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**Climate change adaptation in Southeast Asia –
a systematic mapping of the Asian Development Bank’s
projects in 2016-2020**

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<p>As the effects of climate change have become increasingly more visible in recent years, interest in climate adaptation has grown in both research and policy contexts. However, although Southeast Asia is one of the regions most vulnerable to climate change impacts, there has not yet been an effort to comprehensively track how Southeast Asian countries and communities are adapting to climate change. I apply a systematic review methodology developed for adaptation research to map adaptation responses identified in the Asian Development Bank’s (ADB) projects in Southeast Asia in 2016-2020. My results show that close to a fifth of the ADB’s adaptation projects in Southeast Asia is implemented in Cambodia, while Thailand and Timor-Leste are the least covered countries. In general, the characteristics of my examined projects are relatively similar to global adaptation trends. Flooding, drought, storms, and other heavy rainfall events are the most frequently addressed climate hazards by both the projects I examined as well as by UNFCCC climate fund projects and by adaptation responses documented in scientific papers. The sectors addressed and actors targeted by ADB projects were also typical to multilateral funding institutions, focusing on the agricultural and water sectors as well as national and local governments and farmers. Capacity building was the most frequent adaptation response category, indicating that adaptation implementation as delivered by the ADB is still in a relatively early phase in most Southeast Asian countries. In addition to results related to climate adaptation in Southeast Asia, I also demonstrate the applicability of a systematic review methodology for tracking climate change adaptation responses implemented by multilateral development banks, given sufficient information is made available on relevant projects.</p>			
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<p>Kiinnostus ilmastonmuutokseen sopeutumista kohtaan on lisääntynyt viime vuosina sekä tutkimus- että politiikkakontekstissa ilmastonmuutoksen vaikutusten tullessa yhä selvemmiksi. Vaikka Kaakkois-Aasian haavoittuvuus ilmastonmuutoksen vaikutuksille on yksi maailman korkeimpia, kokonaisvaltaista seuranta siitä, miten alueen maat ja yhteisöt sopeutuvat ilmastonmuutokseen ei ole vielä tehty. Käytän tutkielmassani sopeutumistutkimukselle kehitettyä systemaattista katsausmenetelmää kartoittamaan Aasian kehityspankin Kaakkois-Aasian projekteista vuosina 2016-2020 löytyneitä ilmastonmuutokseen sopeutumistoimia. Tuloksistani käy ilmi, että lähes viidesosa Aasian kehityspankin Kaakkois-Aasian sopeutusprojekteista toimeenpannaan Kambodžhassa. Vähiten projekteja löytyi Thaimaasta ja Timor-Lestestä. Yleisesti ottaen tarkastelemani projektit olivat varsin linjassa globaalien sopeutumistrendien kanssa. Tulvat, kuivuus, myrskyt ja muut rankat sadeilmiöt olivat ilmastouhat, joihin vastattiin useimmiten sekä tarkastelemissani projekteissa että YK:n ilmastonsuojelun puitesopimuksen rahastojen projekteissa ja akateemisista julkaisuista identifioituissa sopeutumistoimissa. Myös sektorit ja toimijat, joihin sopeutumistoimet liittyivät, olivat monenkeskisille rahoitusinstituutioille tyypillisiä, keskittyen maatalous- ja vesisektoreihin sekä kansallisiin ja paikallisiin hallintoihin ja maanviljelijöihin. Valmiuksien kehittäminen oli kaikista yleisin sopeutumistoimi, mikä viittaisi siihen, että Aasian kehityspankin toimeenpanemat sopeutumistoimet ovat yhä varsin alkuvaiheessa useimmissa Kaakkois-Aasian maissa. Näiden Kaakkois-Aasian ilmastonmuutokseen sopeutumiseen liittyvien tulosten lisäksi tutkielmani osoittaa myös, että systemaattinen katsaus soveltuu metodina monenkeskisten kehityspankkien toimeenpanemien ilmastonmuutokseen sopeutumistoimien seurantaan. Edellytyksenä tälle on kuitenkin riittävän informaation saatavuus relevanteista projekteista.</p>			
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Table of Contents

Abbreviations.....	2
1 Introduction.....	3
2 Background.....	6
2.1 <i>The state of climate change adaptation in Southeast Asia.....</i>	6
2.2 <i>Adaptation finance to developing countries.....</i>	9
3 Conceptual framework	12
3.1 <i>Tracking and documenting climate change adaptation</i>	12
3.2 <i>Climate change adaptation categorisation and typologies</i>	15
3.3 <i>Research design and questions</i>	16
4 Methods and data	19
4.1 <i>Methods</i>	19
4.2 <i>Data.....</i>	24
5 Results.....	27
5.1 <i>Project-level analysis.....</i>	27
5.1.1 <i>Geographical distribution of projects</i>	27
5.1.2 <i>The share of climate adaptation in the overall project outputs</i>	28
5.2 <i>Response-level analysis</i>	29
5.2.1 <i>Adaptation responses</i>	29
5.2.2 <i>Hazards responded to.....</i>	31
5.2.3 <i>Sectors addressed.....</i>	33
5.2.4 <i>Actors targeted.....</i>	34
6 Discussion and conclusion	36
Acknowledgements.....	40
Bibliography.....	41
Appendix 1. Adaptation typology by Biagini et al. (2014).....	48
Appendix 2. List of the Asian Development Bank projects included in analysis	49

Abbreviations

ADB	Asian Development Bank
AGR	Adaptation Gap Report
ASEAN	Association of Southeast Asian Nations
COP	Conference of the Parties
GAMI	Global Adaptation Mapping Initiative
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
INDC	Intended Nationally Determined Contributions
IPCC	Intergovernmental Panel on Climate Change
MDB	multilateral development bank
NAPA	National Adaptation Programme of Action
NDC	Nationally Determined Contributions
NGO	non-governmental organisation
RRP	Report and Recommendation of the President
TAR	Technical Assistance Report
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

1 Introduction

Anthropogenic climate change refers to the long-term increase in the average temperature of the Earth as a result of human activity. The rising concentration of greenhouse gases in our atmosphere has already led to observable impacts such as ocean warming and acidification, sea level rise, and an increase in heatwaves and extreme rainfall across the world. Despite current and expected severe consequences of climate change to both natural and human systems, there is relatively little information available on the extent to and the ways in which individuals and societies are responding to these impacts. This is also true for the region of Southeast Asia, home to over 650 million people and some of the world's fastest growing economies (ASEAN Secretariat, 2020). Through a systematic review of the Asian Development Bank's (ADB) projects in Southeast Asian countries that received climate adaptation financing between 2016 and 2020, the primary aim of this master's thesis is to contribute to understandings of the current state of climate change adaptation in the region. I use adaptation responses identified in the ADB's project documentation as proxies for implemented climate adaptation in order to map where, how, in which sectors, by whom and in response to which climate hazards adaptation in Southeast Asia is undertaken.

The Intergovernmental Panel on Climate Change (IPCC) estimates that human activities have already caused approximately 1.0 °C of global warming above pre-industrial levels (IPCC, 2018b). In Southeast Asia, average temperatures have been rising at a rate of 0.14 °C to 0.20 °C per decade since the 1960s. Annual total rainfall has increased by 22 mm per decade and the northern parts of the region suffer from extreme events at a growing frequency (Hijioka et al., 2014). Indeed, four of the ten countries most affected by extreme weather events – calculated as the combination of the total number of events, the number of fatalities, and the scale of economic losses – between 1999 and 2018 are located in Southeast Asia (Eckstein et al., 2019). These already occurring impacts of global warming will only intensify in the coming years and a failure to stabilise global greenhouse gas emissions will have further significant consequences for Southeast Asian countries and their people. Climate change is predicted to cause increased river flooding, coastal inundation, and sea level rise that will affect the rapidly urbanising countries' key coastal megacities, such as Bangkok, Jakarta, Manila, and Ho Chi Minh City. Water stress and risks from intense cyclones, heat-related mortality, and water and vector-borne diseases will increase while agricultural production and labour productivity is expected to decline. These consequences will reverse the development progress achieved in the region over the past decades. According to an ADB estimate, losses caused by the effects of climate change will reduce Southeast Asia's gross domestic product (GDP) by 11% in 2100 under a business-as-usual emissions scenario (Raitzer et al., 2015).

Despite the internationally agreed goal to hold global warming to well below 2 °C and pursue efforts to limit it to 1.5 °C that was adopted in the 2015 Paris Agreement, progress to achieve this target has been slow. Indeed, the continuation of current policies are expected to lead to a temperature increase of 2.9 °C by 2100 while the full implementation of all countries' pledges and targets made as of May 2021 would limit warming to 2.4 °C (Climate Action Tracker, 2021). According to the IPCC, meeting the Paris Agreement goal would require rapid and far-reaching transitions in energy, land, urban and infrastructure, and industrial systems (IPCC, 2018b). Given the scale of this emissions reduction challenge as well as the projected impacts of a level of global warming that has already been locked-in, efforts to adapt to climate change have increasingly been seen as important.

Understanding if and how adaptation is currently taking place is critical to decisionmaking regarding future adaptation options, financing allocations, and investments. However, major conceptual, empirical, and methodological challenges have thus far hindered attempts to track adaptation in a comprehensive manner and to assess progress in reducing vulnerability to climate change. While previous studies have mapped adaptation with various geographical or sectoral foci, such a systematic overview of climate adaptation activities across Southeast Asia is lacking. This research gap is significant considering the scale of current and future impacts of climate change on the region as well as the priority Southeast Asians give to the issue. According to the State of Southeast Asia Survey conducted in 2020 by Singapore-based think tank ISEAS-Yusof Ishak Institute, climate change ranked among the region's top three concerns, with over half of the self-selected respondents viewing climate change as a serious and immediate threat to the well-being of their country (Seah et al., 2021).

This master's thesis presents a systematic mapping of those ADB projects in Southeast Asia that received climate adaptation financing between the years 2016 and 2020. I define the region of Southeast Asia using the ADB's departmental coverage as the following eleven countries: Brunei Darussalam (henceforth Brunei), Cambodia, Indonesia, the Lao People's Democratic Republic (henceforth Laos), Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam. My research project serves three purposes.

First, the descriptive study identifies patterns and trends in the adaptation responses found in ADB projects in Southeast Asia. As such, it maps one particular slice of the overall climate adaptation efforts in the region, thereby contributing to understandings of the state of adaptation in Southeast Asia. Second, the thesis compares adaptation responses identified in these ADB projects to an overview of global adaptation action. This provides indications of whether and how climate adaptation implemented by the ADB in Southeast Asia differs from overall adaptation globally. Third, the thesis takes a systematic review methodology commonly

used to map adaptation using policy documents and peer-reviewed literature as sources and applies it to examine projects of a multilateral development bank (MDB). Efforts to map adaptation responses funded through international climate finance have so far been limited to funds under the United Nations Framework Convention on Climate Change (UNFCCC) (e.g. Biagini et al., 2014; UNEP, 2021). Thus, the thesis tests the systematic review methodology's usefulness in analysing data from a novel source – MDB projects.

In the next section, I provide an overview of existing literature on the state of climate change adaptation in Southeast Asia and briefly describe the international adaptation financing landscape, placing the ADB's adaptation projects in this context. This serves to set the background for my research and its aims. I then expand on the challenges related to adaptation tracking and describe the ways in which systematic review methodologies have been applied to map global adaptation actions. I also present theoretical frameworks and typologies that have informed previous adaptation tracking exercises. The final part of the conceptual framework section outlines the research design of my thesis. Then, under the methods and data section I detail my systematic review process and consider potential biases and drawbacks of my data collection decisions. After presenting the results of my analysis and comparing these to global adaptation trends, I discuss some limitations of my research as well as potential future directions for research in my conclusion.

2 Background

2.1 The state of climate change adaptation in Southeast Asia

Defined by the IPCC as “the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities”, adaptation did not initially have the same status as climate change mitigation in international climate governance (IPCC, 2018a). Under the UNFCCC, adaptation was initially framed as a challenge specifically for low-income countries, with a focus on establishing ways to provide them with technical assistance and financing. It was not until the 16th Conference of the Parties (COP) to the UNFCCC in 2010 that the Cancun Adaptation Framework was adopted, calling for adaptation to be addressed with the same priority as mitigation. Finally in 2015, adaptation was explicitly recognised with its own long-term goal to reflect the international consensus on the urgency of vulnerability reduction, thus formalising adaptation’s status as a key pillar of the UNFCCC alongside mitigation (Hall & Persson, 2018; Lesnikowski et al., 2017). The Paris Agreement strengthened countries’ adaptation commitments, requiring them to submit regular adaptation communications that may contain information on national policies and actions, progress and results achieved as well as monitoring and evaluation (UNFCCC, 2019).

While there is plenty of academic literature on various individual aspects of climate change adaptation in Southeast Asia such as case studies of different sectors or theorising on governance structures most conducive for action, research that tracks the extent and progress of adaptation in the region is more scarce. In 2007, a cursory analysis of National Communication documents submitted to the UNFCCC by Southeast Asian countries found that adaptation policies and measures were generally covered in only a handful of pages out of total submission lengths that ranged between 63-135 pages (Srinivasan, 2007 as cited in Francisco, 2008).

The first major overview of adaptation activity in the region is found in the 2008 report “Climate Adaptation in Asia: Knowledge Gaps and Research Issues in South East Asia” (Resurreccion et al., 2008). Although it was focused on identifying strategic knowledge and capacity gaps, the report also summarises adaptation strategies in Southeast Asian countries. Stakeholder workshops and expert interviews, as well as a review of academic and grey literature were used as sources for this report. It found that in general, planned adaptation initiated by both the national, provincial, municipal or commune-level governments as well as by international and local non-governmental organisations (NGOs) was centred around disaster preparedness, vulnerability reduction, and capacity building. Adaptation measures ranged from the construction of physical infrastructures (e.g. seawalls, breakwaters) and the implementation of coastal laws and land regulations, to providing climate forecasting for farming and supporting farmers in transitioning to other crops and more diversified farming systems. The prominence of traditional disaster risk and poverty reduction strategies over

other direct adaptation measures was explained by the low level of knowledge and awareness of climate change amongst local officials.

In terms of household and individual autonomous adaptation actions, a wide range of actions was documented, including physically reinforcing housing structure, retreat actions, diversification of livelihood sources, cropping system alterations, and labour migration. Autonomous adaptation strategies used varied according to ecological zones and climate stressors. The problems of collecting data on autonomous adaptation were explicitly pointed out in the report, which remarked that while practices are universal and pervasive, they are not regularly and widely recorded. Moreover, studies on them have been static rather than longitudinal, failing to account for the iterative and changing nature of adaptation (Resurreccion et al., 2008). While the report identifies and lists concrete examples of adaptation actions and projects taken across the region, it did not aim to provide a comprehensive overview of the status of climate adaptation in Southeast Asia. The country summary sheets of adaptation related activities in the report's appendix are more snapshots of various individual aspects of adaptation rather than systematic analyses of the extent of adaptation actions and their characteristics, making cross-country comparisons difficult.

Similarly, a 2010 book chapter by Uy and Shaw titled "Climate Change Adaptation in ASEAN: Actions and Challenges" lists several adaptation actions in individual countries and at the regional level. These actions were divided into two categories: 1) state/non-state policy and action, and 2) research/capacity-building. The former consists of submissions to the UNFCCC, domestic legislation and national strategies, activities led by international and local NGOs as well as private sector initiatives. The latter includes collaborations between universities, research institutions, and NGOs. The authors emphasise that most initiatives they reviewed were focused on community-based adaptation and stressed the importance of local implementation to ensure the effectiveness of adaptation. The chapter also considers regional climate adaptation frameworks under the Association of Southeast Asian Nations (ASEAN), focusing on disaster management and emergency response, human health systems, food security as well as climate change and adaptation more generally (Uy & Shaw, 2010). However, this research also did not engage in a systematic analysis or comparison of documented adaptation actions.

Salamanca and Nguyen (2016) categorise Southeast Asian countries based on their climate change adaptation readiness as adaptation pioneers (Philippines and Vietnam), emerging champions (Cambodia, Indonesia and Myanmar), and wait-and-see adaptors (Laos, Malaysia and Thailand). However, the rankings were based primarily on the extent of national-level adaptation governance structures in each country rather than on concrete actions or their results. Interventions were found to be focused on the national level, mostly

addressing natural hazard risks and failing to engage vulnerable populations in decision-making. The review also identified the availability of funding as a critical bottleneck for adaptation in Southeast Asian countries (Salamanca & Nguyen, 2016).

The most recent assessment of the status of climate change adaptation in Southeast Asian countries is by Dedicatoria and Diomampo from 2019. It is based on a review of government reports, including their Intended Nationally Determined Contributions (INDC), National Communications and National Adaptation Programmes of Action (NAPAs), as well as other related documents, such as climate change policies and strategies. The review is broken down into four parts: each country's adaptation vision and priorities, current adaptation trends, gaps and areas for adjustment, and readiness for enhanced adaptation actions. The current adaptation trends and gaps and areas for adjustment are analysed in terms of eight indicators: policy, strategy, legal provision and governance; institutional arrangement; integration and mainstreaming; finance; implementation capacity; technology; decision-making tools and institutionalisation; and awareness, knowledge and access to information. (Dedicatoria & Diomampo, 2019).

As the review is more focused on evaluating each country's institutional, regulatory and implementation frameworks and capacity vis-a-vis climate change adaptation, it contains little information about the various adaptation actions undertaken. However, referring to a continuum of adaptation options from addressing the drivers of vulnerability, to building response capacity, then managing climate risk, and finally, confronting climate change, the review notes that most existing and proposed adaptation initiatives in Southeast Asia to fall under the middle two. Overall, the assessment concludes that huge gaps remain to enhance climate adaptation in the region. These include the weak implementation of policies and laws, poor coordination among relevant ministries, insufficient and underutilised mechanisms to generate alternative sources of financing, conflicting economic priorities, and lack of systems for monitoring and evaluation of programmes (Dedicatoria & Diomampo, 2019).

In short, although there is a high level of concern about climate change and its impacts amongst Southeast Asians and despite some countries in the region receiving significant amounts of climate finance from bilateral and multilateral sources¹, the literature covering climate adaptation efforts in the region remains limited. Where such research exists, its focus is more on providing an overview on various aspects of adaptation (e.g. governance or readiness) rather than conducting a comprehensive mapping exercise of adaptation activities taking place in Southeast Asia.

¹ In 2015-2016, five out of the ten largest climate finance recipient countries were in Southeast Asia: Vietnam (3rd), Philippines (4th), Thailand (5th), Indonesia (6th), and Myanmar (10th) (Timperley, 2018).

2.2 Adaptation finance to developing countries

Despite numerous challenges complicating the estimation of the costs of planning and implementing adaptation measures as well as of the amount of financing mobilised for these adaptation measures, the general consensus is that the gap between the two is significant. According to one calculation by the United Nations (UN), the annual adaptation costs in developing countries alone could range from US\$140 to US\$300 billion by 2030, rising to between US\$280 billion and US\$500 billion by 2050. The range of estimated costs is higher over the long-term and under high emissions scenarios, which underscores the importance of enhanced climate mitigation (Chapagain et al., 2020; Puig et al., 2016). However, the organisation Climate Policy Initiative calculates that in 2017 and 2018, total adaptation finance flows from domestic and international as well as public and private sources amounted only to an annual average of US\$30 billion. Of this, US\$20 billion was directed towards developing countries. In addition, financing labelled as benefiting both mitigation and adaptation efforts averaged to an additional US\$12 billion a year. Adaptation financing thus remains far below the estimated adaptation costs and is very low compared to financing mobilised globally for climate mitigation, which averaged to US\$532 billion a year – 93% of all climate finance (Macquarie et al., 2020).

While adaptation, compared to mitigation, is underrepresented also in the climate financing provided by MDBs, the imbalance is not as large. In 2020, eight MDBs – including the ADB² – committed a total US\$38 billion in climate finance to low- and middle-income countries, of which US\$13.3 billion, i.e. 35%, was for adaptation (African Development Bank et al., 2021). As such, MDBs are a significant source of financing to developing countries for climate adaptation purposes. Indeed, as part of their pledge to align their financial flows with the Paris Agreement and mainstream climate resilience across their portfolios, MDBs have taken significant steps to increase their adaptation finance and to develop a joint methodology and criteria for tracking these flows (African Development Bank et al., 2020). Based on this methodology, a project must contextualise its vulnerability to climate change, explicitly state an intent to address this vulnerability, and present a clear and direct link between the vulnerability and the specific project activities in order to be counted towards the MDB's adaptation finance. Only the incremental cost of adaptation activities, rather than the value of the entire project, is included in the adaptation finance accounting (African Development Bank et al., 2020).

² The eight MDBs that reported their climate finance in joint figures in 2020 are the African Development Bank (AfDB), the Asian Development Bank (ADB), the Asian Infrastructure Investment Bank (AIIB), the European Bank for Reconstruction and Development (EBRD), the European Investment Bank (EIB), the Inter-American Development Bank Group (IDBG), the Islamic Development Bank (IsDB) and the World Bank Group (WBG).

MDB adaptation finance to developing countries can be divided into two financing streams: dedicated climate finance and climate-related development finance. Dedicated climate financing can be used to support discrete adaptation projects. Examples include an MDB helping a country to make decisions and take actions to manage the impacts of climate change, like constructing flood-protective embankments, or supporting people and communities in adopting climate-smart agricultural practices. On the other hand, climate-related development finance refers to funding that has a primary goal of economic development and is delivered in a climate-friendly way (Murphy & Parry, 2020).

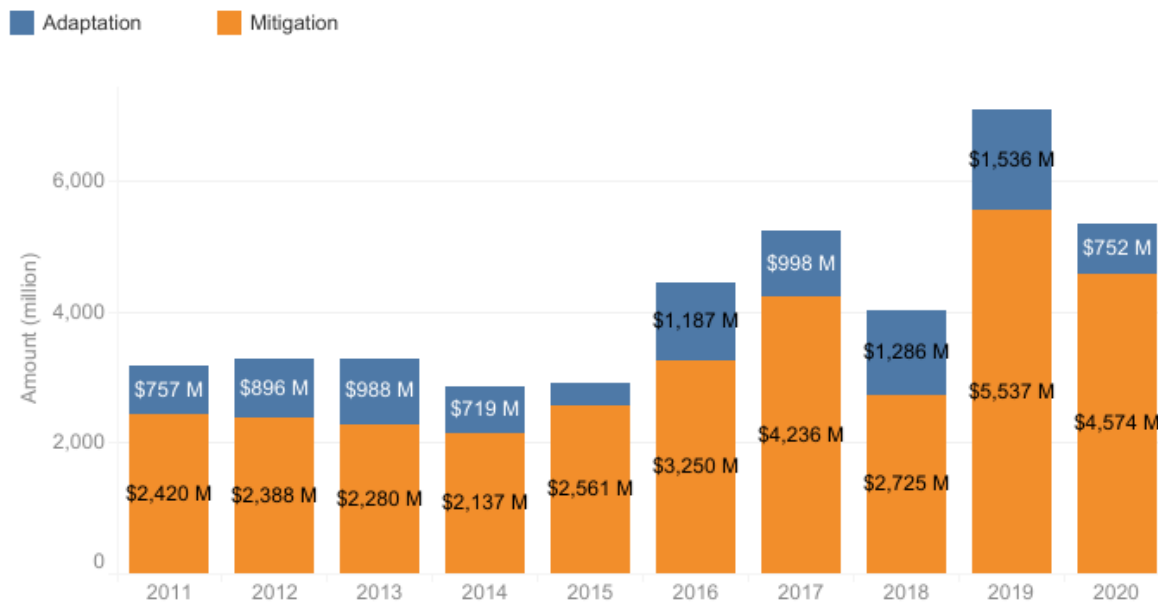
The climate change think tank E3G ranks the ADB's climate finance data transparency as one of the best amongst the nine most prominent public and development banks³ (E3G, 2020). In 2015, the ADB pledged to increase its climate financing to US\$6 billion annually, with US\$2 billion for adaptation, by 2020. According to the ADB's Climate Change Operational Framework 2017-2030, the bank's commitment to mainstreaming climate adaptation throughout its operations will include measures to embed climate and disaster risk assessment in country analysis and project preparation, integrate climate change adaptation and disaster risk management efforts in its projects, promote climate-resilient development at the community level, and promote ecosystem-based adaptation for both rural and urban resilience. The Framework also makes explicit the ADB's aim to go beyond simply ensuring the physical infrastructure it finances is climate proofed by prioritising projects specifically targeted at climate adaptation. Water, agriculture and natural resources, urban development, and social development sectors were identified as primary areas for financed adaptation actions (Asian Development Bank, 2017).

Although the ADB's climate financing peaked in 2019 at over US\$6.37 billion, helping the ADB achieve its overall financing target one year early, only US\$1.54 billion of this was for adaptation. During the period of 2016-2020, the top three sectors receiving ADB adaptation finance across all recipient countries were agriculture, natural resources and rural development, water and other urban infrastructure and services, and transport. These three sectors are overwhelmingly dominant, each receiving around US\$1.5 billion over the five years. In contrast, the finance and energy sectors received around US\$400 million each, with funding levels for other sectors remaining below US\$100 million. The regional breakdown of the ADB's financing does not separate mitigation and adaptation but instead reports overall climate finance. During the period of 2016-2020, Southeast Asia received US\$5.4 billion in climate finance, making up 20% of total financing. It was the

³ The banks covered in E3G's analysis are the Asian Development Bank, the African Development Bank, the Asian Infrastructure Investment Bank, the European Bank for Reconstruction and Development, the European Investment Bank, International Bank for Reconstruction and Development/International Development Association (World Bank), the Inter-American Development Bank, the International Finance Corporation (World Bank Group), and the Islamic Development Bank.

region with the third highest climate financing, following South Asia (US\$9.9 billion) and East Asia (US\$5.5 billion) (Asian Development Bank, n.d.).

Historical Climate Finance (based on approvals) (\$ million)



Source: Asian Development Bank estimates (February 2021)

Figure 1. The ADB’s climate finance in 2011-2020 (Asian Development Bank, n.d.)

In 2020, the ADB’s adaptation financing totalled only US\$752 million, the lowest level since 2016 (Asian Development Bank, n.d.). At its 54th Annual Meeting in May 2021, the bank announced that it will increase its focus on adaptation and resilience to climate change in response to the growing threat faced by Asia and the Pacific. Specifically, emphasis would be placed on investments in nature-based solutions, climate-smart livelihood practices, and community resilience programmes (Asian Development Bank, 2021). My thesis provides an overview of some trends in current adaptation financing by the ADB, such as the type of adaptation response funded. Understanding this, even if only in one region of the bank’s operations (Southeast Asia), makes it possible to better evaluate whether the ADB’s recent commitment has an actual effect on the bank’s financing decisions in the coming years.

3 Conceptual framework

3.1 Tracking and documenting climate change adaptation

The increased attention to climate change adaptation following the adoption of the Paris Agreement has accentuated the need for methodological tools to document and monitor adaptation measures. Adaptation tracking can be defined as “the development and application of systematic approaches to assess progress of adaptation efforts over time and space, and between and across population and sectors” (Berrang-Ford et al., 2019, p. 440). Understanding the current state of adaptation is a crucial step in examining the effectiveness of adaptation support, identifying priorities, evaluating adaptation funding, and justifying allocation of resources (Ford et al., 2013).

However, neither the UNFCCC nor any other organisation has issued formal guidance on how to search for and document adaptation at the larger scale. The absence of agreed international processes for tracking adaptation and the dearth of academic literature attempting to do the same can be explained, at least in part, by the key conceptual, empirical, and methodological challenges present. The conceptual ambiguity of adaptation stems from a lack of consensus on its definition, form and types, effectiveness as well as relationship to other closely related terms such as development, coping, mitigation, and maladaptation (Ford et al., 2013; Tompkins et al., 2018). Large sample adaptation studies rarely explicitly define how they understand and operationalise the concept of “adaptation”, often simply assuming that whatever is reported as adaptation really is adaptation (Biesbroek et al., 2018). Moreover, there is no single unit of analysis that could be used as a proxy to measure or compare adaptation (Berrang-Ford et al., 2019).

Empirical limitations associated with adaptation data, such as availability and quality, are also frequently reported as challenges to conducting comprehensive adaptation tracking exercises. Several databases collating adaptation policy or project documents exist but they are neither comprehensive nor consistent in form or content (Ford et al., 2013; Biesbroek et al., 2018). Some adaptation-tracking studies have expanded their data collection beyond such repositories by using web searches, expert surveys, interviews, and workshops, but these methods require significantly longer times to execute. Language barriers pose a further challenge to adaptation tracking. In addition, gathered data could be contaminated by various reporting biases, for example the over-emphasising of successful projects or the tendency of governments to over-report government-driven adaptation over other types of adaptation action (Biesbroek et al., 2018).

Researchers also differ in their approaches to tracking adaptation, some having a more expansive understanding of what this encompasses than others. Ford et al. (2013) make a distinction between outcome-

based approaches to adaptation tracking (evaluating the extent of reduced negative climate change impacts) on one hand and preparedness-, process-, and policy-based approaches on the other. The latter set of approaches include adaptation readiness, the process through which adaptations are developed and implemented, reported adaptation actions (policies and programmes) and their characteristics, and changing vulnerability as measures available to assess the various stages of adaptation. However, the relationship between the task of documenting adaptation and that of monitoring and evaluating adaptation is also contested, with Tompkins et al. (2018) arguing that the two are separate while Berrang-Ford et al. (2019) regard adaptation tracking approaches as a subcomponent of monitoring, reporting, and evaluation of climate adaptation.

Unstated assumptions about the nature of adaptation and the lack of standardised data sources have led to a diversity of methods used for documenting adaptation. Systematic review approaches have become increasingly popular in adaptation research since 2009, with adaptation tracking as their one subset. Departing from the stringent definition of traditional systematic reviews used in health sciences, the purpose of these knowledge synthesis approaches is to increase methodological transparency and rigor in adaptation research by systematising the review process and enabling its reproducibility through explicit description of data collection and selection. Adaptation research making use of systematic review approaches tend to be aggregative in nature, describing patterns and trends, but it can also have an evaluative and explanatory objective. Peer-reviewed literature is the most commonly used data source but grey literature and stakeholder consultations are also often included. Especially when examining policy and practice, restricting the review only to peer-reviewed literature might exclude key information and bias the results (Berrang-Ford et al., 2015).

When tracking adaptation, systematic reviews identify adaptation actions documented in their data sources and use these actions as the unit of analysis and as proxies through which to assess the extent and type of adaptation taking place. Systematic reviews tracking adaptation usually draw from academic literature (e.g. Berrang-Ford et al., 2011) and from documentation submitted by countries to the UN (e.g. Robinson, 2017). They have various foci ranging from developed countries (Ford et al., 2011) to small island developing states (Klöck & Nunn, 2019) and vulnerable “hotspot” nations in Asia and Africa (Ford et al., 2015). They examine adaptation actions in different sectors and at different levels such as the transport sector (Eisenack & Stecker, 2012), civil society organisations (Poutiainen et al., 2013), public health in large cities (Araos et al., 2016), community-based adaptation (McNamara & Buggy, 2017), indigenous people in the Asia-Pacific (Mohamed Shaffril et al., 2020), and Asian farmers (Shaffril et al., 2018).

The Global Adaptation Mapping Initiative (GAMI) is the most comprehensive effort to systematically map global adaptation efforts to date. Comprising a network of 126 researchers and using a combination of systematic review and machine learning approaches, GAMI examined over 48,000 scientific documents on adaptation published between 2013 and 2019. It is the first global stocktake of empirical adaptation research, identifying and analysing 1,682 peer-reviewed articles that met the inclusion criteria of human-initiated adaptation activities directly intended to reduce risk, exposure or vulnerability to climate-related hazards. The GAMI's findings indicate that while there is growing literature reporting on human efforts to respond to climate change, evidence of actual risk reduction is negligible. The overall extent of global adaptation across regions and sectors was assessed as low, with documented adaptation being largely localised (undertaken by individuals, households and local governments), implemented slowly, and involving small adjustments to business-as-usual as opposed to transformative changes. Adaptation responses most frequently took place in the context of food and agriculture, while drought, inland flooding as well as precipitation variability and extremes were the most cited hazards addressed (Berrang-Ford et al., forthcoming).

The GAMI's results are one of the two main sources of data for the United Nations Environment Programme's (UNEP) Adaptation Gap Report (AGR) 2020's analysis of global progress in implementing adaptation. While the report is already the fifth edition of the AGR, this is the first time such an assessment of adaptation implementation is introduced (UNEP, 2021). Since future AGRs will build upon this assessment to provide an indication of trends over time in the progress of global adaptation progress, the AGR 2020 effectively presents a baseline as well as a new standard methodology for adaptation tracking – at least as done by UNEP. In addition to the GAMI, the report's analysis is based on data extracted from project proposals funded by UNFCCC climate funds: the Adaptation Fund, the Green Climate Fund (GCF) and the Global Environment Facility (GEF) which also manages the Least Developed Countries Fund and the Special Climate Change Fund. Notably, the AGR 2020's analysis does not cover projects from non-UN finance sources such as the MDBs due to data access challenges. The report acknowledges this omission as one of its shortcomings (UNEP, 2021). Just as in the GAMI, readiness and other preparatory actions were excluded, leaving close to 400 explicit adaptation projects financed by the three funds.

Although the projects cover adaptation actions only in developing countries (given the nature of climate finance) and GAMI analysis includes adaptation occurring globally, the results from the two reviews were surprisingly similar. Agriculture and water were the most commonly identified primary sectors of UNFCCC climate fund adaptation projects since 2015, while the top climate hazards addressed were drought, flooding, and rainfall variability. Since international climate funds measure the results of funded projects at the output

rather than outcome level, there was limited information available on their actual effects, such as risk reduction achieved (UNEP, 2021).

In short, despite growing recognition of the importance of tracking climate change adaptation at the global level, efforts to do this have suffered from the lack of formally agreed guidelines as well as numerous conceptual and methodological challenges. There is little consistency in what is meant by “adaptation”, nor in how, from which sources, or with what criteria adaptation should be tracked. Systematic review approaches have emerged as a main methodology for tracking climate adaptation, applied to map activities with various sectoral, thematic, and regional foci. The AGR 2020 presents a baseline for tracking global adaptation progress, making use of data from a systematic review of peer-reviewed adaptation literature and a document review of UNFCCC funded adaptation projects.

3.2 Climate change adaptation categorisation and typologies

There is no formally agreed way to categorise climate change adaptation in the international climate regime. However, the academic community has over the years made numerous attempts to arrange adaptation activities into groupings based on various criteria. Here, I briefly present the methods of categorisation and typologies based on which my data analysis is structured.

One distinction is made between groundwork level activities and tangible adaptation activities. The former are initiatives aimed at informing and preparing for adaptation, such as impact and vulnerability assessments, adaptation research and policy recommendations, climate change scenarios, and stakeholder networking. Adaptation level actions, on the other hand, aim to tangibly improve the resilience of human and natural systems. Examples include regulations, infrastructure and technology changes, public awareness and outreach, surveillance and monitoring, as well as financial support (Lesnikowski et al., 2015). Efforts to document adaptation actions have been criticised for including vulnerability assessments and the building of adaptive capacity as well as for measuring progress towards and effectiveness of the delivery of adaptation policy, as opposed to focusing on evidence of the amount and distribution of actual adaptation occurring (Tompkins et al., 2018).

In an often cited foundational article, Smit et al. (2000) propose a systematic approach to describing an anatomy of adaptations based on three interdependent components: the system of interest and its properties (who or what adapts?), the climate-related stimulus and its actual or anticipated effects (adaptation to what?), and the forms and processes used to respond to the stimulus (how does adaptation occur?). The analysis of primary adaptation projects under the UNFCCC climate funds presented in the AGR 2020 is based on the first

two of these three components (UNEP, 2021). Projects are broken down by the primary sectors within which adaptation occurs and by the actors targeted, addressing the question of who and what adapts. In addition, projects are identified by the climate hazard they address, providing information on what is being adapted to.

Biagini et al. (2014) developed a typology of adaptation actions using a bottom up review of projects financed through the GEF. Examining these real-world adaptation activities through project document review as well as surveys and phone interviews with project leads, the authors were able to verify the various classifications and categories that had been previously theorised in academic literature. The resulting typology consists of ten adaptation categories: capacity building, management and planning, practice and behaviour, policy, information, physical infrastructure, warning or observing systems, “green” infrastructure, financing, and technology. For each category, a short description was included as well as a list of various actions that fall under it. For example, “green” infrastructure is defined as new or improved soft, natural infrastructure aimed at providing protection from climate hazards; it includes actions such as revegetation, afforestation, woodland management and increased landscape cover. The complete descriptions and list of actions belonging to each category is reproduced as Appendix 1.

The typology by Biagini et al. (2014) addresses the third component in Smit et al.’s (2000) anatomy of adaptations regarding the forms and processes used to respond to the climate-related stimulus, i.e. how adaptation occurs. However, distinctions between categories were not all clear-cut. While the majority of adaptation actions identified fit clearly within one of the ten categories, a small proportion could be classified under more than one category. Most GEF projects analysed included combinations of the ten categories rather than being focused on a single category. The journal article that resulted from the GAMI, Berrang-Ford et al.’s (forthcoming) systematic review of global adaptation actions documented in peer-reviewed literature, is an example of research where activities are categorised based on all three of Smit et al.’s components: who is responding, what climate hazards are being responded to, and what type of responses are being undertaken.

While many other, often more in-depth, typologies have been deployed to categorise adaptation actions, I make use only of the above outlined typologies in my data analysis due to the limited scope of the master’s thesis. In addition, using existing typologies also makes it easier to compare my results with those of previous adaptation mapping efforts by ensuring that the research responds to similar questions.

3.3 Research design and questions

This research project is a descriptive systematic review of the ADB’s climate adaptation finance projects in Southeast Asian countries. With the publication of the AGR 2020, review methodologies – systematic or

otherwise – have been established as a standard method for tracking and analysing adaptation actions taking place globally. Since my aim was to contribute to understandings of adaptation implementation in Southeast Asia and globally with my findings, employing a similar research method helps ensure comparability of results. Furthermore, this thesis is also an attempt to advance adaptation tracking scholarship by testing the applicability of a systematic review approach to analysing MDB project data. As such, the systematic review method is as much a key aspect of my research project as my chosen data sources or analytical framework rather than simply being a tool with which the research was carried out.

While numerous manuals on conducting systematic reviews in academic research have been written from various disciplinary perspectives, I use the components of systematic review in adaptation research proposed by Berrang-Ford et al. (2015) as the guiding framework for my research project. These components were formulated based on an analysis of the strengths and weaknesses of previous adaptation literature that has used systematic review approaches. Therefore, they are directly relevant to climate change adaptation research – a distinct advantage over other systematic review guidelines available. Berrang-Ford et al.'s (2015) guidelines consist of eight components: 1) explicit aim and objectives of review; 2) clear description of theoretical or conceptual approach used to guide the review; 3) justification and description of literature source; 4) articulation of search terms and/or detailed description of search process; 5) description of criteria for inclusion and exclusion; 6) documentation of literature included and excluded; 7) description of methods for analysis; and 8) critical appraisal of information quality.

I have briefly touched on the aims of my review already in the introduction. In this sub-section, I will further elaborate on these objectives and spell out the research questions to which my systematic review responds. The conceptual framework guiding the review has been described in the sub-sections immediately preceding this one. Finally, the methods and data section below (Section 4) will detail my research process and cover the justification and description of literature source component, as well as the critical appraisal of information quality, detailed description of search process, description of criteria for inclusion and exclusion, and description of methods for analysis components. The remaining component, documentation of literature included, is covered by a table in Appendix 2.

My thesis describes patterns and trends present in the ADB's adaptation finance to Southeast Asian countries between 2016 and 2020. As such, its main research question is formulated as: **What adaptation responses are being undertaken in Southeast Asia through ADB projects approved in 2016-2020?**⁴

⁴ Southeast Asia is defined following the ADB's departmental coverage as Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam.

Here, I follow Berrang-Ford et al. (forthcoming) in using the word “responses” for two reasons. First, to emphasise the focus on solution-oriented actions rather than readiness actions such as vulnerability assessments and impact studies. This distinction is informed by the conceptual categorisation of adaptation actions as either groundwork level or tangible activities made in adaptation literature, and is one employed by both the GAMI and the AGR 2020. Second, the word choice highlights that while the adaptation responses examined aim to reduce vulnerability and/or exposure to climate change, this might not actually be the achieved result. A similar approach is used in the AGR 2020, which differentiates between adaptation outputs (the sum of activities engaged on the ground) and adaptation outcomes (the results of those activities in terms of reducing risk today and in the future) (UNEP, 2021). In other words, my research results describe the tangible adaptation taking place on the ground in Southeast Asian countries as part of ADB projects without assessing whether they in fact result in risk reduction.

I make use of Smit et al.’s (2000) anatomy of adaptations to formulate the following research sub-questions which also help structure my results in a format comparable to the global adaptation overview as presented in AGR 2020:

- What adaptation responses can be identified in the ADB projects, i.e. how is adaptation being operationalised?
- Who is the actor targeted by the adaptation response?
- What sector is addressed by the adaptation response?
- What climate change impacts and hazards are being responded to?

In addition, a fifth sub-question allows me to break down my results to the previous sub-questions by each country:

- What country or countries is each project, and by extension are the responses, going to be implemented in?

The temporal frame of five years between 2016 and 2020 for my systematic review was determined by data availability as well as to ensure as comprehensive coverage of adaptation responses as possible. The ADB started publishing the project level data for its annual climate financing in 2016, the year the Paris Agreement and its adaptation provisions came into force, and the most recent data published is for 2020. Including data from a period of five years also reduces the possibility of my results being biased by potential year-on-year variability in the type of projects financed and gives a better overall picture of current adaptation responses.

4 Methods and data

4.1 Methods

The first phase of my systematic review was the identification of relevant ADB projects. The ADB is one of only two MDBs⁵ that release their climate finance project level data in an Excel readable format which makes further data analysis possible (E3G, 2020). These datasets contain extensive information on the ADB's climate financing, such as project country and region, fund source, financing type and amount, and climate change response, all listed by project name and number. I downloaded the datasets for 2016-2020 from the ADB's website and combined all data into a single Excel file for more convenient processing. I then filtered the data by "developing member country" and "climate change response". To ensure comprehensiveness of data at this stage, I included not only projects taking place in any of the eleven Southeast Asian countries listed in the research question but also projects that were recorded as regional projects. As for the climate change response criteria, projects marked as "adaptation" or "dual-use" were included, with only those marked as "mitigation" excluded from the list. Using this filtering process, I identified 134 potentially relevant ADB projects.

Next, I screened these identified projects based on their Project Data Sheet, which is a standardised summary of a project available on the ADB website that provides information on a project's target country, rationale, expected outcomes, and implementation progress. For most projects, the Project Data Sheet was easily accessible using a URL included in the ADB climate financing dataset. In those few cases where the URL was broken, I used the ADB website's search function and the project's name and number to locate the relevant Project Data Sheet. Projects that included a clear reference to at least one adaptation response in at least one Southeast Asian country in their Project Data Sheet were retained for analysis. Conversely, projects that did not mention a Southeast Asian country, only referred to readiness actions or did not include adaptation actions at all in their Project Data Sheet were excluded.

As an illustrative example, a project developing country-specific climate projections to support resilience planning⁶ was excluded as this was deemed a readiness action laying groundwork for the actual adaptation response. In contrast, a project training farmers in the use of resilient crops⁷ was retained for analysis as this is a tangible adaptation response. A complete list of inclusion and exclusion criteria is provided in Table 1. In

⁵ The other bank to do this is the Inter-American Development Bank.

⁶ Supporting Adaptation Decision Making for Climate Resilient Investments (project number: 50121-001)

⁷ Tonle Sap Poverty Reduction and Smallholder Development Project (project number: 41435-054)

total, I excluded 64 projects following screening based on their Project Data Sheet, leaving 70 projects eligible for the coding and analysis.

Inclusion criteria	Exclusion criteria
At least one of the following Southeast Asian countries mentioned in connection to an adaptation response: Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, Timor-Leste, and Vietnam	The project has a regional focus without detailing the countries in which it will be implemented or no countries listed in the inclusion criteria are mentioned in connection to an adaptation response
Climate actions mentioned are adaptation, i.e. adjusting “to actual or expected climate change and its effects” (UNFCCC definition)	Climate actions mentioned are not adaptation but instead for example disaster response or mitigation, i.e. reducing greenhouse gas emissions
Adaptation actions mentioned are solution-oriented responses and aim to tangibly improve the resilience of human and natural systems	Adaptation actions mentioned are readiness or groundwork level actions such as vulnerability and impact assessments or support with national planning (e.g. identifying adaptation priorities or financing needs)
The project aims to implement the adaptation responses mentioned	The project is only technical assistance to prepare for a future project that will aim to implement the adaptation responses mentioned
Sufficient information is available on the project to enable coding and data analysis	The project does not have an RRP or TAR document attached to it or the document does not contain sufficient information for coding and data analysis

Table 1. Inclusion and exclusion criteria for projects included in the review.

At this stage, I familiarised myself with the documents that the ADB makes publicly available for each project on its website and identified the Report and Recommendation of the President (RRP) and Technical Assistance Report (TAR) documents as most suitable for analysis. These are the documents submitted to the ADB’s Board of Directors for the project’s approval, the type of document depending on whether the project is categorised as a loan/grant or as technical assistance respectively. The documents have a standardised structure and

describe the context, objectives, key activities, and terms and conditions of the project. Thus, they provide the information necessary to answer my research questions and do so in a consistent format. Here, my approach is similar to that of Biagini et al. (2014) who used CEO Endorsement Request documents – a GEF equivalent of RRP and TARs – for their analysis of adaptation in GEF projects. In the final step of my data collection, I downloaded the RRP and TAR documents corresponding to the 70 remaining projects. As one technical assistance project was submitted for approval within the RRP document of the wider project it was attached to, both of which were in the list of included projects, in the end a total of 69 documents were included in the analysis phase.

In the data analysis phase of my research, I used the qualitative data analysis software Atlas.ti to code the RRP and TAR documents of the remaining projects. I applied a mainly deductive approach based on the guiding sub-questions formulated at the beginning of my research process while also remaining open to other potential interesting aspects in the data. This hybrid coding approach allowed me to focus on the most relevant details in the data and obtain results that can be compared to previous adaptation mapping efforts but also made possible finding additional noteworthy features to complement my analysis beyond the pre-defined aspects.

In practice, I identified adaptation responses mentioned in the RRP and TAR documents and sought to code them by the climate impacts and hazards responded to, the actor as well as the sector targeted by the response, and the way in which adaptation is operationalised. For the first three aspects (hazard, actor, sector), no specific pre-set codebook was used and the codes were derived either directly from the text or they were informed by categories commonly used in similar climate impact research, including the AGR 2020 and the GAMI. However, for the fourth and key aspect that was the operationalisation of the adaptation responses, I followed the typology formulated by Biagini et al. (2014) in my categorisation. Since the aim of my thesis was not to create a new theory of adaptation actions but rather to understand and compare adaptation taking place in Southeast Asia through ADB projects to general adaptation trends, it was more appropriate to use an existing typology instead of applying an inductive coding approach and building my own categorisations from my dataset.

Although MDBs and the International Development Finance Club have jointly developed a list of categories of activities eligible for classification as climate mitigation as part of the Common Principles for Climate Change Mitigation Finance Tracking, a similar category list is lacking from the Common Principles for Climate Change

Adaptation Finance Tracking developed by the same institutions (African Development Bank et al., 2020).⁸ Having been developed based on analysis of adaptation actions in the projects of the GEF, a multilateral financial mechanism for five of the UN's environment related conventions, including the UNFCCC, Biagini et al.'s (2014) typology has high relevance to the context of my own dataset. Moreover, the journal article detailing the development of the typology included the complete list of sub-codes for each of the ten adaptation categories, which significantly aided me in my coding process. The typology's applicability to my dataset was confirmed by the fact that all adaptation responses in my data were also found as sub-codes in the typology, with the sole exception of "climate-smart agriculture" which was not included in Biagini et al.'s (2014) code list under any of the ten adaptation categories. I decided to code this adaptation response under the "practice and behaviour" category because it includes sub-codes of responses similar to climate-smart agriculture, such as "changes in production practices", "expand climate resilient crop technique", "conservation agriculture", and "ecosystem based adaptation".

Following other systematic reviews for adaptation mapping, I also use adaptation responses as my unit of analysis. As such, it was possible for one project document to contain multiple adaptation responses, since a project could aim to address a climate vulnerability in more than one way. Only those responses that were part of the project being presented for approval and implementation in the document were coded, to ensure the analysis responds to specific temporal scope of my main research question (ADB projects approved between 2016 and 2020). Therefore, any adaptation responses described in the documents that referred to past actions (e.g. a previous phase or cycle that the proposed project is a continuation of) or to theoretical future actions outside the scope of the proposed project were excluded from my analysis. In practice, this meant that the adaptation response(s) outlined had to be clearly identified as part of the project implementation and/or outputs sections or under risk assessment and management, rather than being found in the context or background sections. While an effort was made to code all aspects of my sub-questions for each discrete adaptation response, this was not always possible due to insufficient information available in the RRP and TAR documents. However, the core question of how adaptation is operationalised had to be answerable using a category from Biagini et al.'s (2014) typology for an adaptation response to be successfully identified and included in the analysis.

In addition to the response-level analysis, coding projects by the country or countries in which they were going to be implemented to answer my fifth sub-question meant that part of the analysis took place also at the project-level. As such, my thesis has two levels of analysis and results are presented at both levels.

⁸ Although the 2016 Joint Report on Multilateral Development Banks' Climate Finance does provide a non-exhaustive list of adaptation activities, they are categorised by sector and sub-sector and are thus less applicable to my research aims (African Development Bank et al., 2017).

I performed two rounds of coding six weeks apart from each other. The first round of coding acted as my initial coding stage, with the purpose of getting a general overview of the data and confirming each project's eligibility for inclusion in the analysis by checking its full text document against the inclusion and exclusion criteria used in the screening phase. Indeed, this final full text screening revealed that of the 70 projects that had been selected for analysis based on their Project Data Sheet, four were in fact project preparatory funds or other type of readiness actions. Thus, the final number of projects that were included in my analysis and that were coded was 66 (detailed in 65 RRP and TAR documents), a full list of which is provided in Appendix 2.

Furthermore, given my hybrid coding approach, the first coding round also allowed me to make note of interesting aspects in the data that I could focus on in a more systematic manner during the second coding round. As I progressed with the initial coding, it became apparent that a large proportion of climate adaptation financing in the projects included in my analysis seemed to be for climate-proofing the infrastructure being constructed – a classic example of climate-related development finance. Therefore, I used the second coding round to also place projects into three categories depending on the role climate adaptation plays in them: adaptation as the primary objective of the project, adaptation as a major but not primary component of the project, and adaptation as an additional component in a development-focused project. Through this, my aim was to better understand the extent to which the ADB's adaptation finance represents dedicated climate financing versus more generic climate-related development finance. This additional angle adds to the project-level analysis conducted when coding projects for the countries in which they take place.

Finally, while I also completed some preliminary coding to answer my research sub-questions during the first coding round, taking a break away from the data and returning to it six weeks later for the second coding round enabled me to ensure that my coding remained consistent throughout the 66 project documents and that no relevant details were missed out on during the first coding round. This corroboration of past work is especially important in this case because I did the coding for the thesis on my own while systematic reviews usually deploy multiple coders to check interpretations against the data and reduce individual bias.

After finishing the two rounds of coding, I used Atlas.ti's code manager function to aggregate my codes. Since I did not use any fixed codebooks apart from Biagini et al.'s (2014) typology, there was some overlap in the codes used to indicate the climate change impacts being responded to as well as the actor addressed by the adaptation response. These codes were consolidated as presented in Table 2. I then used Atlas.ti's data query tools and Excel to analyse my codes by groundedness and co-occurrence, again guided by the research sub-questions outlined in Section 3.3. The results are presented in quantitative format as graphs with additional comparative analysis in verbal format.

#	Overlapping codes for consolidation		New merged code
1	Water scarcity	→	Drought
	Drought		
2	Extreme rainfall events	→	Increased or heavy rainfall
	Increased rainfall		
3	Extreme climate events	→	Climate and disaster risk
	Extreme weather		
	Extreme weather events		
4	Local government	→	Sub-national or local government
	Sub-national government		
5	Technical government agency	→	Technical agency or institution
	Research institution		

Table 2. Overlapping codes consolidated for clarity before moving on with analysis.

4.2 Data

My final dataset consisted of 65 publicly available RRP or TAR documents (for a total of 66 ADB projects) downloaded from the ADB website. I modelled my document collection and selection process after that of traditional systematic reviews that use academic literature as their data source. Filtering for results from the ADB's climate finance database is an equivalent step to conducting a search in a scientific journal database such as Scopus or Web of Science using defined search terms, and the principle behind conducting a screening based on the summary-like Project Data Sheets is similar to traditional systematic reviews screening their search results by article abstracts to identify relevant articles for analysis. Refining the list of projects included in analysis for a final time after my first round of coding also corresponds to traditional systematic reviews doing a final screening via full-text scanning.

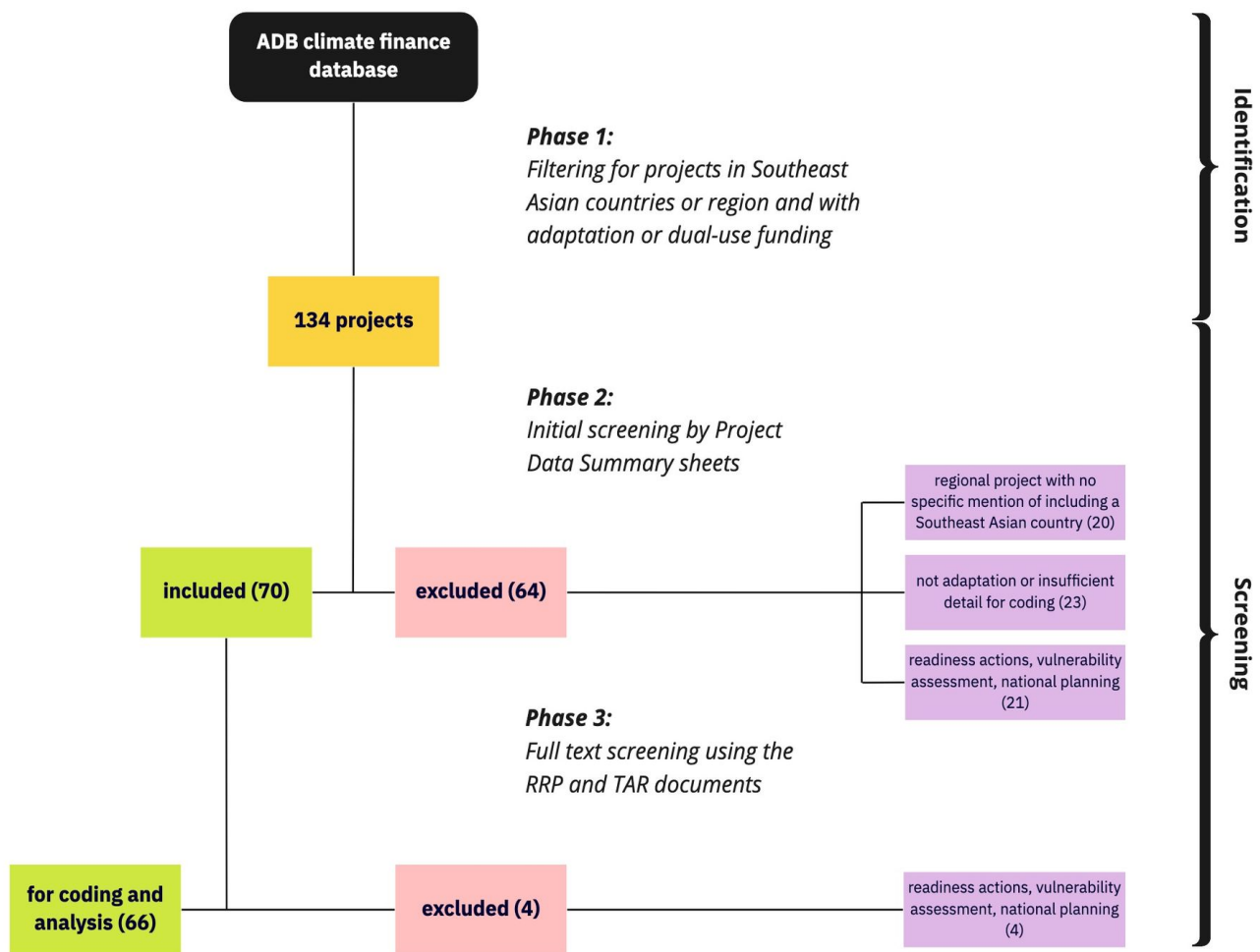


Figure 2. Diagram of the full data collection and selection process.

Although the inclusion and exclusion criteria I used during the search and selection process were directly inferred from my main research question, it is important to consider potential biases that might have resulted from decisions made at that stage of the systematic review and how they could have influenced the results of my analysis. The first notable decision was using the ADB’s climate finance database as my only data source. Since the aim of my research was to map the adaptation responses undertaken in Southeast Asian countries as part of ADB projects, this choice of data source has a chance to miss out on adaptation responses that were part of projects not included in the climate finance datasets. However, I expect the number of such cases to be relatively low since all ADB projects are screened for climate risks at the preparation phase, meaning project design at least takes climate change into consideration by default, and the ADB would likely be institutionally incentivised to be comprehensive in compiling its datasets given its climate finance commitments.

The second issue is also related to the datasets used. While the ADB provides its climate finance data for 2016-2018 based on project approvals, the bank changed its corporate performance measurement practice such that climate finance beyond 2020 will be measured based on commitments rather than approvals. Therefore,

for 2019 and 2020 which were designated as the transition period, the ADB provides data based on both measurement methods in separate datasets. For the purpose of my research project, I used approvals based data for all five years to ensure consistency and avoid potential double-counting of financing across the years. The drawback of this choice is that data will no longer be published based on approvals after 2020, rendering my results incompatible for direct comparison with ADB adaptation financing after this year.

Finally, the choice of using RRP and TAR documents to extract the adaptation responses in ADB projects also influences the data analysis. Despite not being identical in structure or content due to the different nature of grants and loans versus technical assistance projects, RRP and TAR documents can be considered each other's equivalents as they provide similar information of projects and are both prepared for the purpose of getting project approval. Although the Project Data Sheets have a standardised structure regardless of project type, the quality and depth of the information they contain was greatly varied and in some cases insufficient for extended analysis based on my research questions. Moreover, while the Climate Change Assessments linked to RRP projects contained more detailed information on the adaptation responses within the loans and grants projects, no similar climate-specific assessment was available for technical assistance projects. Therefore, the RRP and TAR documents present the best compromise between data quality and consistency on the one hand and data availability on the other hand.

Following my screening process, I excluded from analysis around half of the projects identified during the first stage of the search that was filtering the ADB's database. However, the sum of adaptation finance contained in these excluded projects makes up only 5% (US\$50.3 million) of the total adaptation finance in all 134 projects identified (US\$983.6 million) in the first stage, while the projects included in analysis make up the remaining 95% (US\$933.3 million). In contrast, the full project financing of projects excluded from analysis account for 28% of the total project financing amount at the first stage. As such, it can be presumed that any potential adaptation responses are a relatively minor aspect of these excluded projects and that even if projects relevant to my research questions were mistakenly excluded from analysis as a result of my screening process, the omission is unlikely to be significant and invalidate my research results.

5 Results

In this section, I present the results of my coding and compare them with global level mappings of adaptation responses, the AGR 2020 and the GAMI, as well as the GEF specific analysis of Biagini et al. (2014). The results are divided into two sub-sections based on the level of analysis used: project-level and response-level.

5.1 Project-level analysis

5.1.1 Geographical distribution of projects

The 66 ADB projects coded are implemented across eight Southeast Asian countries as shown in Figure 3. Cambodia's 19 projects made it the country with the highest number of projects with adaptation financing by a clear margin, followed by a relatively even group of Myanmar (13 projects), Indonesia (12 projects), Vietnam (11 projects), Laos (10 projects), and the Philippines (9 projects). Thailand and Timor-Leste were only targeted in three projects each. Notably, no projects are implemented in Brunei, Malaysia, and Singapore. This was not a surprising finding but instead accurately reflects the ADB's list of countries with operations, which does not feature these three countries.

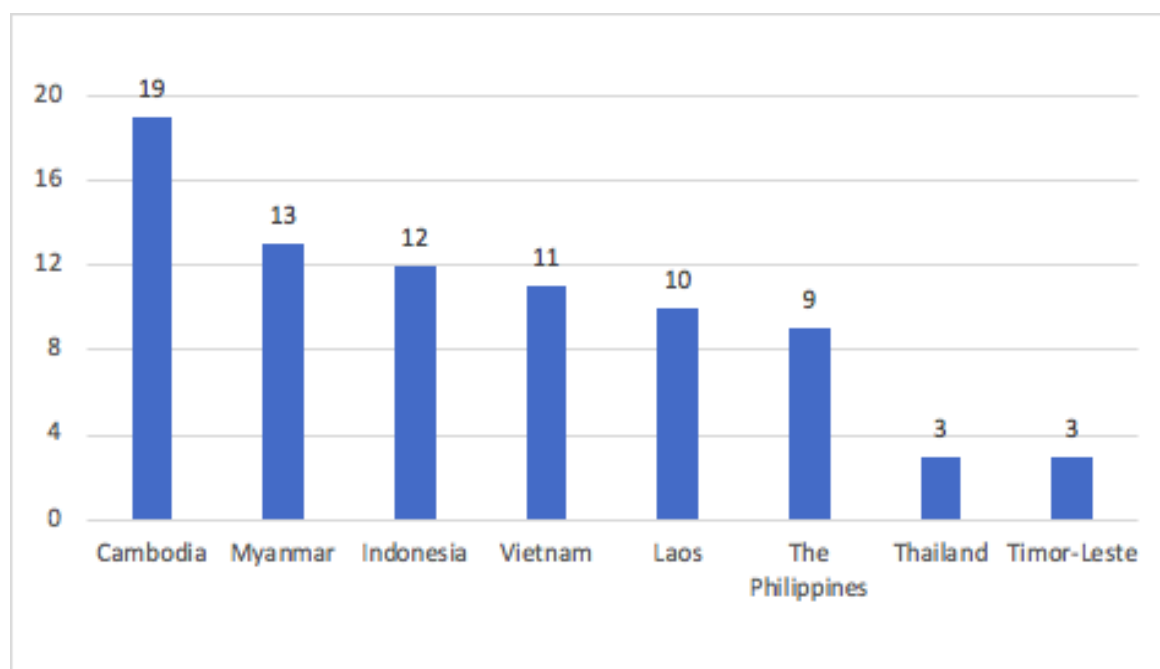


Figure 3. Total projects examined per Southeast Asian country. Since there were a couple of multi-country projects that had several target countries, including more than one Southeast Asian country, the total number shown in the graph exceeds the number of projects coded.

5.1.2 The share of climate adaptation in the overall project outputs

Of the 66 projects, 19 (29%) were categorised as primarily adaptation-focused. Most of these projects were related to strengthening disaster resilience and adaptation in the agricultural sector through capacity building, as well as supporting policy making, planning, and management. To use the MDBs' own adaptation finance terminology, these projects could be categorised as dedicated climate finance.

On the other hand, 39 (59%) of the projects coded were development-focused projects where adaptation served only as an additional component. These projects had almost without exception some kind of physical infrastructure as their intended output and the adaptation response is contained in the climate-resilient design of said infrastructure. As such, the projects are a good example of climate-related development finance in the MDBs' categorisation of adaptation finance.

Not all projects fit neatly into either of the two categories, however, and 8 (12%) were found to feature both major adaptation components and other non-adaptation components that related to developmental objectives. In these cases, the project featured a significant number of adaptation responses beyond designing infrastructure with a consideration of current and future climate risks. However, the project also included other development objectives that were not related to climate change. For example, the "Sustainable Rural Infrastructure and Watershed Management Sector Project" in Laos (50236-002) proposed several climate-related outputs (providing awareness and access to climate-resilient technologies, preparing participatory land-use plans with measures against flooding and landslides, and improving irrigation reliability) but also contained other development outputs such as improving nutrition awareness as well as water, sanitation and hygiene facilities.

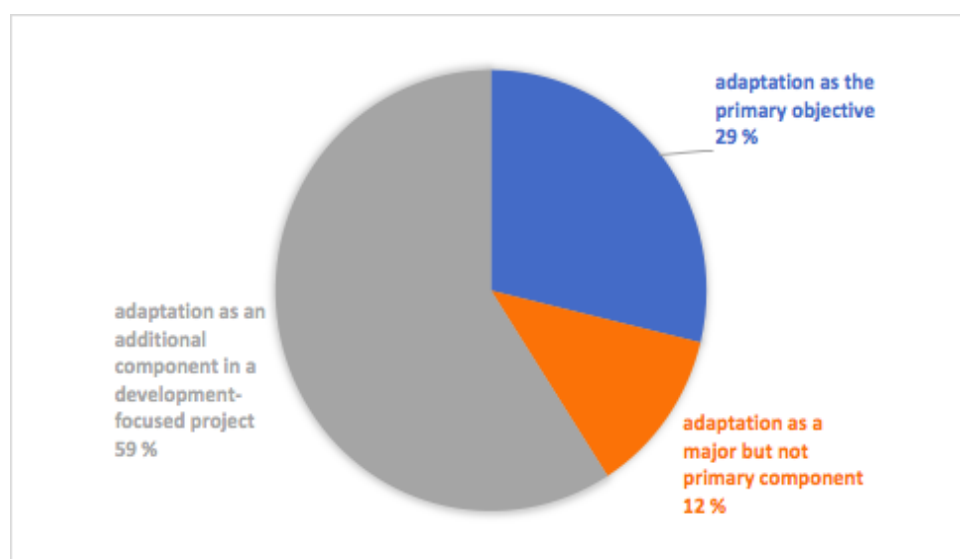


Figure 4. The role of the climate adaptation objectives in each of the 66 projects.

5.2 Response-level analysis

5.2.1 Adaptation responses

A total of 252 adaptation responses were identified across the 66 projects, with capacity building being the most common response category occurring 84 times, followed by physical infrastructure at 67 occurrences. Half of the adaptation response categories were included in the projects less than ten times: information (9 occurrences), policy (8 occurrences), warning or observing systems (5 occurrences), green infrastructure (5 occurrences), and technology (2 occurrences). In comparison, capacity building was the overwhelmingly largest adaptation response category amongst the global adaptation projects financed by the GEF examined in Biagini et al.'s (2014) research. However, physical infrastructure only ranks sixth out of the ten categories in frequency, while practice or behaviour and policy responses, third and fourth respectively, ranked higher in frequency than they did in my dataset where they were the fifth and seventh most common adaptation response categories.

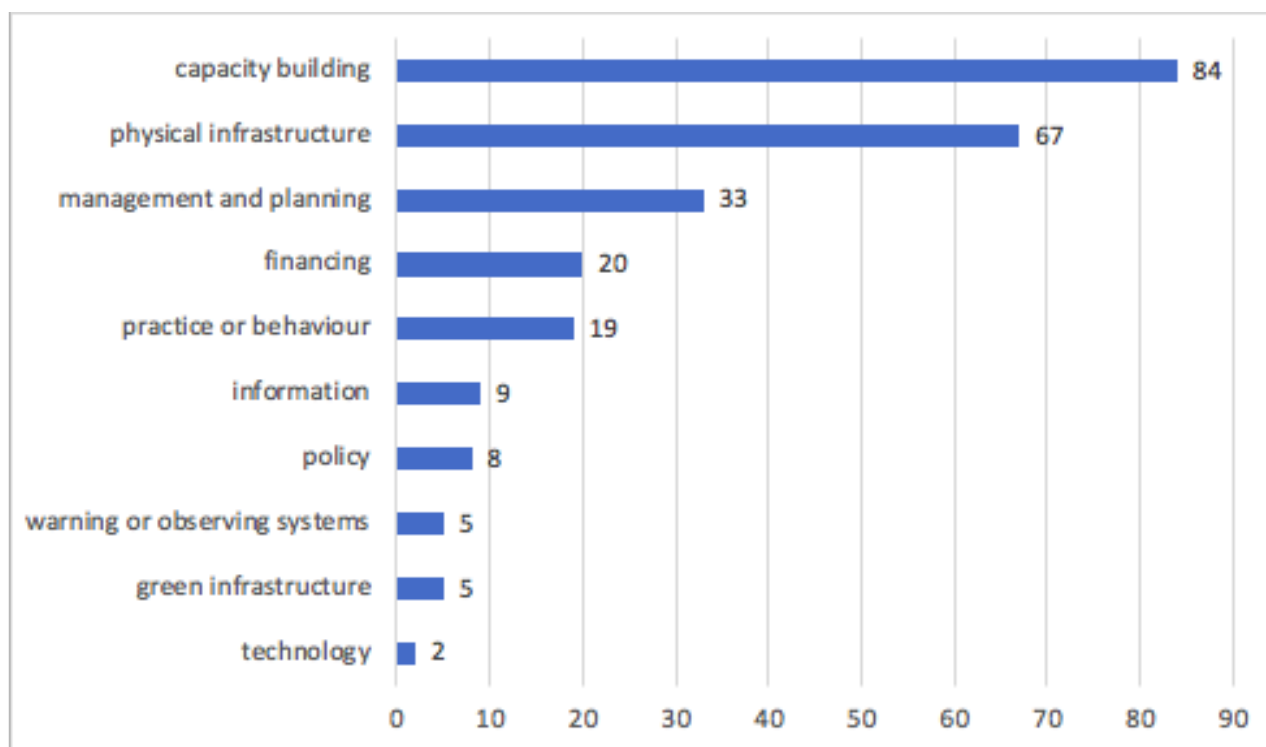


Figure 5. Groundedness of adaptation typology by category in ADB projects in Southeast Asian countries 2016-2020.

Adaptation typology	Number of occurrences in Global Environment Facility texts (groundedness)
Capacity building	1310
Management and planning	474
Practice or behavior	409
Policy	268
Information	219
Physical infrastructure	178
Warning or observing systems	170
Green infrastructure	99
Financing	76
Technology	49

Table 3. Groundedness of adaptation typology by category in the GEF portfolio (Biagini et al., 2014).

The prevalence of adaptation responses in the physical infrastructure category within the ADB's projects compared to the GEF's portfolio is not surprising. Approaching climate adaptation from the angle of physical infrastructure developments (e.g. building sea walls and dykes) could be seen as a natural continuation of the ADB's historical focus in infrastructure development assistance in general (McCawley, 2017). Moreover, a large share of the physical infrastructure category codes in fact come from projects using climate resilience considerations in the infrastructure building performed for other development purposes (e.g. climate-proofing roads built to improve rural access to markets and services) as discussed in the previous sub-section 5.1.2. Given the high share of development-focused projects with an adaptation component in the overall dataset, the number of the physical infrastructure category code would also be high by extension.

In terms of geographical distribution of the adaptation responses, capacity building and practice or behaviour were the only categories found at least once within projects taking place in each of the eight countries, while Vietnam was the only country where adaptation responses belonging to all ten categories were proposed for implementation in the project documents. Cambodia not only had overwhelmingly the most projects but also the highest number of discrete adaptation responses. However, although a higher number of projects was going to be implemented in Indonesia than in Vietnam, more adaptation responses were identified in connection to Vietnam than to Indonesia. The same pattern also applied to the pairing of the Philippines and Thailand.

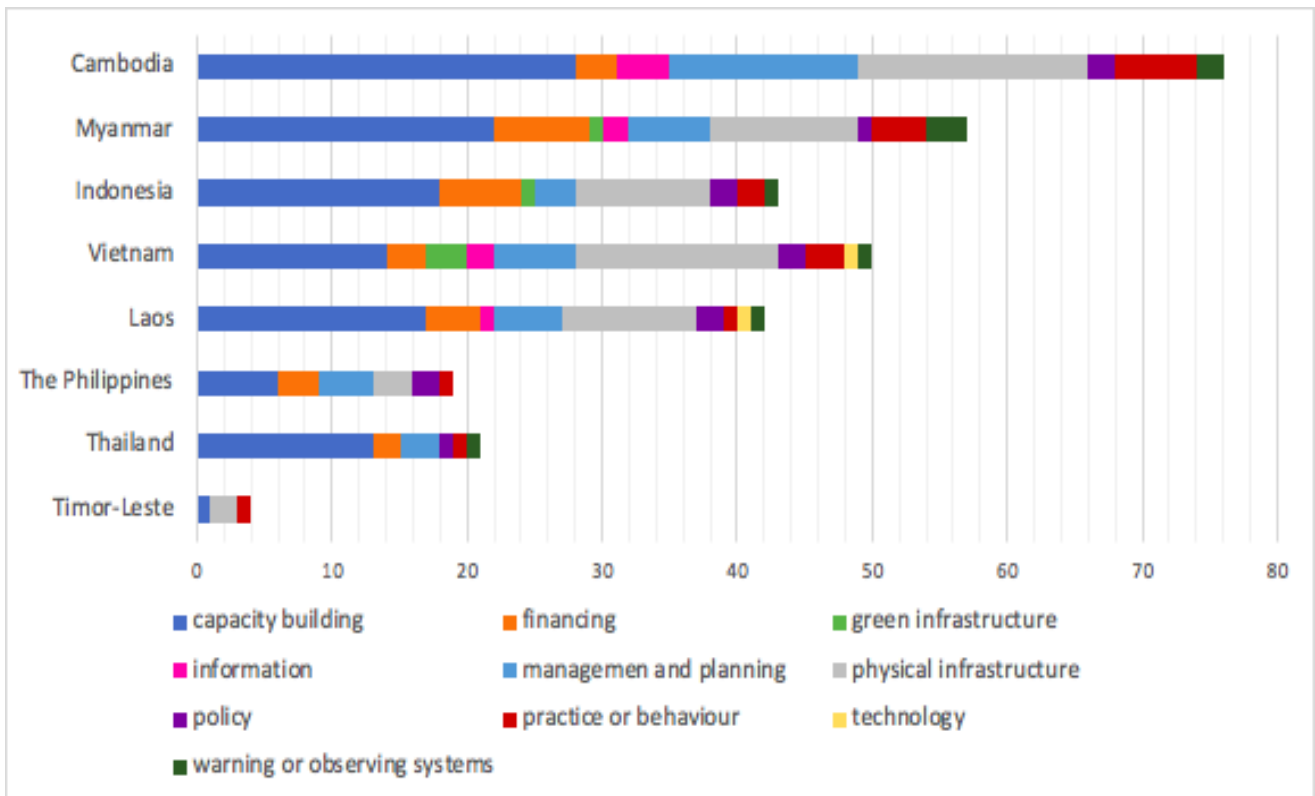


Figure 6. Groundedness of adaptation response categories by country. Since there were a couple of multi-country projects where adaptation responses were detailed, the total number of responses shown by country (312) is higher than the overall total responses identified (252).

In Cambodia, Myanmar, Indonesia, Laos, the Philippines, and Thailand capacity building was the most common category, followed by physical infrastructure in all countries except Thailand which had no adaptation responses characterisable as physical infrastructure at all. By contrast, physical infrastructure was the most common adaptation response category in Vietnam and Timor-Leste, followed by capacity building. These results suggest that the prevalence of capacity building and physical infrastructure categories in the overall groundedness of adaptation typology categories as illustrated in Figure 5 was not due to a few large outliers skewing the results but instead is relatively illustrative of ADB adaptation projects in the Southeast Asian region as a whole.

5.2.2 Hazards responded to

Water-related hazards dominate the list of hazards responded to in the projects examined. Of the ten different hazards identified, five are directly related to an increased amount of rainfall and water in the human living environment. In total, the hazard responded to was possible to determine from the project documentation in relation to 249 adaptation responses. The overwhelmingly most commonly addressed hazard was flooding, which 93 of the adaptation responses aimed to address. This is almost double compared to the next hazard in

frequency, drought, which was addressed by 53 adaptation responses. The four least frequently addressed hazards (rainfall variability, sea level rise, landslides and wildfire) were all addressed by less than 10 adaptation responses.

Compared to the distribution of hazards addressed by UNFCCC climate fund projects globally since 2015 as well as hazards addressed by observed adaptation responses documented in scientific articles from 2013-2019 (Panel A and Panel B in Figure 8 respectively), the same hazards appear in the top 3. This suggests that similar impacts of climate change are being addressed both by the ADB projects receiving adaptation finance and by other adaptation efforts globally. Conversely, it also shows that the impacts that are given less attention globally are also less frequently addressed in Southeast Asia by ADB projects.

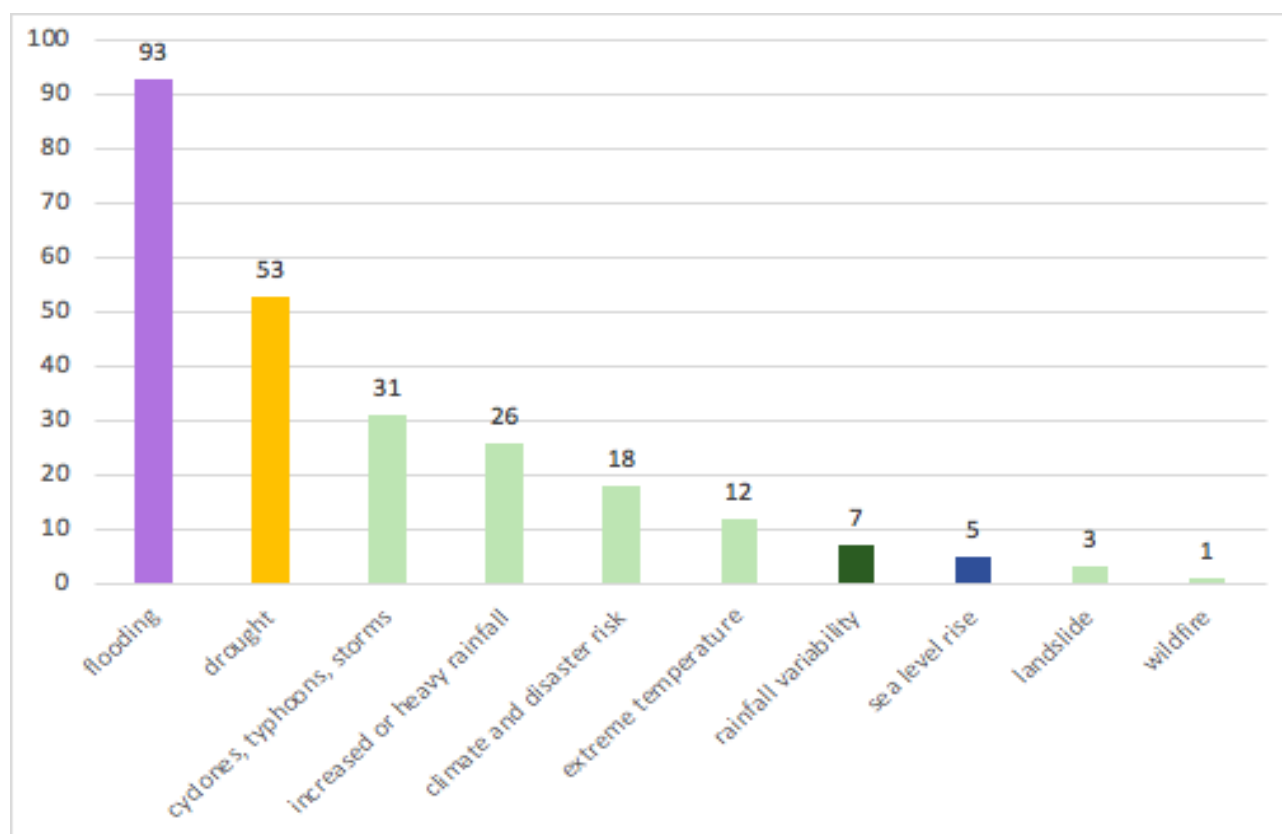


Figure 7. Groundedness of climate hazards addressed by ADB projects receiving adaptation finance in Southeast Asia.

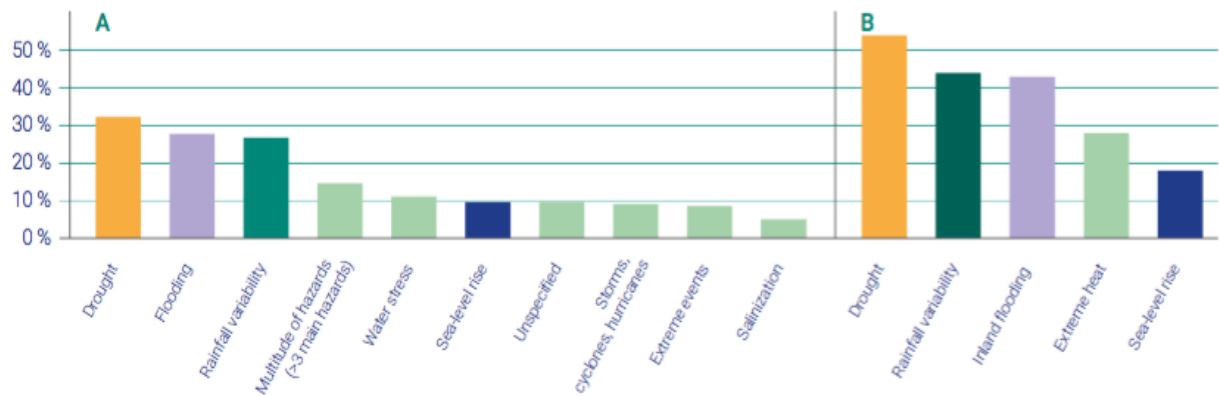


Figure 8. Hazards addressed by UNFCCC climate fund projects (Panel A, left) and by adaptation responses documented in scientific articles (Panel B, right) (UNEP, 2021).

5.2.3 Sectors addressed

It was only possible to assign a sector to 151 of the identified adaptation responses, since in the other cases a sectoral designation was not obvious (e.g. general climate risk training workshops or providing financing and management support to public governance entities). The two most frequently addressed sectors in the ADB projects examined were agriculture and water, corresponding to global results from UNFCCC climate fund adaptation projects. However, the ADB’s infrastructure focus is clear also in this case, as the infrastructure and transport sector is found to be the third largest sector addressed within the ADB projects whilst they are only the ninth primary sector of UNFCCC climate fund adaptation projects.

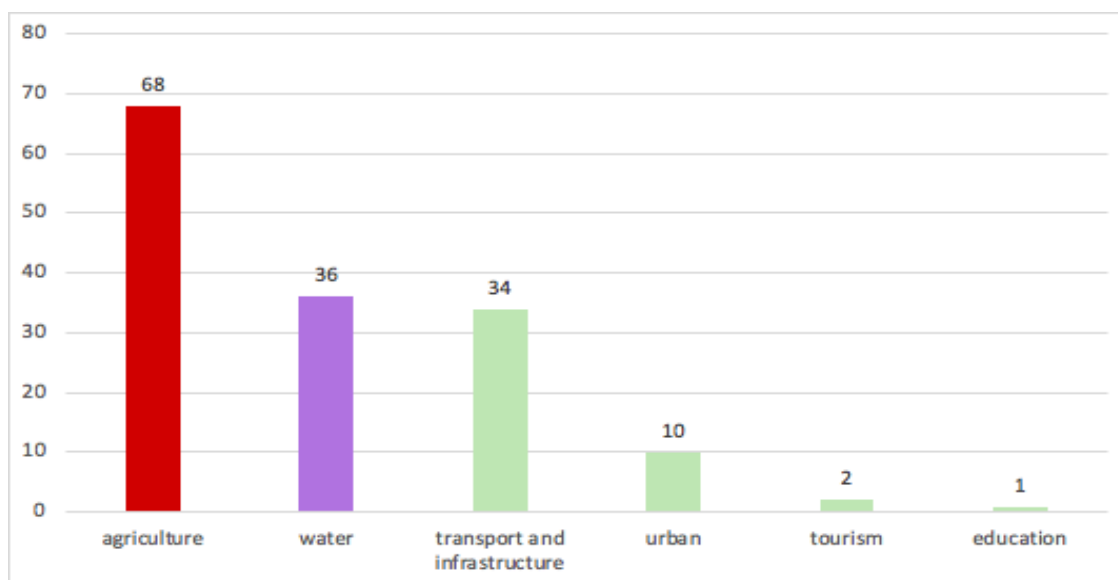


Figure 9. Groundedness of sectors addressed by ADB projects receiving adaptation finance in Southeast Asia.

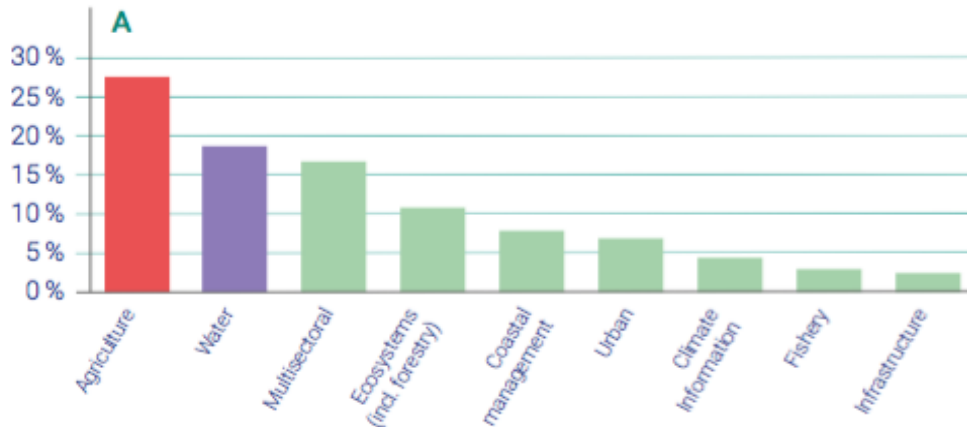


Figure 10. Primary sectors of UNFCCC climate fund projects (UNEP, 2021).

5.2.4 Actors targeted

In the case of 189 adaptation responses, the actor targeted by the response was identifiable. Especially for those projects that were primarily development-focused with an additional adaptation component, such as using adaptation financing to climate proof infrastructure in development, there were no actors targeted by the response as such. Governmental entities at both national and sub-national levels were the most targeted actors, followed by farmers and local community groups. By contrast, non-farmer individuals and households ranked as the least often targeted actors alongside civil society organisations.

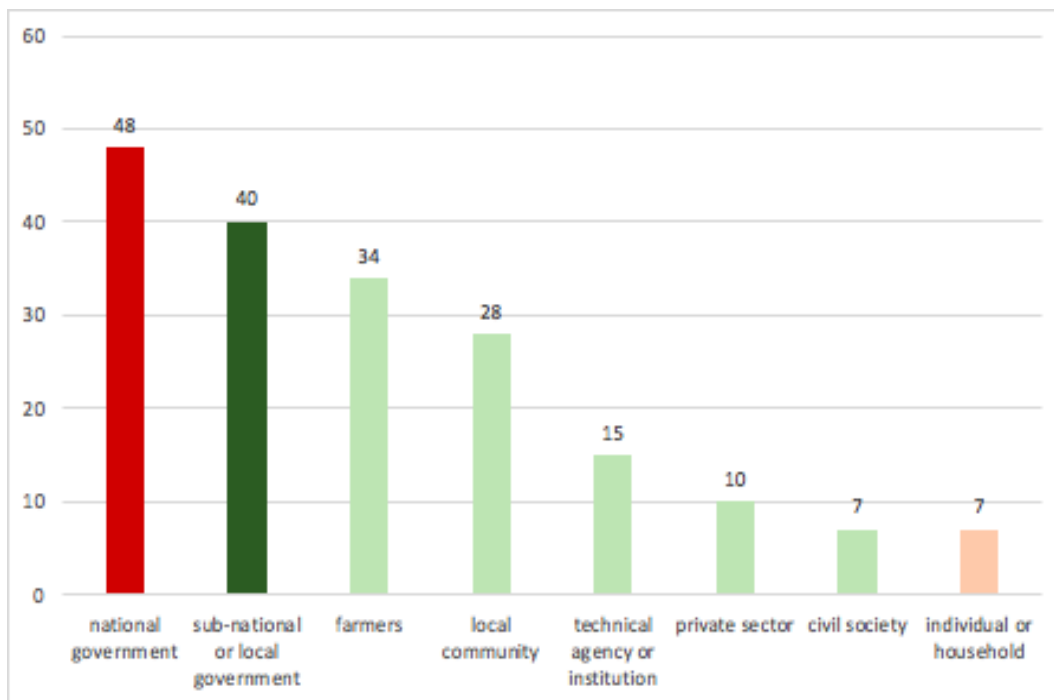


Figure 11. Groundedness of actors targeted by ADB projects receiving adaptation finance in Southeast Asia.

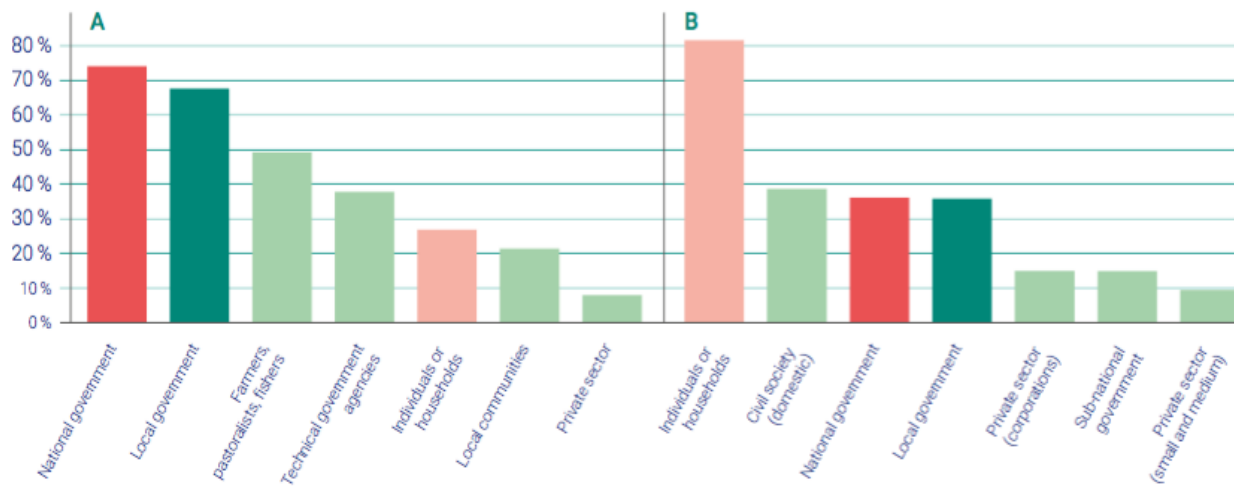


Figure 12. Actors targeted by UNFCCC climate fund projects (Panel A, left) and by adaptation responses documented in scientific articles (Panel B, right) (UNEP, 2021).

Compared to the global results, the results for the ADB projects are much closer to that of the analysis of UNFCCC climate fund projects than of adaptation responses documented in scientific articles. This makes intuitive sense, since the ADB being a multilateral development bank would have projects in its portfolio that are constructed in a specific manner and are likely to resemble projects of the UNFCCC climate funds (also an international financing institution). Scientific articles, on the other hand, are more likely to be able to report on local level actions and adaptation responses that have less centralised or less top-down involvement.

6 Discussion and conclusion

The aim of this thesis was to map the climate change adaptation actions implemented in Southeast Asian countries by ADB projects that received climate adaptation finance in 2016-2020. Using adaptation responses identified in project documents presented for project approval as a proxy for implemented adaptation, I applied a systematic review methodology to code the projects by the country in which they are implemented and the role of climate adaptation in the overall outputs of each project. In addition, I also coded each identified adaptation response using the typology for adaptation action developed by Biagini et al. (2014) as well as for the climate hazards responded to, sectors addressed, and actors targeted.

My results show that close to a fifth of the ADB's adaptation projects in Southeast Asia is implemented in Cambodia, while Thailand and Timor-Leste are the least covered countries. In general, the characteristics of the ADB's adaptation projects in Southeast Asia in 2016-2020 are relatively similar to global adaptation trends, in particular to the global adaptation projects of multilateral climate finance institutions such as the GEF, the GCF, and the Adaptation Fund. Flooding, drought, storms, and other heavy rainfall events are the most frequently addressed climate hazards by both the projects I examined as well as by these UNFCCC climate fund projects and by adaptation responses documented in scientific papers.

The sectors addressed and actors targeted by ADB projects were also typical to multilateral funding institutions, focusing on the agricultural and water sectors as well as national and local governments and farmers. The ADB adaptation projects in Southeast Asia are also aligned with GEF projects globally in the sense that capacity building was the most frequent adaptation response category for both groups, indicating that adaptation implementation as delivered by the ADB is still in a relatively early phase in most Southeast Asian countries. The one area where ADB adaptation projects in Southeast Asia differ from global adaptation projects financed by the UNFCCC climate funds is the high proportion of physical infrastructure category adaptation responses and of responses addressing the transport and infrastructure sector. This distinction could be explained by the ADB's historical profile as an infrastructure-focused MDB also outside its climate finance projects, compared to the UNFCCC climate funds which have no mandate beyond addressing climate change.

Although my mapping of adaptation responses in ADB projects in Southeast Asia cannot be taken as representative of all adaptation trends in the region, it presents one part of the overall picture regarding the state of climate change adaptation in Southeast Asia and would suggest that there might not be significant differences between how adaptation is being implemented in Southeast Asia compared to global adaptation trends as documented in the AGR 2020. The climate hazards, actors and sectors receiving attention globally

are the same ones being addressed and targeted also in Southeast Asian countries by the ADB, with similar adaptation responses. This would also suggest that certain hazards, actors and sectors as well as adaptation responses are being overlooked both globally and in Southeast Asia specifically. However, considering the extent to which autonomous adaptation by individuals and community-based adaptation were found to play a role in responses to climate change in Southeast Asia by previous research (Resurreccion et al., 2008; Uy & Shaw, 2010), my results based on ADB projects alone indeed cannot be taken to present a full picture of adaptation in the region.

However, my results regardless confirm the previous research by Dedicatoria and Diomampo (2019) on the progress of climate adaptation in Southeast Asia, in the sense that the adaptation responses identified in ADB projects also fall under the adaptation options of building response capacity and managing climate risk (as opposed to addressing the drivers of vulnerability or confronting climate change) in the authors' categorisation. However, differences to results of previous Southeast Asia focused adaptation research can also be observed. For example, Salamanca and Nguyen's (2016) emerging climate adaptation champions Cambodia and Myanmar had more identifiable adaptation responses from the ADB projects than adaptation pioneers Vietnam and the Philippines. In fact, there were less adaptation responses in ADB projects in the Philippines than in Thailand or Laos, which were both categorised as wait-and-see adapters. Moreover, there were almost as many identifiable adaptation responses in Laos as in the third emerging champion, Indonesia.

My analysis also shows that most of the ADB's projects in Southeast Asia receiving adaptation finance are still development-oriented with additional adaptation components, i.e. over half of the ADB's adaptation finance is climate-related development finance. Despite the ADB's stated aim to prioritise projects specifically targeted at climate adaptation, dedicated climate finance projects still made up only less than a third of the bank's adaptation projects in Southeast Asia in 2016-2020. This finding is related to long-standing issues in both academic scholarship and policy discussions around the distinctions (or lack thereof) between climate change adaptation and development.

Finally, my aim was also to use the thesis to test the applicability of the systematic review methodology for mapping adaptation responses of MDBs, since such a study has not been previously published in either academic nor grey literature. I found that the methodological approach of extracting and coding adaptation responses outlined in project documentation as a proxy for adaptation responses implemented by the projects was indeed suitable for mapping and analysing climate change adaptation by MDBs. Thus, it could be used to include MDB projects for example in future analysis of AGRs. However, since the AGR 2020 (UNEP, 2021, p. 35) referred to the lack of details related to MDB adaptation portfolios as a key barrier for including them in

the global analysis, it must be pointed out that my thesis was only made feasible by the ADB's transparent publication of their climate financing information in database format, which most other MDBs are not yet providing. As such, further progress in climate finance reporting by MDBs might be a necessary precondition for global adaptation mapping efforts to be able to cover these funding bodies.

Relatedly, the limitations of my thesis research is similar to other research that has employed the same systematic review methodology to map climate adaptation by international funding bodies. Since adaptation responses identified in project documentation at the approval stage are used as proxy for implemented adaptation, my results only reflect intended outputs at the point of project approval. As such, there is no guarantee that the responses identified are in fact implemented or that the sectoral, actor and hazard breakdown accurately represents reality. Projects can often change in scope or be suspended for example due to funding changes or political developments. The most obvious example of this in relation to my thesis is the decision by the ADB to suspend its projects in Myanmar following the military coup that took place in the country in February 2021 (The Irrawaddy, 2021), which undermines the results of my analysis as related to Myanmar.

My thesis project lends itself to multiple avenues of future research. Should regional or country-level breakdowns of the data in the AGR 2020 and the GAMI be released, it would be interesting to compare the Southeast Asia specific results of these mapping efforts to those presented here. This would offer some further insight as to whether the ADB's adaptation projects in the region differ from those by the UNFCCC climate funds or from those documented in peer-reviewed literature. For example, is the overrepresentation of infrastructure-related adaptation responses in my results indeed due to my dataset's focus on the ADB's projects or is it instead a regional feature for all adaptation taking place in Southeast Asia? More generally, the question of whether the ADB's involvement in climate adaptation in a country influences the way it is implemented could also be investigated by comparing my results to climate adaptation implementation in the Southeast Asian countries of Brunei, Malaysia, and Singapore where the ADB does not have operations and which therefore did not feature in my results at all.

Furthermore, it would also be interesting to compare my results to the adaptation needs of each analysed country as outlined for example in their Nationally Determined Contributions (NDCs), as was done in the AGR 2020 for sectors in which projects took place. This would give an indication of whether the ADB is responding to nationally identified adaptation needs and challenges. Finally, the funding modality of my examined projects could also be further analysed to gain an understanding of the ratio between grants and loans-based financing as well as whether certain adaptation responses, or sectors, actors and hazards addressed

correspond to a specific type of financing. For example, it would be interesting to investigate the amount of adaptation finance reported in each project and compare allocations to dedicated adaptation finance with those to climate-related development finance in the ADB's Southeast Asia portfolio to understand whether the latter is overrepresented only in the number of projects or also with regards to total financing amounts. The ADB's reporting of its climate finance includes these details and would make such an analysis possible.

As the impacts of climate change intensify and attention to climate change adaptation grows amongst climate finance providers, international development institutions and practitioners, and national and local decisionmakers, understanding where, how, by whom, in which areas, and in response to which hazards adaptation is being implemented helps better allocate resources and plan adaptation responses going forward. The results of my thesis research provide a partial answer to these questions as pertains to Southeast Asia, one of the regions most vulnerable to the effects of climate change. In addition, my thesis also demonstrates the applicability of a systematic review methodology for tracking climate change adaptation responses implemented by multilateral development banks, given sufficient information is made available on relevant projects.

Acknowledgements

I wrote this thesis during a time of multiple cascading crises, with the COVID-19 pandemic ravaging the world and the devastating impacts of climate change intensifying faster than most scientists had predicted. Southeast Asia was battered by multiple successive storms during autumn 2020 that caused severe floods and landslides, displacing hundreds of thousands of people and leading to hundreds of deaths. I'm grateful to have had great friends and loved ones around me to help me cope with the deep grief this state of the world has caused, to listen to me talk about the colonial, capitalist, and racist roots of the climate crisis one too many times, and to give me comfort when I needed it.

My thanks also go to my thesis supervisor who overlooked my slipping from the original schedule for this piece of work as well as for my thesis seminar group during autumn 2020 and spring 2021 who gave comments to very early drafts. I also received valuable pointers and feedback from the staff at the Nordic Institute of Asian Studies (NIAS) where I spent one month as a virtual visiting research student in May 2021.

Lastly and most importantly, I want to thank my parents who have always given me everything I needed and more, and without whom this thesis would not have been possible (also in a very literal sense, as I wrote it for the most part in the sanctuary of their home), as well as my sister who is always by my side and helps me navigate this tumultuous world.

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Appendix 1. Adaptation typology by Biagini et al. (2014)

Adaptation category	Description	Examples of actions in category	Similar classification in literature
Capacity Building	Developing human resources, institutions, and communities, equipping them with the capability to adapt to climate change	Training/workshops for knowledge/skills development, public outreach and education, dissemination of info to decision makers/stakeholders, Identification of best practices, training materials	Educational/informational (Smit and Skinner, 2002; Wilbanks and Kates, 1999; Huq et al., 2003; Smit et al., 2000; Carter et al., 1994; Tompkins et al., 2010)
Management and Planning	Incorporating understanding of climate science, impacts, vulnerability and risk into government and institutional planning and management	Developing an adaptation plan, livelihood diversification, drought planning, coastal planning, ecosystem-based planning, changing natural resource management	Administrative/institutional/organizational (Smit and Skinner, 2002; Wilbanks and Kates, 1999; Huq et al., 2003; Smit et al., 2000; Carter et al., 1994; Tompkins et al., 2010)
Practice and Behavior	Revisions or expansion of practices and on the ground behavior that are directly related to building resilience	Soil/land management techniques; climate-resilient crops or livestock practices, post-harvest storage, rainwater collection, expanding integrated pest management	Behavioral (Smit and Skinner, 2002; Wilbanks and Kates, 1999; Huq et al., 2003)
Policy	The creation of new policies or revisions of policies or regulations to allow flexibility to adapt to changing climate	Mainstreaming adaptation into development policies, land-use specific policies, improvement of water resource governance, revised design parameters, ensuring compliance with existing regulations	Legislative/Legal (Smit et al., 2000; Carter et al., 1994)
Information	Systems for communicating climate information to help build resilience towards climate impacts (other than communication for early warning systems)	Decision support tools, communication tools, data acquisition efforts, digital databases, remote communication technologies	Infrastructural/structural (Smit et al., 2000; Carter et al., 1994) Educational/informational (Smit and Skinner, 2002; Wilbanks and Kates, 1999; Huq et al., 2003; Smit et al., 2000; Carter et al., 1994)
Physical infrastructure	Any new or improved hard physical infrastructure aimed at providing direct or indirect protection from climate hazards	Climate-resilient buildings, reservoirs for water storage, irrigation systems, canal infrastructure, sea walls	Infrastructural/structural (Smit et al., 2000; Carter et al., 1994)
Warning or observing systems	Implementation of new or enhanced tools and technologies for communicating weather and climate risks, and for monitoring changes in the climate system	Developing, testing and deploying monitoring systems, upgrade weather or hydromet services	Research and development (Smit et al., 2000; Carter et al., 1994)
"Green" infrastructure	Any new or improved soft, natural infrastructure aimed at providing direct or indirect protection from climate hazards	Revegetation, afforestation, woodland management, increased landscape cover	Infrastructural/structural (Smit et al., 2000; Carter et al., 1994)
Financing	New financing or insurance strategies to prepare for future climate disturbances	Insurance schemes, microfinance, contingency funds for disasters	Financial (Smit and Skinner, 2002; Wilbanks and Kates, 1999; Huq et al., 2003; Smit et al., 2000; Carter et al., 1994) Market mechanisms (Smit et al., 2000; Carter et al., 1994)
Technology	Develop or expand climate-resilient technologies	Technologies to improve water use or water access, solar energy capacity, biogas, water purification, solar salt production	Technological (Smit and Skinner, 2002; Wilbanks and Kates, 1999; Huq et al., 2003; Smit et al., 2000; Carter et al., 1994)

Appendix 2. List of the Asian Development Bank projects included in analysis

#	Project Number	Date Approved	Project Name
1	54412-001	03/12/2020	Improved Decision-Making for Climate Resilient Development in Asia and the Pacific
2	54117-001	23/09/2020	Disaster Resilience Improvement Program
3	54022-001	10/09/2020	Disaster Resilience Improvement Program
4	53391-001	25/03/2020	Greater Mekong Sustainable Agriculture and Food Security Program
5	53390-001	18/12/2019	Greater Mekong Subregion Climate Change and Environmental Sustainability Program
6	53353-001	12/08/2020	Competitive and Inclusive Agriculture Development Program (Subprogram 1)
7	53348-001	14/07/2020	Investing in Climate Change Adaptation through Agroecological Landscape Restoration: A Nature-Based Solution for Climate Resilience
8	53223-001	04/12/2020	Accelerated Rural Electrification Project
9	53099-001	19/06/2020	Climate Change Adaptation in Agriculture for Enhanced Recovery and Sustainability of Highlands
10	52316-001	26/06/2019	Emergency Assistance for Rehabilitation and Reconstruction
11	52313-001	14/12/2018	Emergency Assistance for Reconstruction and Recovery of Marawi
12	52282-001	28/05/2020	Geothermal Power Generation Project
13	52251-001	09/03/2020	Building Disaster-Resilient Infrastructure through Enhanced Knowledge
14	52218-001	09/12/2020	Promoting Innovative Financial Inclusion Program (Subprogram 1)
15	52176-001	29/09/2020	Yangon City Water Resilience Project
16	52145-001	22/09/2020	Second Decentralized Public Service and Financial Management Sector Development Program, Subprogram 1
17	52014-001	11/06/2020	Strengthening Integrated Flood Risk Management
18	51325-001	06/04/2018	Advancing Inclusive and Resilient Urban Development Targeted at the Urban Poor
19	51309-002	21/08/2020	Inclusive Finance Development Program (Subprogram 2)
20	51290-001	19/09/2018	Revitalization of Informal Settlements and their Environments using a Water-Sensitive Approach
21	51242-002	26/11/2019	Resilient Community Development Project
22	51159-002	04/12/2019	Irrigated Agriculture Improvement Project
23	51139-005	27/12/2019	OLAM International Limited: Inclusive, Sustainable, and Connected Coffee Value Chain (Subproject 3)
24	51139-004	10/05/2018	Olam International: Inclusive, Sustainable, and Connected Coffee Value Chain (Subproject 2)

25	51115-001	21/02/2018	Baucau to Viqueque Highway Project
26	50403-001	31/03/2017	Strengthening Climate Disaster Resilience of Myanmar Communities
27	50399-003	24/09/2019	Education for Employment Sector Development Program
28	50395-006	29/11/2018	Advanced Knowledge and Skills for Sustainable Growth Project
29	50381-006	29/10/2020	Second Greater Mekong Subregion Highway Modernization Project
30	50264-002	26/11/2020	Agricultural Value Chain Competitiveness and Safety Enhancement Project
31	50236-002	20/09/2019	Sustainable Rural Infrastructure and Watershed Management Sector Project
32	50218-002	11/11/2019	Rural Roads and Access Project
33	50211-001	11/11/2016	Dili to Baucau Highway Project
34	50168-003	25/10/2019	Fiscal and Public Expenditure Management Program (Subprogram 3)
35	50159-001	28/02/2020	Protecting and Investing in Natural Capital in Asia and the Pacific
36	50102-002	01/08/2018	Second Urban Environmental Management in the Tonle Sap Basin Project
37	50101-002	30/09/2019	Third Rural Water Supply and Sanitation Services Sector Development Program
38	50099-003	14/09/2018	Fourth Greater Mekong Subregion Corridor Towns Development Project
39	50099-002	01/08/2018	Fourth Greater Mekong Subregion Corridor Towns Development Project
40	50098-002	11/12/2018	Northern Mountain Provinces Transport Connectivity Project
41	50058-001	11/09/2017	Investment Assessment and Application of High-Level Technology for Food Security in Asia and the Pacific
42	50042-001	28/07/2017	Strengthening Women's Resilience to Climate Change and Disaster Risk in Asia and the Pacific
43	49404-002	26/11/2018	Water Efficiency Improvement in Drought-Affected Provinces
44	49387-003	07/12/2018	Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project
45	49387-002	31/08/2018	Second Greater Mekong Subregion Tourism Infrastructure for Inclusive Growth Project
46	49026-003	15/12/2017	Basic Infrastructure for Inclusive Growth in the North Central Provinces Sector Project
47	49026-002	15/12/2017	Basic Infrastructure for Inclusive Growth in the Northeastern Provinces Sector Project
48	48409-004	30/07/2018	Climate-Friendly Agribusiness Value Chains Sector Project
49	48409-003	09/10/2018	Climate-Friendly Agribusiness Value Chains Sector Project
50	48409-002	29/06/2018	Climate-Friendly Agribusiness Value Chains Sector Project
51	48175-002	31/05/2018	Third Greater Mekong Subregion Corridor Towns Development Project
52	48158-002	07/12/2017	Provincial Water Supply and Sanitation Project
53	47274-004	31/10/2017	Mainstreaming Climate Resilience and Environmental Protection for Secondary Green Cities Development [attached TA

			to Secondary Green Cities Development Project]
54	47274-003	31/10/2017	Secondary Green Cities Development Project
55	47152-002	28/11/2016	Irrigated Agriculture Inclusive Development
56	47087-003	27/11/2018	Greater Mekong Subregion Highway Modernization Project
57	46362-004	18/06/2020	Angat Water Transmission Improvement Project (Additional Financing)
58	45301-003	13/09/2018	Water Supply and Sanitation Sector Project (Additional Financing)
59	45283-001	15/01/2016	Mainstreaming Climate Resilience into Development Planning (Supplementary)
60	43220-014	18/05/2017	Integrated Participatory Development and Management of Irrigation Program
61	42334-018	29/06/2018	Rural Roads Improvement Project III
62	42203-025	31/05/2017	Northern Rural Infrastructure Development Sector Project - Additional Financing
63	41435-054	25/09/2017	Tonle Sap Poverty Reduction and Smallholder Development Project - Additional Financing
64	41123-015	28/09/2017	Road Network Improvement Project
65	41076-048	14/12/2017	Improving Growth Corridors in Mindanao Road Sector Project
66	35182-043	30/09/2016	Flood Management in Selected River Basins