

Disaster Risk Reduction  
Methods, Approaches and Practices

Joy Jacqueline Pereira  
Mohd Khairul Zain  
Rajib Shaw *Editors*

# Climate Change Adaptation in Southeast Asia

 Springer

# **Disaster Risk Reduction**

Methods, Approaches and Practices

## **Series Editor**

Rajib Shaw, Keio University, Shonan Fujisawa Campus, Fujisawa, Japan

## **About the Series**

Disaster risk reduction is a process that leads to the safety of communities and nations. After the 2005 World Conference on Disaster Reduction, held in Kobe, Japan, the Hyogo Framework for Action (HFA) was adopted as a framework for risk reduction. The academic research and higher education in disaster risk reduction has made, and continues to make, a gradual shift from pure basic research to applied, implementation-oriented research. More emphasis is being given to multi-stakeholder collaboration and multi-disciplinary research. Emerging university networks in Asia, Europe, Africa, and the Americas have urged process-oriented research in the disaster risk reduction field. With this in mind, this new series will promote the output of action research on disaster risk reduction, which will be useful for a wide range of stakeholders including academicians, professionals, practitioners, and students and researchers in related fields. The series will focus on emerging needs in the risk reduction field, starting from climate change adaptation, urban ecosystem, coastal risk reduction, education for sustainable development, community-based practices, risk communication, and human security, among other areas. Through academic review, this series will encourage young researchers and practitioners to analyze field practices and link them to theory and policies with logic, data, and evidence. In this way, the series will emphasize evidence-based risk reduction methods, approaches, and practices.

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Joy Jacqueline Pereira · Mohd Khairul Zain ·  
Rajib Shaw  
Editors

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 Springer

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# Foreword

The ASEAN Working Group on Climate Change (AWGCC) and the ASEAN-India Green Fund supported the project on “Enhancing Local Level Climate Change Adaptation in Southeast Asia” (Phase 1) to conduct a needs assessment and scoping study of ASEAN Member States (AMS) with respect to climate change adaptation and to develop a regional climate change adaptation work programme and network. Administered by the ASEAN Secretariat, the initial phase of the ASEAN-India Green Fund Project consisted of an inception workshop and a final planning workshop, with the needs assessment and scoping study in between. I had the pleasure of jointly leading the Project with Prof. Joy Jacqueline Pereira from Universiti Kebangsaan Malaysia’s Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM).

The Inception Workshop on Enhancing Climate Change Adaptation was held in February 2015 in Bangi, Selangor in Malaysia, and the Final Planning Workshop was held in October 2015 in Manila, The Philippines. Representatives of the National Focal Points of the AWGCC participated in both the workshops. The final report on needs assessment and scoping study and establishment of the ASEAN Partner Institutions on Climate Change Adaptation (ASEANadapt) was endorsed by the AWGCC in 2016. Since then, all ASEAN Member States have ratified the Paris Agreement and communicated their Nationally Determined Contributions (NDCs) to the United Nations Framework Convention on Climate Change (UNFCCC).

I am proud to note that members of the ASEANadapt have continued to collaborate over the years to advance local level climate change adaptation in the region, with support from SEADPRI-UKM, the Asian Network on Climate Science and Technology (ANCST) and other partners. Members exchange information on good practices and communication on a regular basis and several have engaged with the Intergovernmental Panel on Climate Change (IPCC). Clearly, the capacity of researchers in the region is expanding. This book is an outcome of that continuous collaboration. It provides a current snapshot of science, policy and challenges related to climate change adaptation in the region. The findings of the stakeholder consultations that were conducted in each AMS under the ASEAN-India Green Fund Project have highlighted potential local level pilots for further funding. This is now more relevant in the post-Paris Agreement context and fast changing climate change scenario.

In 2018, the IPCC reported that Southeast Asia is projected to be challenged by extreme climate temperatures and precipitation as well as disaster risks associated with this change. Climate change and disaster risk reduction tend to be deliberated separately in international platforms. This has contributed to the disconnect that is currently prevalent in national systems within the region. The reality is that at the local level, the issues are interlinked and connected to sustainable development. We are all aware that there are many adaptation options that can benefit and be synergistic with climate change mitigation and also serve disaster risk reduction. By focusing on the local level, as done by each AMS under the ASEAN-India Green Fund Project, there is an opportunity to implement integrated responses that link these aspects as well as other societal objectives related to sustainable development. We have laid a foundation for AMS to be a resilient and sustainable. This book is a valuable one-stop resource that documents our efforts. I would like to personally complement Prof. Joy Jacqueline Pereira for providing leadership and coordinating ASEANadapt beyond the ASEAN-India Green Fund Project.

N. H. Ravindranath  
Project Leader, ASEAN-India Green  
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# Preface

Climate change adaptation is a means to adjust to the long-term impacts of climate change, while disaster risk reduction is critical for managing the near-term effects of climate variability. Both climate change adaptation and disaster risk reduction are essential for building community resilience. Climate change adaptation can be enhanced through complementary actions across all levels, from national, state or provincial governments to local administrations. Stakeholder engagement is critical at all levels. The role of national governments is to provide strong coordination for adaptation efforts at the sub-national levels and ensure that all relevant stakeholders are engaged at each stage. National governments can facilitate adaptation actions by providing a comprehensive policy framework, legal support, adequate resources and appropriate information. Local governments, academia, civil society, non-government organizations and the private sector have to play an increasingly important role in advancing climate change adaptation and linking it to disaster risk reduction.

This book has 11 chapters where the first chapter provides an overview of climate change and key linkages to disaster risk reduction in Southeast Asia, while the remaining chapters offer a snapshot of the status of science and policy in each of the ASEAN Members States (AMS) in this context. Each chapter spotlights national policies relevant to climate change adaptation, linkages to disaster risk reduction, vulnerable ecosystems and regions, key measures, priority sectors and challenges in the respective countries. Information from government documents have been supplemented with material from scientific publications. Findings of the stakeholder consultations to delineate adaptation priorities in the respective AMS, which was conducted under the ASEAN-India Green Fund Project on “Enhancing Climate Change Adaptation in Southeast Asia” (Phase 1), are also highlighted. Pilots that were proposed for further funding in each of the AMS are also documented.

The Editors would like to record their gratitude to the ASEAN Working Group on Climate Change, ASEAN-India Green Fund Project Leader from India, Prof. N. H. Ravindranath and the Government of India for their contribution and engagement in enhancing climate change adaptation in Southeast Asia. The support of the ASEAN Secretariat, Asian Network on Climate Science and Technology (ANCST),



Asia Pacific Network for Global Change Research (APN), Asian Science, Technology and Academic Group (ASTAAG), Indian Institute of Science Bangalore (IISc. Bangalore), Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM) and other partners, in convening capacity building workshops is also acknowledged. The following reviewers are thanked for their assistance: Prof. Vinod K. Sharma (Indian Institute of Public Administration), Dr. Raman Letchumanan (formerly of the ASEAN Secretariat), Dr. Sugeng Triutomo (Indonesia Defense University), Ms. Antonia Yulo Loyzaga (Manila Observatory), Dr. Takako Izumi (Association of Pacific Rim Universities, APRU), Prof. Shi Peijun (UN-ISDR Asia Science Technology Academia Advisory Group, ASTAAG).

The book is written for students, researchers, academics, policymakers and development practitioners in the field of climate change adaptation and disaster risks studies. We hope that they will find the book beneficial and relevant to their work.

Kuala Lumpur, Malaysia  
Kuala Lumpur, Malaysia  
Kanagawa, Japan

Joy Jacqueline Pereira  
Mohd Khairul Zain  
Rajib Shaw

## About This Book

This book provides an overview of climate change adaptation in ten ASEAN Members States (AMS). The chapters have been prepared by members of the ASEAN Partner Institutions on Climate Change Adaptation (ASEANadapt). The ASEANadapt resulted from the ASEAN-India Green Fund Project on “Enhancing Climate Change Adaptation in Southeast Asia” (Phase 1), an initiative under the aegis of the ASEAN Working Group on Climate Change (AWGCC) managed by the ASEAN Secretariat.

The book draws on government documents and scientific publications to spotlight national policies relevant to climate change adaptation, linkages to disaster risk reduction, vulnerable ecosystems and regions, key measures, priority sectors and challenges. Adaptation priorities were delineated through stakeholder consultations in the respective AMS and potential pilots have been highlighted for funding.

Covering aspects of climate change adaptation and disaster risks, this book is a valuable one-stop resource on the status of science and policy in Southeast Asia for students, researchers, academics, policymakers and development practitioners, who will be able to apply the knowledge for informed decision-making.

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## About the Editors

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**Mohd Khairul Zain** is a Senior Science Officer at Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM). He is currently involved in research projects related to disaster risk reduction. He also actively provides input, technical advice and support in the formulation of various government actions and negotiations at national, regional and international platforms. In 2013, Mr. Khairul became involved in the formulation of country's National Platform and Action Plan for Disaster Risk Reduction (MyDRR), which serves to integrate disaster risk reduction and climate change adaptation, engage communities and build resilience at the local level. Mr. Khairul coordinates the ASEAN Partner Institutions on Climate Change Adaptation (ASEANadapt) and founded U-INSPIRE Malaysia, a platform to empower Malaysian youth and young professionals in science, engineering, technology and innovation; to build disaster resilience at the national, regional and global levels.

**Dr. Rajib Shaw** is a professor in Graduate School of Media and Governance in Keio University's Shonan Fujisawa Campus (SFC). Earlier, he was the Executive Director of the Integrated Research on Disaster Risk (IRDR). He is also the Senior Fellow of Institute of Global Environmental Strategies (IGES) Japan and the Chairperson of SEEDS Asia, a Japanese NGO. Previously, he served as a Professor in the Graduate School of Global Environmental Studies of Kyoto University. He is the editor of a book series on disaster risk reduction, published by Springer, and is the Chair of UN ISDR's Global Science Technology Advisory Group (Global STAG) and a Co-chair of UN ISDR's Asia Pacific Science Technology Academic Advisory Group (APSTAAG). Prof. Shaw is also Coordinating Lead Author for the Asia Chapter of the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC-AR6). He has published more than 40 books and over 300 academic papers and book chapters.

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# Chapter 1

## Southeast Asia: An Outlook on Climate Change



Joy Jacqueline Pereira and Rajib Shaw

**Abstract** Climate change and disaster risks are mainstreamed in the three major pillars of the Association of Southeast Asian Nations (ASEAN) and complement the UN 2030 Agenda for Sustainable Development. All ASEAN Member States (AMS) have ratified the Paris Agreement. The projected climate change impacts for Southeast Asia are less severe for global warming of 1.5 °C compared with 2 °C or more. Overall, there is only a medium level of readiness in handling the projected impacts for global warming of 1.5 °C in the region, except for prioritized adaptation measures to address reduction in rice yields in several AMS. Transitioning to a 1.5 °C world requires astute adaptation, linking climate change and disaster risk reduction, amplified engagement with targeted stakeholders, and smart partnerships to hasten the process of developing truly effective climate change adaptation plans in AMS. Greater ambition is also required to create a healthy environment in AMS. Potential strategic initiatives that could benefit AMS will require mobilization of resources and technical support. All nations of the world have a critical role to play in limiting global warming to 1.5 °C.

**Keywords** Climate change · Vulnerability · Disaster risk · ASEAN · Southeast Asia

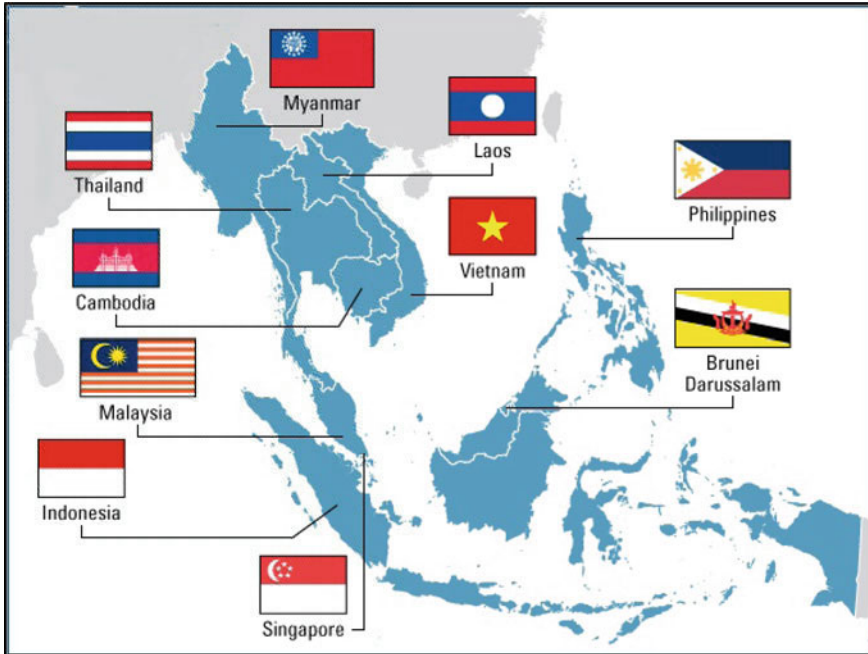
### 1.1 Introduction

Southeast Asia has ten countries that are members of the Association of Southeast Asian Nations (ASEAN), which was established in 1967 with a focus on promoting stability and economic growth in the region. The ASEAN Member States (AMS) are Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam (Fig. 1.1). With a total area of 4.4

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**Fig. 1.1** ASEAN member states comprise 10 countries in Southeast Asia

million square kilometers, and a population of over 622 million representing about 8.5% of the global populace, the AMS currently have the third largest labor force in the world (WPR 2020). The collective economic growth of ASEAN has increased remarkably since 1999, from USD 577 billion in 1999 to USD 2.5 trillion in 2016, with an average growth of 5.3% in 2018 (OECD 2019). Among the AMS, Singapore, Brunei and Malaysia are categorized as very high on the human development index, while Thailand, the Philippines, and Indonesia are in the high category, with Cambodia, Laos PDR, Myanmar, and Vietnam falling within the medium category (UNDP 2019). Economic growth has been slower than forecasted due to global geopolitical challenges and the COVID-19 pandemic.

Between 1970 and 2010, Southeast Asia was one of the three regions of the world (in addition to Europe and China) that experienced the largest conversion of agricultural lands to urban land uses (Güneralp et al. 2020). Urbanization and industrialization have driven economic growth that benefitted the region but also led to unbridled energy demand. Energy efficiency has not improved in many AMS due to weak regulations and lack of market-based pricing (Shi 2016). The combined sectors of manufacturing and transportation have been identified as the primary energy consumer in Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam (Setyawan 2020). Economic growth has also contributed to environmental and health impacts associated with air pollutants such as nitrogen oxides, sulfur dioxide and particulate matter in Southeast Asia (Fong et al. 2020). The emission of carbon dioxide and particulate matter (PM<sub>2.5</sub>) has recently been identified as major risk factors for



lung cancer in the region (Farhad and Farzad 2020). Increasing use of renewable energy and higher investment in healthcare expenditure per capita have been linked to decreased prevalence of lung cancer.

Climate change and natural disasters are recognized as a threat to advancement in Southeast Asia, disproportionately affecting the poor and marginalized (ADRFMI 2010; The ASEAN Post 2019). Climate-related hazards in the region include floods, storms, tropical cyclones, droughts, and extreme temperatures; 62% of the population is exposed to drought and about 24% to floods (ESCAP 2020). The landscape for risk is contributed by droughts (60%), floods (22.5%), tropical cyclones (14.3%), earthquakes (4.1%), and tsunamis (0.2%), based on impacted population, geographical area, and economic losses. Among the AMS, the average annual loss as a percentage of GDP associated with intensive risk, extensive risk, indirect losses, and agriculture drought, is highest in Lao PDR (8.7%), followed by Cambodia (8%), Myanmar (6.2%), and Vietnam (5.6%) compared with the other countries in the region, with Singapore having the lowest value at 0.5% (ESCAP 2020).

The outlook on climate change in Southeast Asia commences with an overview of institutions and arrangements in ASEAN that support the region in addressing climate change, including the status of participation of AMS in global climate agreements, specifically the United Nations Framework Convention on Climate Change (UNFCCC). This is followed by a short description of the prognosis for 1.5 °C global warming and beyond in the region, based on the latest available science of the IPCC. A cursory evaluation of the readiness of the AMS in tackling emerging issues, drawing on information from the national communication of the AMS under the UNFCCC is then presented. This provides the context for discussing key challenges and opportunities for the AMS in transitioning to a 1.5 °C world, drawing on findings from the subsequent chapters and other sources. The chapter concludes with a highlight of potential initiatives that could be supported in the region to benefit AMS.

## 1.2 Regional Arrangements

### 1.2.1 ASEAN and Climate Change

ASEAN was established in 1967 and the ASEAN Charter, adopted in 2007, is a legally binding agreement recognized by the United Nations; it frames the institutional arrangements and codifies the norms, rules, and values, serving as the foundation of the ASEAN Community (ASEAN 2020). The Declaration on ASEAN 2025: Forging Ahead Together was signed by all the AMS in Kuala Lumpur to complement the UN 2030 Agenda for Sustainable Development. The Declaration on ASEAN 2025 comprises three major pillars, the Political-Security Community

Blueprint 2025, ASEAN Economic Community Blueprint 2025 and ASEAN Socio-Cultural Community Blueprint (ASCC) 2025; the latter succeeds the ASEAN Socio-Cultural Community Blueprint (ASCC) 2009–2015. Climate change and disaster risks are mainstreamed in all the three pillars of the Declaration on ASEAN 2025. Highlights are as follows:

- The Political-Security Community Blueprint 2025 emphasizes disaster management and emergency response in the region. More importantly, the Blueprint also includes the element to “Ensure that disaster risk reduction is integrated into ASEAN strategies on disaster management and emergency response”; this supports implementation of the Sendai Framework on Disaster Risk Reduction in the region.
- The ASEAN Economic Community Blueprint 2025 is envisioned to “Create a more dynamic and resilient ASEAN, capable of responding and adjusting to emerging challenges through robust national and regional mechanisms that address food and energy security issues, natural disasters, economic shocks, and other emerging trade-related issues as well as global mega trends,” among other matters. Aspects emphasized include science-based support for green technology and energy, energy efficiency and renewable energy, reduction in greenhouse gas emission in agriculture, increased resilience to climate change, natural disasters and other shocks, and increased resilience to climate change in the context of food security.
- The ASEAN Socio-Cultural Community (ASCC) Blueprint 2025 aims to deliver and fully realize human development, resiliency, and sustainable development within the region. A key objective is to deliver “a resilient community with enhanced capacity and capability to adapt and respond to social and economic vulnerabilities; disasters, climate change as well as emerging threats, and challenges.”

The ASEAN Working Group on Climate Change (AWGCC) was established in 2009, with the obligation to oversee the implementation of climate change actions incorporated in the ASCC Blueprint 2009–2015. The Action Plan on Joint Response to Climate Change was developed in 2012, paving the way for more nuanced implementation of the ASCC Blueprint in conjunction with dialogue partners and other organizations; the ASCC Blueprint 2009–2015 was succeeded by the ASCC Blueprint 2025. The AWGCC also supports the issuance of periodic joint statements of the ASEAN Heads of State and Government to express their common positions in addressing climate change. For example, the 2014 Statement of ASEAN Heads of State and Government agreed that the AMS would improve collective capacity to address climate change and strengthen rapid response through existing mechanisms under the ASEAN Agreement on Disaster Management and Emergency Response (AADMER). The 2019 Statement of ASEAN Heads of State and Government agreed that the AMS would have collective targets on energy efficiency of vehicles and renewable energy.

Climate change aspects are explicit in the AWGCC, which is under the ASEAN Ministerial Meeting on the Environment (AMME), ASEAN Senior Officials on the

Environment (ASOEN). The linkages to disaster risks and energy are also addressed to varying extents under the ASEAN Ministerial Meeting on Disaster Management (AMMDM), ASEAN Committee on Disaster Management (ACDM) and ASEAN Coordinating Centre for Humanitarian Assistance on Disaster Management (AHA), as well as the ASEAN Ministers on Energy Meeting (AMEM), Senior Officials Meeting on Energy (SOME), ASEAN Transport Ministers Meeting (ATM), Senior Transport Officials Meeting (STOM), and ASEAN Centre for Energy (ACE). In addition, there are several ASEAN Sectoral Ministerial Bodies in all the three major pillars where climate change adaptation, mitigation, and disaster risks are implicit (ASEAN 2020). However, the extent to which these issues are addressed vary. Such bodies include the ASEAN Regional Forum, ASEAN Regional Forum Senior Officials Meeting (ARF SOM), ASEAN Ministers Meeting on Agriculture and Forestry (AMAF), Senior Officials Meeting of the ASEAN Ministers Meeting on Agriculture and Forestry (SOM-AMAF), ASEAN Senior Officials on Forestry (ASOF), Conference of the Parties to the ASEAN Agreement on Transboundary Haze Pollution (COP), ASEAN Centre for Biodiversity (ACB), ASEAN Specialized Meteorological Centre (ASMC), and the ASEAN University Network (AUN), among others.

The Declaration on ASEAN 2025 requires translation into national systems and the three major blueprints are supported by sector-specific master plans. All AMS have ratified the Paris Agreement and communicated their Nationally Determined Contributions (NDCs) as of 2019 (Fig. 1.2). All AMS have also submitted their Initial National Communications (NC1) and Second National Communications (NC2) to

Brunei Darussalam						NC1 NDC1 2016	NC2 2017		
Cambodia		NC1 2002	NAPA 2007				NC2 2016	NDC1 2017	
Indonesia	NC1 1999			NC2 2011		NDC1 2016		NC3 2018	
Lao PDR	NC1 2000		NAPA 2009		NC2 2013	NDC1 2016			
Malaysia	NC1 2000			NC2 2011		NDC1 2016		NC3 2018	
Myanmar				NC1 2012	NAPA 2013		NDC1 2017		
Philippines	NC1 2000				NC2 2014		INDC 2017		
Singapore	NC1 2000			NC2 2011	NC3 2014	NDC1 2016		NC4 2018	NDC1 Update 2020
Thailand	NC1 2000			NC2 2011		NDC1 2016		NC3 2018	
Vietnam		NC1 2003		NC2 2010		NDC1 2016			NC3 2019

**Fig. 1.2** Submission of various reports on climate change by ASEAN member states as reflected in the UNFCCC Registry. *Source* <https://unfccc.int/> accessed on 19 July 2020

the UNFCCC, except for Myanmar which is still in the process of preparing their NC2. Indonesia, Thailand, and Vietnam have already submitted their Third National Communications (NC3), while all the other AMS are working to communicate their NC3; Singapore has already submitted their fourth National Communication (NC4). The Paris Agreement encourages all parties to engage in the formulation and implementation of National Adaptation Plans (NAPs). Initiatives have commenced in some AMS to address this matter. A National Adaptation Program of Action (NAPA) is a type of plan similar to NAPs submitted by the least developed countries to the UNFCCC. Cambodia, Lao PDR, and Myanmar, have submitted their NAPA to identify urgent and important actions to adapt to climate change.

### ***1.2.2 ASEAN Collaborations on Climate Change***

The ASEAN Regional Forum (ARF) is a broad-based political and security cooperation platform for creating constructive dialogue among AMS and partners such as the European Union (EU), Australia, Canada, China, India, Japan, the Republic of Korea, New Zealand, and the United States. The ARF has facilitated collaboration on issues related to disaster management and emergency response as well as climate change, among others, which then come under the purview of the AWGCC, and also other relevant working groups on the environment, agriculture and forestry, energy and transport, and science and technology sectors. Some key regional initiatives on climate change that laid the foundation for regional collaboration include the following:

- Rehabilitation and Sustainable Use of Peatland Forests in Southeast Asia (2009–2013): The focus was on measures to prevent peatland fires, the major source of haze in the region;
- Biodiversity and Climate Change (2010–2015): The emphasis was on developing and implementing strategies and instruments related to biodiversity and climate change;
- Workshop and Exchange on Climate Resilient Cities (2010): The event was held in Jakarta (18–19 January 2010) to bring together officials from ASEAN cities and national governments to exchange best practices, lessons learned, and experiences in addressing climate change impacts;
- Workshops on Risks and Impacts from Extreme Events of Floods and Droughts in ASEAN (2010): Events were held in Indonesia (9–10 June 2010) and Thailand (22–23 September 2010), respectively, to assess the capacity of AMS on flood and drought management, review preparedness to engage in risk mitigation and adaptation planning, and exchange best practices on solutions;
- ASEAN Environmental Education Plan (2008–2012): Two events were convened under this initiative in 2010: (i) the ASEAN Plus Three Youth Environment Forum: Creating a Climate for Change, held in Brunei Darussalam, to generate interest and awareness of youths on climate change issues and seek their pledge to play

their part in safeguarding the environment and (ii) the annual ASEAN Plus Three Leadership Program on Sustainable Production and Consumption: to equip business and industry leaders with knowledge, skills, and tools to develop strategies for sustainable development;

- ASEAN Environmentally Sustainable Development Film Festival on Climate Change (2011): The event was held in Phnom Penh, Cambodia to showcase unique, creative, indigenous, and impactful initiatives taken by various stakeholders in ASEAN countries to inspire and promote awareness of multi-stakeholder participation in addressing climate change;
- The Yogyakarta City Greenhouse Gases (GHG) Emissions and HEAT + (2012): A collaboration with the International Council for Local Environmental Initiatives (ICLEI)—Local Governments for Sustainability, the ASEAN-US Technical Assistance and Training Facility (ASEAN-US TATF). The initiative involved training and the launch of the Yogyakarta City Greenhouse Gases (GHG) Emission Inventory Report. Yogyakarta was the ASEAN pilot city to demonstrate a systematic and standardized methodology to measure and monitor city-wide carbon emissions. The pilot served as a model for other ASEAN cities in developing effective strategies for low carbon economic growth and climate resiliency.

### ***1.2.3 ASEAN-India Collaboration***

In 2012, the Expert Meeting on Regional Program of Climate Change was held in Bangalore, India, to mark the commencement of initiatives supported by the ASEAN-India Green Fund, under the purview of the AWGCC, with administrative support from the ASEAN Secretariat. The purpose was to exchange information, develop a framework for collaboration, and discuss ways forward to address climate change adaptation and mitigation. This was followed by the initiation of several ASEAN-India Green Fund projects. An initial project was on “Enhancing Local Level Climate Change Adaptation in Southeast Asia,” administered by the ASEAN Secretariat, which consisted of an inception workshop and a final planning workshop, with the needs assessment and scoping study in between. The Inception Workshop on Enhancing Climate Change Adaptation was held in February 2015 in Bangi, Selangor in Malaysia, and the Final Planning Workshop and regional engagement was held in October 2015 in Manila, the Philippines. Representatives of the National Focal Points of the AWGCC participated in both the workshops. The final report on needs assessment and scoping study as well as establishment of the ASEAN Partner Institutions on Climate Change Adaptation (ASEANadapt) was endorsed by the AWGCC in 2016.

The project documented a broad range of national needs and priorities across the AMS. Generally, climate change is mainstreamed at the national level but its embedment in governance processes at the local level is relatively limited. In conducting the needs assessment, stakeholder engagement in many AMS was limited, focusing primarily on the government sector. The regional engagement of 2015 involved

representatives from entities such as the Asian Development Bank (ADB), Asia Pacific Network for Global Change Research (APN), Asian Science, Technology and Academic Group (ASTAAG), Asian Network on Climate Science and Technology (ANCST), the University of Cambridge, the University of Keio, Universiti Kebangsaan Malaysia, and the University of the Philippines. The aspects noted include the following:

- Regional requirements for climate change adaptation include both conventional research and action-oriented projects, capacity building, advocacy of policy and decision-makers, public awareness about climate change impacts, climate risk communication, early warning for climate extremes and best practices case studies, and promotion of public–private participation;
- Platforms for sharing and exchange of information relevant to climate change would advance the climate change adaptation agenda in the region, specifically if it served to maintain ties among AMS researchers and practitioners, who have a lot of experience and success stories that could be shared;
- A flagship regional initiative on climate change assessment (similar to that conducted by the Intergovernmental Panel on Climate Change, IPCC) led and implemented by ASEAN researchers on a periodic basis and administered by the ASEAN Secretariat would serve the governments of AMS and the international community in making evidence-based decision-making for the region.
- Funding should give priority to the development of local adaptation plans as communities are the most vulnerable, with researchers in ASEAN being mobilized to support the development of local adaptation action plans, and embedment into local governance systems via selected pilots so that they can then be replicated by the stakeholders.
- The participation of local governments in climate change adaptation is important and necessary to effectively tackle the impacts of climate change as they are the ultimate implementers. However, coordination at the national level is critical to make this happen. Emphasis should be given to build capacity and knowledge management skills of local government units.

The project also concluded that within the national boundaries of the AMS, there are variations in local conditions and this is where the problems need to be tackled. Thus, the emphasis should be on specific areas such as a landscape or an ecosystem, or a watershed, which has clusters of settlements, where both the aspects of adaptation and mitigation can be considered. Short-term risks can be handled via immediate disaster risk management programs, where climate modeling outputs are not required. Long term planning and resilience development program can draw insights from climate modeling. This can be handled using the same context and area-specific approach. Notwithstanding, there are common tools, techniques, methods, and approaches that are applicable across the ten AMS that require a self-sustaining long-term collaborative effort to enable sharing and exchange of information relevant to climate change among the AMS researchers and practitioners. This was the basis for establishing a virtual network of ASEAN Partner Institutions on Climate Change

Adaptation (ASEANadapt), to continue with exchange of information on good practices and communication beyond the project and advance the climate change adaptation agenda in the region (<https://aseanadapt.org>). ASEANadapt is hosted and coordinated by Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Initiative (SEADPRI-UKM).

### 1.3 Regional Climate Change Risks and Key Issues

#### 1.3.1 Implications of 1.5 °C Global Warming

The cycle of the IPCC Sixth Assessment Report (AR6) includes the preparation of three Special Reports that precedes the main Assessment Report. The Special Report on the impacts of Global Warming of 1.5 °C above pre-industrial levels (IPCC SR1.5 °C) was released in 2018. The report was prepared in response to the invitation of the 21st Conference of Parties of the UNFCCC. The Special Reports on Climate Change and Land (IPCC SRCCL) and Ocean and Cryosphere in a Changing Climate (IPCC SROCC) were released in 2019. The IPCC Special Reports are based on the assessment of the available scientific, technical, and socioeconomic literature relevant to global warming, and among the key findings include several projected impacts that are specific to the tropics and relevant to Southeast Asia (Table 1.1).

The IPCC SR1.5 °C confirmed that humanity and its ecosystems are already impacted by warming of 1 °C since pre-industrial times. Current development is expected to lead humanity to global warming of 1.5 °C between 2030 and 2052 but this track can be altered. Apathy is expected to result in a range of impacts affecting some tens to hundred million people in the world, where the intensity is geographically differentiated. As tropical Southeast Asia moves toward 2 °C, the impacts of 1.5 °C include higher levels of precipitation associated with tropical cyclones; greater net reductions in yields of maize, rice, and other cereal crops as well as CO<sub>2</sub>-dependent nutritional quality of rice; increased number of hot days; the largest impacts on economic growth due to climate change. Many of the projected impacts could be avoided by limiting global warming to 1.5 °C compared with 2 °C or more.

The IPCC SRCCL states that lives and livelihoods in cyclone-prone areas of the region are expected to be exposed to land degradation resulting from the combination of sea level rise and more intense cyclones. While regional warming is expected to reduce in areas where increased rainfall is projected due to increased growth of vegetation and wetter soil conditions, areas with drier soil conditions will experience more severe heatwaves. Afforestation and reforestation in the region is expected to contribute to cooling and lower the scale of heat-related events due to greater evapotranspiration. Warming is projected to result in the emergence of unprecedented climatic conditions by the mid to late twenty-first century under medium and high GHG emissions scenarios by mid to late twenty-first century.

**Table 1.1** A cursory view of readiness\* of AMS in handling projected impacts for Southeast Asia based on adaption measures reported in their respective National Communications (NC)

Region-Specific Projected Impact (extracted from three IPCC Special Reports**)	ASEAN MEMBER STATES (AMS)									
	BD	Cam	Ind	Lao	Msia	Myn	Phi	Sing	Tha	Viet
Heavy precipitation associated with tropical cyclones (medium confidence) <sup>1</sup>	?	👉	?	👉	?	👉	👉	?	👉	👉
Land degradation from combined sea level rise and cyclones jeopardise lives and livelihoods in cyclone prone areas (very high confidence) <sup>2</sup>	👉	👉	👉	NR	👉	👉	👉	👉	👉	👉
Increase in the number of hot days in most land regions, with highest increases in the tropics (high confidence) <sup>1</sup>	👉	👉	👉	👉	👉	👉	👉	👉	👉	👉
Emergence of unprecedented climatic conditions by the mid to late 21 <sup>st</sup> century (medium confidence) <sup>2</sup>	👉	👉	👉	👉	👉	👉	👉	👉	👉	👉
Net reductions in yields of maize, rice, wheat, and potentially other cereal crops (IPCC SR 1.5°C) (high confidence) <sup>1</sup>	😊	👉	😊	👉	😊	👉	😊	👉	😊	😊
Net reductions in the CO <sub>2</sub> -dependent nutritional quality of rice and wheat (high confidence) <sup>1</sup>	👉	👉	👉	👉	👉	👉	👉	👉	👉	👉
Region expected to experience the largest impacts on economic growth due to climate change (medium confidence) <sup>1</sup>	👉	👉	👉	👉	👉	👉	👉	👉	👉	👉
Increase in frequency, duration, extent and intensity of marine heatwaves by 20 times (RCP2.6, medium confidence) <sup>3</sup>	👉	👉	👉	NR	👉	👉	👉	👉	👉	👉
Significant changes in wave heights and coastal tidal amplitudes and patterns (high confidence) <sup>3</sup>	👉	👉	👉	NR	👉	👉	👉	👉	👉	👉
Decrease in biomass of marine animal communities, production, and fisheries catch potential in all scenarios (high confidence) <sup>3</sup>	👉	🚫	👉	NR	👉	👉	👉	👉	👉	👉
Decline in ocean net primary production by 7–16% (very likely range) <sup>3</sup>	👉	🚫	👉	NR	👉	👉	👉	👉	👉	👉
Widespread challenges to fisheries governance in regional hotspots (medium confidence) <sup>3</sup>	?	?	?	NR	?	?	?	?	?	?
😊	High Level of Readiness: Region-specific projected impact is stated in the NC and adaptation measures are a priority.		🚫	Low Level of Readiness: Region-specific projected impact is not stated in the NC nor is the associated sector a priority for adaptation.						
👉	Medium Level of Readiness: Region-specific projected impact is not stated in the NC but the associated sector is a priority for adaptation.		?	Low Level of Readiness: Region-specific projected impact has to be investigated in the AMS.						
			NR	Not Relevant: Region-specific projected impact is not applicable to the AMS.						

\*Readiness in this context refers to the adaptation planning measures where actual implementation for many AMS depends on the availability of resources and technical support

\*\*The ocean projections are under RCP8.5 scenarios unless stated otherwise. In the RCP2.6 scenario, surface warming stays below a 2 °C threshold at the end of the twenty-first century, and for RCP8.5, the range is 3.5–4.5 °C in 2100

Sources for region-specific projected impact:<sup>a</sup>IPCC SR1.5 °C, <sup>b</sup>IPCC SRCCCL, and <sup>c</sup>IPCC SROCC Sources for adaptation priorities: NC2 Brunei Darussalam (2017), NC2 Cambodia (2015), NC3 Indonesia (2017), NC2 Lao PDR (2013), NC3 Malaysia (2018), NC2 Lao PDR (2013), INC Myanmar (2012), NC2 Philippines (2014), NC4 Singapore (2018), NC3 Thailand (2018), NC3 Vietnam (2019), and the following chapters



The IPCC SROCC conveys that Southeast Asia is expected to experience more frequent, longer duration, wider coverage, and higher intensity marine heatwaves. Changes in wave heights arising from altered weather patterns as well as tidal amplitude changes due to sea level rise will influence coastal hazards differently in the region. Marine biomass production will be altered, affecting fish catch potential, with tropical oceans expected to experience the highest impacts threatening the livelihoods of economically vulnerable coastal communities. The redistribution of ocean resources is expected to increase the risk of conflicts and bring widespread challenges for fisheries governance.

### ***1.3.2 Tackling Climate Change Risks***

The latest National Communications (NC) submitted by AMS under the UNFCCC were reviewed to delineate their projected impacts and adaptation priorities (INC Myanmar 2012; NC2 Lao PDR 2013; NC2 the Philippines (2014); NC2 Cambodia 2015; NC2 Brunei Darussalam 2017; NC3 Indonesia 2017; NC3 Malaysia 2018; NC4 Singapore 2018; NC3 Thailand 2018; NC3 Vietnam 2019). These were then compared with the specific projected impacts that are relevant to Southeast Asia in the IPCC Special Reports to assess the readiness of the AMS in tackling the challenges. Five categories were delineated (Table 1.1). The highest level of readiness is where the region-specific projected impact mentioned in the IPCC Special Report is also mentioned in the NC, and adaptation measures are prioritized for the projected impact. A medium level of readiness is ascribed where the region-specific projected impact mentioned in the IPCC Special Report is not stated in the NC, but the associated sector is a priority for adaptation. A low level of readiness is given where the specific projected impact mentioned in the IPCC Special Report for the region is not stated in the NC nor is the associated sector a priority for adaptation. A low level of readiness is given when a specific projected impact is not a conventional phenomenon in several AMS and has to be investigated. A “not relevant” status is assigned where an impact is not applicable. For example, the projected impact for the marine sector is not applicable for Lao PDR, which is a land-locked AMS.

Global warming of 1.5 °C is expected to challenge Southeast Asia with heavy precipitation associated with cyclones. The AMS that are traditionally exposed to cyclones have a medium level of readiness to handle heavy precipitation associated with this hazard (Table 1.1). The NC of these AMS allude to the need for investment in disaster preparedness and early warning to handle impacts associated with heavy precipitation, particularly floods. Some AMS such as Brunei, Indonesia, Malaysia, and Singapore are not within the tropical cyclone belt but they have been occasionally subject to heavy rainstorms associated with squalls during a tropical cyclone. Thus, projected heavy precipitation associated with tropical cyclones merits further investigation in these countries. While adaptation to sea level rise is a priority for all