



EAST ASIA
PACIFIC

World Bank Group

COUNTRY CLIMATE AND DEVELOPMENT REPORT



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2.

Climate change and development

2 Climate change and development

2.1 Motivation and context

Thailand is, in many respects, a development success story, having rapidly transitioned from an agriculture-based economy to one that is modern, industrialized, and export-driven. Between 1980 and 2019, the country achieved an average annual growth rate of 3.8 percent—surpassing Indonesia and Malaysia, though trailing Viet Nam. This progress was underpinned by a shift toward market-friendly macroeconomic policies and greater outward orientation in the 1980s and 1990s, coupled with strong investments in broad-based basic education. These reforms spurred significant structural transformation and income growth. Poverty fell sharply, with the share of the population living in poverty dropping from 77.2 percent in 1981 to just 13.5 percent in 2019. Over the same period, Thailand’s “prosperity gap”—a measure of how far a population is from the prosperity threshold of \$25 per day (2017 PPP)—narrowed significantly, indicating that rising living standards were broadly shared.¹

But Thailand’s recent growth and development experience has been less rosy. Progress toward high-income status has slowed. Investment growth has lagged, and structural transformation has stalled over the past decade, even though the share of low-productivity agricultural employment remains high relative to peers at about 30 percent. Inefficiencies in the regulatory framework, restrictions on services trade and foreign investment, and the presence of price controls are together deterring competition and limiting incentives to innovate. The decline in labor force participation associated with Thailand’s rapidly aging population is also beginning to limit potential growth, while the Bangkok economy, which accounts for around a third of national GDP, is being constrained by increased congestion and emerging signs of diseconomies of scale.

At the same time, Thailand’s economic development is exposed to the physical impacts of climate change because of the susceptibility of key industries to flooding, drought, heat stress, and other extreme weather events. Climate change is already affecting Thailand, which ranks as the 30th most affected country by extreme weather events in the last two decades, and its exposure to disasters and higher temperatures will continue to rise.² As laid out in reminder of this chapter, manufacturing, tourism, and agriculture will increasingly be disrupted by floods, coastal erosion, and water shortages. Additionally, while Thailand’s carbon emissions are relatively small on a global scale, air pollution is worsening the health of Thai people. The cumulative impacts of these challenges will increasingly strain Thailand’s human capital, labor productivity, and quality of life.

Moreover, climate change disproportionately impacts vulnerable populations in Thailand, a country where high inequality is a key constraint to sustainable and inclusive growth. With a Gini coefficient of income of 43.3 in 2021, Thailand ranked as the 13th most unequal out of 63 countries for which income-based Gini coefficients are available. Inequality is starker when considering concentration of wealth; over half of the country’s wealth is held by the richest 10 percent of the population. Addressing this divide, which has a distinct spatial dimension, is critical to building a robust middle class that can propel Thailand into high-income country status. But climate change exacerbates the vulnerability of Thailand’s poorest people to extreme weather events, disrupting their livelihoods, and increasing their exposure to health risks and economic insecurity.

The rapidly changing external environment is posing further challenges to the outlook. The net-zero transition is a global shift that will have particularly important implications for Thailand’s trade and ability

¹ The prosperity gap is a recently introduced measure of shared prosperity. It refers to the amount by which incomes of everyone in a country needs to be multiplied by, on average, for the country to arrive at the prosperity standard of \$25 a day (2017 PPP). Between 1981 and 2019, Thailand’s prosperity gap declined from 8.0 to 2.2.

² Thailand is ranked 30th out of 174 countries on the 2025 Germanwatch Climate Risk Index for countries most affected by extreme weather events between 1993 and 2022 and ranked 51 out of 191 countries on the 2025 Inform Risk Index, with the fourth highest exposure to river flooding in the world, the 37th highest exposure to drought, and the 51st highest exposure to coastal flooding.

to attract foreign direct investment. Thailand is not a major contributor to global climate change, but its per capita emissions surpass those of several neighboring ASEAN countries. Shifting demand toward low-carbon goods and services means that Thailand's future comparative advantage will likely depend on its ability to lower the emissions intensity of production. Furthermore, the green transitions taking place within some of Thailand's major trade and investment partners are set to have ripple effects on the Thai economy. For instance, initiatives such as the EU's Carbon Border Adjustment Mechanism could have a larger impact if it is expanded to a wider set of products or services and/or if other countries implement similar measures. Failure to decarbonize could expose the country to rising costs, reduced access to global supply chains and foreign investment, and the possibility of stranded assets in some carbon-intensive industries.

Although Thailand is not a major global emitter, meeting the targets of carbon neutrality by 2050 and net zero emissions by 2065 will pose significant challenges. The country remains heavily reliant on fossil fuels, particularly for power generation, transport, and heavy industry, and transitioning to cleaner energy sources will require structural reforms in key sectors and substantial investment in renewable infrastructure, grid modernization, and energy efficiency. Introducing an effective carbon pricing mechanism will be an important part of this transition. A well-designed carbon price would prompt firms to internalize the environmental costs of emissions, shift investment and consumption patterns, and generate revenue to support green innovation and a just transition. However, a carbon price on its own will be insufficient on its own to lead to transformational change, in the absence of other reforms and investments as set out in Chapter 4.

Finally, Thailand's export-driven growth model faces mounting pressures and will likely falter unless the country takes decisive steps to mitigate emerging risks and seize new opportunities. Historically, Thailand's impressive growth and poverty reduction have been closely linked to its success in expanding manufactured goods and tourism exports. However, export growth has slowed in recent years, and the global trade landscape has become increasingly uncertain, marked by rising protectionism, fragmented trade rules, and the restructuring of global supply chains—all of which threaten Thailand's market access and competitiveness. Compounding these challenges, the post-pandemic acceleration of disruptive technologies—including green technologies—is reshaping global production and trade dynamics. Thailand's traditional export model, which has relied on low-cost labor and integration into established supply chains, is increasingly vulnerable in this shifting context. While these global shifts also present opportunities, particularly in high-value-added sectors such as electric vehicles, solar modules, and energy-efficient cooling technologies, Thailand faces several structural constraints which prevent it from fully capitalizing. These include persistent skills mismatches, restrictive regulations that inhibit innovation and market entry, and limited domestic competition that stifles productivity growth. Addressing these issues will be critical to ensuring that Thailand can adapt its export model and thrive in a more sustainability-focused and technologically advanced global economy.

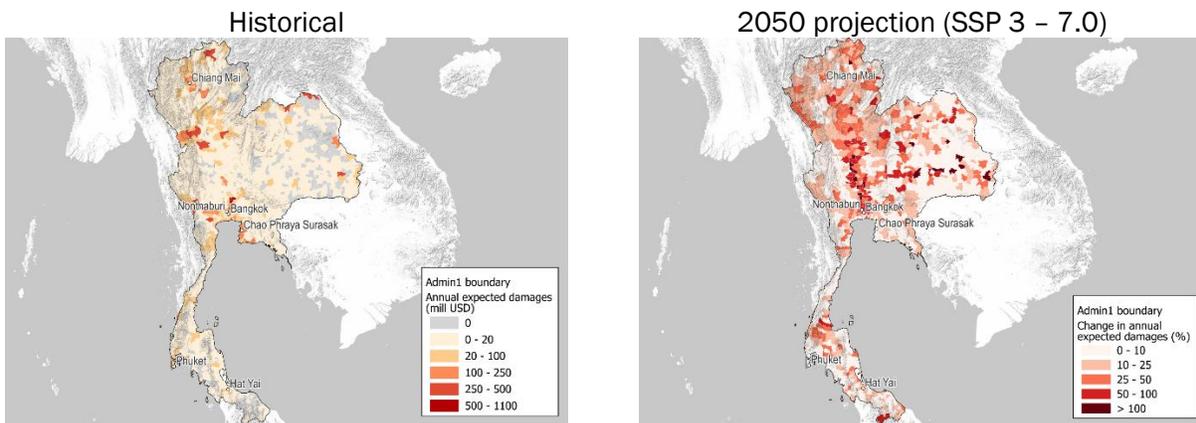
In the face of these challenges, Thailand aspires to become a resilient, green, and high-income economy—an ambition that lies at the heart of this report. The country aims to achieve high-income status by 2037, guided by the principles of security, prosperity, and sustainability outlined in its 20-year National Strategy. Attaining this goal will require sustained annual GDP growth of approximately 5 percent over the next 13 years—nearly double the average growth rate of 2.6 percent recorded since 2010. Supporting this ambition is Thailand's "4.0" vision, which emphasizes innovation and the transition to a Bio-Circular-Green (BCG) economic model. This approach focuses on producing higher value-added goods and services, reducing resource intensity, and safeguarding natural capital. In parallel, Thailand has committed to achieving carbon neutrality by 2050 and net zero greenhouse gas emissions by 2065, contributing to global climate goals while seeking to unlock new drivers of sustainable growth.³

³ Achieving net-zero involves eliminating or offsetting all greenhouse gas emissions, both carbon (carbon dioxide) and non-carbon (including methane, nitrous oxide, and F gases).

2.2 The physical impacts of climate change on development

Floods are the greatest natural hazard facing Thailand in terms of economic and human impacts. Thailand is one of the ten most flood-prone countries in the world. Riverine floods occur nearly every year, during the latter part of the monsoon season (July to October), most prominently in the central floodplains along the Chao Phraya basin, which includes many agricultural and urban areas. As a particularly devastating example, in mid-2011 monsoon rains triggered by tropical storms caused flooding in the northern, north-eastern and central regions along the Mekong, Mun, Chi, and Chao Phraya basins, affecting 13.6 million people in 65 provinces, causing 815 deaths, and resulting in property damages worth an estimated 12.6 percent of GDP. Flooding incidence across Thailand is likely to increase because of climate change, with higher frequency of intense rainfall events contributing to riverbank overflow, flash floods in urban areas and landslides and flash floods in mountain areas (Figure 2.1). Compared to 2010, climate change has been projected to increase the number of people affected by floods by a factor of 2.5 for the period 2035 to 2044.⁴ Previous estimates have suggested that under a high-emission scenario, the economic impact (as a share of GDP) of a 1-in-50-year flood in the early 2030s would be double that of the 2011 floods.

Figure 2.1: Change in annual expected damages from inland flooding



Source: Modeling conducted for this CDDR by Industrial Economics, Incorporated (IEC)

A combination of sea level rise and changing weather patterns could further accelerate coastal flooding and erosion. Current coastal flooding damages concentrate in the coastal urban areas around the Bay of Bangkok, as well as in Phuket, with limited damages elsewhere along Thailand's coastline. By 2050, most areas exposed to coastal flooding in the historical period will see increases in damages from future storm surges (Figure 2.2), although the effects of sea level rise (at around 0.2 meters) are expected to have only limited impacts over this period.⁵ Coastal erosion also threatens Thai beaches. Although several flood and coastal erosion protection measures have since been implemented in Bangkok, they have often ended up diverting water to neighboring areas and increasing their vulnerability.

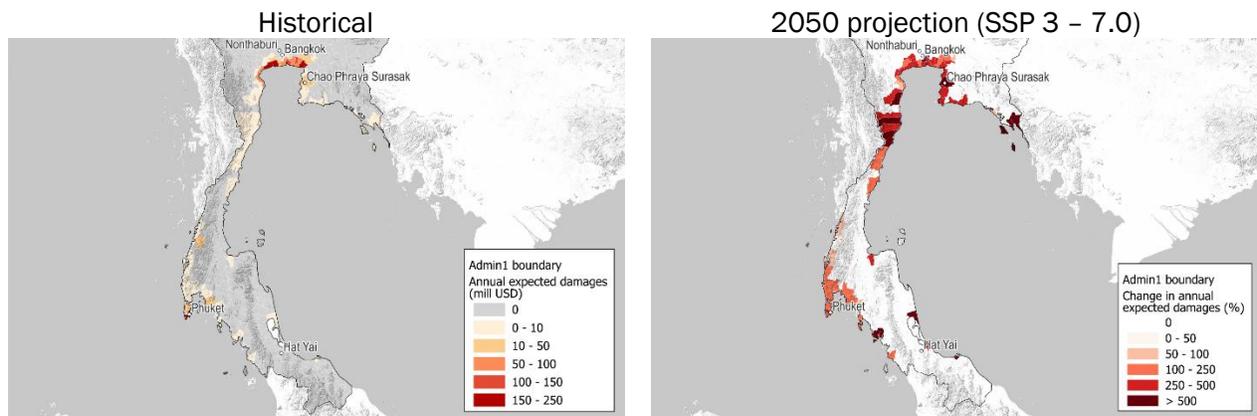
Bangkok and the Upper Gulf of Thailand, where population and economic activity are concentrated, remain especially vulnerable to flooding. Over 14 million people (about 22 percent of the total population) live within the Greater Bangkok area, which contributes close to half of Thailand's GDP. Bangkok is less than 2 meters above sea level and is sinking because of excessive underground water use and the weight of large-scale high-rise development. The combination of rising seas and sinking land means Bangkok is vulnerable to risks of flooding, storm surges, and permanent water incursion that are likely to worsen with climate change. Bangkok and the Upper Gulf of Thailand have already suffered six major flooding events

⁴ The number of people affected by an extreme river flood could grow by over 2 million by 2035–2044, and coastal flooding could affect a further 2.4 million people by 2070–2100.

⁵ More significant effects from sea-level rise are expected by the end of the century, with the median sea levels projected to increase by about 0.6 or 0.7 meters depending on the climate scenario.

since 1980, despite the introduction of flood control measures. A 2019 study indicated that parts of Bangkok could be unviable by 2050 with much of the area at risk of lying under water.

Figure 2.2: Change in annual expected damages from coastal flooding



Source: Modeling conducted for this CCDR by Industrial Economics, Incorporated (IEC)

Drought is another major hazard which will intensify further with climate change, exacerbating existing concerns about water security across large parts of Thailand. Changes in weather patterns are increasing the frequency of droughts and exacerbating water shortages in agricultural areas, including the north and north-eastern provinces. As one of the world’s largest rice exporters, Thailand’s agricultural sector demands vast amounts of water for irrigation. Traditional rice farming methods, which rely heavily on flooding fields, exacerbate this problem. This practice not only depletes local water resources but also leaves them susceptible to climate variability, such as prolonged dry seasons and unpredictable rainfall patterns. Industrial activity is also being affected by water supply constraints, including in the Eastern Economic Corridor. Competition for water between agricultural needs and other sectors – including urban and industrial use – is increasing.

Heat stress resulting from climate change poses a significant threat to labor productivity in Thailand by increasing average workday temperatures and reducing the number of hours individuals can safely and effectively work. Among macroeconomic sectors, agriculture is projected to experience the most severe productivity losses due to elevated temperatures between 2041 and 2050, followed by industry and services. Across all sectors, informal workers will likely be particularly vulnerable. The impact will be most pronounced in the south-central provinces—including Bangkok, Pathum Thani, Samut Prakan, and Phra Nakhon Si Ayutthaya—where labor-intensive activities are concentrated and temperatures are expected to rise sharply. Beyond productivity, climate change will also have serious public health implications. By mid-century, the incidence of waterborne diseases is projected to increase by 7 to 15 percent, while the incidence and mortality rates from heat-related illnesses could more than double. More than two million people in Bangkok—and several hundred thousand more in other densely populated urban centers across the Chao Phraya basin—are already exposed annually to severe heat stress. These findings underscore the urgent need for adaptive measures to protect both livelihoods and public health in the face of escalating climate risks.⁶

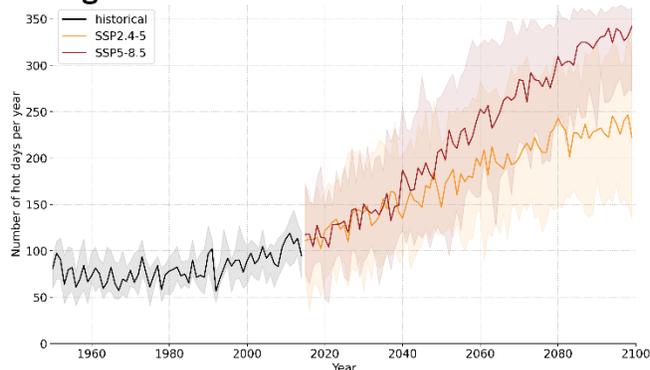
Bangkok, already accustomed to a tropical climate, is now facing prolonged periods of extreme heat that put vulnerable populations—such as the elderly, children, and outdoor workers—at heightened risk. The Urban Heat Island (UHI) effect exacerbates this crisis, turning built-up areas into heat traps while straining infrastructure, energy demand, and economic productivity.⁷ Due to the UHI effect, some Bangkok

⁶ Mani, M. & Pollitt, H. (2024) “Towards a Green and Resilient Thailand” (September), World Bank, Washington, DC.

⁷ The UHI effect is driven by replacing the natural landscape with man-made materials and structures – such as asphalt roads and steel buildings – that absorb and radiate heat. With less tree and vegetation cover, cooling from the evaporation of water held in the leaves of plants is also reduced. Abundant high-rise buildings in Bangkok also mean that heat from the built environment and from sources such as car engines, motors and air-conditioning units is often trapped between buildings.

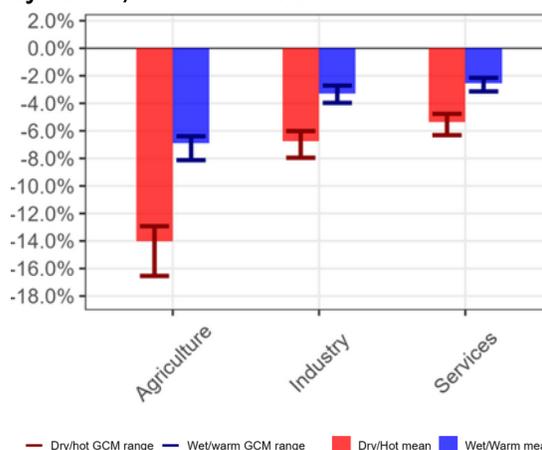
neighborhoods can be 2–3°C hotter on average than surrounding rural zones, with nighttime temperatures in certain spots surging to 6°C higher. Demographic data indicate that vulnerable groups—particularly the elderly, children, and those working outdoors—cluster in the hardest-hit areas. Economic estimates from the World Bank’s Urban Heat report reveal that each additional degree Celsius could cost Bangkok between THB 85 billion to THB 123 billion—an equivalent to 1.6 and 2 percent of its GDP in 2019—in heat-related mortality, lost productivity, and higher energy consumption.⁸

Figure 2.3: Projected number of dangerously hot days in Bangkok



Source: World Bank analysis based on NASA Earth Exchange Global Daily Downscaled Projections (NEX-GDDP-CMIP6, Trasher et al., 2022).

Figure 2.4: Projected labor productivity shocks by sector, 2041 – 2050



Source: Modeling conducted for this CCDR by Industrial Economics, Incorporated (IEC)

Taking a sectoral perspective of the economic effects of climate changes, projections suggest that Thailand’s agriculture and fishing sectors could face significant impacts. Agriculture (which accounts for about 8 percent of GDP but around a third of all employment) is vulnerable to the labor productivity impacts of heat stress, and the impacts of droughts and water shortages, with highly water-intensive rice production especially susceptible as noted above. Rising temperatures, unpredictable rainfall patterns, and extreme weather events are already impacting other major agricultural commodities, including sugarcane, maize, livestock, and aquaculture. Water scarcity affects 58 percent of farmers, and only 26 percent have irrigation. Soil fertility is declining, and pesticide use is among the region’s highest. Antimicrobial use in livestock is the world’s highest, with central Thailand identified as a global hotspot. The rural poor in the North and Northeast, who rely on rainfed subsistence farming, face particular inequities in resource access, low labor productivity, and an aging population. Heat stress will also affect the oceans and losses from fishing are projected to be substantial in all climate scenarios, exceeding those from agriculture.

Manufacturing faces particular risks due to the concentration of industrial activity in areas which are exposed to flooding and urban heat effects. The manufacturing of goods for export is concentrated in and around Bangkok and is vulnerable to urban flooding; 70 per cent of the recorded damages and losses from the 2011 floods were attributed to the manufacturing sector, mainly from flooding in industrial estates in Ayutthaya and Pathum Thani. Even in indoor jobs, rising heat has been shown to increase workers’ absenteeism and worsen their health and productivity, while the costs (and electricity needs) of cooling buildings across a range of economic sectors are likely to increase substantially.

Water supply constraints in manufacturing are also likely to worsen with climate change. Covering an area of ~13,000 km² in the provinces of Rayong, Chonburi, and Chachoengsao, the Eastern Economic Corridor

⁸ See Rubinyi, Steven, Putu Sanjiwacika Wibisana, Jane Park, Nicholas K.W. Jones, Juan A. Acero, and Pichaya Moeller. 2025. *Shaping a Cooler Bangkok: Tackling Urban Heat for a More Livable City (English)*. Washington, DC. The World Bank.

(EEC) serves as a critical production base for advanced industries including petrochemicals, automotives, and smart electronics, accounting for approximately 15 percent of Thailand's GDP in 2022, and is already affected by water shortages. Current water infrastructure is inadequate to cope with peak demand during the dry season, leading to critical shortages that affect not only the industrial sector but also public utilities, tourism businesses and ecological systems. Currently only around half of water demand is being met, and in 2037 the deficit is projected to remain high at about 40 percent even with planned investments in water supply. Water security for the EEC cannot be achieved by supply augmentation alone. However, the international experience suggests that with investments in circularity and measures to increase the efficiency of water use, it is possible to reduce the supply gap and effectively decouple water demand from economic growth in the EEC.

Tourism is a vital pillar of Thailand's economy, contributing nearly one-fifth of GDP prior to the COVID-19 pandemic. While the pandemic dealt a severe blow to the sector, international arrivals have since recovered. However, the sector faces mounting longer-term risks from climate change, particularly given the concentration of tourism clusters along Thailand's coastlines. Tourism operators are increasingly vulnerable to coastal erosion, flooding, and other climate-related hazards (including air pollution) that can damage critical infrastructure, cultural heritage sites, and tourism assets, disrupt transport access, and compromise visitor health and safety.

Recent inland flooding in northern tourist provinces such as Chiang Mai has also negatively impacted visitor arrivals and revenue, highlighting that the risks extend beyond the coast. Left unaddressed, these climate impacts may erode Thailand's reputation as a safe and attractive tourist destination, with potential long-term consequences for the sector. While zoning regulations have been introduced in some locations to restrict the construction of new tourism infrastructure in high-risk areas, enforcement has often been inconsistent or weak. Moreover, rising temperatures could diminish visitor comfort, shift peak tourism seasons, and reduce overall competitiveness, while increasing reliance on air conditioning will drive up operational costs for tourism businesses. To safeguard this critical sector, Thailand will need to strengthen climate resilience planning, improve enforcement of risk-informed zoning policies, and support sustainable tourism practices.

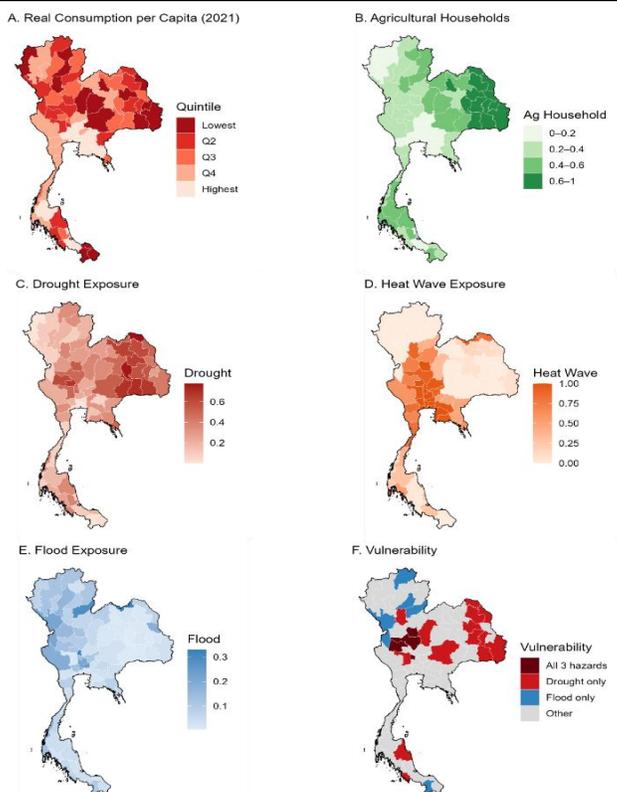
Moreover, warmer water temperatures and acidification are already affecting coral reefs and marine ecosystems. As one example, after finding that 50-70 percent of the coral had experienced bleaching caused by rising sea temperatures, Thailand's Department of National Parks, Wildlife, and Plant Conservation closed 12 marine national parks to allow coral reefs to recover to their usual condition. Increased water temperatures can therefore have major economic implications for those destinations that depend on marine ecosystems and marine tourism.

Thailand's low-income populations are particularly exposed to the physical risks of climate change. Provinces such as Nakhon Ratchasima, Nakhon Sawan, and Khon Kaen face a combination of high vulnerability to both floods and drought, and high physical risk (Figure 2.5). Together with Bangkok, Nakhon Ratchasima also faces very high heat risks. Samut Sakhon stands out in terms of its exposure to risks from coastal erosion, along with Samut Prakan and Chachoengsao. These regions are not only facing immediate risks to their coastlines but also potential long-term impacts on local economies reliant on coastal and marine resources. Populations in these areas are characterized by lower income and employment levels, high dependency ratios, and weaker community response systems, as well as a lack of infrastructure, education, and healthcare which compounds these challenges. A relatively high proportion of individuals engage in agriculture and fishery sectors, which are particularly sensitive to heat and drought conditions.

The heightened impacts of natural disasters on the most vulnerable were illustrated in the aftermath of the 2011 floods. Households across income distribution were affected, but the impacts were relatively larger for poorer households. Richer households primarily faced losses in business incomes and were able to build back more quickly in subsequent years. Poorer households were most affected due to losses in agricultural incomes and were slower rebuilding their homes and livelihoods. Government

compensation was not only inadequate to cover the full extent of these losses but also ended up benefiting relatively richer households rather than the poor (Noy, Nguyen and Patel 2019).⁹

Figure 2.5: Climate hazard exposure and vulnerability across Thailand



Source: Doan et al (2024)

Note: Hazard exposure is measured as the share of population likely to be affected by 20-year return period event, with separate estimates for drought, heatwave and flood risks as described in Doan et al (2024).¹⁰ A province is classified as vulnerable if it is in the bottom 40 percent of the average per capita consumption distribution and top 40 percent in terms of exposure to a given hazard.

Inequalities in household welfare are also linked to security of water access. Historically, higher rainfall is positively associated with the average level of welfare, as measured by household consumption expenditures, and negatively associated with poverty and a variety of measures of inequality in the country. More frequent and more intense shortages of rainfall will decrease welfare and increase inequality at the national level and in both urban and rural areas. While social assistance can ameliorate some of these effects, at present there is considerable variation in the extent to which access to social benefit and credit programs mitigate the negative impacts of rainfall shortages on welfare.

2.3 The development challenge of emissions reduction

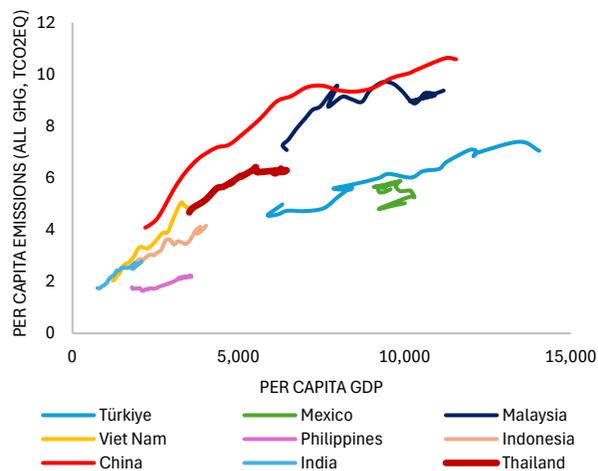
Thailand is not a large emitter of greenhouse gas emissions in global terms. In 2022, Thailand accounted for 0.88 percent of global greenhouse gas (GHG) emissions, ranking as the world’s 20th largest emitter. Emissions per capita are well below the global average but are higher than those in several other ASEAN

⁹ Noy, Ilan; Nguyen, Cuong; Patel, Pooja (2019), “Floods and spillovers: households after the 2011 great flood in Thailand”, CESifo Working Paper, No. 7644, Center for Economic Studies and ifo Institute (CESifo), Munich.

¹⁰ Doan, Miki Khanh; Hill, Ruth; Hallegatte, Stephane; Corral Rodas, Paul Andres; Brunckhorst, Ben James; Nguyen, Minh; Freije-Rodriguez, Samuel; Naikal, Esther G. (2024). “Counting People Exposed to, Vulnerable to, or at High Risk From Climate Shocks – A Methodology”. Policy Research Working Paper; no. WPS 10619 Washington, D.C: World Bank.

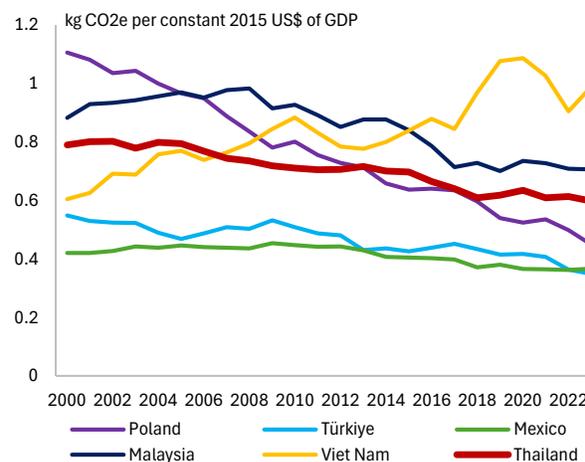
countries (Figure 2.6). Conversely, Thailand’s GHG intensity of production (i.e. emissions per unit of GDP) is below ASEAN competitors but above the global average (Figure 2.7).

Figure 2.6: Per Capita GDP (constant 2015 US\$) vs. Per capita Emissions (2000-2022)



Source: EDGAR and World Development Indicators

Figure 2.7: Carbon intensity of GDP (kg CO2e per constant 2015 US\$ of GDP)



Source: World Development Indicators

There have been some signs that GDP growth is decoupling from GHG emissions, but achieving carbon neutrality and net zero will require substantial investments and policy effort. Between 2010 and 2022, real GDP per capita increased by 1.8 percent per year on average, while GHG emissions from all sources were flat and GHG emissions from energy increased by an average of 0.7 percent (Figure 2.8). But substantial work remains to be done to achieve carbon neutrality and net zero objectives, with emissions not yet declining as they have in many high-income countries. These international commitments to reduce emissions will not be met in the absence of further policy reforms and investments.

Table 2.1: Measures of Thailand’s carbon footprint

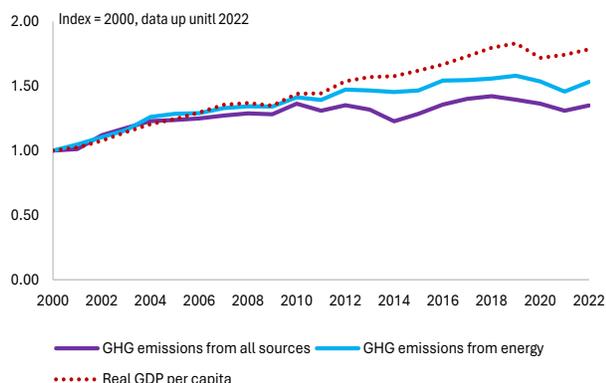
Country	GHG EMISSIONS PER CAPITA (tCO2e per capita)	CARBON INTENSITY (tCO2e per USD million of GDP)	TOTAL GHG EMISSIONS (MtCO2e)	ANNUAL GHG EMISSIONS GROWTH RATE (% between 2011 and 2021)
China	9.1	718	12792	2.22
Viet Nam	4.6	1247	457	6.45
Cambodia	4.5	2091	77	-2.73
Indonesia	5.4	1251	1485	-1.03
Philippines	2.1	603	238	3.91
Thailand	6.3	888	450	2.12
USA	16.8	235	5565	-0.44

Sources: ClimateWatch, WDI, World Bank analysis.

Industry, power, transport, and agriculture account for most of Thailand’s GHG emissions. In 2022, the energy sector was responsible for approximately two-thirds of Thailand’s total greenhouse gas emissions, with most of these emissions stemming from electricity generation, transport, and manufacturing activities (see Figures 1.8 and 1.9). Energy emissions grew gradually between 2000 and the mid-2010s, before stabilizing. Agriculture accounted for 18 percent of emissions, while industrial processes contributed around 10 percent: both these shares have remained broadly stable over time. Within the power sector, carbon dioxide (CO₂) represents the predominant greenhouse gas emitted, whereas agricultural emissions are primarily composed of methane (CH₄) and nitrous oxide (N₂O). Industrial

emissions include a rising share of fluorinated gases (F-gases), which are potent greenhouse gases with significant warming potential.

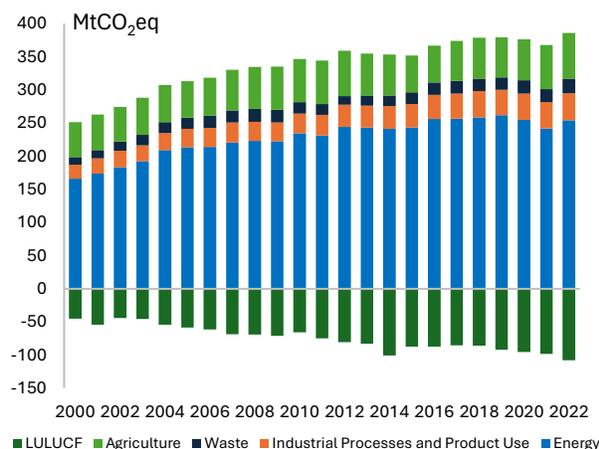
Figure 2.8: GHG emissions and GDP per capita



Source: Thailand. 2024 Biennial Transparency Report (BTR) and World Development Indicators

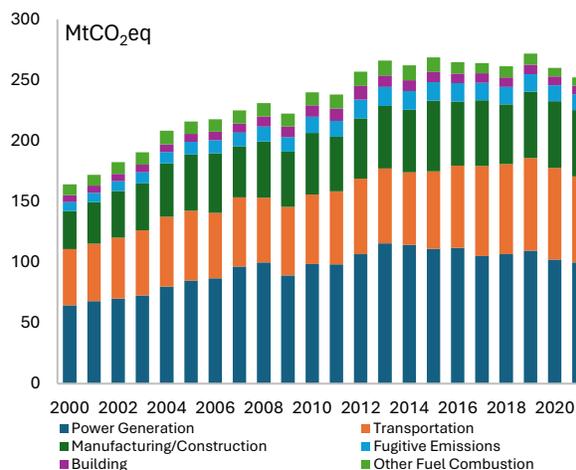
Thailand’s energy consumption and supply relies heavily on petroleum products, driven mainly by the industrial and transportation sectors. The largest user of energy is the transport sector (28 percent), followed by the industrial sector (22 percent), largely manufacturing. Oil is the major energy source (42 percent of total), with transportation and industry as main consumers. Other non-renewable sources of energy consist of natural gas and coal, specifically for electricity production. Renewable energy sources accounted for 18 percent of total energy supply, with biofuels and waste representing by far the largest share, accounting for about 95 percent of renewable energy sources. Biofuel and solar PV have increased their share of electricity production in Thailand in recent years, but starting from very low levels.

Figure 2.9: Trend of national GHG emissions/removals by sector



Source: Thailand 2024 BTR

Figure 2.10: Energy emissions by sector



Source: Climate Watch

The manufacturing sector is more emissions intensive than other sectors in Thailand but less emission intensive than the manufacturing sector of most of Thailand’s peers. That said, the manufacturing sector in Thailand remains 26.5 percent more emission intensive than the manufacturing sector in the EU, despite being 7.5 percent less energy intensive. As Chapter 4 shows, there are large differences in emission intensity across manufacturing subsectors in Thailand, and among manufacturing firms even within the same subsector. Moreover, emissions are highly concentrated among a relatively small number of firms, with the top 1 percent of firms responsible for more than three quarters of emissions from the sector.

Agriculture is a large source of GHG emissions in Thailand, with rice farming and livestock contributing significantly. Around half of agricultural emissions are contributed by rice farming and another quarter by the livestock sector. Rice fields are a significant source of methane emissions, primarily due to the anaerobic decomposition of organic matter in flooded paddies. Swine and poultry farms generate methane emissions from manure decomposition and carbon emissions from energy use, while ruminants (cattle, sheep, and goats) produce significant methane and nitrous oxide emissions through enteric fermentation and manure management. The burning of agriculture residues is a major contributor to carbon dioxide and black carbon emissions, impacting air quality and climate. It is estimated that biomass burning contributes to 25 percent of atmospheric particulate matter (PM_{2.5}) in the Bangkok Metropolitan Region, which rises to 35 percent in dry season. Accounting for the entire agrifood supply chain, from on-farm production to processing and sale, Thailand is the second largest agrifood emitter in Southeast Asia, after Indonesia.

Deforestation and land conversion, especially for agricultural expansion, are the primary drivers of emissions in the Land Use, Land Use Change, and Forestry (LULUCF) sector. Forested areas are often cleared to make way for rubber plantations and other commercial crops, releasing carbon stored in trees and soil. Additionally, degradation from illegal logging, forest fires, and infrastructure development exacerbates carbon release. Poor land management practices, including insufficient reforestation efforts, hinder the natural carbon sequestration potential of forests. At sea, mangrove forests have been cleared for shrimp farming, with the pollution from these farms causing further damage. Thailand's LT-LEDS aims to increase annual net emission removals from the sector from 90 to 120 mtCO₂e/year by 2050, which would offset more than 25 percent of current GHG emissions and would be a key factor in bringing emissions towards net-zero in the second half of the century.

To meet the LT-LEDS target, around 40 percent of Thailand's land mass would need to be covered by forest. But the overall share of forested land in Thailand is decreasing. In 2020, forests covered 31.6 percent of Thailand's land mass, down from a corresponding share of 33.4 percent in 2008. Despite efforts by several agencies in Thailand to promote reforestation, satellite images show that the level of forest coverage is decreasing by around 0.3 percent per year. Some forests have been degraded because of natural forest fires. However, the main reasons for deforestation are human encroachment and illegal logging.

Beyond their primary goal of reducing greenhouse gas emissions, climate mitigation measures offer a range of important co-benefits that can enhance economic, social, and environmental outcomes. For instance, improving energy efficiency and accelerating the transition to renewable energy sources will not only curb emissions but can also significantly lower energy costs over the medium to long term. This shift reduces Thailand's reliance on imported fossil fuels, thereby enhancing national energy security and buffering the economy against volatile global energy markets and price shocks. While the upfront capital investment required to deploy renewable technologies and upgrade infrastructure can be substantial, the rapidly declining costs of renewables—combined with the inclusion of environmental externalities such as air pollution and carbon emissions—are making clean energy increasingly cost-competitive compared to conventional fossil fuels. This evolving economics creates a compelling case for accelerated deployment, particularly as renewables also tend to have lower operating and maintenance costs.

Reducing emissions will also be important to secure Thailand's position in greener global value chains (GVCs). In pursuit of their own climate goals, surveys suggest that a majority of multinational corporations (MNCs) plan to exclude high-carbon producers from their supply chains (see Chapter 4). Carbon pricing and other decarbonization measures could help to shield Thailand's economy from the associated risks to trade. They could also help Thailand adapt to international trade policy measures such as the EU's CBAM, and reduce risks associated with the potential implementation of similar measures by other countries. As discussed in Chapter 4, the impacts on Thailand of the CBAM in its current form are likely to be limited outside the carbon-intensive plastics sector. Nevertheless, an expansion of CBAM to encompass other products or the adoption of CBAM-like mechanisms by other countries would have more significant impacts on Thailand in the absence of measures to decarbonize.

2.4 Climate commitments and plans

Thailand has made a range of climate commitments, captured in various plans and policy statements, which demonstrate its recognition of the need to act on climate change given the risks outlined above. The Climate Change Master Plan 2015-2050 provides a long-term national framework for climate change adaptation and the promotion of low carbon growth in line with sustainable development principles. In line with the global commitments made by countries under the Paris Agreement, Thailand submitted a Long-Term Low Greenhouse Gas Emission Development Strategy (LT-LEDS) to the UNFCCC in 2021, which was subsequently updated in 2022 – together with a second updated Nationally Determined Contribution (NDC) – to target a reduction in GHG emissions of 30 to 40 percent from business-as-usual levels by 2030.¹¹ This is an intermediate step towards meeting Thailand’s overall objectives of carbon neutrality by 2050 and net zero greenhouse gas emissions by 2065.

A range of plans for the power and transport sectors are linked with Thailand's net-zero emissions goal. These include the National Energy Plan (which supports these targets and outlines pathways for decarbonizing the energy sector), Power Development Plan, Alternative Energy Development Plan, and Energy Efficiency Plan. These plans set specific targets for renewable power generation (50 percent of total generation by 2050, with the recently updated draft PDP 2024 targeting 90 percent) and energy intensity (30 percent reduction from 2010 levels by 2037). Thailand has also set ambitious targets for the sale and production of electric passenger cars and light commercial vehicles.

The National Committee on Climate Change Policy (NCCC), chaired by the Prime Minister, was set up in 2007 to coordinate climate change efforts across various ministries to meet UNFCCC commitments. The NCCC is responsible for defining national climate policies and devising implementation mechanisms. The NCCC includes members from both the public and private sectors, as well as experts from relevant agencies, and comprises nine subcommittees. Among the NCCC’s key decisions was the approval of the updated Nationally Determined Contribution (NDC) in 2022. More recently, the NCCC approved the principles of the draft Climate Change Act in December 2024 and instructed the Ministry of Natural Resources and Environment to expedite the submission of the draft bill to the Cabinet.

The Ministry of Natural Resources and Environment (MONRE) oversees climate change initiatives in Thailand. Within MONRE, the Office of Natural Resources and Environmental Policy and Planning (ONEP) has been the National Focal Point (NFP) for the UNFCCC since 1995, coordinating Thailand’s climate change efforts. In August 2023, the Government created a new Department of Climate Change and Environment (DCCE) as the central coordination body for Thailand under the United Nations Framework Convention on Climate Change (UNFCCC). As a relatively new agency within MONRE, DCCE is in the process of building up its technical capacity, supported by an expanding budget allocation. DCCE's current remit is largely confined to policy recommendations and coordination with other institutional stakeholders. It lacks legal power to mandate actions (especially information sharing and reporting) by public sector agencies as well as regulated private sector entities. This is expected to change once the Climate Change Act is enacted and assigns additional roles and powers to DCCE.¹²

The Climate Change Act will provide an overarching legal framework for carbon pricing and Thailand’s emissions reduction efforts (Box 2.1). The draft bill is under review and is expected to be approved by 2026.

¹¹ The higher target (40 percent) is contingent upon enhanced access to technology development and transfer, financial resources, and capacity-building support. Thailand’s NDC 3.0 will shift to an absolute emissions reduction target for 2035.

¹² DCCE will have to operationalize the new climate mitigation instruments, offer technical support to sub-national government entities as well as sectoral ministries/departments on both climate mitigation and adaptation fronts, and supervise and regulate the domestic carbon markets, among other new responsibilities.

Box 2.1: Thailand's Climate Change Act

The draft bill has been assessed against the World Bank's key legislative criteria for effective climate governance.¹³ The assessment covers 12 critical elements, highlighting strengths and gaps in Thailand's framework for mitigating and adapting to climate change. Overall, Thailand's current draft CCA provides a strong foundation for climate governance, with clear targets, policy tools, and institutional structures. The framework aligns with international standards but could benefit from stronger accountability and subnational support. Gaps remain in parliamentary oversight, independent review mechanisms, and explicit 2030 targets.

Targets: The bill requires the country's climate change goals to be integrated into the missions of government agencies, as well as sector-specific targets, action plans and measures that align with the national objectives. The bill mandates the production of a national climate change master plan, to be updated every 5 years (or sooner, if necessary), that includes greenhouse gas emission scenarios, greenhouse gas reduction targets, and adaptation measures, including implementation guidelines and monitoring.

Instruments: The bill proposes several policy instruments to support GHG reduction. These include:

- A carbon tax
- An emission trading system (ETS), to be applied to industries based on their carbon intensity.
- A regulatory framework for carbon credits, which inter alia sets out licensing requirements for carbon credit businesses, certification services, and trading centers.
- A Carbon Border Adjustment Mechanism (CBAM)
- A Climate Change Fund to finance activities related to GHG reduction, climate change adaptation, and climate research and development, and funded with revenues from the ETS, CBAM, and other sources including government subsidies.
- The bill also mandates GHG reporting and establishes a national GHG database to track the quantity of GHG emissions from human activities, sequestration, and reduction efforts.

While a hybrid ETS/carbon tax system is envisaged, it remains unclear which sectors will be subject to which system and how the interactions between the ETS and the carbon tax will be managed.

Institutions: The bill mandates a high-level committee (essentially the existing National Climate Change Policy Committee) to oversee and coordinate the government's climate actions. It tasks DCCE to operationalize the new climate mitigation policy tools listed above by, inter alia, establishing necessary databases (e.g., GHG inventory) and registries (e.g., CBAM, ETS, carbon credits), monitoring and reporting on implementation progress (e.g., National Climate Change Master Plan, National Climate Adaptation Plan); and supervising/regulating carbon trading markets, adjudicating any appeal from regulated entities, and resolving any inconsistency between the Master Plan, the GHG Reduction Plan, etc., and sectoral plans/actions.

Through public consultations, some segments of the private sector, especially small and medium enterprises, have raised concerns about the cost of GHG reductions and the associated investments to make their operations less carbon intensive.¹⁴

Critical Elements	Assessment
1. Long-Term Targets	<ul style="list-style-type: none">• The CCA identifies targets of carbon neutrality by 2050 and net-zero GHG emissions by 2065, as well as high-level adaptation objectives.
2. Intermediate & Sectoral Targets	<ul style="list-style-type: none">• No explicit 2030 target in the CCA, but Thailand's NDC commits to 30–40 percent emissions reduction (BAU) by 2030.• Requires sectoral action plans, budgets, and alignment with national goals.• Given the proliferation of plans and strategies, the bill could play a role in streamlining the “policy ecosystem”, specifying the minimum necessary plans and strategies within a clear hierarchy and relationships among them.

¹³ The draft bill is as of November 2024, Public Hearing Version. See also World Bank (2023), [Reference Guide to Climate Change Framework Legislation](#).

¹⁴ See <https://enviliance.com/regions/southeast-asia/th/th-climate-change-act-draft>.

Box 2.1: Thailand's Climate Change Act	
3. Risk & Vulnerability Assessments	<ul style="list-style-type: none"> Mandates periodic climate risk assessments (water, agriculture, health, etc.) and public dissemination.
4. Climate Strategies & Plans	<ul style="list-style-type: none"> Requires a National Climate Change Master Plan (updated every 5 years) and sectoral GHG reduction plans and adaptation plans.
5. Policy Instruments	<ul style="list-style-type: none"> Comprehensive tools: ETS, carbon tax, carbon credits, CBAM. Few details on the sectoral coverage of the ETS and carbon tax or the management of interactions between these instruments.
6. Independent Expert Advice	<ul style="list-style-type: none"> A National Climate Change Policy Committee (with private sector and civil society reps) provides expertise, but no formal requirement for government response to advice. The bill could be strengthened by mandating an independent advisory body (as opposed to minority representation of non-governmental actors in an otherwise government-led committee as proposed) to institutionalize use of scientific advice in climate policy-making and implementation.
7. Coordination Mechanism	<ul style="list-style-type: none"> The Department of Climate Change and Environment (DCCE) leads implementation, with oversight from a Prime Minister-chaired Committee. Subnational governments must develop Provincial Action Plans.
8. Stakeholder Engagement	<ul style="list-style-type: none"> Mandates public consultations for climate plans and includes private sector/civil society in policymaking.
9. Subnational Governance	<ul style="list-style-type: none"> Requires local adaptation plans and allows provinces to request support for climate action.
10 Financing Implementation	<ul style="list-style-type: none"> Establishes a Climate Fund (from carbon pricing, donations, etc.) but lacks direct integration of climate risks into national budgeting.
11. Measurement & Reporting	<ul style="list-style-type: none"> DCCE collects and publishes GHG and climate risk data, with mandatory reporting for key sectors.
12. Oversight	<ul style="list-style-type: none"> Cabinet oversight (not Parliament) of climate plans; no independent progress assessments.

Thailand's National Adaptation Plan (NAP) was updated in 2023. This plan addresses climate impacts and enhanced resilience across six sectors: water resources management, agriculture and food security, tourism, public health, natural resources management, and human settlements and security. It specifies institutional responsibilities for implementation, as well as the monitoring and evaluation framework including targets and indicators. In addition, measures are being implemented to manage natural disasters, including the development of early warning systems and strategies for managing contingent liabilities. Under the NCCC, the Subcommittee on Climate Change Policy and Planning Integration provides expert guidance on integrating mitigation and adaptation into national strategies, recommends legal and financial measures, and advocates for coordinated budget allocation.

Institutional fragmentation poses challenges for climate adaptation in Thailand. Several sectoral ministries and agencies which need to incorporate climate adaptation into their policies and operations suffer from technical capacity deficits and struggle to manage climate adaptation against other competing priorities. Some actions are constrained by legal, financial, or knowledge constraints. Progress has been made to improve policy coordination and oversight – e.g. in the water sector; see Box 2.2 – but more needs to be done to clearly define roles and responsibilities across ministries and agencies and ensure that climate actions are appropriately prioritized.

Box 2.2: Strengthening coordination and oversight of water resource management

With the adoption of the Water Resources Act in 2018 and the creation of ONWR in 2017, the Government of Thailand implemented long-standing policy recommendations aimed at increasing coordination among ministries and departments responsible for water resources management. More than 30 ministries and departments are responsible for water resources management, leading to a scattered institutional landscape, unclear mandates and overlapping responsibilities. Prior to the establishment of ONWR, Thailand lacked an effective policy coordination and oversight body to guide water resources management. This often resulted in a series of sector plans or fragmented strategies without effective coordination (ADB, 2015). ONWR was created with the mandates of formulating water management policies, developing strategic plans and master plans, integrating information and projects, scrutinizing projects and budgets, and monitoring and evaluating water resource management. ONWR also has an important role as the Secretariat of the Thai National Mekong Committee, which serves as Thailand's main coordinating body for transboundary water cooperation.

The institutional reform process that started with the establishment of ONWR now needs to be further advanced. For example, the current protocols for inter-agency co-ordination during flood emergencies are inadequate and should be improved, including through development of Standard Operating Procedures. Building upon the coordinating role of ONWR, more clearly defined roles and responsibilities among the related agencies regarding operation of infrastructure, data integration, communication, planning and response are critical.

Key issues that are yet to be addressed include (i) strengthening of early warning communication with the public and affected communities, (ii) enhancing coordination among government departments in the context of preparedness and response, (iii) strengthening land management and flood zoning, (iv) preparing comprehensive risk reduction and contingency planning tools, (v) strengthening hydraulic modelling, data management, and data integration, (vi) dissemination of risk information, and (vii) enabling community driven disaster prevention. While Thailand has robust hydrometeorological services, the communication with stakeholders and affected communities when a flood event is expected could be improved.

As many climate adaptation needs are location specific, sub-national governments play an important role, but in Thailand their mandate and ability to plan and implement adaptation solutions is limited. In many countries, sub-national governments are assigned specific sectoral functions, such as water resource management, environmental conservation and urban development, that are relevant for climate change. In Thailand, the actual roles of the elected provincial and local governments are constrained due to their limited legal mandates, fiscal resources, and technical capacity. The situation is further complicated by the co-existence of deconcentrated national government agencies that operate in parallel with elected provincial and local authorities in the same geographic spaces. For example, Provincial Offices of Natural Resources and Environment under MONRE are responsible for implementing MONRE directives. On the other hand, MONRE has no legal power to oblige elected provincial and local administrative organizations to follow its directives, unless specifically authorized to do so by legislation. Provincial governors appointed by the Ministry of Interior coordinate national government actions at the provincial level but do not control their budgets. The provincial offices of national ministries and departments retain primary reporting lines to their ministry/department headquarters in Bangkok. Governors do have the authority to review and approve budget proposals from elected sub-national administrations but play no role in implementation.

To meet its ambitious climate goals, Thailand will need to modernize its policies, regulations, and institutional frameworks. This includes strengthening the coherence and enforcement of climate-related regulations across sectors, enhancing transparency and data systems for better 'climate screening' of public investments and better monitoring and reporting of emissions, and fostering more agile and integrated governance structures capable of coordinating climate action at national and subnational levels. Accelerating the passage of the Climate Change Act will be important to set the framework for carbon pricing and other proposed climate policy instruments, provide DCCE with the mandate to lead and implement climate actions and regulations, and reduce private sector uncertainty. Institutional mechanisms should be developed to strengthen the linkages between sectoral climate plans and ensure that these plans are also linked with annual budgets.



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