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ENVIRONMENTAL MIGRATION AND POPULATION DISPLACEMENT AS A RESPONSE TO CLIMATE CHANGE IN SOUTHEAST ASIA

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Abstract

The Intergovernmental Panel on Climate Change has established that human influence on the climate is evident and that greenhouse gas emissions are now the highest they have ever been during human history. Climate change has already had significant impacts on human and natural systems and is estimated to cause an increase in population movement under future projections. Migration and displacement as a response to environmental changes or shocks is not an unknown phenomenon, but is one of the oldest adaptation strategies for humans dealing with environmental changes.

Climate change will amplify the population's existing risks as well as create new risks for natural and human systems. The risks have uneven geographical distribution and are generally greater for the already disadvantaged population and communities. Risks are intensified for those lacking essential infrastructure and services or living in poor-quality housing and exposed areas. Southeast Asia is particularly vulnerable to climate change due to the dependence on agriculture, densely populated coastal regions, weak institutions, and poverty among a considerable proportion of the population.

This study investigates the role of climate change in affecting past and future environmental migration and population displacement in Southeast Asia. The identified events of environmental migration and population displacement over the last 100 years that might be linked to climate impact are characterised as different environmental hazards that may have led to migration or displacement and discuss the future outlooks of environmental migration and displacement under the ongoing and projected future climate change.

Keywords: Environmental Migration, Internal Displacement, Climate Change, Southeast Asia, Mekong River Delta, Climate Justice, Climate Resilience, Climate Adaptation

Sammanfattning

IPCC har fastställt att mänsklig påverkan på klimatet är uppenbar och att utsläppen av växthusgaser nu är de högsta de har varit under mänsklighetens historia. Klimatförändringarna har redan haft betydande effekter på mänskliga och naturliga system och beräknas orsaka en ökning av befolkningsrörelser under framtida klimatscenarier. Migration som ett svar på klimatförändringar eller klimatshocker är inte ett okänt fenomen, utan är en av de äldsta anpassningsstrategierna för människor att hantera förändringar i klimatet och miljön.

Klimatförändringarna kommer att förstärka befolkningens befintliga risker samt skapa nya risker för naturliga och mänskliga system. Riskerna har ojämn geografisk spridning och är generellt sett större för den redan utsatta befolkningen och samhällena. Riskerna ökar för dem som saknar nödvändig infrastruktur och tjänster eller bor i bostäder av dålig kvalitet och utsatta områden. Sydostasien är särskilt sårbart för klimatförändringar på grund av beroendet av jordbruk, tätbefolkade kustområden, svaga institutioner och fattigdom bland en betydande del av befolkningen.

Denna studie undersöker klimatförändringarnas roll i att påverka historiska och framtida klimatmigration i Sydostasien. De identifierade händelserna av klimatmigration under de senaste 100 åren undersöks om de kan vara kopplade till klimatpåverkan och karakteriseras som olika klimatkatastrofer som kan ha lett till migration. Slutligen diskuteras framtidsutsikterna för klimatmigration under den pågående och förväntade framtida klimatförändringar.

Nyckelord: Klimatmigration, Klimatförändringar, Sydostasien, Mekongfloden, Klimat-rättvisa, Klimatmotståndskraft, Klimatanpassning

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Abbreviations

ADB Asian Development Bank

CRED Centre for Research on the Epidemiology of Disasters

EM-DAT Emergency Events Database

GIDD Global Internal Displacement Database

GMDAC IOM's Global Migration Data Analysis Centre

IDMC Internal Displacement Monitoring Centre of the Norwegian Refugee Council

IPCC United Nations Intergovernmental Panel on Climate Change

IOM International Organisation for Migration

MECC IOM's Division of Migration, Environment and Climate Change

WGI IPCC's Working Group I

1 Introduction

This chapter presents the context behind the study and background regarding the present and future Climate Change and its relation to environmental migration. Later, the aim of the study is presented followed by the general disposition of the report.

The Sixth Assessment Report (2022) of the Intergovernmental Panel on Climate Change (IPCC, 2022) establish that human influence on the climate is evident and that greenhouse gas emissions are now the highest they have ever been during human history. Climate change has already had significant impacts on human and natural systems and is estimated to cause an increase in population movement under future projections (IPCC, 2022). Migration and displacement as a response to environmental changes or shocks is not an unknown phenomenon (Jha et al., 2018). Migration is one of the oldest adaptation strategies for humans dealing with changes in the environment (Kolmannskog, 2008).

The number of displacements in the world reached the highest figure in a decade in 2020 with 40.5 million new displacements in the world. Out of these, 30 million displacements are due to weather-related disasters such as storms, floods, and wildfires (IMDC, 2020). With the projected increase of extreme weather events, more geographic places in the world are prone to experience significant impacts of climate change on population movement (Foresight, 2011). Climate change will amplify the population's existing risks as well as create new risks for natural and human systems. The risks have uneven geographical distribution and are generally greater for the already disadvantaged population and communities. Risks are intensified for those lacking essential infrastructure and services or living in poor-quality housing and exposed areas (IPCC, 2022).

1.1 Drivers of Population Movement

Migration and internal displacement are driven by spatial and temporal variation in the effects of different drivers of migration (Geddes et al., 2012). Black et al. (2011) recognise five groups of drivers that influence migration: economic, political, demographic, social, and environmental drivers. Economic drivers include employment opportunities and income differentials between locations (Foresight, 2011), which have a key role in driving migration and have direct effects on internal displacement and international migration (Black et al.,2011). Political drivers can have several direct effects on migration (Black et al., 2011) since the

drivers cover conflict, security, discrimination, persecution, and political drivers of policies, for example, land ownership or enforced relocation (Foresight, 2011). Demographic drivers of migration are most likely to be observed through the interaction with other drivers, for example, economic drivers. Demographic drivers include the size and structure of populations in source areas, together with the prevalence of diseases that affect morbidity and mortality (Black et al. 2011). Social drivers include familial or cultural expectations, the search for educational opportunities and cultural practices regarding, for example, inheritance or marriage (Foresight, 2011). Social drivers have the largest effect on the destination of migrants and give insight into the uneven distribution of opportunities to migrate. Environmental drivers are characterized as the exposure to environmental hazards and the availability of ecosystem services that provide for human well-being. Rapid-onset extreme environmental events such as floods and storms are well-known triggers of displacement, which are often internal and short distances (Black et al., 2011). The five drivers rarely operate in isolation from each other, but the interaction between these drivers regulates the scale of the population movement (Black et al, 2011).

1.2 Climate Change and Migration in Southeast Asia

Parts of Asia are particularly vulnerable to climate change due to the dependence on agriculture, densely populated coastal areas, weak institutions, and poverty among a considerable proportion of the population (ADB, 2012). Climate change and weather-related hazards are already major drivers of migration and internal displacement in Southeast Asia (Warner et al., 2010; Lavell & Ginetti, 2014).

Vietnam is considered one of the countries most severely impacted by sea-level rise and flood impacts are increasingly contributing to environmental migration in the Mekong Delta (Warner et al., 2010). In the Mekong Delta, urbanisation has been particularly rapid, reflecting the significant environmental and economic transformations that have occurred in the region in recent decades (Seto, 2011; Miller, 2019).

Climate projections of temperature and sea-level rise are anticipated to increase further as well as the intensity of droughts and storms in the region (IPCC, 2022). The major risks facing Southeast Asia in the future are more frequent extreme events and greater risks to the ocean's ecosystems. In some projections, entire ecosystems are estimated to be eliminated, coastal regions are expected to face greater risks and vulnerabilities, and vulnerabilities for food

security are projected to increase (IPCC, 2022). Environmental migration and displacement are expected as an outcome of these projected trends (Warner et al., 2010) and are an important environmental challenge, as well as a social, and political challenge on a national and international level.

1.3 Study Region

The study region Southeast Asia refers to the subregion of Asia including eleven countries: Brunei Darussalam, Cambodia, Indonesia, Lao People's Democratic Republic (PDR), Malaysia, Myanmar, Singapore, the Philippines, Thailand, Timor-Leste, and Vietnam. The Mekong River flows from northern Lao PDR along the national border to Thailand, through southern Lao PDR and through Cambodia to southwest Vietnam, the Mekong Delta.

The climate in Southeast Asia ranges from temperate and partially arid in the north mainland of the region to tropical climate in most of the remaining region (Figure 1) according to the Köppen-Geiger climate classification (Beck et al., 2018).

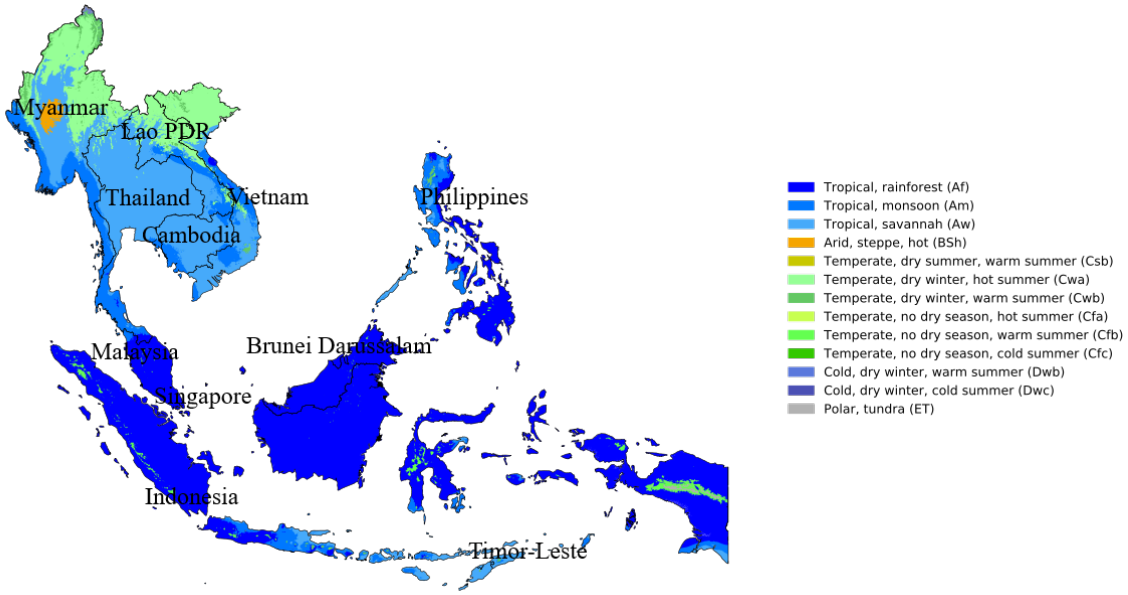

Figure 1: *The climate classification of Southeast Asia. Source: Beck et al. (2018) Present and future Köppen-Geiger climate classification maps at 1-km resolution. Sci Data 5, 180214. https://doi.org/10.1038/sdata.2018.214.*

1.4 Aim

This study aims to investigate the role of climate change in affecting past and future environmental migration and population displacement in Southeast Asia. The goal is to identify events of environmental migration and population displacement over the last 100 years that might be linked to climate impact, to characterise environmental hazards for migration linked to climate change. Lastly, the study aims to discuss the future outlooks of environmental migration and displacement under the ongoing and projected future climate changes in Southeast Asia.

1.5 Disposition

In chapter one, the context and background are presented, including the frame for the study region, the study's aim, and its disposition. In chapter two, the methodology is presented including the review approach, the data collection and analysis, the key terminology, and the research ethics. In chapter three, the result from the literature review is presented as well as the statistics from the data analysis. In chapter four, the discussion takes place, and the results are interpreted. In chapter five, the last chapter of this study, the conclusions are summarized in a way that ties in with the aim of this study.

2 Methodology

In this chapter, the literature review approach is presented, including the search strategies, selection, and relevance assessment as well as the empirical data collection and processing.

2.1 Review Approach

This study applies a mixed-methods research approach including two main methods: a systematic literature review of relevant peer-reviewed articles and reports on the subject, and a data analysis of available empirical data on environmental migration in Southeast Asia from two databases.

A systematic literature review approach was adapted from Kaczan & Orgill-Meyer (2020) to generate an inventory of peer-reviewed articles and reports that examine environmental migration in Southeast Asia, published after 2010 (Kaczan & Orgill-Meyer, 2020). During the literature search, multiple search methods and databases of bibliographic records were used: GeoRef, GEOBASE, CliMig, Web of Science and Google Scholar.

The systematic search was implemented using keywords to identify articles and reports on environmental change and migration in the study region (Table 1). The included articles and reports were then studied to identify additional articles in the reference lists related to the subject but that were not included in the bibliographic records. The first inventory of literature resulted in 92 articles and reports.

Table 1. Keywords used in the systematic literature review.

Environment	Study region	Migration
Climate Change	Asia	Climate migration
Disaster	Mekong River	Displacement
Environmental Change	Mekong River Delta	Environmental migration
Extreme weather	Southeast Asia	Human migration
Flood		Migration
Storm		

The first screening of the literature inventory was conducted using a few principles for selection and relevance assessment when reading the title and abstract. The selection of pieces of literature was conducted using three key criteria, the first being that the literature had to refer

to the entire study region, the Mekong River Delta or individual sites or nations in the region. Comparative studies with regions outside of Southeast Asia were excluded. Secondly, they had to focus on human migration. Studies that mainly focus on ecological or biological changes were excluded as well as studies on the migration of other species. Lastly, the studies had to refer to current or future environmental migration. Studies about prehistorical and historical environmental migration before the 20th century were excluded. One additional note is that reports and articles only available in other languages than English were excluded. After the first screening, 25 articles remained from the original inventory that met the three key criteria.

2.2 Empirical data Collection

In addition to data from peer-reviewed articles, empirical data collection was possible from two databases showing internal displacement data and emergency events data in Southeast Asia. Displacement data from 2008 to 2020 are provided through the Internal Displacement Monitoring Centre (IDMC) Global Internal Displacement Database (GIDD). The disaster-induced displacement data is monitored on an event-by-event basis. For each event, information is collected by IDMC from multiple sources to generate a comprehensive displacement estimate for the specific disaster event. The data is sourced primarily from national governments and other institutions such as local authorities, the UN and other international organisations, civil society organisations, research institutions, national Red Cross and Red Crescent societies and the private sector (IDMC, 2022a). The search strategy in the database is adapted to limit and filter the data to include only disaster-related displacement and therefore exclude conflict and violence-related displacement data. Also, within the disaster data, only displacement due to weather-related hazards are included and geophysical hazards are filtered out since they surpass the frame of this study. The obtained weather-related disaster data include an estimation of the number of new displacements based on reported displacement following a disaster event in ten countries: Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Thailand, Timor-Leste, Viet Nam. In this dataset, Singapore is excluded.

Emergency Events data from 1902 to 2022 are provided through the Centre for Research on the Epidemiology of Disasters (CRED) Emergency Events Database (EM-DAT).

The database is compiled from multiple primary sources including the United Nations (UN), governmental and non-governmental agencies, insurance companies, research institutes and

press agencies. The search strategy in the database is adapted to limit the emergency events data to only natural disasters that are meteorological, hydrological, and climatological, excluding geophysical, biological and extra-terrestrial since they are not relevant for this study. The obtained dataset includes data on the number of people affected as well as homeless following an emergency event from the same ten countries in Southeast Asia as the displacement dataset. In comparison to the displacement data, the number of people affected by an event does not directly indicate environmental displacement but can give an indication of the severity of the event.

2.3 Key Terminology

In the use of terminology throughout this study, all definitions regarding the subject of environmental migration are gathered from IOM's Glossary on Migration (2019a).

In the use of the term *Displacement*, the study is referring to the following definition:

> The movement of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalised violence, violations of human rights or natural or human-made disasters (IOM, 2019a, p. 55).

This study uses the term *Environmental Migration*, which is defined by the International Organisation for Migration (IOM) as:

> The movement of persons or groups of persons who, predominantly for reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are forced to leave their places of habitual residence, or choose to do so, either temporarily or permanently, and who move within or outside their country of origin or habitual residence (IOM, 2019a, p. 65).

Climate migration is a subcategory of Environmental migration and is defined by the IOM as follows:

> The movement of a person or groups of persons who, predominantly for reasons of sudden or progressive change in the environment due to climate change, are obliged to

> leave their habitual place of residence, or choose to do so, either temporarily or permanently, within a State or across an international border (IOM, 2019a, p. 31).

The definitions of the most important terminology presented in the study may be experienced as rather long but are motivated by the wish to bring clarity to the reader of the differences in the terminology. The choice to refer to the term Environmental migration is based on the data available through the Migration Data Portal developed by IOM's Global Migration Data Analysis Centre (GMDAC). The term is broader compared to climate migration and is the definition used within the databases available through the data portal. Therefore, this study uses the same definition as the data used for consistency.

2.4 Research Ethics

The author of this report chose to write this report in English rather than her native language Swedish. This choice is motivated by the available literature in English on the subject of environmental migration and by the risk of part of the information, terminology and content being lost in translation. Neither the academic writing nor the quality of the content of this report is affected by this choice.

The author of this report declares that she has no conflict of interest.

3 Results

In this chapter, the result is presented in two steps. First, the current environmental migration is investigated and presented, followed by the observed factors of environmental migration.

3.1 Current and Past Environmental Migration

To explore the current and recent past events of people displacement in Southeast Asia during the 20th century, the data from IDMC was investigated to indicate the extent of every weather-related hazard in the number of people displaced during the period 2008–2020. The analysis of the number of people displaced in each nation showed that 71% of all displacements occurred within the Philippines where 46.2 million people were displaced due to weather-related disasters during the recent period (Figure 2).

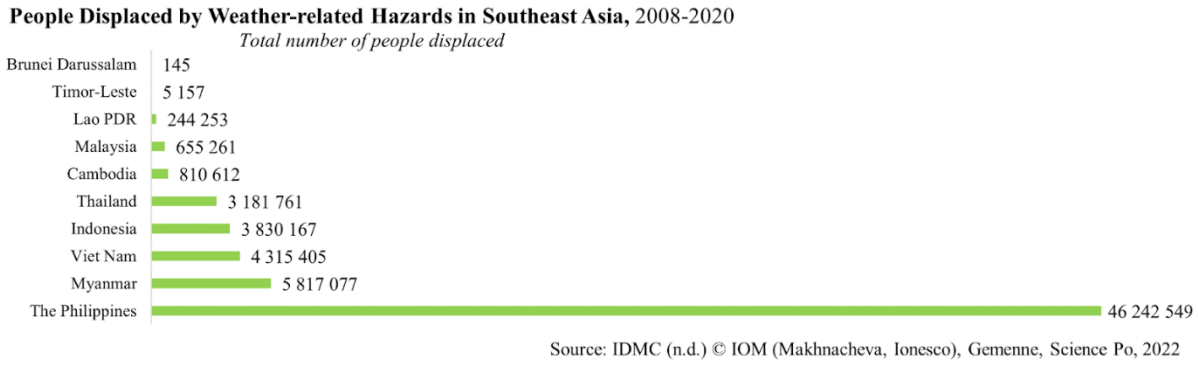

Figure 2: *The total number of people displaced by weather-related hazards in each country in Southeast Asia during the period 2008-2020. Source: IDMC. (2022b). IOM (Makhnacheva, Ionesco), Gemenne, Science Po.*

To explore the current and past events of natural disasters dating further back into the past, the data from EM-DAT was investigated to estimate the number of people affected by natural disasters during the period 1902–2022. The results show that 46% of the total number of people affected occurred in the Philippines where 239.1 million people were affected by natural disasters during the entire period (Figure 3).

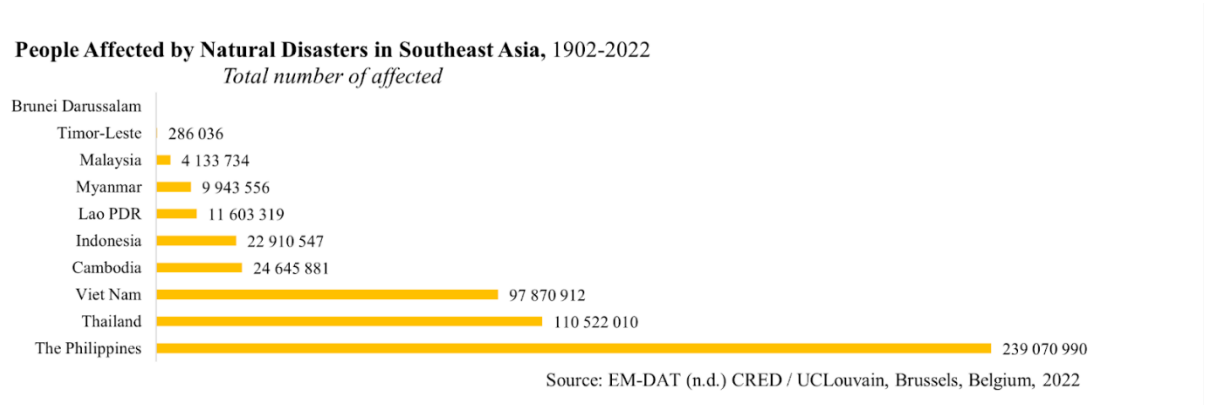

Figure 3: *The total number of people affected by natural disasters in each country in Southeast Asia during the period 1902-2022. Source: EM-DAT. (2022). CRED / UCLouvain, Brussels, Belgium.*

3.2 Factors of Environmental Migration

In order to characterise environmental hazards linked to climate for migration, the data from IDMC (2022b) was investigated for each hazard type: wildfire, wet mass movement, storm, mass movement, flood, extreme temperature and drought during the period 2008–2020. The factors of environmental migration are investigated through the number of people displaced by each of the hazards. The results show that storm-related hazards displaced an estimation of 46.4 million people during the period, which represents 71% of the total hazard-induced displacement (Figure 4). Flood-related hazards displaced an estimation of 18.6 million people during the period, which represents 29% of the total number of new displacements.

Figure 4: *The total number of people displaced by the type of natural hazard for the period 2008–2020. Source: IDMC. (2022b). IOM (Makhnacheva, Ionesco), Gemenne, Science Po.*

In order to further characterise the storm- and flood-related hazards, the subtypes from the IDMC dataset are investigated through the number of new displacements within each subtype and the percentage of displacements caused by the subtypes within the two hazard types (Table 2). The results show that the majority (82.2%) of the flood-related hazards do not include any specific subtype more than a *flood* and that 12.9% of the data does not include any subtype.

Further, flash floods constitute the largest proportion (3.0%) of the named subtypes: dam release floods, flash floods and riverine floods.

The results show that the majority (54.3%) of storm-related hazards are categorised as *storms* and 11.6% of the data does not include any subtype. In the categorised subtypes, Tropical typhoons (23.3%) and tropical cyclones (8.2%) constitute the greatest proportion of the storm-related hazards leading to the highest number of new displacements.

Table 2. The number of new displacements by the subtypes of flood- and storm-related hazards. Source: IDMC. (2022). IOM (Makhnacheva, Ionesco), Gemenne, Science Po.

Hazard type and subtype	New displacements	Subtype share
Flood	**18579039**	
Dam release flood	568	0.0%
Flash flood	559741	3.0%
Flood	15270700	82.2%
Riverine flood	358771	1.9%
(No subtype)	2389259	12.9%
Storm	**46427323**	
Hailstorm	35018	0.1%
Monsoon	5000	0.0%
Storm	25209863	54.3%
Storm, Convective	56883	0.1%
Storm, Gale	2172	0.0%
Storm, Inter-Tropical Convergence Zone	900	0.0%
Storm, Storm surge	105056	0.2%
Storm, Tropical	1010704	2.2%
Storm, Tropical, Cyclone	3785804	8.2%
Storm, Tropical, Depression	18000	0.0%
Storm, Tropical, Typhoon	10809431	23.3%
Thunderstorm	2095	0.0%
Tornado	8002	0.0%
(No subtype)	5378395	11.6%

The data from EM-DAT (2022) was investigated for each of its hazard types for the entire period 1902–2022. The dataset contained three disaster subgroups: hydrological, meteorological, and climatological disasters. Each group contain the natural disaster type and the number of people affected by said disaster type. The results show that 255.6 million people (51%) were affected by storm-related disasters during the period (Figure 5). Flood-related disasters affected 167.2 million people (33%) during the period.

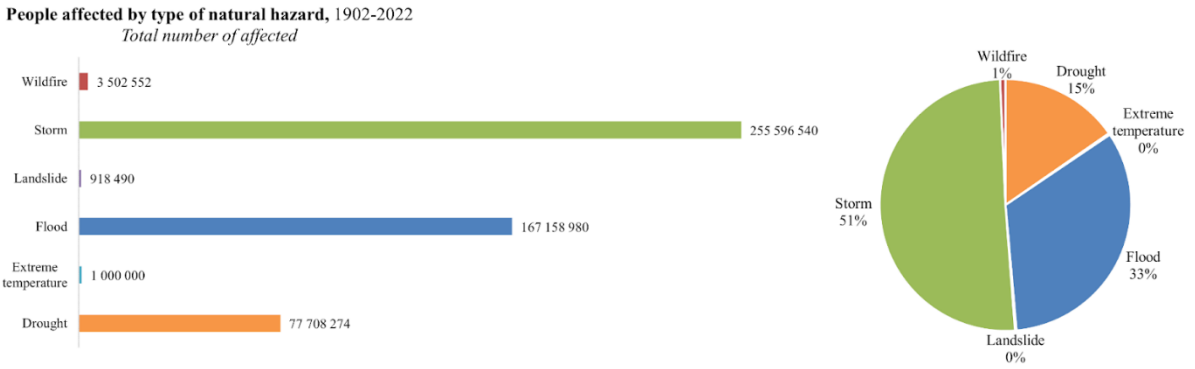

Figure 5: *The total number of people affected by the type of natural disaster for the period 1902-2022. Source: EM-DAT. (2022). CRED / UCLouvain, Brussels, Belgium.*

To characterise the storm- and flood-related disasters for the period 1902-2022, the subtypes from the EM-DAT dataset are investigated through the number of people affected within each disaster subtype and the percentage of people affected caused by the specific subtypes within the two hazard types (Table 3). The results show that riverine floods constitute the greatest proportion (62.3%) of the total number of people affected by flood hazards. Following, flash floods constitute 11.2% and 23.7% of the floods are not categorised in the dataset. The results show that tropical cyclones are the cause of 97.4% of the people affected by all storm-related disasters.

Table 3. The number of people affected by the subtypes of flood- and storm-related disasters. Source: EM-DAT. (2022). CRED / UCLouvain, Brussels, Belgium

Disaster type and subtype	Number of people affected	Subtype share
Flood	**169466103**	
Coastal flood	4775922	2.8%
Flash flood	18903746	11.2%
Riverine flood	105553663	62.3%
(No subtype)	40232772	23.7%
Storm	**267330089**	
Convective storm	300228	0.1%
Extra-tropical storm	4652	0.0%
Tropical cyclone	260450040	97.4%
(no subtype)	6575169	2.5%

4 Literature Review and Discussion

4.1 Projection of Future Environmental Migration

The statistics of the current and past environmental migration in Southeast Asia, provided in chapter 3.1, show that the Philippines and Vietnam are among the three top countries in Southeast Asia with the highest number of people displaced by weather-related hazards and affected by natural disaster in both datasets. The results are not surprising and agree with previous literature that these are two of the most vulnerable nations in the region to climate change and to environmental migration.

The characterisation of environmental hazards and disasters, provided in chapter 3.2, shows that the factors of environmental migration in Southeast Asia are mainly storms, floods and droughts during the past period of the datasets. The result shows that storm-related factors have the greatest impact on affecting the population and on displacement in both datasets and that Tropical Typhoons are the most common occurrence of storms in Southeast Asia during the individual periods.

In the emission scenarios of RCP4.5 and RCP8.5, Southeast Asia is generally projected to experience drier conditions during the end of the century due to a decrease in total annual precipitation of up to 15% (IPCC, 2022). An increase in annual precipitation is projected over small areas in the north of the region: Myanmar, Northern Lao PDR and Northern Thailand (Supari et al., 2020). Heavy and intense precipitation is projected to strengthen and become more frequent in Southeast Asia in the climate scenarios. The proportion of intense tropical cyclones and typhoons is predicted to increase globally and especially in Southeast Asia, while the total number of these events is expected to decrease or remain unchanged (IPCC, 2022).

The IPCC (2022) highlights the growing evidence that climate change has amplified extreme weather events induced by the El Niño–Southern Oscillation (ENSO). The El Niño event during 2015–2016 was the strongest it had been in 145 years and caused multiple severe droughts in southeast Asia (IPCC, 2022). Increasing temperatures and intensified precipitation will persist to be important vulnerability drivers that will shape migration caused by both climate-related hazards and disasters, and caused by food and water insecurity (Heinonen, 2006; IPCC, 2022).

Sea-level rise is a main environmental factor that is predicted to grow in importance due to climate change and that has a direct impact on migration (Piguet, 2014). The Sea-level is projected to continue to rise as a consequence of global warming and melting glaciers (IPCC,2022). The projected sea-level rise could lead to large-scale flooding in low-lying areas due to rising water levels, higher tides, and further-reaching waves (Piquet, 2014). Since a large proportion of the population in Southeast Asia lives in low elevation coastal zones, the risk from climate change hazards is particularly high (Hijioka et al., 2014). Low-lying areas are also prone to salinity intrusion and coastal erosion occurring simultaneously with sea-level rise (IPCC, 2022). The projected sea-level rise could lead to large-scale migrations and displacement in low-lying areas, particularly in Southeast Asia (IPCC, 2022).

4.2 Vulnerability, Justice, and Resilience

Climate change impacts are unevenly distributed around the world and poor nations that have contributed very little to climate change are often the most vulnerable to its damaging impacts (Füssel, 2010). The main cause for the higher vulnerability of poor nations is caused by their lower adaptive capacity. The existing asymmetry between responsibility and vulnerability is considered an injustice environmental issue (Füssel, 2010). The environmental injustice implies that nations with a higher responsibility for climate change have an obligation to act and assist highly vulnerable nations, based on their capability to do so. This can be interpreted that a higher responsibility for climate change lies with the nations with currently and historically high emissions of greenhouse gasses. Looking at the asymmetry of responsibility and vulnerability of nations may be helpful in terms of the accountability for climate change and in distributing resources in the world for adaptation and building resilience.

Miller (2019) presents the concept of *just resilience* referring to the ability of people to cope, recover and restore their livelihoods after natural disasters and shocks, preserving peoples' relations to the place, between people and livelihoods. How resilience is affected during migration and displacement strongly influences the extent of adaptation to disasters and shocks caused to climate change (Miller, 2019). The concept of just resilience when discussing adapting to climate change may result in more just outcomes for people most affected and displaced by climate risks.

Building community and institutional climate resilience are particularly important for hazard-prone and developing countries (Jacobson, 2020; Grefalda et al., 2020;). The development of community resilience in the developing countries in Southeast Asia is essential due to the dependency on agriculture and fisheries for livelihood (Jacobson, 2020). Community resilience is defined as a community's ability to anticipate hazards, adapt to changes, and recover quickly from disturbances. Building community resilience includes the development of community resources that foster knowledge and opportunity for adaptation, self-organisation, collective capacity, and collective processes (Jacobson, 2020). Gerfalda et al. (2020) emphasise the importance of institutional resilience in the Philippines for a greater understanding of current and projected climate risks and for the application of meaningful adaptation strategies. Institutions play an essential role in the amount of exposure, sensitivity, and capacities of the population to respond to disaster events (Grefalda et al., 2020). Building institutional resilience through the increase of financial support and knowledge about management systems may enable institutions to anticipate climate risks, respond to and craft adaptation strategies, and recover after climate hazards (Elliott, 2012). Building both community and institutional resilience will be an increasingly important strategy to mitigate the risks of climate change under future climate projections.

4.3 Adaptation and Climate Risk Management

A favourable approach to addressing environmental migration is within a development framework and through adaptation strategies (Hijioka et al., 2014). The risk of displacement increases when populations lack the resources for planned relocation and experience higher exposure to extreme weather events, such as floods, droughts, and storms (IPCC, 2014). A step towards adaptation to future climate change is reducing the vulnerability and exposure to present climate variability. By expanding the opportunities for population movement, we may reduce the vulnerability of communities and populations at risk of hazards and disasters. Planned relocation is recognized as a tool for reducing disaster risks and adapting to climate change (Bower & Weerasinghe, 2021), and could be used also in reducing the vulnerability and exposure to projected climate change and variability.

Since floods in Southeast Asia in one of the major drivers of current disaster displacement, and since risks and vulnerabilities to coastal livelihoods are expected to increase in climate projections (IPCC, 2022), adaptation and climate risk management is essential. Alexander et al.

(2012) address planned relocation through the managed retreat of coastal communities to adapt to the projected sea-level rise (Alexander et al., 2012). The vulnerability of coastal populations can be greatly reduced through the managed retreat of homes and infrastructure at risk of flooding in Southeast Asia (Lauri et al., 2012). Further ways to reduce the risk facing the coast of Southeast Asia may be coastal planning and management and early warning systems for flooding. Also, coastal reforestation of mangroves can be implemented to make up for the significant losses of mangroves in Southeast Asia to adapt to mitigate the effects of floods due to sea-level rise in the coastal regions. Reducing the vulnerability to climate change and the risk of displacement are done through adaptation plans, and policies by governments (Kelley, 2022; IPCC, 2014). International, national, and local responses to climate change are important for disaster risk management, coastal management, and water management in order to secure investments in energy and infrastructure and improve climate projections. One nation's economic development can also be considered an adaptation action to climate change as it often also contributed to the general income, health, and mobility of the population.

Planned migration can be used as an adaptation strategy for climate change and variability (Kolmannskog, 2008) but have consequences and impacts on labour shortages, child welfare, and female safety, and does not necessarily improve food security for the population (Jacobson et al., 2019). Jacobson et al. (2019) argue that migration may be a maladaptive response long term and that climate-induced migration and displacement may instead result in climate-induced poverty among the displaced population (Jacobson et al., 2019). Adaptation strategies intended to reduce vulnerability may instead have unintended consequences. In the Mekong River basin, the construction of dams and water reservoirs to provide water security for agriculture has been implemented as an adaptation strategy in north Southeast Asia, upstream of the Mekong River (Dun, 2011; IPCC, 2022). The impacts of the building of dams have maladaptive outcomes as the vulnerability is merely shifted to the south of Southeast Asia as it increases the risk imposed by floods and droughts further downstream of the Mekong River (IPCC, 2022). It is clear that maladaptive climate migration needs to be avoided in order in order to not only shift the vulnerability but to consider the possible impacts of the adaptation strategies not only for the already affected region but also nationally and globally.

5 Conclusion

The aim of this study was to investigate the role of climate change in affecting past and future environmental migration and population displacement in Southeast Asia. The study identifies events of population displacement over the last 100 years that are caused by natural disasters and weather-related hazards. The identified environmental disasters and hazards are interpreted as population displacement linked to extreme weather events caused by climate change. The factors of disaster and hazard displacement were represented mostly by storms and floods in Southeast Asia.

The future outlooks of environmental migration and displacement under the ongoing and projected future climate change are expected to continue to increase. The climate in Southeast Asia is projected to be drier, decrease in total annual precipitation (exception for the north region), more intense and frequent heavy and intense precipitation, an increase in tropical cyclones and typhoons intensity, as well as a projected sea-level rise. The increase in temperatures and intensified precipitation and generally amplified extreme weather events will persist to be drivers that shape climate vulnerability and migration caused by climate change.

This study provides a discussion of the geographic distribution of climate change impacts through the concepts of vulnerability, responsibility, and justice to highlight the importance of building resilience and to mitigate the effects of climate change through sustainable adaptation strategies.

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