATION & RESILIENCE WORKING GROUP

SECRETARIAT:
ENERGY TRANSITION DIVISION
Department of Energy, PMO

SECRETARIAT:
LAND TRANSPORT DEPARTMENT
Ministry of Transport & Info-communications

ENERGY TRANSITION DIVISION
Department of Energy, PMO

SECRETARIAT:
BRUNEI CLIMATE CHANGE OFFICE
PMO

NATIONAL DISASTER MANAGEMENT CENTRE
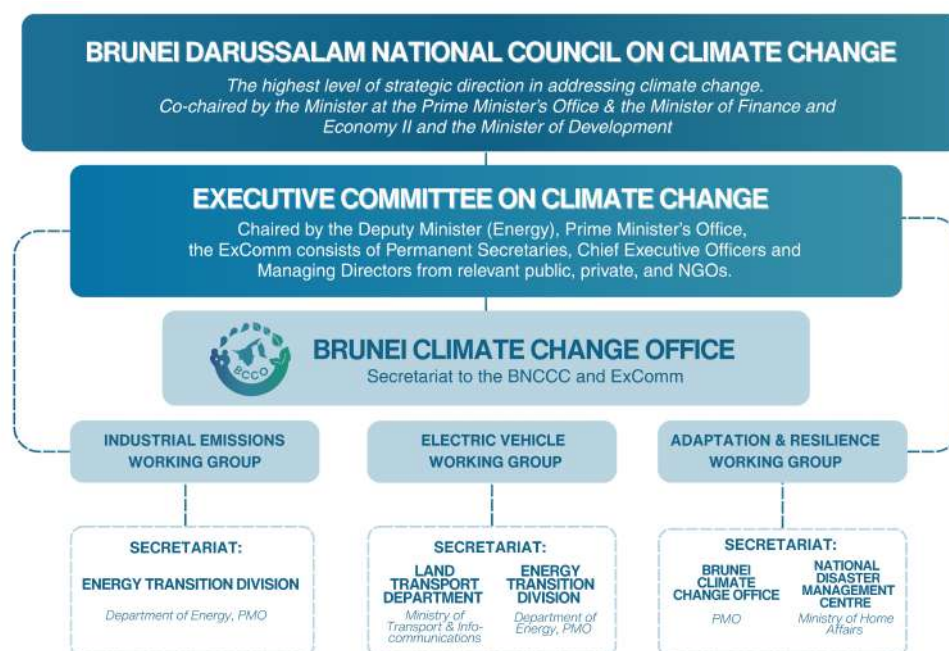*Ministry of Home Affairs*

Figure 2: Overview of Brunei Darussalam's Climate Change Governance

1.3.1.1 Brunei Darussalam National Council on Climate Change

The climate change institutional governance structure (*Figure 2*) includes the **Brunei Darussalam National Council on Climate Change (BNCCC)**, which provides the highest level of strategic direction in addressing climate change. Co-chaired by the Minister at the Prime Minister's Office and the Ministry of Finance and Economy II and the Minister of Development, the BNCCC members include representatives from various ministries such as Minister of Primary Resources and Tourism, Minister of Transport and Infocommunications, Deputy Minister of Finance and Economy (Economy) and Deputy Minister (Energy).

1.3.1.2 Executive Committee on Climate Change

Supporting the BNCCC is the **Executive Committee on Climate Change (ExComm)**, chaired by the Deputy Minister (Energy), Prime Minister's Office and consisting of Permanent Secretaries, Chief Executive Officers and Managing Directors from relevant public, private, and non-governmental

organisations (NGOs). The ExComm oversees the Industrial Emissions Working Group (IEWG), Electric Vehicle Working Group (EVWG), and the Adaptation and Resilience Working Group (ARWG). Membership in these committees spans across government, non-government, and academic bodies, ensuring a multi-sectoral approach to climate change mitigation and adaptation. Any decisions taken at ExComm and other bodies require endorsement by the BNCCC.

1.3.1.3 Brunei Climate Change Office, Prime Minister's Office
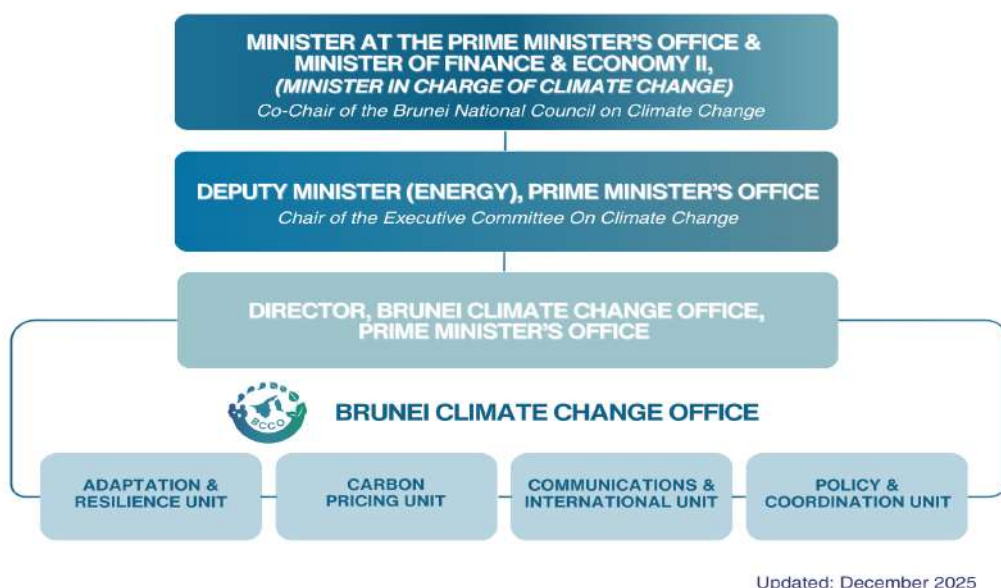
Figure 3: Organisational structure of Brunei Climate Change Office

The **Brunei Climate Change Office (BCCO)**, formerly known as the Brunei Climate Change Secretariat, under the Prime Minister's Office, serves as secretariat for both BNCCC and the ExComm (*Figure 3*). Established in July 2018, it is the governmental authority responsible for the development, implementation, monitoring, and evaluation of Brunei Darussalam's climate change policies, strategies, and actions. Its mission is to ensure a Whole-of-Nation approach in addressing the challenges and opportunities of climate change, with an objective to coordinate and ensure strategic alignment on climate action across the Government and non-Government agencies.

1.3.2 Brunei Darussalam National Climate Change Policy

In 2020, the country introduced its first climate policy called the Brunei Darussalam National Climate Change Policy (BNCCP) to pave for Brunei Darussalam's low-carbon and climate-resilient pathways for a sustainable nation through 10 strategic approaches (*Figure 4*).

The BNCCP sets forth 6 primary mitigation approaches: targeting reductions in industrial emissions, increasing forest cover, minimising emissions from land transportation, boosting the share of renewable energy, reducing emissions from power generation and reducing emissions from waste.
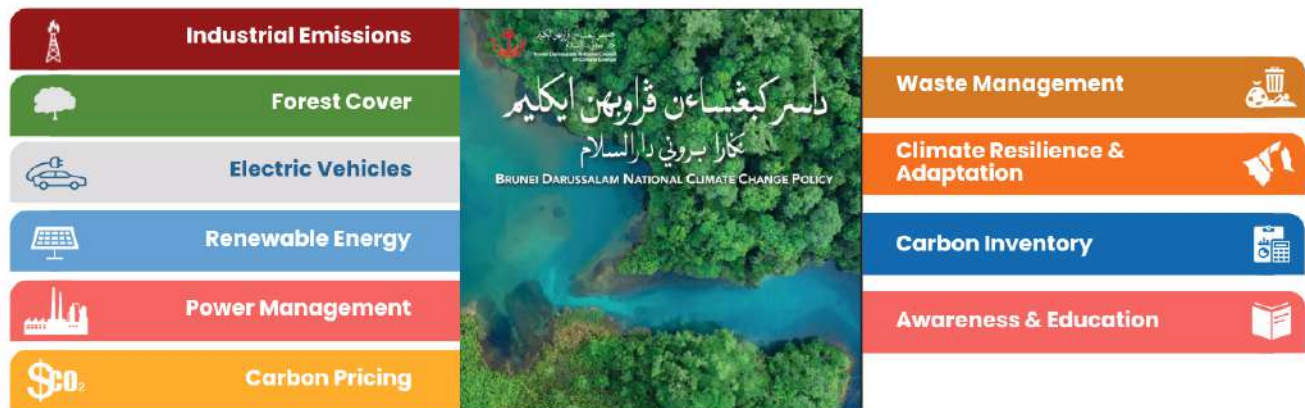

Figure 4: Overview of Brunei Darussalam National Climate Change Policy

In addition, it includes 4 cross-cutting strategies: exploring carbon pricing mechanisms, enhancing adaptation and resilience to climate impacts, maintaining a comprehensive carbon inventory for effective tracking and policymaking, as well as fostering climate awareness and education among the public.

1.3.3 Adaptation and Resilience Working Group

Figure 5: Members of the Adaptation and Resilience Working Group

The ARWG plays a pivotal role in coordinating efforts to strengthen climate resilience against climate change risks and enhance its adaptive capacity to the impacts of a changing climate. It is co-chaired by the Deputy Permanent Secretary (Construction Industry and Development), Ministry of Development and Deputy Permanent Secretary (Security and Welfare), Ministry of Home Affairs, with various members from government agencies, academia, NGOs and the private sector (*Figure 6*). BCCO, under the purview of the Prime Minister's Office and the National Disaster Management Centre (NDMC), under the Ministry of Home Affairs serves as the co-secretariat to the ARWG.

Its primary focus is to ensure that members acquire a comprehensive understanding of climate impact on infrastructure decisions, while actively formulating and implementing climate adaptation policies and strategies within the existing regulatory framework. Additionally, the ARWG conducts comprehensive studies to evaluate the country's vulnerability to climate change impacts and risks.
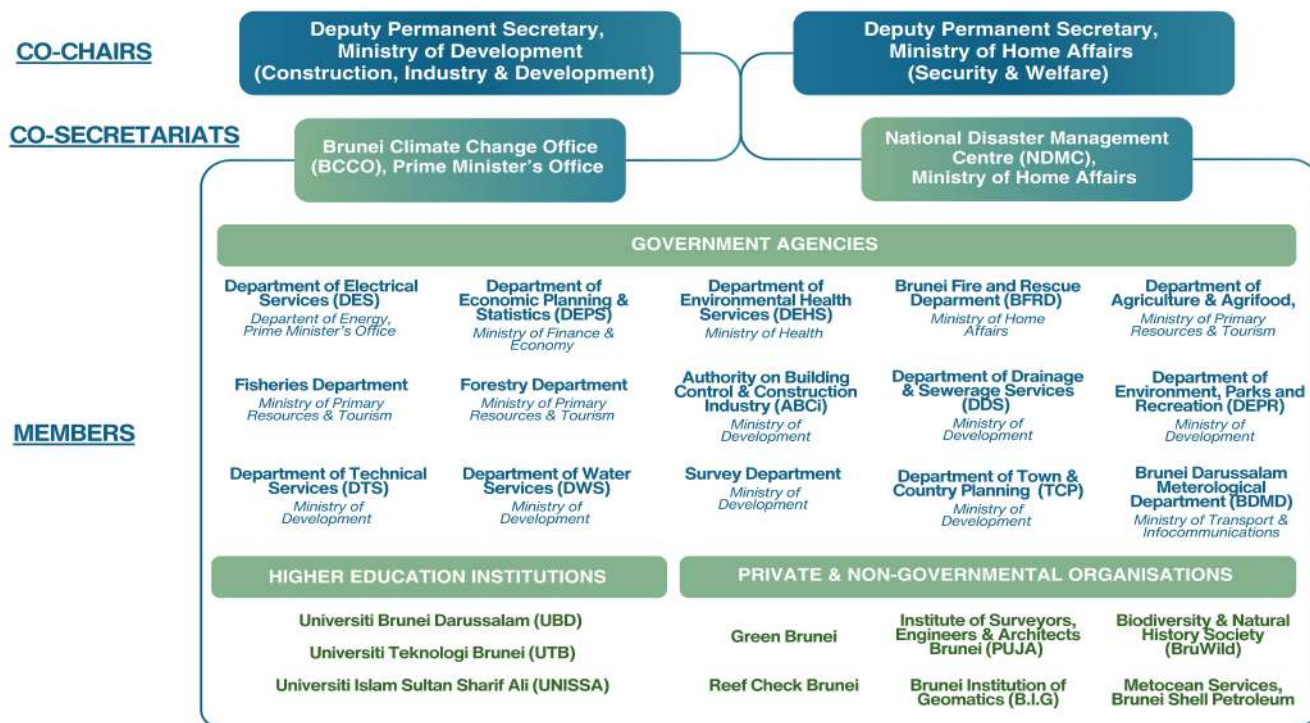
Figure 6: Overview of the ARWG

1.3.3.1 National Disaster Management Centre, Ministry of Home Affairs

The NDMC, under the Ministry of Home Affairs, serves as the primary national agency responsible for implementing Brunei Darussalam's disaster management policies and programmes, as mandated under the Disaster Management Act (Chapter 293). It coordinates national efforts in disaster preparedness, response, capacity building, and multi-agency collaboration, working closely with government agencies, the private sector, NGOs and communities to strengthen national resilience across all phases of disaster management.

In line with the Disaster Management Strategic Policy Framework, the NDMC adopts a Whole-of-Nation approach to reduce disaster risks, enhance early warning systems, improve risk assessments, and mainstream Disaster Risk Reduction and Climate Change Adaptation across sectors, contributing directly to safeguarding lives, protecting national assets, and building a disaster-resilient Brunei Darussalam.

Strategic Framework of the National Adaptation Plan

2.1 Importance of NAP to Brunei Darussalam and its Vision

Despite Brunei Darussalam's relatively low global GHG emissions of less than 0.02%, the Sultanate is not exempt from the impacts of climate change, such as extreme weather events and rising sea levels. Considering the country's vulnerable geographic location and economic landscape, it does recognise the inherent value in urgently taking actions to mitigate and adapt to climate-induced disasters, which otherwise may lead to increased costs through repair and recovery efforts.

In 2023, the country initiated its NAP process through a comprehensive "Whole-of-Nation" approach, aiming to establish robust climate adaptation planning and strengthen adaptive capacity. This underscores the nation's proactive commitment to tackling climate risks, guided by the best available data and science to formulate strategies tailored to Brunei Darussalam's context, while creating an enabling environment to mobilise actions.

As such, the vision of the NAP is to build a climate-resilient and adaptive society where communities, ecosystems and the economy still thrive despite the challenges posed by climate change. This will be achieved by the identification and implementation of context-specific strategies that reduce climate-related loss and damage, as well as by integrating climate adaptation into national priorities, policies and programs to ensure a sustainable, equitable and prosperous future for all.

2.2 Objectives of NAP

The NAP offers a valuable opportunity for Brunei Darussalam to reduce its vulnerability to climate change impacts by building its adaptive capacity and enhancing climate resilience through the facilitation and implementation of well-defined and coherent adaptation strategies, plans and projects. This effort is also consistent with supporting **the Global Goal on Adaptation (GGA), under Article 7.1 of the Paris Agreement, in "enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change."**

Specifically, the objectives of NAP are to:

1. **Outline the key priority climate hazards, their impacts, and existing strategies**, which will serve as the baseline for conducting more detailed risk assessments and developing targeted adaptation strategies, plans and projects;

2. **Facilitate the integration of climate adaptation considerations into national planning, coordination, and implementation processes**, including relevant new and existing policies, programmes and activities, by active engagements with various government agencies, academia, NGOs and the private sector across key sectors; and

3. **Align adaptation strategies, plans and projects with both national and international commitments** to maximise their impacts, while promoting harmonisation with existing obligations, visions and frameworks, e.g., Brunei Darussalam's Nationally Determined Contributions (NDCs), *Wawasan* 2035, Sendai Framework for Disaster Risk Reduction and Sustainable Development Goals (SDGs).

2.3 NAP Formulation: Processes and Approaches

A technical guideline on the NAP process was developed by the Least Developed Countries Expert Group (LEG) and adopted at the 17th COP in 2011. Recognising that these technical guidelines are non-prescriptive and that there is no universal approach to adaptation planning, Brunei Darussalam has exercised maximum flexibility by utilising all available and appropriate data and tools suited to its context.

Given that this is the first NAP formulated for the nation, Brunei Darussalam placed a particular emphasis on laying down the groundwork. This entailed building a robust institutional arrangement and fostering collaboration across various sectors and levels of society, enabling a strong foundation for effective coordination, ownership and monitoring of the NAP process.

Additionally, the country carried out a national stocktake on the available climate change hazards, their impacts and present adaptation-linked strategies, as well as assessed critical gaps and needs to be addressed moving forward.

Figure 7: Brunei Darussalam's NAP Formulation Process

Consequently, Brunei Darussalam designed its own 3-step NAP formulation process as shown in Figure 7 and summarised below:

Step 1: Stock-Taking, which involved comprehensive information and data gathering, including both historical climate change trends and future climate projections.

Step 2: Assessing Preliminary Risks to provide a clear understanding of the climate hazards Brunei Darussalam is facing and their respective impacts. Assessments executed included Hazards and Effects Register (HER), Risk Assessment Matrix (RAM), Barriers Assessment (or Swiss Cheese Model) and Bowtie Analysis.

Step 3: Synthesising the NAP Document, including structuring the outcomes from the preliminary risk assessments, as well as acknowledging and addressing any gaps, risks and challenges that emerged during the entire process.

Following the conclusion of preliminary risk assessments, more detailed risk assessments will be undertaken to gain further insights and a deeper understanding of the nation's exposure, adaptive capacity and vulnerability. Hence, **the NAP will remain a living document – regularly improved to incorporate the latest scientific knowledge and technological advancements**. This will ensure that feasible, context-specific implementation strategies are rolled out within identified key sectors, fostering alignment and synergy across multiple sectors to work in tandem, rather than in isolation.

On top of that, a continuous Monitoring, Evaluation, and Learning (MEL) system will be designed as an essential part of the NAP process to ensure that Brunei Darussalam's strategies will remain adaptive, effective and responsive to emerging threats, thereby reinforcing the Sultanate's capacity to navigate a changing climate successfully.

As a whole, **the 3-step process has been carefully designed to align with continuous, progressive, and iterative nature of the NAP, which embodies a country-driven, gender-responsive, participatory and fully transparent approach.**

2.4 Key Sectors for Adaptation

The NAP classified 6 key sectors as national priorities for building resilience and enhancing preparedness (*Figure 8*). By strategically focusing on these sectors, Brunei Darussalam stands poised to not only navigate the complexities of environmental changes but also thrive in the face of adversity.

Not only that, the country recognises the intricate nexus between these sectors where disruptions in one sector can trigger cascading impacts on other interrelated systems. Thus, the NAP emphasises the importance of an integrated approach to maximise the resulting co-benefits.

Figure 8: Brunei Darussalam's Key Sectors for Climate Adaptation

2.4.1 Agriculture and Food Security

Brunei Darussalam has undertaken several initiatives to increase production in agriculture, fisheries, and livestock, while boosting value chain models to achieve self-sufficiency especially in rice production, as it is a staple food and remains a national priority. As a result, food availability remains stable and undernourishment remains low.

Nevertheless, climate change poses a significant threat to agricultural productivity through temperature changes and rainfall patterns. Elevated temperatures can accelerate pest life cycles and enhance their survival rates, while modified humidity and rainfall patterns can foster the proliferation and emergence of plant diseases. Furthermore, reduced and unpredictable rainfall patterns can induce drought stress, impede plant development, diminish yields, and, in extreme instances, result in crop failure. Erratic precipitation also complicates irrigation management and elevates the risk of soil erosion.

Bottom-Trawl Survey

This also affects fisheries and aquaculture productivity. Rising sea surface temperatures, ocean acidification, and changing salinity levels can disrupt fish habitats, migration patterns, and breeding grounds, while extreme weather events may damage fishing infrastructure and aquaculture systems. In addition, altered rainfall and runoff patterns may affect coastal ecosystems and water quality, influencing the survival and growth rates of fish and shellfish.

The combined effects of the factors mentioned above can lead to significant fluctuations in the supply of agricultural and fisheries products. When supply decreases due to climate-related impacts, and demand remains constant or even increases with a growing population, the prices of food can rise. This can have significant implications for food security, particularly for vulnerable populations with limited purchasing power.

Hence, Brunei Darussalam endeavours to boost the resilience of its agricultural and fisheries sector by ensuring stable food production and safeguarding the livelihoods of those dependent on agriculture, fisheries and food-related sectors in the face of climate-related risks.

2.4.2 Biodiversity and Environment

At present, the total forest area in Brunei Darussalam is recorded at 380,000 hectares (ha). Of these, 263,000 ha are primary forests, 112,000 ha are other naturally regenerated forests and around 5000 ha are planted forests. The national forest reserves constitute 41% of the country's total land and are protected by law.

The Sultanate has 7 distinguishable forest types based on their floral composition, forest formations, soil conditions and micro-environment Mangrove Forests, Beach Forests, Freshwater Swamp Forests, Peat Swamp Forests, Heath ('*Kerangas*') Forests, Mixed Dipterocarp Forests and Montane Forests.

Mangrove Forest
Photo by the Forestry Department

Despite its relatively small land area, Brunei Darussalam harbours remarkable floral richness. At present, the country has documented a total of 204 families of angiosperms and gymnosperms, representing 1,088 genera and 5,221 species. A total of 71 species identified are known to be endemic to the country. The country's faunal diversity is equally impressive, with 186 species of mammals, 534 species of birds, 89 species of amphibians, 132 species of reptiles and 260 species of arachnids. This diverse array of flora and fauna underscores Brunei Darussalam's ecological

significance and its vital role in preserving regional biodiversity.

Moreover, the Government has implemented numerous measures, initiatives, policies and regulations to protect the environment. A notable example is the Environmental Protection and Management Act, Chapter 24, which seeks to protect and properly manage the environment by preventing or minimising pollution through mechanisms such as Environmental Impact Assessments and Environmental Management and Monitoring Plans. The country also frequently boasts of having the safest and cleanest air, which is attributed to robust air quality monitoring and strict regulations on open burning.

But climate change threatens to undo the good progress made. Extreme weather events can cause extensive damage to ecosystems and heighten the risk of pests and diseases, which may lead to the loss of important species and habitats. Therefore, Brunei Darussalam seeks to safeguard its rich biodiversity through enhancing ecosystem resilience and ensuring that environmental health is retained.

2.4.3 Health and Livelihoods

The Government of Brunei Darussalam provides comprehensive, as well as accessible and free health services for its citizens. This aligns with the country's commitment to strengthening the healthcare system through the principles of Universal Health Coverage, ensuring the provision of services that are fair and accessible to all.

However, climate change presents multifaceted challenges to the health sector. Rising temperatures can exacerbate heat-related illnesses, particularly among vulnerable populations, and may also influence the transmission dynamics of vector-borne diseases such as dengue. Changes in rainfall patterns, leading to both increased flooding and prolonged dry periods, can impact water quality and sanitation, potentially increasing the incidence of water-borne diseases. Furthermore, extreme weather events can damage healthcare infrastructure, disrupt essential medical service delivery, and impede access to medical care.

Surveillance Centre for Vector-borne Diseases
Photo by the Ministry of Health
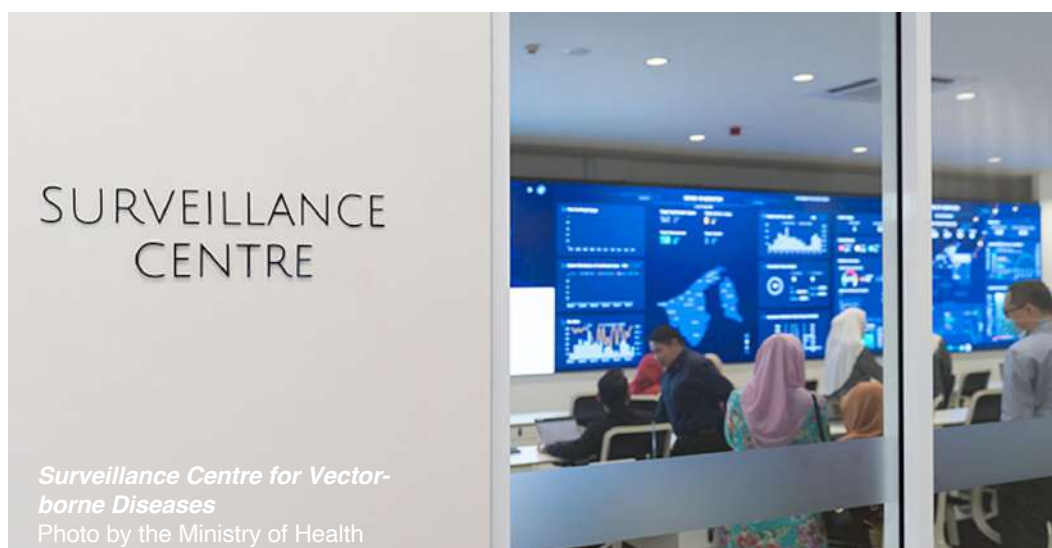
Health also plays a huge role in influencing an individual's capacity to sustain their livelihoods, as poor health can affect their ability to work, which may limit their productivity and income generation. This can exacerbate existing inequalities, particularly in vulnerable communities, where poverty, food insecurity, and health disparities are more pronounced.

While Brunei Darussalam carries out proactive measures to prevent and minimise the adverse impacts of climate change on health and natural disasters through strategic preparedness, mitigation, and recovery efforts, the interconnectedness between health and livelihood necessitates a robust system to protect the well-being of Brunei Darussalam's population in the face of a changing climate.

2.4.4 Infrastructure and Urban Resilience

The nation has long provided facilities such as transport (roads, ports, airports), energy (generation, grids, pipelines), water and sanitation systems, telecommunications and digital networks, and housing and public facilities, that are critical not just for economic activity, but also for public health, safety, and quality of life.

BFRD responds to roof damage caused by strong winds
Photo by the Brunei Fire & Rescue Department

DTS clears landslide blocking road in Temburong
Photo by the Department of Technical Services

One example is the preparation and review of the National Land Use Master Plan (NLUMP), which provides policies and guidance to coordinate the country's overall land use allocation, conservation, and development needs. Besides that, other initiatives that have helped in promoting green building and sustainable practices within the construction industry include the Brunei Accredited Green Unified Seal (BAGUS), which accredits non-residential buildings which meet the Green Building Certification criteria, alongside the adoption of the Green Rating System and Sustainable Products Scheme. To encourage the adoption of green building technology in development, a number of planning incentives are offered at the planning permission application process based on the respective green mark grading.

The nation continues to expand and improve the provision of services towards the population, exemplified by the installation of the 1.2 MW Tenaga Suria Project to diversify power generation sources, and the enactment of the 2023 Energy Efficiency (Standards and Labelling) Act to promote

energy-efficient appliances. Besides that, connectivity remains a high priority, with nearly 99% of the population having access to mobile cellular networks in an increasingly digital era. Since the 1970s, Brunei Darussalam has also long believed in access to affordable and quality housing, which is being supported through the national housing scheme.

But extreme weather events such as floods, heatwaves, and storms brought upon by climate change can wreak havoc on these critical systems, leading to the disruption of essential services and undermining the overall quality of life on a socioeconomic level. Hence, the Sultanate aims to create a safe, sustainable, and climate-resilient urban environment that can adapt to and address the impacts of climate change.

2.4.5 Marine Protection and Coastal Resilience

Brunei Darussalam diligently monitors ocean acidification and its marine health to preserve the marine food chain and ultimately, the nation's food security, with marine acidity levels having remained stable between pH 6 and 8 since 2015. The Sultanate has also implemented reef restoration projects to rehabilitate degraded coral reefs due to ocean acidification.
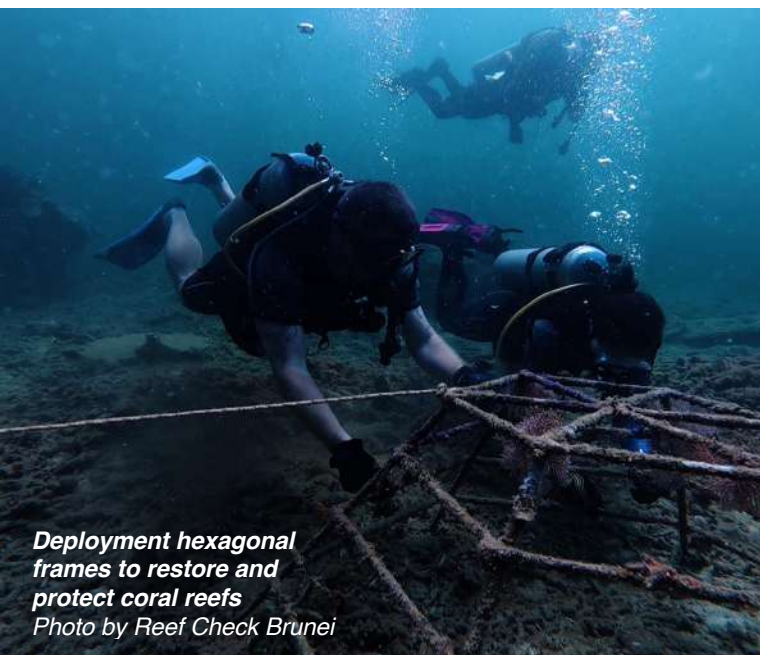
Deployment hexagonal frames to restore and protect coral reefs
Photo by Reef Check Brunei

The country continues to protect its 130-km coastline, with over 57 km safeguarded through coastal mitigation measures such as sand nourishment, coastal barriers, seawalls, and headlands. Complementing these efforts, flood mitigation strategies have been carried out, such as retention and detention ponds, pump stations, levees, bunds, and tidal barriers.

Even so, the stark reality remains; the country's coastlines have been facing erosion for many years, ranging from beach loss on a small scale to cliff erosion on a larger scale, posing threats to residents, infrastructure and economic hubs situated along the coastline [9] .This can be caused by either short-term events, such as storms, or long-term events, such as tectonic processes.

Thus, the objective of this sector is to strengthen its coastal resilience and ensure the long-term resilience of its marine environments in the face of climate change.

2.4.6 Water Resources

Water is an integral part of life, supporting human health, food security, and ecosystems. Sustainable management of water and sanitation remains as a national priority, with a strong commitment to

ensure water security through 4 key strategies: water balance, water efficiency, water quality and water governance.

Freshwater resources have been facing an increased strain due to growing demands from agriculture, industry, and domestic use. As a result, roughly half of the global population now experiences severe water scarcity, with nearly a quarter experiencing 'extremely high' levels of water stress.[10] This rising demand, aggravated by the impacts of climate change, threatens to worsen water availability.

Climate change is projected to intensify the global water cycle, leading to more erratic weather patterns, where some regions may face wetter conditions i.e., flooding, whereas others may experience dry spells and severe droughts. Furthermore, rising sea levels can lead to saltwater intrusion into coastal freshwater sources, compromising the availability of safe and potable drinking water.

Bukit Barun Water Treatment Plants
(Photo Credit: Department of Water Services)

Nevertheless, Brunei Darussalam remains committed to ensuring clean and reliable water resources for its entire population, despite climate-related disruptions.

Climate Change Impacts in Brunei Darussalam

The first step in Brunei Darussalam's NAP formulation process is to undertake stocktaking, which is vital to gain a clear understanding of the nation's climate situation. This process helps identify and address existing data gaps and inconsistencies, which, if left unaddressed, could undermine the reliability of climate projections and weaken confidence in adaptation planning and decision-making.

This chapter expands on observed historical climate trends, including climate-induced disasters and future climate projections. The data, compiled from various sources, are summarised in Table 1.

Table 1: Type and Source of Data Compiled for NAP

DATA REQUIRED		SOURCES
Climate Trends	Temperature	Brunei Darussalam Meteorological Department, Ministry of Transport and Infocommunications
	Rainfall	Brunei Darussalam Meteorological Department, Ministry of Transport and Infocommunications
	Sea level	Survey Department, Public Works Department, Ministry of Development; and Brunei Shell Petroleum Metocean Services
Climate Induced Disasters	Forest and Bush Fires	Brunei Fire and Rescue Department, Ministry of Home Affairs
	Flash Flood & Flooding	National Disaster Management Centre, Ministry of Home Affairs; and Department of Drainage and Sewerage, Public Works Department, Ministry of Development
	Landslides	Department of Technical Services, Public Works Department, Ministry of Development
	Fallen trees & rooftops blown away due to strong winds	Brunei Fire and Rescue Department, Ministry of Home Affairs

3.1 Historical climate change trends

Historical data on extreme weather and climate is essential for managing risks and/or potential opportunities that affect communities, natural ecosystems as well as the economy. By observing past climate patterns and events, Brunei Darussalam can identify trends and construct informed projection models. These insights will aid in the development of well-grounded adaptation strategies, plans and projects that are corroborated with real-world evidence.

3.1.1 Temperature

Global Trends

The IPCC AR6 remarked that the global surface temperature was 1.09 (range: 0.95 to 1.20) °C higher in 2011-2020 compared to 1850-1900, which is primarily contributed due to GHG emissions released from human activities.[11] Additionally, global mean temperature saw that the past decade (2015–2024) was individually the 10 warmest years on record, with 2024 being the warmest at 1.55°C ±0.13°C.[12]

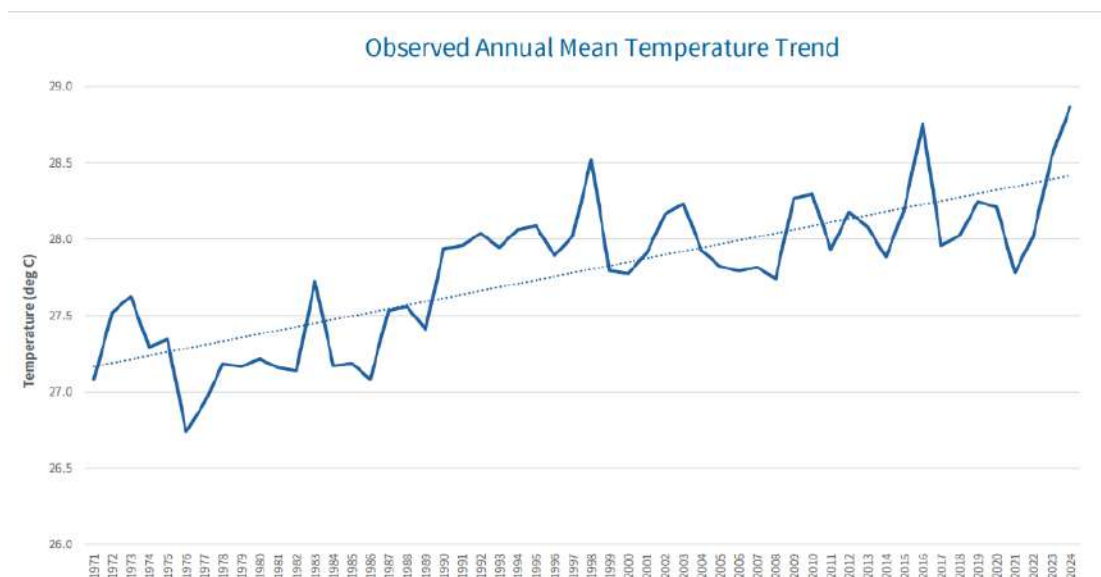**Brunei Darussalam Trends**

Figure 9: Brunei Darussalam's Annual Mean Temperature (1971–2024)

Annual mean temperature has increased by 0.24°C per decade from the years 1971 to 2024 (*Figure 9*). **The year 2024 was the warmest year on record for Brunei Darussalam, with an annual mean temperature of 28.9°C, which is 0.8°C above the long-term average of 28.1°C.**
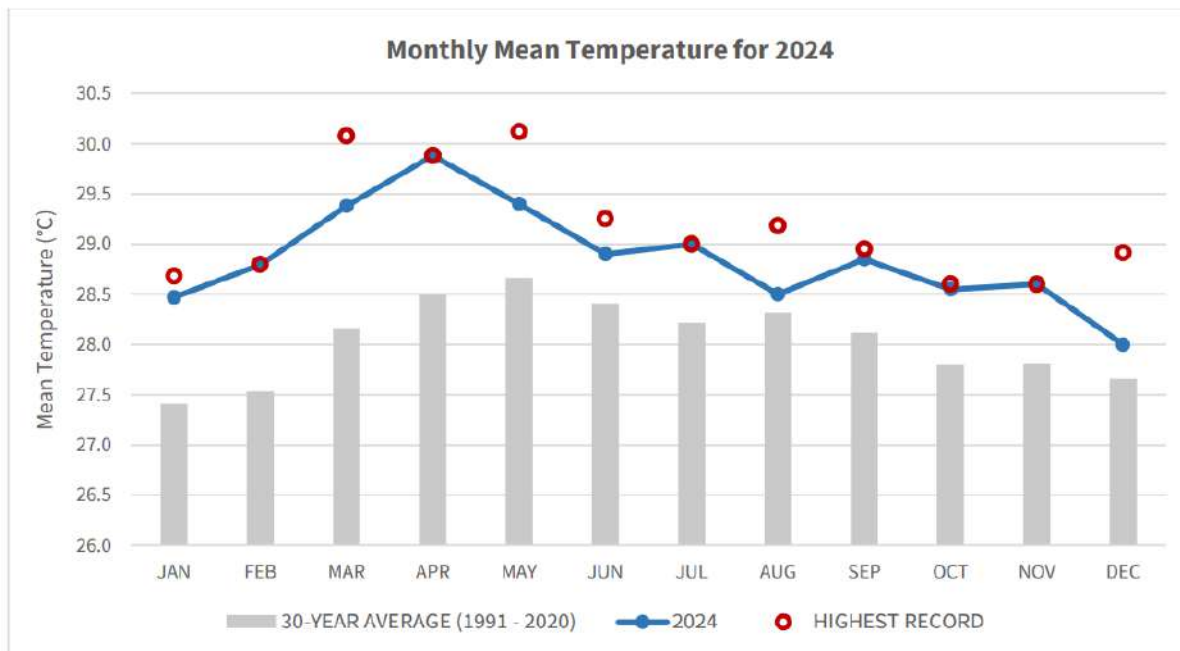
Figure 10: BIA Climate Station's Monthly Mean Temperature for 2024

In 2024, monthly mean temperatures at Brunei International Airport (BIA) were consistently above the long-term average (*Figure 10*). The month of April was the hottest of the year, recording a mean temperature of 29.9°C, which was 1.4°C warmer than the long-term mean for April. Not only was April 2024 the hottest month of the year, but it also stands out as the hottest April in the past two decades in Brunei Darussalam. Additionally, the monthly mean temperatures for February, April, July, and November 2024 all reached record-breaking highs since national records began in 1970.

The highest daily temperature of the year was observed on 30 March, reaching 36.9°C. At Brunei Darussalam's official climate reference station, BIA, the decadal mean temperature for 2015–2024 reached 28.3°C, exceeding the previous decadal record of 28.2°C (2014–2023). This marks a continued warming trend at the national scale. **In summary, this national warming trend mirrors the global climate temperature trend.**

3.1.2 Rainfall

Global trends

Besides rising temperatures, the IPCC AR6 reported that there is **strong evidence that both the frequency and intensity of heavy precipitation events have increased since the 1950s**. Despite varying confidence levels across regions, it is agreed that human-induced climate change is likely the main driver behind this phenomenon.
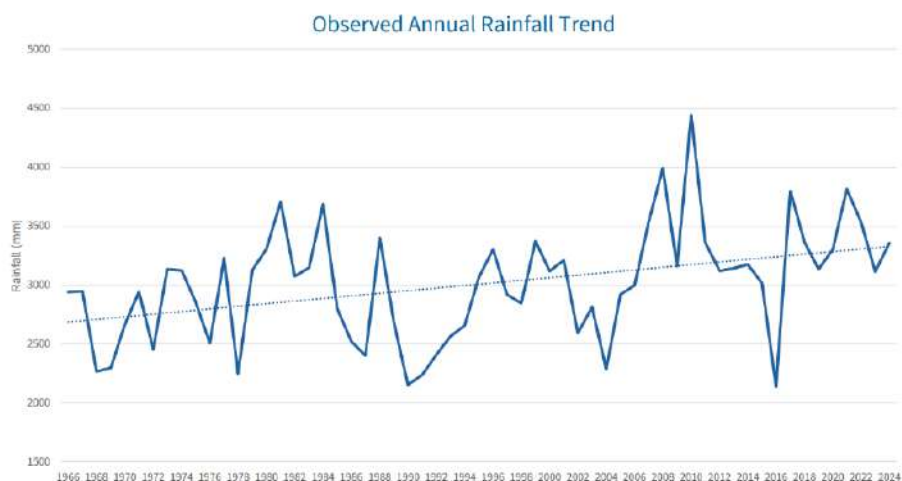
Brunei Darussalam Trends

Figure 11: Brunei Darussalam's Annual Rainfall (1966–2024)

Annual rainfall trend in the Sultanate has increased by 110 mm per decade from the years 1966 to 2024 (*Figure 11*). Near-average annual total rainfall was recorded at the BIA Station in 2024. The annual total of 3356.5 mm is about 9% above the long-term average of 3065.9 mm. The station also observed a total of 212 raindays in 2024, which is around the long-term average of 211 raindays.
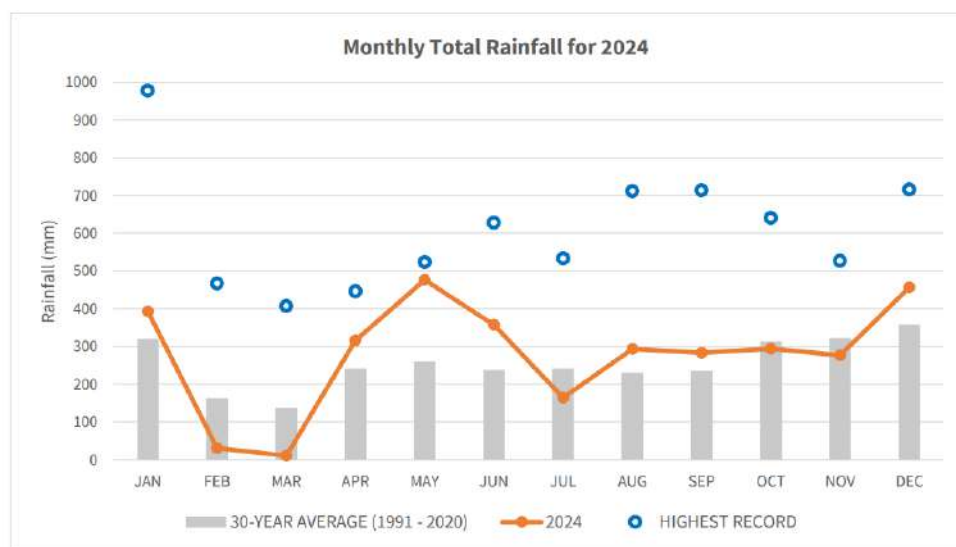
Figure 12: BIA Climate Station's Monthly Total Rainfall for 2024

A mixture of mostly above-normal and some normal-to below-normal monthly total rainfall was observed in 2024, as shown in Figure 12. Seven months in 2024 (January, April, May, June, August, September, and December) recorded above-normal monthly total rainfall.

The year's wettest month was in May with a total rainfall of 476.5 mm, which is more than 80% of the month's long-term average of 260.3 mm. Three out of twelve months (February, March, and July)

recorded below-normal monthly total rainfall (*Figure 12*). The driest month of 2024 was in March with a total rainfall of only 11.0 mm, which is about 92% below the month's long-term average.

Figure 13: Brunei Darussalam's Annual Total Rainfall Distribution for 2024

The inland areas of Brunei, particularly over Belait, Tutong, and Temburong districts, recorded more annual total rainfall compared to other areas of the country (*Figure 13*). **The main climate driver that influences Brunei's climate is the El Niño Southern Oscillation (E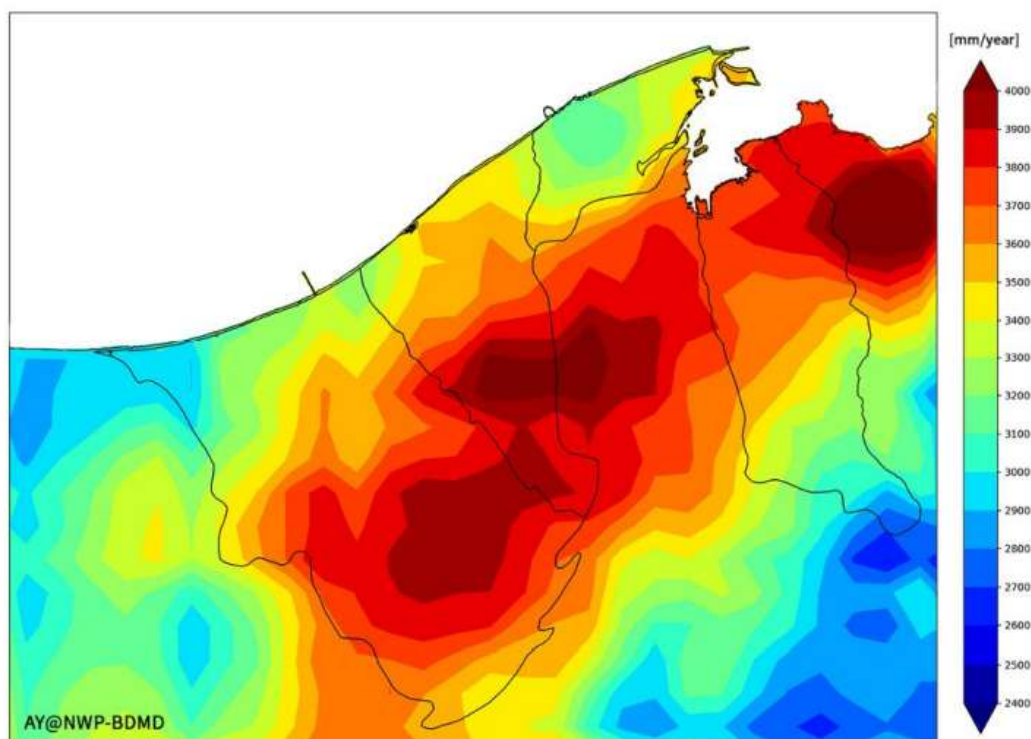NSO), whereby El Niño episodes will observe drier-than-average conditions, while La Niña episodes will bring about wetter-than-average conditions**. Despite this, not every El Niño or La Niña event will have the same impact on Brunei Darussalam's rainfall.

3.1.3 Overview of historical climate indices in Brunei Darussalam

Besides this, climate indices were calculated to describe the state and changes in the climate system. This allows a statistical variation study of dependent climatological aspects such as analysis and comparison of time series, means, extremes and trends. Table 2 shows the trends for both temperature and rainfall.

In summary, **both temperature and rainfall exhibit an upward trend** across the country. The climate indices (*Table 2*), which were calculated to describe changes in the climate state and to track climate variability for long-range weather forecasting trend analysis, support the previous statement.

Table 2: Summary of Climate Indices and Trends on Temperature and Rainfall

NO	INDEX	TREND/RATE
	Temperature	
1	Warmest Day Trend (TXx)	+0.12°Cper decade
2	Maximum Temperature Above the Median Temperature (TXgt50p)	+5.66% per decade
3	Amount of Hot Days (TX90p)	+2.73% per decade
4	Unusual Hot Weather (TXge34)	+4.44 days per decade
5	Maximum Temperature at least 35°C (EHW) (TXge35)	+0.69 days per decade
6	Coldest Night Trend (TNn)	+0.36°C per decade
7	Amount of Warm Nights (TN90p)	+6.37% per decade
8	Warm Spell Duration Index (WSDI) (TX90pge3days)	+5 days per decade
	Rainfall	
9	Amount of Heavy Rain Day (R40mm)	+1.33mm per decade
10	Amount of Rainfall from Very Wet Days (R95p)	+46.96mm per decade
11	Amount of Rainfall from Extremely Wet Days (R99p)	+0.6mm per decade
12	Contribution from Very Wet Days (R95pTOT)	+0.39% per decade
13	Consecutive Wet Days (CWD)	-0.26 days per decade
14	Consecutive Dry Days (CDD)	No significant trend

3.1.4 Sea level rise

Global trends

It is undeniable that the rate of sea level rise was increased over the years. IPCC AR6 reported that the average rate was 1.3 mm/year between 1901 and 1971, which later increased to 1.9 mm/year between the years 1971 and 2006. This figure would later surge at an alarming rate of 3.7 mm/year between 2006 and 2018. Similar to global mean temperature, human influence was identified as the principal driver of sea level rise since at least 1971.[13]

Brunei Darussalam Trends

It is difficult to ascertain the sea level rise trend in Brunei Darussalam, as there is only one data point that can be referred to. A 2021 preliminary study conducted by the Survey Department and Department of Technical Services, Public Works Department, Ministry of Development looked into areas that are potentially subjected to coastal inundation by 2100 based on 3 different scenarios:

1.   0.5m sea level rise;
2.   1.1m sea level rise; and
3.   1.1m sea level rise and tide.
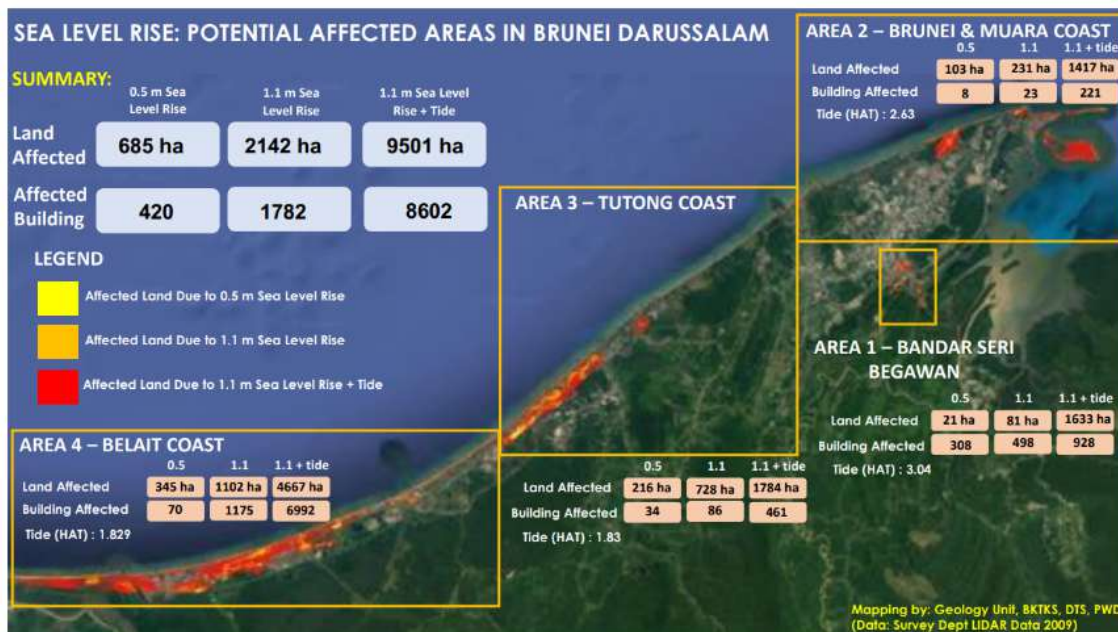

Figure 14: Potential Affected Areas from Sea Level Rise by 2100

However, these projections bring about a high level of uncertainty due to a number of reasons. Firstly, there is no continuation of the study, which may not reflect the changing state of the climate. Secondly, the trend was derived using a satellite altimetry approach. However, the satellite paths utilised in the

study did not align directly with the coastal waters of Brunei Darussalam, but rather closer to the Malaysian region of Sarawak. This makes it challenging to determine the actual sea level rise, specifically on the coast of Brunei Darussalam. Lastly, the projections do not represent the entire country, with the Temburong district being excluded, thus, leaving a significant number of the population and assets unrepresented.

Additional efforts have also been made to collate and extrapolate data sourced from satellite altimeters and offshore platforms via the Survey Department, Public Works Department, Ministry of Development and Brunei Shell Petroleum Metocean Services, respectively. It was analysed that the country's water level has increased about 5.00 to 5.5mm/year, with sea level rise projected at a range of 0.44 to 0.45 m by the end of the 21st century. Despite this, the figures are only initial and may be understated.

These uncertainties bring about high risks to the Sultanate, especially when rising sea levels are compounded by other factors such as land subsidence. Based on Figure 14, **the preliminary study indicated that the Belait district is projected to be the most impacted by sea level rise, a situation further exacerbated by the district also experiencing land subsidence at a rate of 30 mm/year.**

3.2 Historical climate-induced disasters in Brunei Darussalam

This section elaborates on the historical climate-induced disasters in the country between 2012 and 2024, such as forest and bush fires, flash floods and flooding, landslides, alongside fallen trees and rooftops blown away due to strong winds. These events can help deepen the understanding of climate patterns and the risks they pose to communities and the environment.

3.2.1 Forest and Bush Fires

Figure 15 shows the total number of both forest and bush fire incidents over the 2012–2024 period.
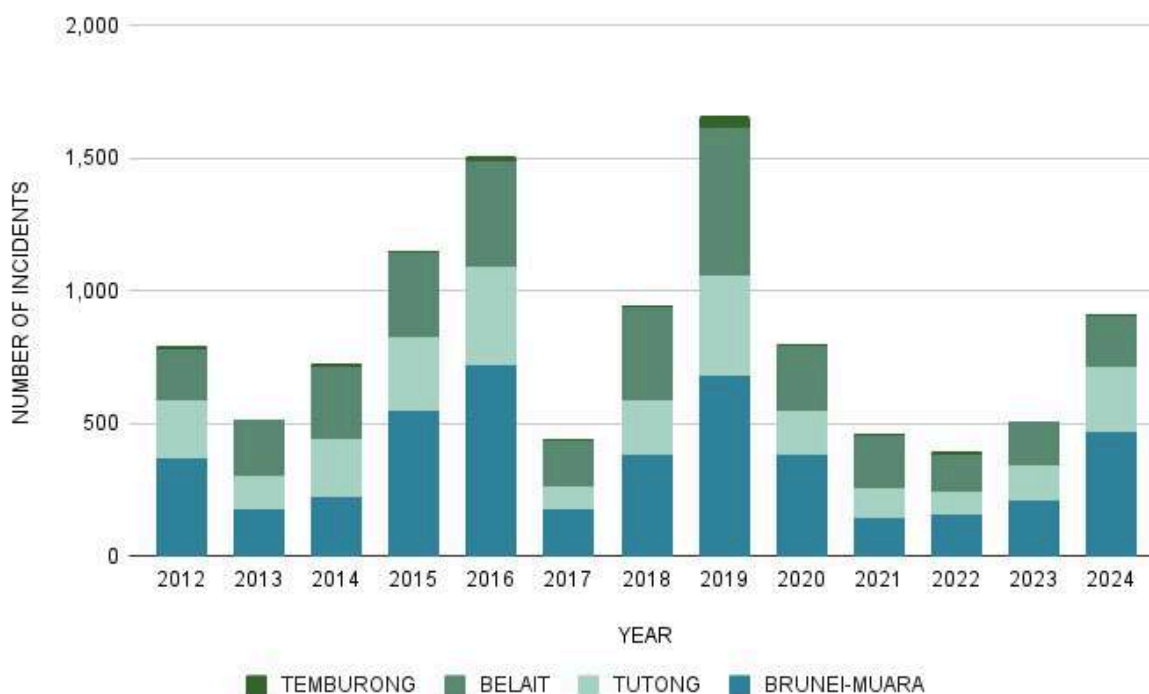
Figure 15: Total Incidences of Forest and Bush Fires in Brunei Darussalam (2012–2024)

The primary cause of these fires is often difficult to determine, as they may unintentionally result from various human activities such as regulated open burning for land clearing related to agricultural and development projects, as well as improperly extinguished campfires in recreational areas. However, this also exacerbates the risk of fires, particularly during El Niño periods when hotter and dry conditions prevail. These became evident in 2016 and 2019, as both years coincided with the El Niño period.

The Brunei Muara district reported the highest number of fire incidents over the 2012–2024 period, which may be attributed to its high population density and urban activity, leading to a greater likelihood of incidents being reported. On the other hand, the second highest number of incidents in the Belait

district is typically due to the Badas peat swamp forest fires that occur along the highway. Industrial and residential infrastructure development around the area have resulted in a lowered water table, causing dried-out peat conditions and making it more susceptible to igniting fires. Most incidents have typically been surfaced fires that occur near highways, causing disturbances in road visibility and air quality.

3.2.2 Flash Flood and Flooding

Brunei Darussalam experiences 2 types of flooding: (i) flash flood and (ii) slow-onset flooding.

Flash flood and flooding are not the same; flash flood is sudden onset within minutes to hours caused by intense rainfall over short period, while flooding is slow onset over hours or days, often due to prolonged rain, river overflow or tides.

a) Flash flood
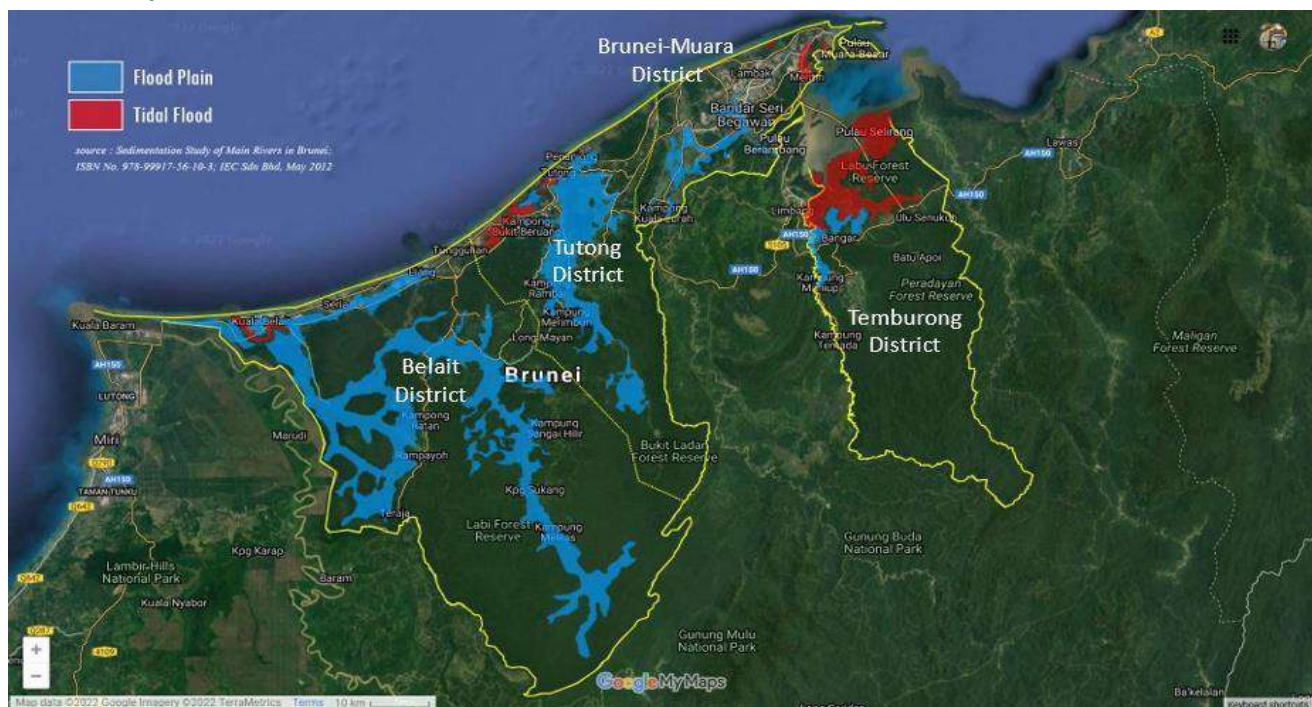
Figure 16: Brunei Darussalam's Flood Mapping Based on Flood Types

These can be further subcategorised into **3 types**:

1) **River flood plain**: Occurs when prolonged heavy rainfall causes rivers to exceed their capacity, resulting in overflow surrounding low-lying areas adjacent to the riverbanks.

2) **Tidal flooding**: Occurs when high tides coincide with storm surges or strong wind conditions during extreme weather events. This leads to elevated water levels, where the water will inundate low-lying areas, generally along the estuaries of the main rivers.

3) **Localised flooding**: Occurs frequently due to obstruction of drainage channels or inadequate culverts or bridges to handle excess runoff.
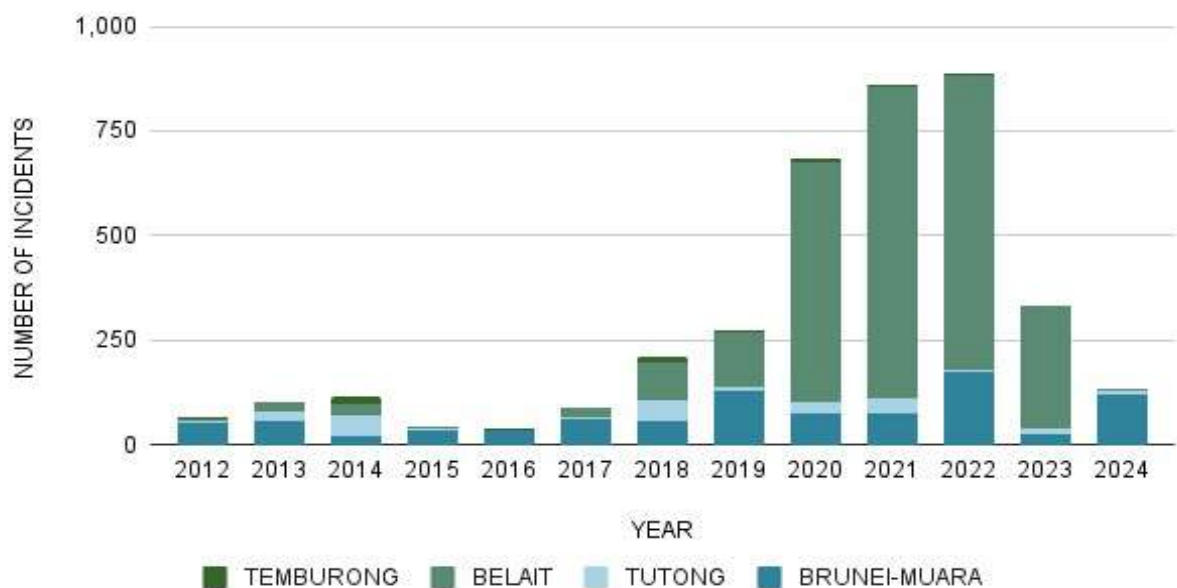
Figure 17: Total Incidences of Flash Floods in Brunei Darussalam (2012–2024)

Figure 18: Flood-prone Areas in Brunei Darussalam

While Figures 17 and 18 show that Belait and Tutong districts are prone to river floodplain flooding and Temburong district is likely to experience tidal flooding, Brunei Muara district recorded the highest number of flood cases. Coincidentally, this district is the most urbanised area with rapid development which may overwhelm existing drainage systems. This was evident during the high influx of flash floods events reported between 2018 and 2022. Nonetheless, this does not understate the significance of flood incidents in the other districts.

b) Flooding

Figure 19: Total Amount of Flooding Days in Brunei Darussalam (2012–2024)

Figure 19 shows the total amount of flooding days in Brunei Darussalam, where the Belait district shows that it frequently experienced longer duration of flooding, especially Mukim Sukang and Mukim Bukit Sawat.

To elaborate, the 2 '*mukims*' are sparsely populated and located in remote parts of the Belait District. These areas are known to be challenging in terms of accessibility, especially during prolonged or heavy rainfall. Response time may be slower due to limited road access, long travel distances from emergency services and occasional reliance on river transport. Flooding in these areas may also last longer compared to more urban settings if drainage infrastructure is limited or inaccessible. This reinforces the need for community preparedness.

3.2.3 Landslides
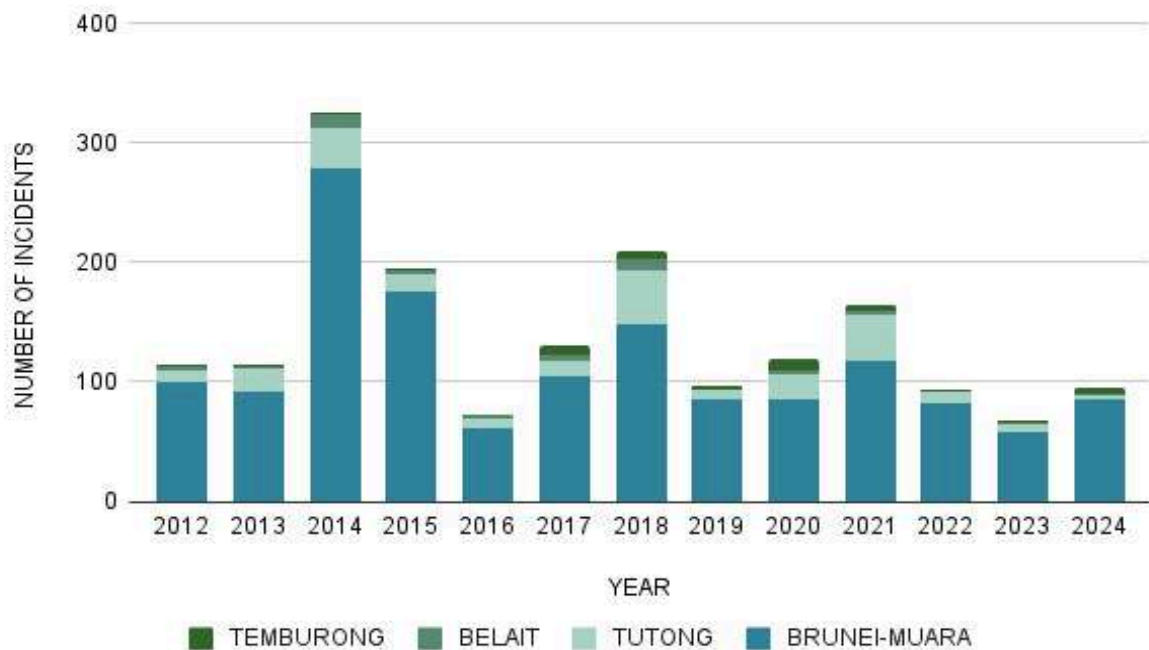
Figure 20: Total Incidences of Landslides in Brunei Darussalam (2012–2024)

Figure 20 shows the number of landslide incidents over the 2012–2024 period. While landslides are infrequent, they mainly occur in developed areas with the Brunei Muara district being the most afflicted. Several factors are at play, such as the location of government and private properties situated within sloping proximity due to soil erosion and ground movement.[14] Monsoon season, which brings continuous rainfall, can further worsen landslide risks, with rain soaking loose soil, turning it into mud and making slopes unstable.

3.2.4 Fallen trees and rooftops blown away due to strong winds

Figure 21: Total Incidences of Strong Winds in Brunei Darussalam (2012–2024)

Apart from wetter conditions, the monsoon season also brings strong winds and storm surges, which increase risks of rooftops being blown away due to ageing infrastructures, as well as fallen trees, as shown in Figure 21.

3.3 Future climate projections for Brunei Darussalam

The cascading impacts of such disasters can destabilise our communities by disrupting livelihoods and services, straining resources allocated towards delivering community disaster aid, repairing and upgrading damaged infrastructure and services, as well as sustaining essential operations and protecting vulnerable populations from prolonged disruption and long-term socio-economic setback.

Future climate conditions were projected under the Coordinated Regional Climate Downscaling Experiment (CORDEX) project– a framework established by the World Climate Research Programme (WCRP) to evaluate and improve regional climate information through a set of standardised experiments. CORDEX provides high-resolution climate simulations that bridge the gap between coarse global climate models and the finer spatial scales needed for local planning. These simulations are developed under various Representative Concentration Pathways (RCPs) or Shared Socioeconomic Pathways (SSPs), representing different GHG emission trajectories and development futures.

For Brunei Darussalam, the CORDEX Southeast Asia (CORDEX-SEA) domain plays an important role in enhancing our understanding of future climate risks. The higher-resolution projections from this

project are critical for identifying localized climate impacts, particularly in a geographically small and climate-sensitive country like Brunei Darussalam. This improved spatial detail supports more targeted climate impact assessments, strengthens the scientific basis for adaptation strategies, and informs policy decisions across sectors.

3.3.1 Temperature

Figures 22 and 23 show the preliminary results based on CORDEX-SEA Phase 1 on temperature projections over the 2006–2099 period. The blue line shows the model with the lowest positive trend, while the red line shows the model with the highest positive trend. The black line represents the mean of a multi-model ensemble derived from the CORDEX-SEA project, which includes outputs from 14 regional climate models.

By averaging these models, the ensemble mean helps reduce uncertainties associated with individual models and provides a more reliable estimate of future climate conditions. This approach is widely used in climate science to better understand projected trends and support evidence-based adaptation planning.
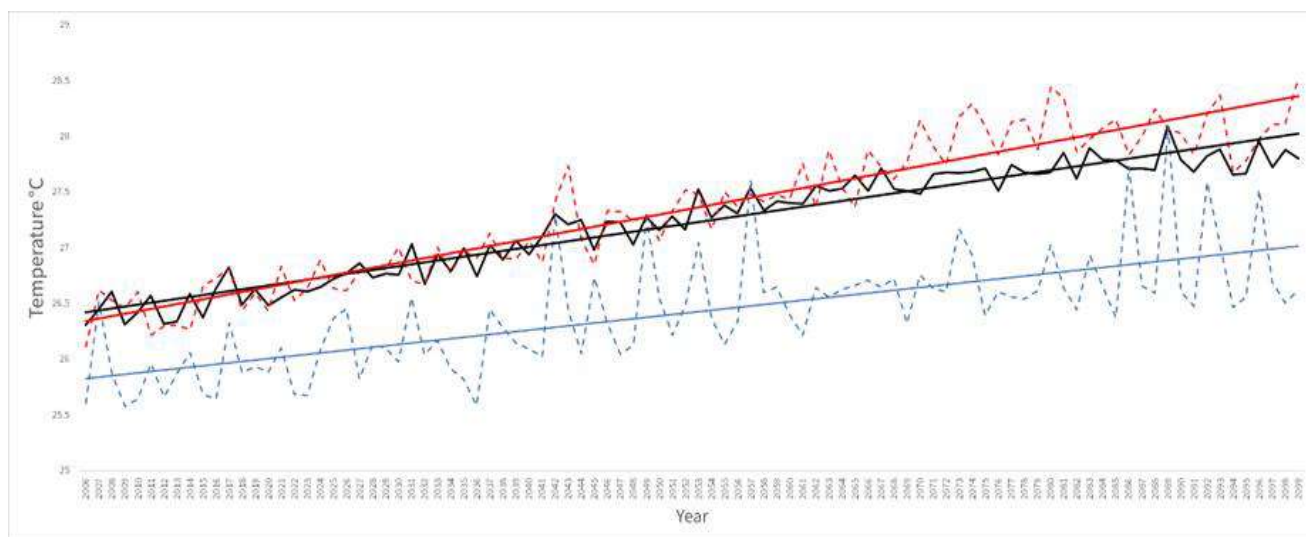
Figure 22: RCP 4.5 Projection of Temperature
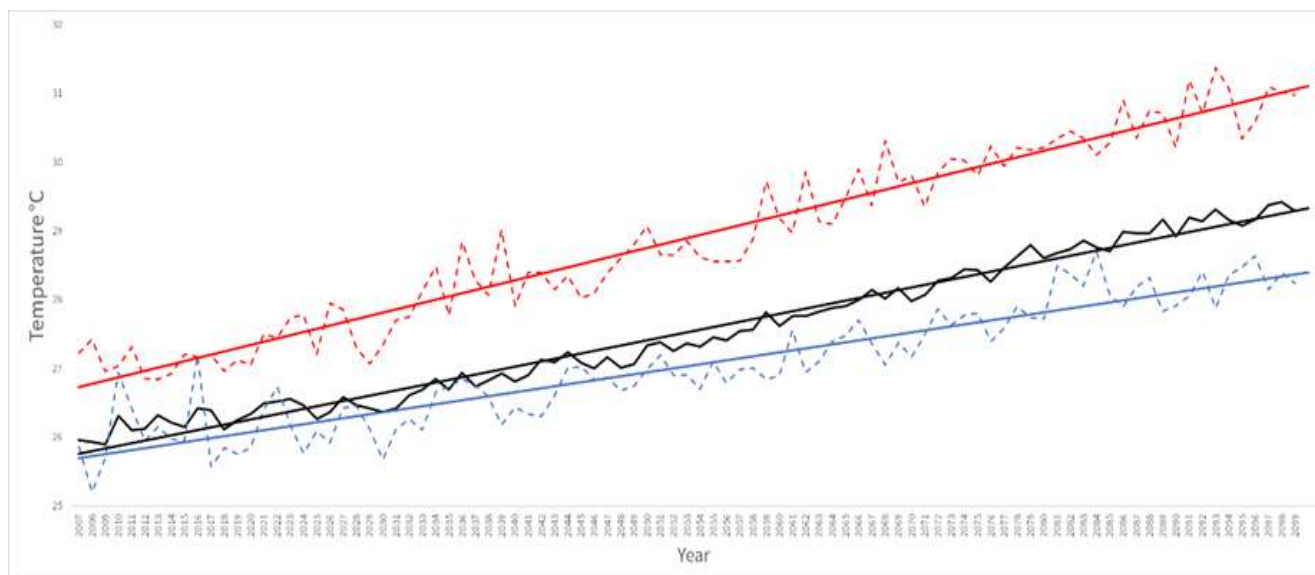
Figure 23: RCP 8.5 Projection of Temperature

3.3.2 Rainfall

Figures 24 and 25 show the preliminary results based on CORDEX-SEA Phase 1 on rainfall projections over the 2006–2099 period. The blue line shows the model with the highest negative trend, while the orange line shows the model with the highest positive trend. The black line shows the mean multi-model ensemble.
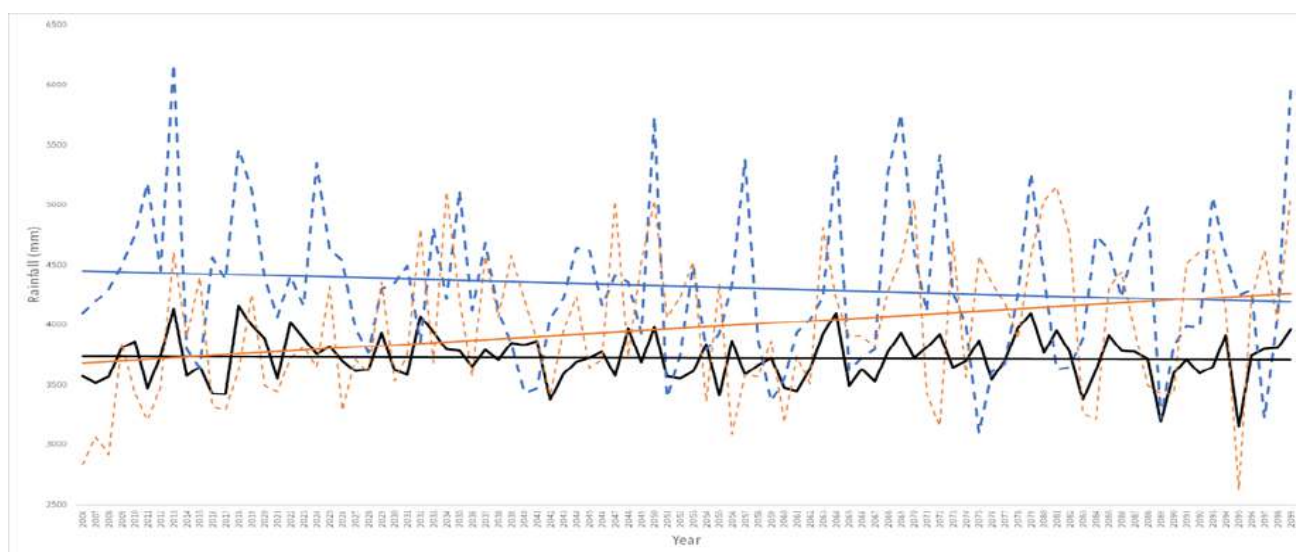
Figure 24: RCP 4.5 Projection of Rainfall
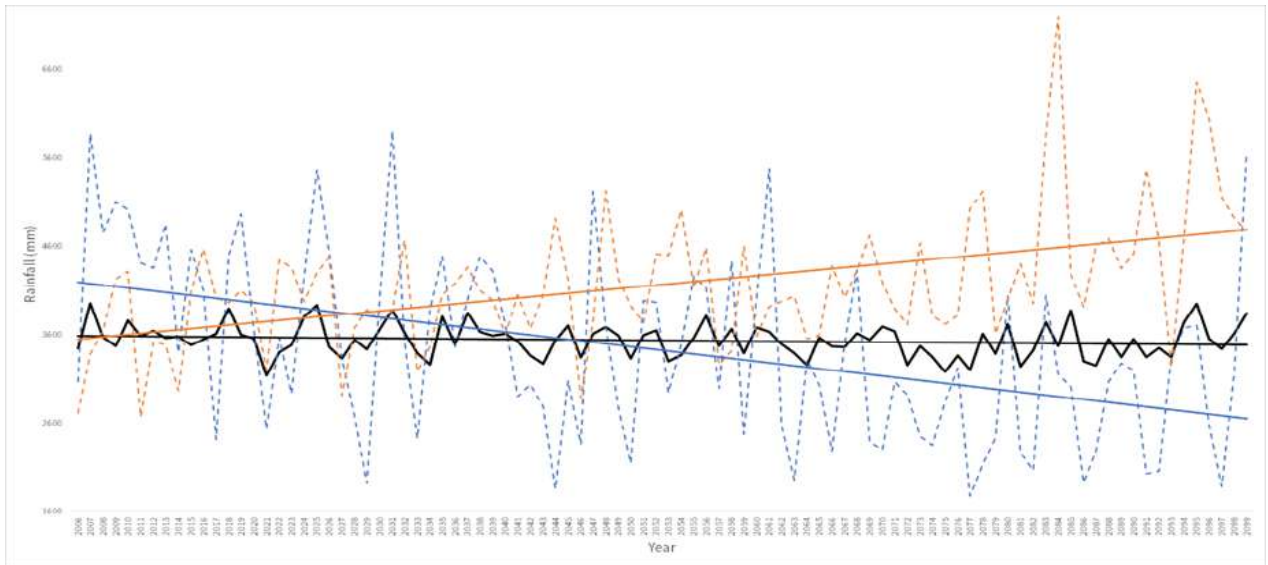
Figure 25: RCP 8.5 Projection of Rainfall

3.3.3 Summary for Future Climate Projections

The projection results for both temperature and rainfall under both RCP 4.5 and RCP 8.5 scenarios can be summarised in the Table 3 below.

Table 3: Projection Trends for Temperature and Rainfall Over the 2006–2099 Period

VARIABLES	SCENARIO RCP4.5	SCENARIO RCP8.5
Annual temperature projections	+0.13°C/decade to +0.22°C/decade	+0.29°C/decade to +0.47°C/decade
Mean multi-model ensemble for temperature projections	+0.17°C/decade	+0.38°C/decade
Annual rainfall projections	-23mm/decade to +63mm/decade	-166mm/decade to +133mm/decade
Mean multi-model ensemble for rainfall projections	-2.8mm/decade	-11.4mm/decade

Overall, projections from multiple experiments under both RCP scenarios indicate a **strong warming agreement in Brunei Darussalam's long-term mean annual temperature**. In contrast, projections for long-term mean annual rainfall show large variability, with models under both scenarios showing increasing and decreasing trends, resulting in no significant trend agreement.

Although projections for long-term mean annual rainfall remain uncertain, it **is more certain that rainfall extremes are expected to intensify**. In other words, wet periods are likely to become wetter and dry periods drier, even if the overall mean annual rainfall does not change significantly. For Brunei Darussalam, this means to a heightened risk of extreme weather events such as flash floods.

Preliminary Climate Risk Assessments in Brunei Darussalam

Climate-induced disasters are not only difficult to predict, but they can also bring severe consequences. Understanding these climate risks is essential for maintaining and enhancing resilience, unlocking opportunities, and ensuring the implementation of pragmatic and effective adaptation strategies, plans and projects. While stakeholders are aware of these risks, many remain insufficiently prepared.

Next, the second step in Brunei Darussalam's NAP formulation process involves executing preliminary risk assessments, specifically on climate hazards and their potential impacts. This chapter presents the findings from several risk assessments conducted to support the NAP formulation, such as HER, RAM and Barriers Assessment (or Swiss Cheese Model) and Bowtie Analysis (*Figure 26*).

Figure 26: Preliminary Risk Assessment Executed

Climate risks and opportunities should be a critical component of any development strategy, guiding risk management, financial, strategic and operational decisions at all levels. Moreover, climate transition and resilience plan to manage these risks should be informed by a quantified assessment of underlying climate risks across a range of scenarios.

4.1 Hazards and Effects Register (HER)

HER was conducted to identify all climate-induced hazards in the country and **assess the potential effects posed to People, Environment, Asset, Reputation and Legal (PEARL) aspects**. This information will be used in the subsequent stages of the risk assessment to guide effective management strategies.

4 key climate risk drivers were identified that influence the likelihood and severity of climate-induced hazards, namely:

Figure 27: Climate Risk Drivers Identified Under HER

The full list of HER can be found in Appendix 1.

4.2 Risk Assessment Matrix (RAM)

Following the identification of HER, the climate hazards and their respective effects on PEARL are further categorised into 2 elements:

1. **Likelihood of occurrence**: This considers various aspects such as applicability to the country, probability of occurrence and the potential timeline.

2. **Severity**: This assesses multiple factors such as the qualitative and quantitative definitions of hazards, stakeholder impacts and any cascading consequences.

SEVERITY >>>		A	B	C	D	E
CATASTROPHIC	5	Tropical Storm	Drought	Thunderstorm New Disease Outbreak	Forest Fire Landslide Haze Sea Level Rise	
MAJOR	4			Higher wave energy at coastal areas Water Pollution	Strong wind Agricultural Pests & Diseases	Flooding Flash Flood Extreme Heat
MODERATE	3	Heatwaves	Land Pollution		Coastal Erosion Coastal Inundation	
MINOR	2					
INSIGNIFICANT OR NO RISK	1					
		A	B	C	D	E
		UNLIKELY OR RARE	POSSIBLE	LIKELY	HIGH LIKELY	ALMOST CERTAIN

>>>LIKELIHOOD>>>

Full elaboration on the scales of likelihood of occurrence and severity can be found in Appendices 2 and 3, respectively.

In brief, Table 4 showcases climate-induced hazards rated by their likelihood of occurrence and severity. The RAM helps visualisation to support strategic planning and resource allocation, enabling effective management, mitigation and neutralisation of risks.

At the moment, Brunei Darussalam is focusing on both Forest Fire and Flooding due to their linkages with the ENSO event.

4.3 Bowtie Analysis

The Bowtie Analysis systematically assesses and outlines both preventive and recovery measures for climate-induced disasters in Brunei Darussalam, especially forest fires (*Figure 28*) and flooding (*Figure 29*).

Figure 28: Bowtie Analysis for Forest Fires

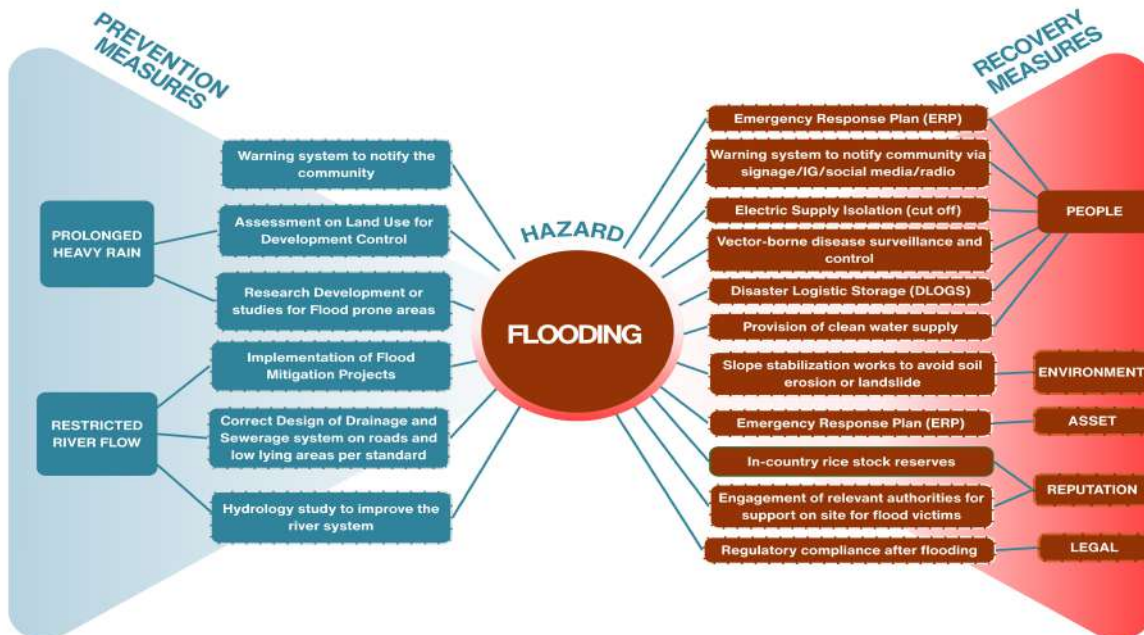*Figure 29: Bowtie Analysis for Flooding*

The outcomes were categorised into strategies to avert **severe impacts (preventive measures) and strategies to address the consequences of disasters (recovery measures)**, specifically in terms of PEARL. These assessments were developed through multi-agency workshops that reviewed existing adaptation, response, and recovery strategies across all relevant sectors

4. 4 National Climate Vulnerability Assessment (NCVA)

Although the preliminary risk assessments have revealed various efforts and initiatives undertaken to address existing hazards, they should not be viewed as the final step. Instead, given the anticipated intensification of climate risks over the coming decades, proactive adaptation planning over a longer time horizon will remain essential.
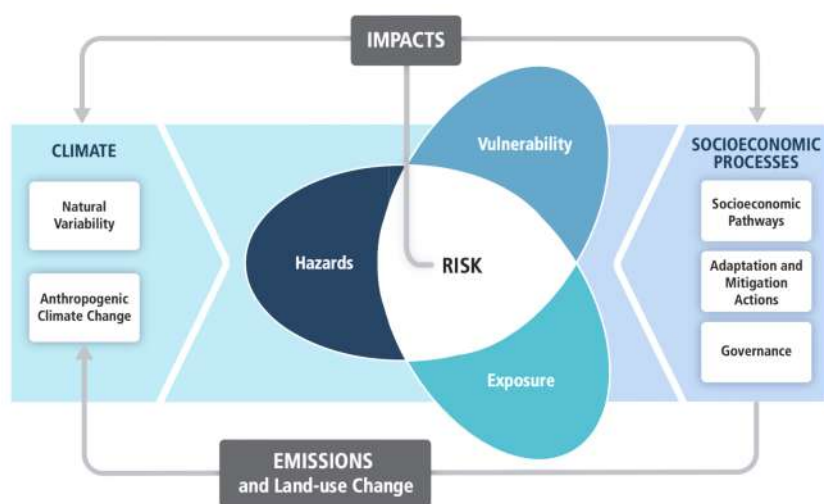
As climate risks result from the interplay of hazard, exposure and vulnerability within both natural and socioeconomic systems, an assessment of vulnerability – determined by both sensitivity and adaptive capacity – will play an integral role in informing the adaptation planning process (*Figure 30*).

Figure 30: Concept of Risk under the IPCC AR5[15]

To elaborate, vulnerability assessments can help illuminate the sources and extent of vulnerability, including the communities and sectors, and inform the prioritisation and allocation of resources based on best available science and technology. This will support the development of adaptation strategies that are targeted, feasible and coherent.

To this end, the country has initiated its National Climate Vulnerability Assessment (NCVA), anticipated to conclude by 2027. An inception workshop was held to determine the prioritised indicators for the 6 key sectors.

These indicators were chosen based on data availability, scale of impacts, the cross-sectoral relationships, as well as alignment to national and international commitments. Furthermore, they were derived and modified from existing frameworks such as the SDGs and the Sendai Framework. However, these indicators are provisional and may undergo revisions to better reflect evolving national and international priorities.

Key Sector	Priortised Indicators
Agriculture & Food Security	1. Fish Stock Population 2. Food Access 3. Food Availability 4. Poultry Mortality
Biodiversity & Environment	5. Air Quality 6. Forest Management 7. Protected Areas 8. Water Quality
Health & Livelihoods	9. Extreme Weather Events 10. Heat-related Illnesses 11. Waterborne Diseases 12. Vector-borne Diseases
Infrastructure & Urban Resilience	13. Assets/ Proximity of Infrastructure including Assets Management & Maintenance 14. Building Codes, Infrastructure & Planning Standards 15. Infrastructure & Building Quality 16. Soil Composition
Marine & Coastal Resilience	17. Coastal Stability and Protection 18. Coastal Tidal Gauging Station 19. Coastal Stability and Protection 20. Health of Marine and Reef Habitats
Water Resources	21. Biological Oxygen Demand 22. Raw Water Storage Capacity 23. Water Infrastructure 24. Water Quality

Figure 31: Prioritised Indicators under the NCVA

Gaps and Challenges for NAP Formulation

A study by Boston Consulting Group (BCG) has found that failing to act on climate change can cost a global economy loss between 11 - 27% of its cumulative GDP by 2100. To illustrate the magnitude of this loss, the same amount is roughly 3 times greater than the world's healthcare spending by the same period.[16] **If Brunei Darussalam follows the same global trajectory, the Sultanate GDP will be substantially affected**. [17]

The current NAP acknowledges the presence of several gaps and challenges that must be addressed. Conducting a thorough gap analysis serves as another foundational step towards enhancing the development, effectiveness and comprehensiveness of future NAPs. This process will help the nation craft more resilient and meaningful national responses to the pressing challenges posed by climate change. Despite the clear economic case for climate inaction, investment in climate adaptation in Brunei Darussalam continues to be constrained by a few barriers. These include:

Table 5: Gaps and Challenges for NAP Formulation

FACTOR	EXPLANATION
Fragmented Policy, Regulatory and Institutional Framework	Climate adaptation considerations and benefits are **often not integrated across national government processes and planning**. This leads to siloed and uncoordinated efforts among stakeholders, resulting in overlapping or conflicting multisectoral adaptation strategies. As a result, the lack of coherence and coordination jeopardises the strategies' effective implementation and limits their overall impact.
Limited Inclusivity and Participatation in Stakeholder Management	While the ARWG comprises of members across the government, private sector, higher education institutions and NGOs, there is a **noticeable gap to fully capture the diverse needs and unique experiences across society**, especially vulnerable groups including women and girls, youth, elderly and the differently abled.

FACTOR	EXPLANATION
High Cost and Restricted Access to Funding	The **absence of climate adaptation considerations and benefits in national government projects and strategies** makes it challenging to identify the financial resources allocated to those efforts, i.e., no climate budget tagging. Moreover, **financial support is primarily sourced from national budgets**, which would demand more funds to be allocated to fully finance adaptation projects and strategies in the long run. There is a need to diversify from other channels, such as technology transfer and know-how from the private sector. Access to international financial support remains hindered due to stringent adaptation criteria that can impede the timely approval and disbursement of funds, further delaying urgent adaptation needs.
Underdeveloped Future-ready Adaptation Skills and Capacity	Skills and capacity building efforts have been predominantly focused on preparedness, response and recovery measures for current climate hazards such as forest fires and flooding. While these efforts are crucial for immediate risk management, a **significant gap still exists in developing expertise for addressing future climate risks such as sea level rise and slow-onset climate risks.** Areas such as **climate modelling, long-term scenario analysis and forward-looking adaptation strategies remain underdeveloped**, limiting the nation's ability to anticipate and prepare for evolving climate risks.
Data, Information Gaps and Biases	At the moment, the Sultanate only collects the frequency and locations of the 4 climate hazards identified, which are typically based on phone calls from the public and redirected to the appropriate agency. This may inadvertently pose a **misguided perception of "at-risk" areas and an overrepresentation of hazards in those locations, as areas with high population density will generate more calls**. Furthermore, the data collected is non-comprehensive as it does not account for other factors such as economic contributions, critical infrastructure, biodiversity significance and others.

Actions and Recommendations for Future Updates to the NAPs

Given the iterative nature of the NAP, these actions and recommendations have been identified to guide the development of future NAPs.

Table 6: Actions and Recommendations for Future Updates to the NAPs

FOCUS AREAS	KEY RECOMMENDATIONS	ACTIONS
NAP	Comprehensive and Holistic NAP	Future NAPs will consider the inclusion of other climate-induced hazards identified in RAM.
	Improvement of Data Collection through Transparency and Accessibility	Establishing a centralised data hub and improving data collection tools to ensure data accuracy. In addition, partnering with local and international bodies to enhance climate data management and transparency.
	Broader Reach of Stakeholder Engagements	Collaborate with a wide range of stakeholders to broaden perspectives on climate impacts in vulnerable areas.
	Mobilising Resources and Finances for Formulation and Implementation Of NAP	To explore innovative climate financing and partnerships. Furthermore, to conduct economic analysis for prioritisation of NAP projects with sectoral strategies and national development plans.
	Strengthening Capacity Building	Build capacity through training, local international collaboration, and targeted programs to upskill staff and recruit experts in climate science, risk assessment, and adaptation planning.

FOCUS AREAS	KEY RECOMMENDATIONS	ACTIONS
MOI	Climate Data and Research	Invest in climate research and leverage expertise across government, academia, NGOs, and the private sector to better understand local impacts and adaptation practices.
	Infrastructure Resilience	Develop and strengthen key infrastructure to address the impacts of climate change, including improvements to seawalls and the development of early flood warning systems.
	Policy and Legal Framework	Review and update existing policies and regulations to align with current climate adaptation initiatives and efforts.
	Public Awareness and Advocacy	Promote and advocate for the NAP by engaging the public through awareness campaigns and community outreach.
	Technology	Investment on modern technology such as satellites, drones, early warning systems, and smart sensors to strengthen data collection, especially in remote or low-data areas.

Monitoring, Evaluation, and Learning

It is equally essential to design and operationalise a robust monitoring, evaluation and learning (MEL) system to complement the formulation and implementation of NAP. This enables the effectiveness and impacts of adaptation strategies to be systematically tracked, assessed, and reported. Moreover, it also provides valuable insights for the continuous refinement and improvement of strategies in order to advance adaptation progress and reduce vulnerability to climate change.

While the significance of the MEL is well recognised, its development is still at a nascent stage and faces additional challenges to define a "successful" adaptation that extends beyond those already outlined in Chapter 5, indicating that further efforts are needed. These include:

Table 7: Factors to Consider for MEL System

FACTOR	EXPLANATION
High Variability for Adaptation Efforts	Establishing a risk baseline is essential for designing and implementing effective adaptation strategies; however, adaptation itself is an ongoing, dynamic process without a fixed endpoint, continuously evolving over time. Consequently, **adaptation efforts will vary depending on the evolving climate conditions, the level of resilience and adaptive capacity developed, and the degree to which vulnerability has been diminished**.
Deficiency of Data and Information to support MEL	As stated in Chapter 5, the current state of data and information—both in terms of quality and quantity— remains insufficient to effectively support the MEL system. The Sultanate has identified several indicators under the NCVA that provide a useful starting point for this effort. However, these **indicators are still provisional and will require time to be refined and adjusted** in accordance with the latest scientific research and knowledge-based information.

Succeessful establishment of the native plant, Bakong (Hanguana anthelmenthica),
in the canals as an alternative nature-based canal blocking solution
Photo by Universiti Brunei Darussalam

Conclusion

The imperative for climate action is unequivocal. While significant efforts have been undertaken to adapt to climate change, there remains consideration scope for improvement such as data collection, resource mobilisation, and capacity building.

Looking ahead, the successful realisation of the NAP requires a strengthened communication and coordination among all stakeholders across the 6 key sectors identified. Effective coordination ensures that adaptation measures are systematically integrated within each agency's mandate and that implementation is consistent and well-aligned, making inter-agency and inter-sectoral collaboration as critical priorities.

While advancing climate adaptation, it is equally important to maintain economic growth. As a developing country with an economy predominantly reliant on oil and gas, **Brunei Darussalam will continue its efforts toward sustainable economic diversification in parallel with climate mitigation and adaptation**. This approach will be instrumental in helping the nation to reap long-term mitigation as well as adaptation and resilience gains, while ensuring the economy remains both competitive and sustainable.

Additionally, progress cannot rely solely on national efforts. Adaptation transcends national interests and stands as a global necessity, especially as the world remains far from meeting the Paris Agreement goal to limit warming to well-below 2°C, while striving to stay below 1.5°C.[18][19] International support in providing and mobilising finance, technology transfer, and capacity-building initiatives will play critical roles in supporting Brunei Darussalam's climate efforts and steering towards a greener and more sustainable future. Furthermore, the successful implementation of the NAP will also require effective international cooperation that facilitates data sharing, enhances access to timely information through facilities, such as upgraded Early Warning Systems, and fosters capacity building to effectively coordinate joint response mechanisms in addressing climate risks and reduces climate change impacts.

Finally, acknowledging that addressing climate change is a long-term endeavour, **Brunei Darussalam emphasises the importance of ambition, unity, and effective implementation to build a resilient and adaptive nation**. With this commitment, Brunei aspires to set a regional example and position itself at the forefront of climate action to protect the people, ecosystem, and secure a long-term well-being.

Appendix 1: Hazards and Effects Register (HER)

Climate Risk Driver		Hazard	Effect				
			People	Environment	Asset	Reputation	Legal
Temperature	Increased temperature (Heatwaves)	Forest Fire Haze Drought	Dehydration Heat-related illnesses Cardiovascular diseases Adverse mental health	Poor air quality Loss of forest	Damage to buildings and crops Agricultural pest and disease outbreak	Inflation Unreliable utilities	Infrastructure and building design
Rainfall	Increased rainfall	Flood Landslides Disease outbreak	Respiratory issues Vector and water-borne diseases Injuries and fatalities	Mold growth Soil erosion	Damage to building and crops Agricultural pest and disease outbreak	Inflation Unreliable utilities	Infrastructure and building design
Rainfall	Decreased rainfall (Drought)	Forest Fire Haze Drought	Dehydration Malnutrition	Poor air quality Groundwater depletion	Water scarcity	Decrease in agricultural productivity	
ENSO event	Prolonged El Niño	Forest Fire Haze Drought New disease outbreak	Health problems Human-wildlife conflict Loss of lives	Poor air quality Biodiversity loss Loss of habitat Loss of carbon sinks	Damages to building, government roads, private properties Low fisheries production	Supplier disruption (for Micro, Small, and Medium Enterprise (MSME) under agricultural and fisheries sectors) Inflation Decrease in incoming tourists	Transboundary haze and disease outbreak

	Flood Landslides Typhoon Storm surges New disease outbreak	Injuries, Fatalities Lower food supply Health problems Malnutrition	Biodiversity loss Loss of habitat Loss of carbon sinks	High stress on budget allocation for healthcare and emergency response Damages to building, government roads, private properties Low agricultural production	Supplier disruption (for MSME under agricultural and fisheries sectors) Inflation Decrease in incoming tourists	Transboundary disease outbreak
Prolonged La Niña						
Sea level rise	High coastal wave energy Coastal erosion Inundation Coastal flooding	Adverse mental health Limited mobility and access to resources Migration of people due to loss of land	Food insecurity Wildlife loss Saltwater intrusion Poor water quality	Coastal erosion and inundation Loss of property and land Damage to crops	Increased infrastructure spending Inflation of land prices	Potential for new Health, Safety and Environment (HSE) New policies Infrastructure and building design

Appendix 2: RAM Likelihood Scale

Likelihood Scale	Recurrent Risk	Single Event
Almost Certain	Not heard of, Not forecasted	Unlikely/Negligible (Small probability ≥ 0%)
High Likely	Not heard of, but could occur	Less likely than not, but still appreciable (50% ≥ Quite high probability)
Likely	Likely to occur as expected	As likely as not (50/50 chance)
Possible	Could occur several times more than expected	More likely than not (Probability > 50%)
Unlikely/Rare	Could occur multiple times more than expected	Most likely than not (Probability > 75%)

Appendix 3: RAM Severity Scale

Severity Rating	Consequences				
	People	Environment	Asset	Reputation	Legal
Catastrophic	Multiple major injuries and permanent displacement, permanent disability, loss of life.	Large extent of areas affected, with irrecoverable changes over a prolonged period of time.	Extensive damage to major infrastructure	Internationally impacted, requiring government to government relations.	Transboundary and regional impact with potential imposed penalty; Major changes to legislative framework
Major	Major but treatable injuries, temporary disabilities and displacement.	Several areas affected, with some changes over a prolonged period of time.	Major damage requiring major repairs	Nationally impacted, requiring government intervention and collaboration between multiple authorities.	Major impact requiring new legislations/guidelines to be developed
Moderate	Minor treatable injuries, temporary displacement over a short time period.	Localised area affected, with minor changes over a period of time.	Damage to infrastructure, requiring some repairs	Nationally impacted, requiring collaboration within district and agencies	Moderate impact
Minor	Minor/slight discomfort	Minor effect	Minimal damage	Localised impact within industry/district	Minor impact
Insignificant /No risk	No injuries and no impact	Slight/No impact	Non-noticeable/No impact	No impact	No impact

Appendix 4: Bowtie Analysis (Preventive Measures for Flooding)

Preventive Key Strategies	Brief Description	Action Party Sector	Current Status
Assessment on Land Use for Development Control	Proposed new developments on state lands within protected areas are subjected to stringent restrictions. Such developments necessitate thorough assessments and approvals from the Site Selection Committee, an Environmental Impact Assessment (EIA), and other relevant authorities.	Infrastructure & Urban Resilience	On-going
Warning system to notify the community	Early notification dissemination, meteorological sensor data regarding rainfall amounts and real-time weather monitoring, public warnings and announcements via mass media channels.	Multi-sector	On-going
Research Development or studies for Flood prone areas	Develop comprehensive studies and research on areas susceptible to flooding, working in close partnership with relevant institutions to encourage experts to publish research findings on flood mitigation measures applicable to Brunei Darussalam.	Infrastructure & Urban Resilience Water Resources	On-going
Correct Design of Drainage and Sewerage system on roads and low-lying areas as per standard	Continuous enhancement of existing drainage design, adhering to the Urban Drainage Design Manual, Catchment Management Plan, and Land Use Master Plan.	Infrastructure & Urban Resilience Water Resources	On-going
Implementation of Flood Mitigation Projects	Strategically implement a range of flood mitigation projects, encompassing the construction of detention ponds, pump stations, levees, river walls, barrages, flow diversion structures, alongside channel widening and dredging operations.	Infrastructure & Urban Resilience Water Resources	On-going
Hydrology study to improve the river system	This allows for the development of effective strategies to mitigate flooding, manage water resources sustainably, enhance ecological health, and ensure the long-term resilience of the river system.	Infrastructure & Urban Resilience Water Resources	On-going

Appendix 5: Bowtie Analysis (Recovery Measures for Flooding)

Recovery Key Strategies	Brief Description	Action Party Sector	Current Status
Emergency Response Plan (ERP)	The District Disaster Management Committee (DDMC) will activate the Incident Command Post (ICP). All relevant agencies are required to report to the ICP to provide coordinated support, operating under a unified Joint Standard Operating Procedure (SOP). The MOH will deploy the Emergency Medical Ambulance Service (EMAS) as the initial response unit.	Multi-sector	On-going
Warning system to notify community via signage/social media/radio	BDMD issues early weather notifications, utilising data from sensors, rainfall, and live monitoring. Moreover, the DDS has installed flood level signage at flash flood hotspots. Additionally, river gauges will provide high tide warnings, and daily wave height and rainfall updates will be broadcasted via national radio and television.	Health & Livelihood Infrastructure & Urban Resilience Marine Protection & Coastal Resilience	On-going
Electric Supply Isolation (cut off)	All residences will be equipped with a circuit breaker (DES-approved) designed to interrupt electrical flow. This mechanism, controlled by DES, is typically activated at the substation level during significant flooding events.	Infrastructure & Urban Resilience	On-going
Engagement of relevant authorities for support on site for flood victims	JAPEM provides essential relief assistance by distributing food necessities to affected households.	Health & Livelihood	On-going
Disaster Logistic Storage (DLOGS)	Provided by the NDMC to various district offices across the country to support emergency preparedness and response measures. The inventory of these stored provisions is subject to monthly monitoring or as required.	Health & Livelihood	On-going
Slope stabilisation works to avoid soil erosion or landslide	The construction of cut-off drains and the deployment of concrete mattresses or foundations.	Infrastructure & Urban Resilience	On-going
In-country rice stock reserves	'Stor Negara', operating under the Ministry of Finance and Economy (MOFE), is responsible for managing national reserves.	Agriculture & Food Security	On-going

	Should poultry supply decrease, imports will be initiated to meet the country's needs.		
Regulatory compliance after flooding	Encompasses established procedures for public safety and welfare, adherence to the National Standard Operating Procedures (NaSOP), stringent evacuation protocols, and compliance with the '*Tekad Pemedulian Orang Ramai*' (TPOR) framework to ensure process efficiency.	Multi-sector	On-going
Provision of clean water supply	The DWS will ensure the provision of clean water. This includes the door-to-door delivery of water via tanker supply when emergency conditions necessitate such immediate distribution.	Water Resources	On-going
Vector-borne disease surveillance and control	Post Flood Evacuation Plan includes shelters with food, clean water and toilet to decrease any potential disease outbreak during post flood period, Vector control team for 4 districts will be dispatched for vector control and immunisation.	Health & Livelihood	On-going

Appendix 6: Bowtie Analysis (Preventive Measures for Forest Fire)

Preventive Key Strategies	Brief Description	Action Party Sector	Current Status
Early Climate Warnings	Early climate warnings (1–3 monthly) will be disseminated via the official website, press releases, social media platforms, and national weather briefings.	Health & Livelihood	On-going
Infographic for dry and wet season	This multi-agency effort, overseen by NDMC, is dedicated to enhancing public awareness of current weather forecasts.	Infrastructure & Urban Resilience	On-going
Regulation on open burning	DEPR has implemented regulations prohibiting open burning during periods of dry season or drought. These measures are designed to mitigate environmental hazards, such as air pollution and the risk of widespread fires.	Biodiversity & Environment	On-going
Forest Act on Forest Reserves	The Forestry Department enforces the Forest Act, which prohibits activities such as trespassing and unauthorized burning within Forest Reserves, specifically to prevent fires in these protected areas.	Biodiversity & Environment	On-going
Monitoring and patrolling by BFRD	Conducted during periods of hot weather, and identified forest fire hotspots are actively monitored.	Biodiversity & Environment Health & Livelihood	On-going
Approved standards for structures near hotspots	Approved ABCi standards for structures near hotspots mandate the use of fire-resistant materials and adequate fire equipment such as inspections for fire safety certification and buffer zone separation distances are determined case-by-case under safety guidelines.	Infrastructure & Urban Resilience	On-going
Excessive Hot Weather (EHW) monitoring	BDMD maintains a daily monitoring system for unusual temperature increases. Should the established criteria for EHW be met, an official statement will be released by BDMD.	Health & Livelihood	On-going
Project in removal of invasive prone trees	The removal of invasive-prone species has been part of the greening projects implemented over the past few years, with a total of 8 projects carried out since 2022. Currently, the Forestry Department is undertaking 2 ongoing greening projects, both of which include activities such as the	Biodiversity & Environment	On-going

	removal of invasive species, particularly *Acacia mangium.*		
Peat soil/swamp management	Brunei Darussalam has officially ceased and stopped all logging operations since 2017. Although Badas is not designated as a forest reserve, the Forestry Department, in collaboration with relevant government agencies and research institutions such as DEPR and UBD, has been proactively implementing restoration and rehabilitation efforts. These include tree planting activities, hydrological restoration through canal blocking, and raising the water table to support peatland recovery. Ongoing research by the Forestry Department and UBD on the peat swamp forest ecosystem aims to deepen scientific understanding and inform the development of effective conservation strategies, including appropriate methods for restoration and rehabilitation.	Biodiversity & Environment	On-going
Assessment for Land Use and Farmland	Assessment for land use is coordinated by TCP with assessments from relevant agencies. As for farmland, assessment is done by the Department of Agriculture and Agrifoods (DoAA), Ministry of Primary Resources and Tourism (MPRT) on suitability of land for agricultural activities and informed to TCP for site allocation subject to approval from site selection committee.	Infrastructure & Urban Resilience	On-going
Government to Government ASEAN Transboundary Haze Pollution	This agreement mandates mitigation through concerted national efforts and enhanced regional and international cooperation, for ASEAN Member States to ensure compliance regarding haze management.	Biodiversity & Environment	On-going

Appendix 7: Bowtie Analysis (Recovery Measures for Forest Fire)

Recovery Key Strategies	Brief description	Action Party Sector	Current Status
Emergency Medical Response (EMR)	EMAS team will be activated to manage the EMR. In a worst-case scenario, NDMC will coordinate the response, with EMAS serving as the primary first responder, providing transportation and initial paramedic intervention only.	Health & Livelihood	On-going
Health Advisory on heat stroke and haze	Advisories to public such as precautionary measures during hot weather, early detection of heatstroke symptoms and Pollutant Standards Index (PSI) threshold alerts are issued through mass media channels.	Health & Livelihood	On-going
Monitoring and surveillance on air quality monitoring system	PSI monitoring done by DEPR. A push notification will be sent by District Emergency Operation Centre to relevant committees if PSI exceeds the threshold.	Health & Livelihood	On-going
Disaster Logistic Storage (DLOGS)	Provisions are supplied by NDMC to various district offices across the country to support emergency preparedness and response efforts. The inventory of these stored supplies is monitored monthly or as needed.	Health & Livelihood	On-going
ERP for Forest Fire scenario	Based on the given scenario, the BFRD will adhere to its internal tiered response protocol: **Tier 1**: The BFRD will lead the initial response effort. **Tier 2**: A commanding fire officer will assume control, focusing on establishing firebreaks. **Tier 3:** The BFRD will formally request support from the DDMC to activate the ICP.	Health & Livelihood Biodiversity & Environment	On-going
Bantuan Kecemasan Bencana	JAPEM provides essential relief assistance by distributing food necessities to affected households.	Health & Livelihood	On-going
Fire breaks at sensitive at fire prone area and sensitive area at forest reserves	There are 3 projects focusing on firebreak construction since 2022. But no permanent firebreaks have been established as of yet. Currently, there is one on-going firebreak construction project in the Arboretum Forest Reserve.	Biodiversity & Environment	On-going

	However, should a fire occur, the BFRD will implement temporary firebreaks as advised by the Forestry Department.		
RBAF support on water bombing using helicopter	BFRD will formally request assistance from the Royal Brunei Armed Forces (RBAF) through NDMC.	Health & Livelihood Biodiversity & Environment	On-going
Fasts response time to reach affected area	The BFRD achieves a fire removal response time within 2 minutes, which is instrumental in mitigating potential economic setbacks across agricultural and other affected sectors.	Health & Livelihood Biodiversity & Environment	On-going
National Standard Operating Procedure (NaSOP)	NaSOP is owned and coordinated by NDMC. However, the implementation of NaSOP requires active collaboration among multiple sectors. This multi-sectoral approach ensures comprehensive management and active response to disasters, such as forest fires, safeguarding both the environment and the communities.	Multi-sector	On-going
SOP '*Kebakaran Hutan'*	The SOP stipulates the designated equipment, required firefighting resources, and criteria for engaging additional support, such as support provided by the RBAF.	Health & Livelihood	Waiting for endorsement

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