Forum: United Nations Environment Programme

Issue: Implementing systems to tackle rising sea levels and flooding in Southeast Asia

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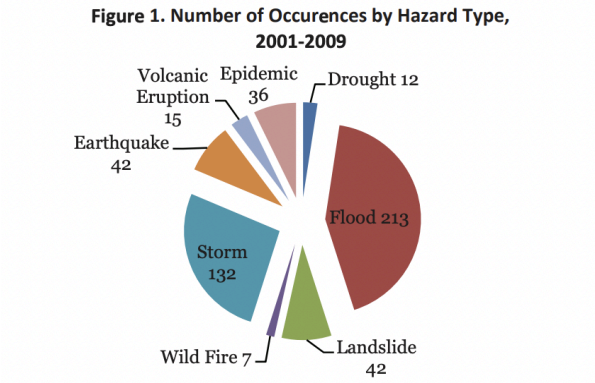
Introduction

The rise in sea levels and the increased frequency and severity of flooding events is an undeniable and pressing environmental challenge our world faces today. In no region is this challenge more severely felt than in Southeast Asia, a region characterised by its extensive coastline, dense populations, and vulnerability to the impacts of climate change.

Coastal and low-lying regions in Southeast Asia are facing an increased threat of flooding, with 19 of the 25 most at-risk cities to a one-meter sea-level rise located in this area, including 7 in the Philippines. Indonesia is predicted to bear the brunt, as approximately 5.9 million people are expected to be exposed to annual flooding until 2100. Paradoxically, alongside the rising flood risks, there are concerns about water shortages due to changing climate patterns and growing water demand driven by population and economic growth. This shifting climate is likely to lead to the depletion of vital water sources like rivers, lakes, and aquifers, putting regions susceptible to drought under pressure. As a result, adapting to a changing climate and preparing for extreme weather events have become the "new normal" for countries in the region.

From 2001 to 2009, various regions experienced recurrent natural disasters, including floods, storms, earthquakes, and landslides. These events had a devastating impact on numerous cities and communities as depicted in Figure 1. Collectively, these disaster occurrences in the region constituted 14 percent of the world's total number of disasters during the same timeframe. Although flooding was the most frequently encountered

hazard, earthquakes resulted in the most significant adverse consequences, including loss of life, injuries, and displacement of people.



(ASEAN Agreement on Disaster Management and Emergency Response work programme 2010-2015)

More recent examples of natural disasters also exist, such as the Misamis Occidental floods of late 2022 to early 2023 in the Phillipines, and the 2021 central Malaysian floods that resulted in a cumalative 125,490 people displaced.

The looming threat of rising sea levels and flooding poses not only environmental hazards but also socioeconomic and geopolitical risks to nations across Southeast Asia. In response to this pressing concern, the following research report delves into the critical need of implementing comprehensive systems to mitigate and adapt to the consequences of rising sea levels and flooding within the Southeast Asian context.

In light of the recent study published in the journal Nature Climate Change, it has become clear that the impact of climate change and natural oceanic fluctuations could lead to catastrophic consequences for millions of people residing in the coastal areas of Southeast Asia. The study suggests that the degree of sea-level rise and subsequent flooding caused by natural ocean fluctuations have been severely underestimated in previous analyses.

Here are some of the key findings from the study:

- Rising sea levels due to increasing ocean temperatures and unprecedented levels of ice melting caused by climate change.
- Natural fluctuations in the ocean have a high degree of variability, which makes it hard to quantify their impact.
- With the maximum possible impact from natural fluctuations combined with the expected consequences of climate change, several Southeast Asian megacities would become new hotspots of high sea-level rise.
- Parts of Asia's largest cities could be under water by 2100, putting millions of people at risk.
- While many shoreline Asian megacities were already at risk of flooding, the impact of natural fluctuations could exacerbate the situation and lead to more severe flooding.

Definition of Key Terms

Early Warning Systems

An early warning system, utilizing integrated communication, helps communities prepare for climate-related emergencies, saving lives, jobs, land, and infrastructure, while also supporting long-term sustainability and economic stability.

Flooding

The overflow of water onto otherwise normally dry land. Flooding results in damage or nature and infrastructure

GIS (Geographic Information System)

Computer-based technology used to store, visualize, analyze, and interpret geographic data.

Hard Engineering

Hard engineering involves the use of physical structures and technological solutions to control and mitigate the effects of rising sea levels and flooding. These solutions are typically rigid and often highly engineered. Hard engineering measures are typically effective in protecting specific areas from flooding, but they can be expensive, environmentally disruptive, and may not always provide a sustainable, long-term solution. Examples of types of hard engineering:

Dike or Levee

A barrier built to prevent the overflow of water, commonly used to protect low-lying areas from flooding. They help prevent excess water spillage and decrease chemicals brought in from the land.

Reservoirs and Detention Basins

Creating artificial storage areas for excess water to reduce the effects of runoff and futher down-stream flooding during heavy rainfall.

Runoff

In the context of flooding, runoff refers to the movement of excess water over the land's surface, often from heavy monsoon rains, which can lead to flooding in low-lying coastal and urban areas in the region. The flooding is caused often when drainage systems and natural water bodies become overwhelmed.

Soft Engineering

Soft engineering focuses on more natural and environmentally friendly approaches to manage rising sea levels and flooding. These methods work with natural processes and

ecosystems to reduce the impact of flooding. Soft engineering methods tend to be more sustainable, environmentally friendly, and adaptable to changing conditions. However, they may not provide the same level of immediate protection as hard engineering measures in certain situations. Examples of types of soft engineering:

Mangrove Restoration

Restoring and conserving mangrove forests along coastlines. Used to act as natural buffers against storm surges and flooding.

Wetland Restoration

Restoring and conserving wetlands to absorb floodwaters, filter pollutants, and provide wildlife habitat.

Tidal Surge

A significant sudden increase in height of the tide often seen during storms. Often resulting in the flooding of the coast

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Key Issues

Food Security

Recent food price surges in Asian economies, including China, Mongolia, and Myanmar, have been significant. From January to July 2020, the average food prices in these countries increased by 24.2%, 31.0%, and 34.1% compared to 2015. Climate change is a major factor driving food insecurity. Mongolia's vulnerability to climate variability, as a landlocked nation, substantially affects its agricultural production, resulting in higher production costs and supply chain losses, contributing to elevated food prices]. Notably, rice prices play a pivotal role in food price fluctuations in the region, and volatility in rice production in exporting countries has a substantial impact on regional and global rice markets. These price increases disproportionately affect the vulnerable [29]. Some Asian

economies have long relied on political interventions for rice price stability and self-sufficiency. However, there is a call for these economies to open up rice trade to reduce the external costs of stabilizing the global rice market, particularly given the impact of climate change on food security.

Water availability and timing can create sanitation issues and affect the quality of available drinking water, leading to health issues such as diarrhea. Additionally, climate change can lead to more frequent and severe natural disasters like droughts and floods, which can exacerbate food insecurity. It's important to note that addressing global food security requires addressing other factors such as poverty, inequality, and political instability, not just climate change. However, mitigating the effects of climate change, such as reducing greenhouse gas emissions and improving agricultural practices, is a critical step in ensuring global food security for all populations. It is essential to adopt sustainable practices in agriculture and reduce our carbon footprint to ensure the future of food security in the world.

Malnutrition is a pressing concern in flooded regions, compounded by food security issues in Southeast Asia. The delivery of food supplies to flood-affected areas is challenging, exacerbating the situation. Widespread damage to agricultural land and livestock, particularly rice, maize, and coffee bean crops, along with losses in livestock and poultry, disrupts the food supply chain. This results in unemployment for those reliant on these forms of food production, straining the economy and affecting businesses and families. Health care centers also suffer extensive damage, making access to medical care more challenging in the areas that need it most. The overall impact is a critical threat to food security and public health in flooded regions.

Urbanisation

Rapid urbanization brings with it plenty of challenges, including increased pressure on infrastructure and natural resources. In the context of flooding, urbanization can worsen the problem by increasing the amount of water-repellent surfaces (such as concrete) that

prevent water from being absorbed into the ground. This can lead to more runoff and greater risk of flooding. Urbanisation can be seen is countries such as the Philippines, where the country is expected to become 75% urbanized by 2035 according to the World Bank, and according to the IURC “Currently, roughly 50% of the country's [Thailand’s] 70-million population lives in urban areas, and the number is expected to rise to 72% by 2050.”

Urban development often leads to the construction of buildings and infrastructure in flood-prone areas, which not only increases the exposure of assets to flood risk but can also disrupt natural water flow patterns. In some cases, wetlands and natural floodplains, which can act as natural buffers against flooding, are drained or built upon to make way for urban development. The concentration of people and assets in cities also means that the economic and social impacts of flooding can be more severe. To mitigate these issues, urban planning and infrastructure development must incorporate measures to manage and mitigate flood risks, such as improved drainage systems, green infrastructure, and zoning regulations that prevent construction in high-risk areas.

Disease and health risks

Flooding in Southeast Asia often triggers relentless outbreaks of water-borne diseases. When floodwaters inundate communities, they can contaminate drinking water sources with pollutants and pathogens. This contaminated water, coupled with overcrowded living conditions in temporary shelters, facilitates the rapid transmission of diseases such as cholera, dysentery, and typhoid. In the wake of flood events, the increased risk of water-borne illnesses places a heavy burden on public health systems, as they must respond to and contain these outbreaks, underscoring the urgent need for clean water and sanitation facilities to prevent such health crises during and after flooding incidents.

The onset of flooding in Southeast Asia poses significant immediate threats and health risks. Drowning is a major cause of death, often occurring when people attempt to navigate through fast-moving floodwaters or when they are swept away while trying to assist others. Additional fatalities result from being struck by objects in the water,

suffering heart attacks, electrocution, or being buried under mud and collapsed infrastructure. In 2011 alone, Southeast Asia experienced 1,302 direct flood-related deaths.

Following the initial flood, the risks persist. As individuals return to their homes, weakened and damaged structures can collapse, posing a threat of injury. Exposure to electric cables and submerged wires increases the risk of electrocution and burns. Carbon monoxide poisoning becomes a concern as electric generators are used for cleanup in poorly ventilated spaces. Hypothermia cases rise due to prolonged exposure to cold water. Communicable diseases, especially fecal-oral diseases, become more prevalent due to inadequate sanitation, contaminated drinking water, and consumption of tainted foods. This includes diseases like typhoid fever, paratyphoid, polio, hepatitis A, and hepatitis E. Vector-borne diseases, such as those transmitted by mosquitoes, increase as stagnant water becomes a breeding ground. Additionally, rodent-borne diseases surge due to heightened rodent excrement in floodwaters.

Mental health

The emotional toll of flooding on mental health is a critical issue that often receives insufficient attention. Among the most prevalent mental health problems experienced by flood-affected populations are anxiety, depression, and stress. The psychological impact of flooding is profound, with many individuals forced to uproot their lives and relocate, often in government shelters, resulting in a sense of displacement, loss of identity, and weakened emotional attachments. Posttraumatic stress disorder, suicide, sleep disturbances, irritability, anger, and even schizophrenia are among the mental health challenges that become more burdensome during and after floods. These issues can persist long after the floodwaters recede, emphasizing the urgent need for mental health support and awareness in disaster response and recovery efforts.

Major Parties Involved and Their Views

ASEAN (Association of South East Asian Nations)

ASEAN, the Association of Southeast Asian Nations, is a regional intergovernmental organization comprising ten countries in Southeast Asia. These member states include Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam. In recent years, ASEAN nations have shown a growing awareness of the urgent need to address climate change and its associated impacts, particularly the escalating threats of rising sea levels and flooding. This recognition stems from the region's vulnerability to climate change due to its extensive coastlines and low-lying areas, which are highly susceptible to environmental challenges.

The Republic of the Philippines

The Philippines is at risk of increased flooding due to rising sea levels, frequent cyclones, and rapid urbanization. Major cities along the coast are particularly vulnerable. To address this, measures such as flood control structures and sustainable urban planning practices are being taken, but more action is needed to effectively mitigate the effects of flooding.

People’s Republic of China

China has been criticized for its construction of artificial islands in the South China Sea, which some argue may exacerbate flooding risks and environmental damage in the region. The dredging process utilized in constructing artificial islands has significant environmental consequences. Coral reefs are broken up, ecosystems are disturbed by changing wave patterns, and the migration corridor of many species, including tuna, through the South China Sea is disrupted.

The United States of America

The U.S. government acknowledges the region's vulnerability to these climate impacts and claims to be committed to supporting international efforts to mitigate and adapt to them. This includes funding initiatives, promoting sustainability, and rejoining

international climate agreements to foster cooperation with Southeast Asian nations in addressing these challenges.

Kingdom of The Netherlands

The Netherlands is a vital partner in aiding Southeast Asian countries in tackling flooding and climate-related issues. Leveraging their renowned expertise in water management and flood control, the Dutch provide technical assistance, capacity building, and collaborate on joint projects with regional governments. Their knowledge-sharing and research initiatives focus on innovative urban planning and sustainable solutions to mitigate flood risks. Public-private partnerships further contribute to enhancing water management and resilience in the region, reinforcing the Netherlands' crucial role in addressing Southeast Asia's flooding challenges.

Development of Issue/Timeline

Date	Event	Outcome
1971	The 1971 flooding in North Vietnam significantly impacted the local community, resulting in a devastating loss of at least 100,000 lives. The catastrophic flooding was likely worsened by heavy rainfall, leading to the overloading of dikes and subsequent inundation.	While later construction of multiple reservoirs in the Hanoi region aimed to mitigate such disasters, the area remains persistently susceptible to recurring flooding, indicating the continued vulnerability of the region despite additional flood prevention measures.
2004	The 2004 Indian Ocean tsunami stands as one of the most devastating disasters in recent history, claiming the lives of approximately 230,000 people. Triggered by the immense Sumatra-Andaman	Post disaster damage and loss assessment revealed staggering numbers on the calamity that include over 220,000 human fatalities and the destruction of 139,000 houses, 73,869 hectares of agricultural

	earthquake, this catastrophic event is estimated to have released energy on a scale comparable to 23,000 Hiroshima-type atomic bombs.	lands, 2,618 kilometers of roads, 3,415 schools, 104,500 small-medium enterprises, 13,828 fishing boats, 119 bridges, 669 government buildings, 517 health facilities, 1,089 worship places, 22 seaports, and 8 airports and airstrips (BRR-Agency for the Rehabilitation and Reconstruction of Aceh and Nias, 2009)
2007	In 2007, Jakarta experienced a devastating flood that led to the inundation of 70,000 homes and the displacement of 500,000 residents, resulting in damages totaling US$400 million.	In response to this crisis, the governments of Indonesia and the Netherlands collaborated to initiate the National Capital Integrated Coastal Development master plan.
2008	During the second week of August 2008, extreme flooding occurred in the Mekong Basin, particularly in areas like Luang Prabang, Vientiane, and Nong Khai. This flood event was triggered by tropical storm Kammuri, which moved westward across northern Laos and southern Yunnan from the 8th to the 10th of the month. The storm brought heavy rainfall, averaging 100–150 mm, with some areas receiving as much as 250 mm of rain. The flooding was exacerbated by already saturated catchments due to the strong monsoonal	The extreme flooding in the Mekong Basin in August 2008 had far-reaching consequences. It resulted in loss of lives, community displacement, damage to infrastructure, agricultural losses, economic setbacks, relief and recovery efforts, environmental consequences, and an increased emphasis on disaster preparedness and resilience-building. This flood event left a profound impact on the affected regions, highlighting the critical need for comprehensive disaster management and mitigation strategies.

	conditions in May, June, and July, which led to a maximum runoff of floodwaters.	
2011	The 2011 Thailand floods were a major natural disaster that occurred in Thailand from July 2011 to early 2012. Triggered by unusually heavy monsoon rains. The floodwaters inundated homes, businesses, and industrial areas, causing widespread devastation and economic losses. It was one of the most severe flood events in Thailand's history, affecting millions of people and leading to significant disruptions in the global supply chain due to the country's importance in manufacturing and exports.	The 2011 Thailand floods, triggered by heavy monsoon rains, resulted in significant economic losses, widespread devastation, and disruptions to the global supply chain. This natural disaster affected millions of people, led to loss of life, and caused damage to homes, infrastructure, and agricultural sectors. Thailand's pivotal role in manufacturing and exports meant that the floods had far-reaching consequences, impacting industries worldwide and emphasizing the need for improved flood management and disaster preparedness. This event underscored the vulnerability of global supply chains to natural disasters and prompted efforts to strengthen resilience in the face of future challenges.
2013	On November 8, 2013, the Philippines faced the devastating impact of Typhoon Haiyan, a formidable category five typhoon. This typhoon stands out as one of the most powerful to have ever hit the country. Its ferocious winds wreaked havoc on homes, rendering numerous people homeless. The typhoon's forceful winds disrupted the	The immediate response to Typhoon Haiyan in the Philippines involved several actions. In response to a televised warning, about 800,000 people were evacuated to safer places. Many sought shelter in a Tacloban stadium, but sadly, some lost their lives when it got flooded. The government quickly provided necessary equipment and

	electric supply, inflicted severe damage on the airport, and obstructed roads with fallen trees and debris. Moreover, the areas of Leyte and Tacloban experienced a catastrophic 5-meter storm surge, with up to 400mm of rainfall causing extensive flooding that extended nearly 1 kilometer inland. Tacloban, in particular, suffered immense devastation, with around 90% of the city destroyed. The human toll was tragic, with 6,190 people losing their lives, and 29,000 individuals sustaining injuries. The catastrophe left a staggering 4.1 million people homeless and affected a total of 14.1 million. The economic cost of the damage was estimated at approximately $12 billion, while the agricultural sector bore the brunt, with 1.1 million tonnes of crops destroyed, 1.1 million houses damaged, and 1 million farmers and 600,000 hectares of farmland severely impacted. The roads in Tacloban were submerged, further compounding the disaster's impact on the region.	medical supplies and enforced a curfew to prevent looting. They also set up over 1,200 evacuation centers to assist those who lost their homes. The main airport was reopened within a few days, and emergency aid started arriving. Power was restored in some areas within a week, and relief efforts provided one million food packs and 250,000 liters of water within two weeks. International support, totaling more than $1.5 billion, was promised by 33 countries and organizations, aiding in rescue operations and recovery. A "cash-for-work" program was initiated to help clear debris and rebuild Tacloban, and organizations like Oxfam replaced fishing boats to assist affected communities. In 2014, the government launched the "Build Back Better" initiative to reinforce damaged buildings against future disasters, establish a no-build zone along the Eastern Visayas coast, develop a storm surge warning system, and replant mangroves to reduce the impact of future storm surges.
2018	In 2018, Typhoon Mangkhut, the world's most powerful storm that year, wreaked havoc in the Philippines, Hong Kong, and	Typhoon Mangkhut's secondary effects included significant economic costs, particularly in Cagayan, a key agricultural

	China. The Philippines issued widespread storm warnings, imposed travel restrictions, and saw a more diligent response from residents. The government closed schools, canceled flights, and put the army on standby, cautioning about landslides and flash floods due to heavy rains. Over 9,000 people were evacuated, and many tried to protect their homes. Despite crops not being fully ripe, farmers worked non-stop to salvage them. While over four million people were in the storm's path, officials raised alert levels and prepared relief goods worth ₱1.7 billion by September 13, 2018.	province in the Philippines, where extensive damage to farmland threatened staples like rice and corn. Hong Kong reported economic losses exceeding ¥4.2 billion (£464 million), and China's total financial losses were estimated at ¥5.3 billion (£586 million). Immediate responses involved charitable organizations launching fundraising campaigns, such as World Vision and Global Giving, while provincial and municipal authorities in the Philippines led disaster response efforts, supported by the Department of Social Welfare and Development (DSWD) field offices and the Philippine Red Cross. The United Nations Population Fund provided support, and UNICEF supplied emergency resources to assist approximately 12,500 families with essential needs such as safe drinking water, sanitation, hygiene, nutrition, education, and child protection.

Previous Attempts to Solve the Issue

Chao Phraya Dam Project (Thailand)

Started in 1952 and completed in 1964, The Chao Phraya Dam Project involved the construction of dams and reservoirs along the Chao Phraya River in Thailand to regulate

water flow, reduce the risk of downstream flooding, and ensure a stable water supply for agriculture and urban areas.

MRC (Lower Mekong Region - Thailand, Vietnam, Cambodia, Lao PDR)

Established in 1995, The Mekong River Commission (MRC) is an intergovernmental organization that facilitates cooperation among Cambodia, Lao PDR, Thailand, and Vietnam in managing the Mekong River. Its central goal is to collaboratively oversee the responsible utilization of shared water resources in the Lower Mekong River region, ensuring sustainable development. Leveraging its Technical Support Division, which includes a dedicated Flood Forecasting Team, the MRC offers early warnings and real-time information through the Decision Support Framework (DSF) to assist with flood management efforts in the area.

JCDIS (Indonesia)

Started 2014, The Jakarta Coastal Defense Strategy initiative aims to address the chronic flooding problems in Jakarta by constructing a network of coastal and river defenses, including sea walls, sluice gates, and embankments, to protect the city from tidal surges and river floods.

The National Capital Integrated Coastal Development plan

Announced in 2015, The governments of Indonesia and the Netherlands collaborated to initiate the National Capital Integrated Coastal Development master plan. Leveraging Dutch expertise and experience, this collaborative effort aimed to protect Jakarta from urban flooding and the rising sea levels, with the shared goal of safeguarding the city and its residents from future flood-related disasters.

Pampanga Delta Development Project (Phillipines)

The aim of this project was to improve flood control measures in the lower regions of the Pampanga River, located in Central Luzon, an area susceptible to frequent flooding. This was achieved by implementing enhancements to the river infrastructure, with the goal of

raising the quality of life in the region and stimulating economic development at the local level.

Possible Solutions

Urban Planning

Land use planning is a pivotal tool for mitigating flood risk, with the potential to either increase or decrease vulnerability to flooding. It involves public authorities identifying, assessing, and deciding on land use options while considering long-term economic, social, and environmental objectives. Effective land use planning safeguards lives, homes, and livelihoods from floods by avoiding the placement of development in high-risk flood areas like floodplains. In urban areas, nature-based solutions, such as green spaces and natural floodplains, enhance water absorption and reduce flood risks. While government bodies, local leaders, and urban planners play vital roles, civil society, grassroots organizations, community groups, and residents also contribute significantly to building flood resilience in urban areas through sound land use planning.

Afforestation and Reforestation

Healthy ecosystems naturally possess resilience to environmental and climatic changes, a crucial factor in safeguarding communities. Their destruction exacerbates climate impacts and increases risks to populations. Land converted from forests and grasslands for agriculture, industry, or urban development loses its ability to absorb and regulate rainfall. Forests play a vital role in reducing flooding and landslides by fortifying soils, preventing erosion, and safeguarding freshwater supplies. Coastal barrier systems, including mangroves, coral reefs, dunes, and wetlands, mitigate storm surges and dampen wave energy, reducing damage and casualties during storms or tsunamis. Natural and man-made wetlands effectively filter pollutants, nutrients, and microbial contaminants, enhancing downstream water quality and acting as permanent sinks for these substances. Bioswales, vegetated channels guiding stormwater, reduce peak flows by up to 89%.

Infrastructure Resillience

Infrastructure resilience is crucial in the face of rising sea levels and flooding. It involves the development and enhancement of infrastructure systems to withstand these challenges effectively. This includes the construction of flood defenses, such as levees and sea walls, to protect coastal areas from inundation. Improving drainage systems helps manage excess water and prevent flooding in urban and low-lying regions. Additionally, elevating critical infrastructure components, such as roads, power stations, hospitals, and utilities, makes them less vulnerable to flooding, ensuring their continued functionality during extreme weather events. Such proactive measures are essential for safeguarding communities and maintaining the uninterrupted operation of vital services in the face of climate-induced threats.

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