



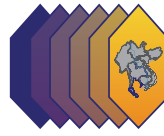
ADB

GREATER MEKONG
SUBREGION
CORE ENVIRONMENT
PROGRAM



GREATER MEKONG SUBREGION
**ENVIRONMENTAL PERFORMANCE
ASSESSMENT 2006–2016**

October 2018



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Cover photo: Villagers patrol a forest in Quang Nam Province, Viet Nam (photo from ADB).

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Abbreviations

3R	reduce, reuse, recycle
CEP	Core Environment Program
DPSIR	driver–pressure–state–impact–response
ELC	Economic land concession
EPA	Environmental performance assessment
FAO	Food and Agriculture Organization of the United Nations
FDI	foreign direct investment
GDP	gross domestic product
GHG	greenhouse gas
GMS	Greater Mekong Subregion
IUCN	International Union for Conservation of Nature
kg	kilogram
km	kilometer
km ²	square kilometer
Lao PDR	Lao People’s Democratic Republic
MDG	Millennium Development Goal
MRB	Mekong River Basin
PM	particulate matter
PRC	People’s Republic of China
REDD+	reducing emissions from deforestation and forest degradation
SDG	Sustainable Development Goal
t	ton
UNFCCC	United Nations Framework Convention on Climate Change
WHO	World Health Organization

EXECUTIVE SUMMARY

The Greater Mekong Subregion (GMS) has experienced impressive growth since the launch of the GMS Economic Cooperation Program, in 1992, becoming one of the world's fastest-growing regions. Unfortunately, this impressive economic growth has precipitated worrying environmental consequences, including the depletion of natural resources, environmental degradation, and impacts on human health. Such negative impacts undermine sustainable development in the GMS by affecting future economic growth and poverty reduction in the six member countries.

This environmental performance assessment examines the consequences of rapid development in the GMS, characterizing natural resource and environmental issues and how well the countries have responded to them. The assessment covers the period 2006–2016. During this period the GMS Core Environment Program supported country efforts to address the subregion's natural resources and environmental management challenges with its goal of creating an “environmentally friendly and climate-resilient GMS Economic Cooperation Program.”

The environmental issues covered by the assessment are air, biodiversity and habitats, climate change, fish, forests, land degradation, solid waste management, and water resources. Although pressures continued to be consistently medium to high for all issues during 2006–2016, the overall state of the environment was generally satisfactory and stable. Individual country responses were largely sustained, but more substantive actions are necessary to address persistent pressures.

Urban air quality across the GMS continued to be mostly satisfactory despite medium to high pressures associated with large numbers of vehicles on city roads and increasing industrial emissions. Air quality contaminants such as fine particulate matter rose steadily in all countries, with corresponding impacts on human health. Countries employed a variety of responses, such as more stringent emission standards, that are proving successful to some extent in addressing pressures.

Pressures on biodiversity and habitats remain high, stemming from the regional demand for wildlife and non-timber forest products and loss and/or degradation of forest and mangrove habitats. Protection policies are in place and management actions were taken to reduce wildlife trafficking and protect remaining habitats. Despite this, law enforcement remains too weak to cope with the many pressures, while protected areas are insufficiently funded to ensure their effective management.

Although the GMS contribution to global emissions remains low, fossil fuel energy consumption, hydropower generation, land use changes and intensified agriculture, and deforestation are generating growing greenhouse gas emissions. Impacts of climate change in the subregion include reduced agricultural production, infrastructure damage, and loss of human life caused by extreme weather events. Country responses to climate change encompass national and sector policies, and a combination of adaptation and mitigation measures. Countries are additionally pursuing green growth by encouraging cleaner, less polluting production technologies and striving for energy savings.

Inland and marine fisheries are very important in Cambodia, the Lao People’s Democratic Republic, and Viet Nam, where they account for a large portion of gross domestic product. Key pressures on fish populations are high harvesting levels and habitat loss. Freshwater migratory species are further affected by waterway obstructions such as hydropower dams and irrigation weirs. Declines in wild fisheries are partly offset by expanding aquaculture production. Nevertheless, depleted fish populations have worrying implications for people dependent on fish for their diet and livelihoods. Country responses involved both fisheries management and habitat protection, although the measures taken are considered to be only partly effective in maintaining fish stocks.



▲ Wind turbines in Thailand (photo from Shutterstock.com).

The GMS is richly endowed with forest resources, with a reported forest cover of 52% of total land area. Forest depletion is occurring primarily in Cambodia and Myanmar, while other countries increased their forest cover. Pressures on forests are generally high and increasing, the key pressures being natural forest conversion to agriculture and plantation forest, excessive logging, and land clearance for large-scale development projects such as hydropower and mining. While total forest cover has increased, forest composition has changed, with naturally regenerated forest predominating over planted forest and primary forest. However, the reported trend of increasing forest cover is largely an artifact of how the countries report forest cover. Calculations are now based on a standard of 10% canopy cover and include plantation forest, masking a worrying loss of primary forest, which is of critical importance as biodiversity habitat. Forest management efforts are proving partially effective as countries continue to focus on forest protection and sustainable management, and devote more resources to reforestation and natural regeneration of degraded forests.

Land degradation caused by forest loss, agricultural intensification, growing upland populations, and associated farming is of concern in several GMS countries. The impacts have included declining agricultural yields, increasing desertification, and soil erosion, all of which will have food-security and income-generation implications, and will affect ecosystem services such as flood retention and erosion control. Affected countries made sustained efforts to address land degradation through policy frameworks, the designation of protected areas, soil rehabilitation, and restrictions on agrochemical use.

Economic growth, industrialization, and urbanization are contributing to increasing solid waste generation. Cities in particular are struggling to respond to the volume of waste generated by rising urban populations and associated increasing consumption. Tourism and industry are also major solid waste sources. Urbanization has not been matched with enough investment in infrastructure to provide effective waste collection, disposal, and treatment. Countries are making sustained but belated efforts to improve solid waste management by setting up waste collection and disposal infrastructure; addressing pollution concerns arising from the handling and disposal of hazardous waste; promoting greater public awareness; and adopting reduce, reuse, and recycle strategies.

Riverine and marine water quality in the GMS continues to be generally satisfactory despite increasing pressures. Water pollution is mainly attributable to discharges of untreated domestic wastewater, agricultural runoff containing harmful chemicals, and effluent discharges from factories. However, instances of poor water quality associated with highly urbanized and industrialized areas persist. Recognizing that degraded water quality can affect human well-being and environmental health, countries are increasingly putting in place pollution prevention strategies and more stringent control measures.

Water supply and sanitation broadly improved across the GMS, with most countries approaching or achieving their 2015 Millennium Development Goal targets. Access to safe drinking water and adequate sanitation continues to be greater in urban than in rural areas. Unsatisfactory drinking water and sanitation access have high human health and economic costs. This emphasizes the need for more expenditure on drinking water supply and sanitation; continued awareness raising on good water, sanitation, and hygiene practices; and efforts to prevent pollution and manage water in a way that protects both water quality and quantity.

▼ The Mekong River at sunset, Nong Khai Province, Thailand (photo from Shutterstock.com).



1 INTRODUCTION

The Greater Mekong Subregion (GMS) comprises six countries—Cambodia, the Lao People’s Democratic Republic (Lao PDR), Myanmar, Thailand, and Viet Nam, as well as the Guangxi Zhuang Autonomous Region and Yunnan Province of the People’s Republic of China (PRC). The GMS has shown continual impressive economic growth and poverty reduction since the launching of the GMS Economic Cooperation Program in 1992. The GMS countries’ economic success is largely founded on the subregion’s rich natural resources. While these resources have so far sustained the growing demand for water, food, energy, and commodities, they have declined considerably, along with a reduction in environmental quality and ecosystem services, and worsening human health impacts. This report examines these consequences of rapid development in the GMS, characterizing natural resource and environmental issues and how effectively the countries have responded.

This assessment covers the period 2006–2016, during which the GMS Core Environment Program (CEP) supported country efforts to address the subregion’s growing environmental challenges and respond to emerging opportunities. The CEP has strived to create an “environmental friendly and climate resilient GMS Economic Cooperation Program.” It has helped improve natural resource management and environmental protection in the GMS by strengthening strategic planning processes, enhancing country environmental safeguards and institutional capacities, supporting enhanced biodiversity and livelihoods in key biodiversity landscapes, supporting climate change adaptation and mitigation, and improving national environmental monitoring and reporting systems.

Figure 1: Greater Mekong Subregion Economic Corridors



Source: ADB.

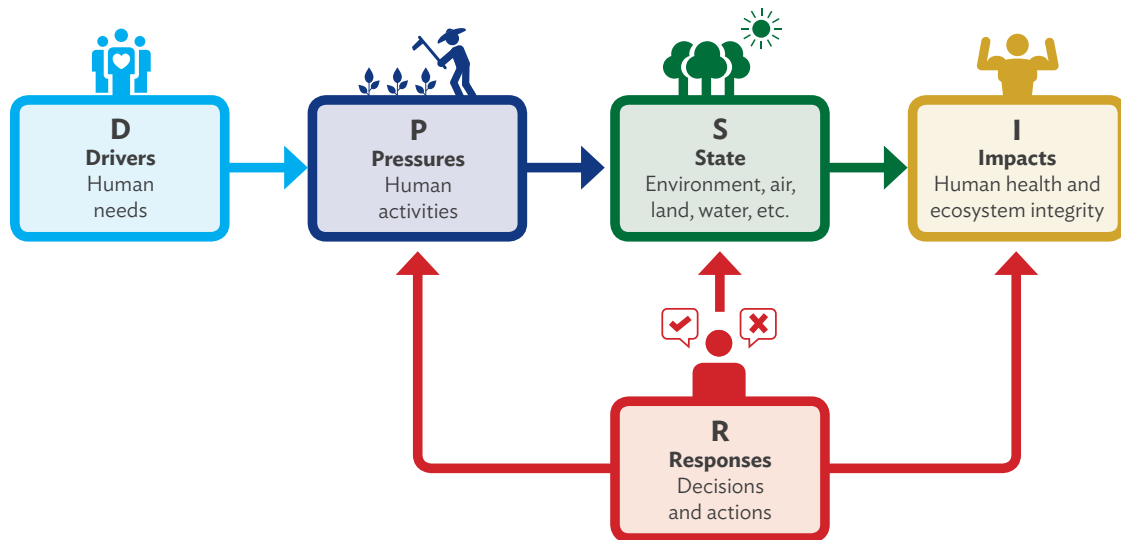
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2 ENVIRONMENTAL PERFORMANCE ASSESSMENT

An environmental performance assessment (EPA) is an analytical framework used to analyze environmental performance over a defined period, revealing conditions and trends, as well as progress in reaching environmental and social targets. A common feature of EPAs is the use of causal analysis (Figure 2) to better understand and explain cause–effect relationships. Both pressure–state–response and driver–pressure–state–impact–response (DPSIR) assessments are used to analyze priority issues. The terms are defined as follows:

- “**Pressure**” refers to the forces exerted by human activities on the environment, particularly on natural resources and ecosystem services. Typical pressures include the generation of air pollutants and other waste, land clearing, and the intensity of natural resource extraction.
- “**State**” refers to environmental conditions, the status of natural resources, or the capacity of an ecosystem service. State indicators include the degree of contamination of a water source, human health effects from exposure to a degraded environment, the status of wildlife populations and habitats, and the condition of natural resource stocks.
- “**Response**” refers to actions intended to mitigate, prevent, or adapt to environmental damage; to rehabilitate ecosystems and their services; and to preserve and conserve the environment and natural resources. Responses can involve expenditure on environmental protection, the imposition of environment-related taxes and subsidies, prosecution of illegal wildlife trade, or the enforcement of pollution abatement and control measures. More broadly, society responds to changes in the environmental state through economic and environmental policy and management choices.
- “**Driver**” and “**impact**” provide deeper insights into pressures on the environment and the resulting effects on humans and the environment. Using a forest management example, drivers such as population growth or external demand can produce a pressure—forested land clearance—which results in a change in the forest cover. Reduced forest cover negatively affects households that depend on income from non-timber forest products, and wildlife that depends on intact forest habitats. A government response might be to expand protected forest areas or introduce multiple-use forest management regimes.

Figure 2: Driver–Pressure–State–Impact–Response Analytical Framework



Source: Adapted from Organisation for Economic Co-operation and Development. 1993. *Report of OECD Core Set of Indicators for Environmental Performance Review*. Paris.

A key feature of EPA is the identification of policy targets, against which performance is judged. Target examples are GMS country commitments to achieve the Millennium Development Goals (MDGs) by 2015 and more recently the broader Sustainable Development Goals (SDGs) by 2030. Progress toward MDGs was tracked annually, allowing countries to gauge their progress, assess the likelihood of achieving the goals by the target date, and identify any additional interventions required to achieve the goals.

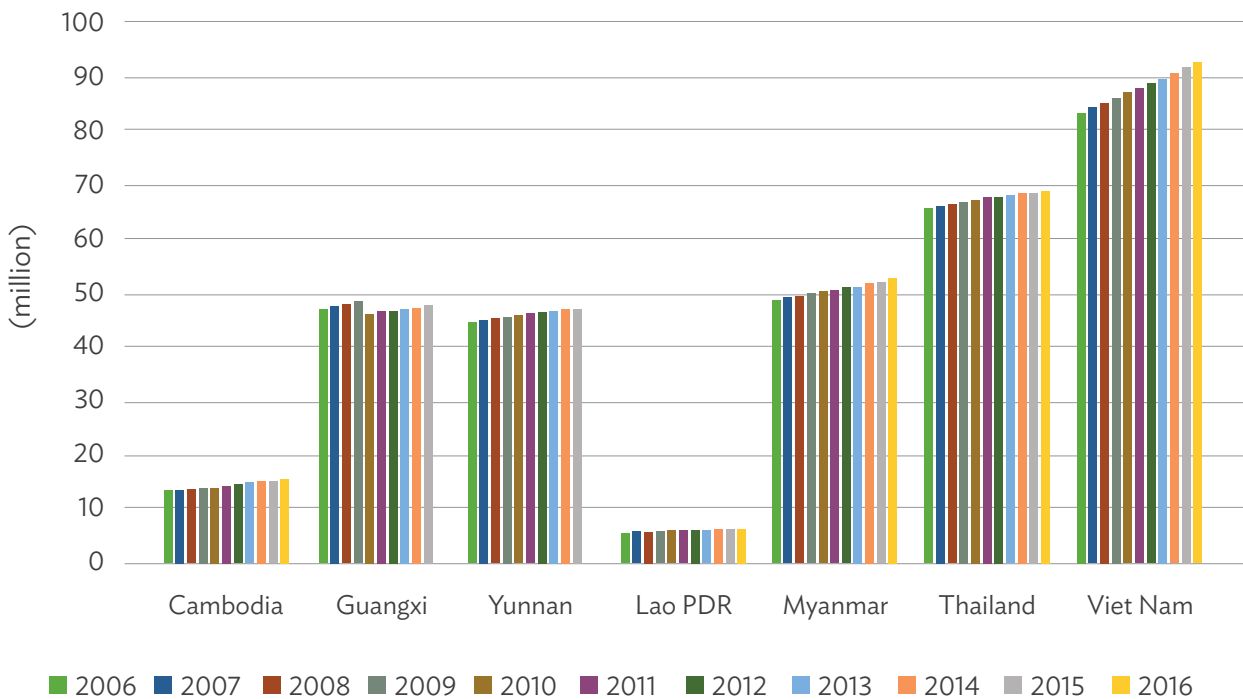


▲ Farmers at work in a sugarcane field in the Lao PDR (photo from ADB).

3 SOCIOECONOMIC CONTEXT

The population of the GMS grew continually during 2006–2016 (Figure 3), with the highest annual growth rate in the Lao PDR (5.13%), followed by Cambodia (3.72%), Viet Nam (3.32%), and Myanmar (2.39%).

Figure 3: Greater Mekong Subregion Populations, 2006–2016

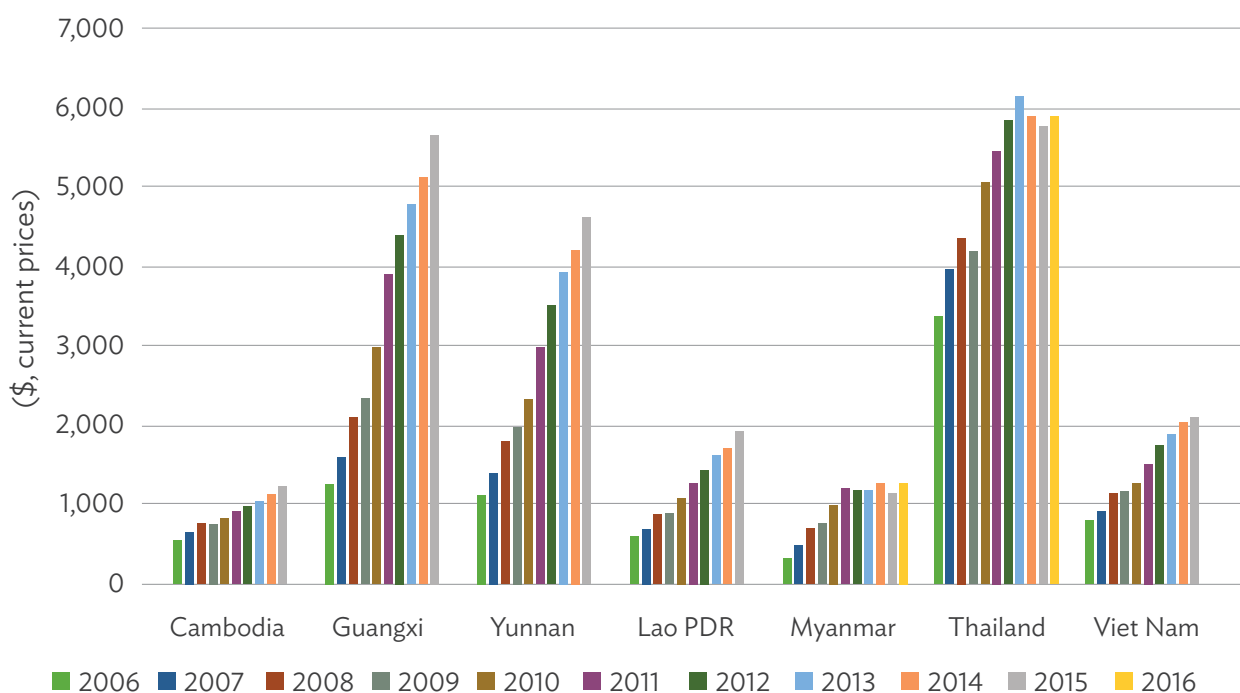


Lao PDR = Lao People’s Democratic Republic.
 Source: World Bank. Population, Total. <http://data.worldbank.org/indicator/SP.POPT.TOTL> (accessed 14 October 2017).

GMS economies grew rapidly during 2006–2016 (Figure 4), particularly in Guangxi and Yunnan. Strong growth was also seen in the Lao PDR, largely due to hydropower and mine development; and in Myanmar, which benefited from the opening up of its economy since 2012. Thailand experienced comparatively slower growth, in part because of its relatively advanced integration into the global markets, which suffered financial crises beginning in 2008. Strong country growth performances resulted in increases in per capita gross domestic product (GDP) and per capita incomes throughout the region. In 2006, gross GDP per capita averaged \$1,354 in the GMS, ranging from \$346 in Myanmar to \$3,379 in Thailand. By 2016, per capita GDP had increased to \$1,269 in Myanmar and \$5,899 in Thailand.

Increasing prosperity in the GMS as a result of economic growth enabled countries to make good progress on some MDG commitments. These are the goals to eradicate extreme poverty and hunger; achieve universal primary education; promote gender equality and empower women; reduce child mortality; improve maternal health; and combat HIV/AIDS, malaria, and other diseases. Most notably, as national incomes increased, poverty levels fell dramatically, with all the GMS countries meeting the 2015 target of halving the proportion of people who live in extreme poverty. This mirrors the impressive progress achieved across Southeast Asia, where poverty declined from 52% to 17% between 1990 and 2015, with the rate of reduction accelerating since 2008. Good progress was also made toward other MDGs: infant mortality rates halved in almost all the GMS countries, life expectancy increased in all the GMS countries, and primary and secondary school enrollment rates and literacy levels increased significantly throughout the GMS.¹

Figure 4: Per Capita Gross Domestic Product in the Greater Mekong Subregion, 2006–2016



Lao PDR = Lao People’s Democratic Republic.

Note: The absence of a bar for 2016 is due to a lack of data.

Source: Greater Mekong Subregion Information Portal. <http://portal.gms-eoc.org/> (accessed 28 October 2017).

Progress toward achieving MDG 7—Ensure Environmental Sustainability—was mixed between 2006 and 2016. Deforestation generally slowed, but continued to jeopardize biodiversity and people’s livelihoods. Global greenhouse gas (GHG) emissions continued to rise. Inland and marine fisheries were increasingly overexploited, threatening aquatic ecosystems and livelihoods. Conservation efforts were in a race against time to save animals and plants from extinction. More encouragingly, targets for drinking water were mostly met ahead of schedule and many people gained access to improved sanitation.

Although EPAs are primarily concerned with MDG 7, which deals specifically with natural resource and environmental issues, there will be negative implications for other MDGs if MDG 7 is not achieved. For example, there is a cause–effect relationship between the MDG 7 target to halve the proportion of the population without sustainable access to safe drinking water and basic sanitation by 2015 and the MDG 4 target to reduce child mortality, given that contaminated water and poor sanitation are major causes of infant mortality.

¹ United Nations. 2015. *The Millennium Development Goals Report 2015*. New York; The ASEAN Secretariat. 2017. *ASEAN Statistical Report on Millennium Development Goals 2017*. Jakarta.

Table 1 presents a summary of the seven out of the 17 new SDGs that have the same or equivalent indicators used for EPA reporting in the GMS.

Table 1: Mapping Sustainable Development Goals and Environmental Performance Assessment Indicators

Sustainable Development Goals	Indicators for the Sustainable Development Goals and the Environmental Performance Assessment
 <p>SDG 2: End hunger, achieve food security and improved nutrition, and promote sustainable agriculture</p>	<ul style="list-style-type: none"> • Proportion of agricultural area under productive and sustainable agriculture
 <p>SDG 3: Ensure healthy lives and promote well-being at all ages</p>	<ul style="list-style-type: none"> • Mortality rate attributed to ambient air pollution • Mortality rate attributable to chronic respiratory disease
 <p>SDG 6: Ensure availability and sustainable management of water and sanitation for all</p>	<ul style="list-style-type: none"> • Proportion of population using safely managed drinking water services • Proportion of population using safely managed sanitation services • Proportion of wastewater safely treated
 <p>SDG 11: Make cities and human settlements inclusive, safe, resilient, and sustainable</p>	<ul style="list-style-type: none"> • Annual mean levels of particulate matter in cities • Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated • Hazardous waste generated and treated • Proportion of bodies of water with good ambient water quality
 <p>SDG 13: Take urgent action to combat climate change and its impacts</p>	<ul style="list-style-type: none"> • Number of deaths, missing persons, and persons otherwise affected by disasters • Economic costs of disasters, including damage to critical infrastructure and disruption of basic services
 <p>SDG 14: Conserve and sustainably use the oceans, seas, and marine resources for sustainable development</p>	<ul style="list-style-type: none"> • Proportion of fish stocks within biologically sustainable levels • Coverage of protected areas in relation to marine areas • Coverage of protected areas in relation to inland fisheries
 <p>SDG 15: Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation, and halt biodiversity loss</p>	<ul style="list-style-type: none"> • Proportion of land area that is degraded over total land area • Red List Index • Proportion of traded wildlife that was poached or illicitly trafficked • Forest area as a proportion of total land area • Proportion of important biodiversity habitats covered by protected areas

Source: United Nations. Sustainable Development Goals: 17 Goals to Transform Our World. <http://www.un.org/sustainabledevelopment/sustainable-development-goals/>.

4

GREATER MEKONG SUBREGION ENVIRONMENTAL PERFORMANCE ASSESSMENT

Considerable commonality in priority natural resource and environmental issues exists across the GMS, although the countries prioritize these issues differently and often use different indicators in their performance assessments. Most or all of the countries are concerned about various aspects of air quality; biodiversity and habitats; climate change; solid waste management; and fish, forest, land, and water resources. In this chapter, the issues are described and subregional environmental performance assessed, with country examples.

Synopsis

Box 1: Condition and Trend Ranking

The overall analysis for each issue in this assessment combines the following condition and trend rankings.

Condition Rank	Color Code		
Pressure	High	Medium	Low
State	Poor	Satisfactory	Good
Response	Limited	Moderate	Substantial

Trend Rank	Symbol Code		
	▲	■	▼
Pressure	Increasing	Stabilizing	Decreasing
State	Deteriorating	Stabilizing	Improving
Response	Sporadic	Intermittent	Sustained

When the condition and trend rankings are combined, each issue can be summarized as in the colored bar below. In this instance, the pressure on a natural resource or environment is high and increasing, the state of the natural resource or environment is satisfactory and stabilizing, while the responses are substantial and sustained.



Source: Author.

Summary ratings for the natural resource and environmental issues examined in this assessment are provided in Table 2.

Table 2: Summary Environmental Performance Assessment Ratings for the Greater Mekong Subregion

Issue	Pressure	State	Response
Air quality	■	■	▼
Biodiversity and habitats	■	■	■
Climate change	▲	■	■
Fish	▲	■	▲
Forest	■	■	■
Land degradation	■	■	▼
Solid waste management	▲	■	▼
Water pollution	■	■	▲
Drinking water and sanitation access	■	▼	▼

Source: The author's calculations.

Air Quality

Large cities in the GMS countries are increasingly facing problems with urban ambient air quality. The transport sector is usually the largest contributor to air pollution. The pollutants of main concern are particulate matter (PM), especially very small particles (known as PM₁₀ and PM_{2.5}), and nitrogen and sulfur oxides. There has been a moderate to slight decrease in sulfur dioxide levels, and they remain below the guideline limit set by the World Health Organization (WHO).² In contrast, total PM has often reached levels harmful to human health, while ambient concentrations of nitrogen dioxides have gradually increased and slightly exceed the WHO guideline.

Car ownership has been increasing with the rising per capita incomes of urban residents (Figure 5). The number of registered vehicles in 2015 was highest in Thailand (16.2 million), Yunnan (4.8 million), and Guangxi (3.6 million). Car ownership also grew rapidly in all the other GMS countries. In addition to passenger cars that emit mainly carbon dioxide, commercial diesel trucks and buses are associated with particulate emissions, while two-wheel vehicles emit nitrogen oxides and three-wheel vehicles emit hydrocarbons. Increasing traffic congestion in major cities and the generally low quality of petroleum-based fuels used in the subregion have worsened the problem.

Country reporting on air quality is not uniform due to differences in the indicators being used. For example, Myanmar compares measured air quality against WHO guidelines. Thailand uses an air quality index based on selected pollutants, and reports on a scale with the categories of good, moderate, some health effects, high health effects, and dangerous. Viet Nam has a national air quality standard.³

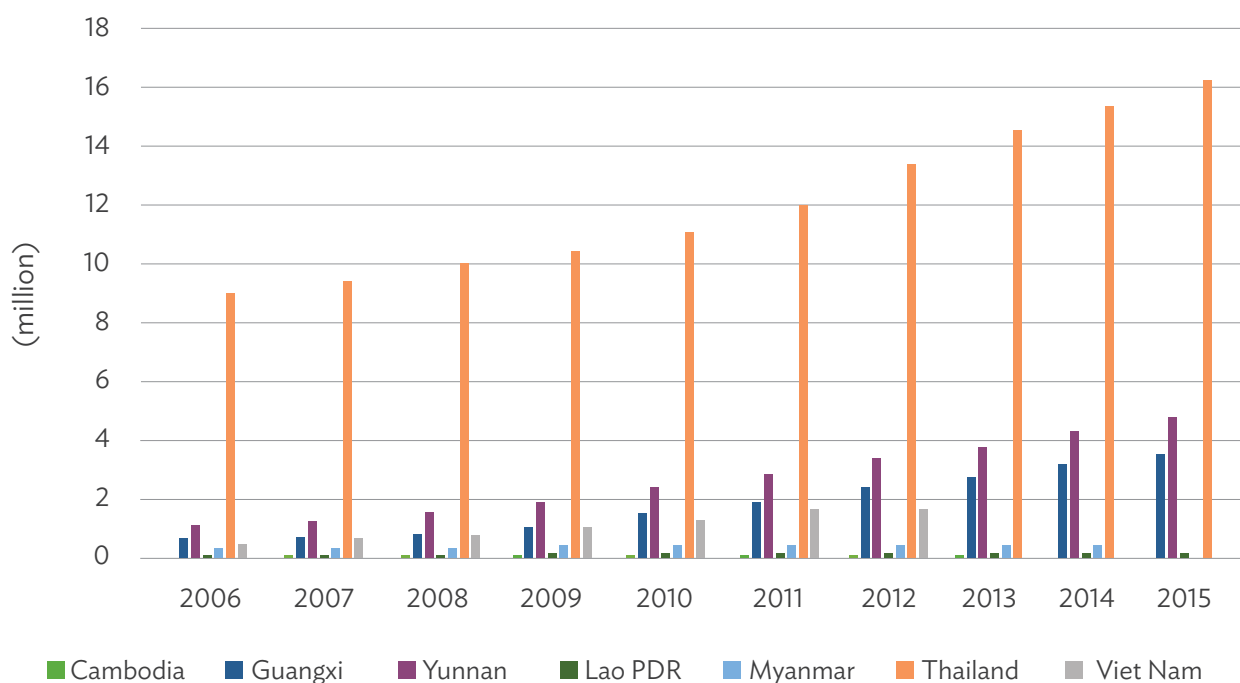
² World Health Organization. 2006. *Air Quality Guidelines: Global Update 2005*. Geneva.

³ GMS Environment Operations Center. 2014. *Viet Nam National Environmental Performance Assessment Report 2010*. Bangkok.

The indicators for the state of air quality in Guangxi and Yunnan are measured by the percentage of cities meeting applicable air quality standards and, for major cities, by the number of days with air quality better than the standard values.

In Myanmar, increasing industrialization and increasing use of automobiles are the primary causes of declining outdoor air quality.⁴ The number of motor vehicles, excluding motorcycles, more than doubled from 2007 to 2014. In Yangon, vehicle ownership in 2012–2013 alone rose almost 5%.⁵ From 2006 to 2015, air pollution worsened, particularly in peri-urban areas, where industry is concentrated. In 2006, concentrations of PM exceeded the WHO guidelines, while nitrogen dioxide and sulfur dioxide remained within the guideline values. By 2015, total PM, PM₁₀, and concentrations of nitrogen dioxide and sulfur dioxide all exceeded the WHO guideline values in Yangon and Mandalay, while concentrations continued to be acceptable in Nay Pyi Taw.

Figure 5: Number of Motor Vehicles (Excluding Motorcycles) in the Greater Mekong Subregion, 2006–2015



Lao PDR = Lao People’s Democratic Republic.

Note: Missing bars indicate a lack of data.

Source: Greater Mekong Subregion Information Portal. <http://portal.gms-eoc.org/> (accessed 22 October 2017).

In Thailand, motor vehicles are the largest source of air pollution; vehicle numbers increased from 9.0 million in 2006 to 16.2 million in 2015, linked to population and economic growth. In rural areas, the open burning of domestic waste and agricultural residues are the main causes of air pollution. Urban air quality has remained generally acceptable, however, with conditions typically being moderate to good. Some parameters have shown a slightly rising trend; for instance, the average PM increased from 24.8 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) in 2006 to 26.4 $\mu\text{g}/\text{m}^3$ in 2015. Air quality in cities sometimes reaches unhealthy levels, particularly in Chiang Mai, which is also affected by haze from agricultural field burning.⁶

4 GMS Environment Operations Center. 2014. *Myanmar National Environmental Performance Assessment Report 2010*. Bangkok.

5 United Nations Environment Programme. *Myanmar Environmental Outlook 2014. Status of Environment: Atmosphere*. Bangkok. Draft.

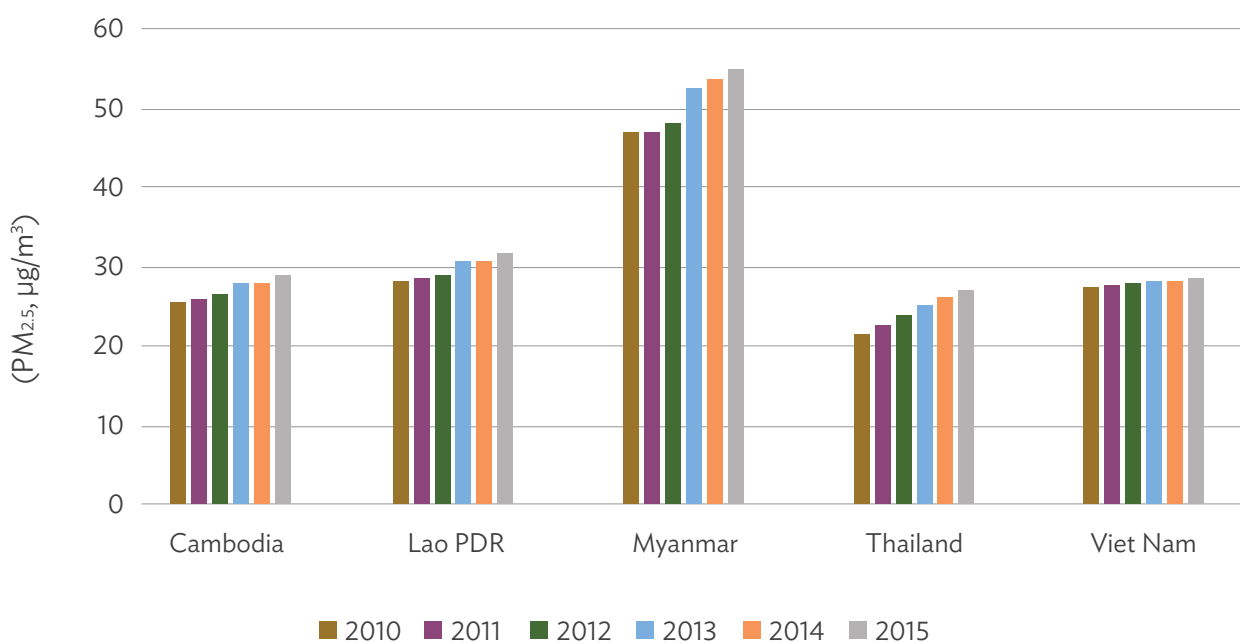
6 GMS Environment Operations Center. 2014. *Thailand National Environmental Performance Assessment Report 2010*. Bangkok.

In Viet Nam, the main contributor to air pollution is the increase in travelers. Vehicular traffic accounts for about 70% of the pollution load, with the remainder attributable to industrial zones and factories located in peri-urban areas. The number of cars increased from 656,000 in 2006 to 1,540,000 in 2012. The number of motorcycles in major cities such as Ho Chi Minh and Ha Noi has now reached saturation (e.g., Ha Noi’s population of 7 million owns 5 million motorcycles). Industrial parks have also increased rapidly, reaching 299 parks in 2015. Urban air pollution in Viet Nam’s cities is worsened by infrastructure and residential construction, which causes dust and PM pollution. As a result, air quality in most urban areas is typically moderate to poor, with the amount of PM exceeding the allowable limit. Monitoring data, primarily for PM, show that concentrations consistently exceed the national air quality standard.

Air quality in Guangxi and Yunnan also suffers from vehicular and industrial emissions, and is significantly worsened by air pollution due to continually increasing sulfur dioxide emissions from the burning of high-sulfur coal. Overall air quality worsened during 2006–2016, and the number of cities meeting the applicable criteria is lower than targeted.⁷

Overall, urban air quality has worsened in the GMS, as evidenced by the increasing PM_{2.5} concentrations (Figure 6).

Figure 6: Urban Particulate Matter Concentrations in the Greater Mekong Subregion, 2010–2015



µg = microgram, Lao PDR = Lao People’s Democratic Republic, m³ = cubic meters, PM = particulate matter.

Source: The World Bank. PM_{2.5} Air Pollution, Mean Annual Exposure (Micrograms Per Cubic Meter). <http://data.worldbank.org/indicator/EN.ATM.PM25.MC.M3> (accessed 22 October 2017).

⁷ GMS Environment Operations Center. 2014. *Guangxi National Environmental Performance Assessment Report 2010*. Bangkok; 2014. *Yunnan National Environmental Performance Assessment Report 2010*. Bangkok.

Air pollution is a major environmental risk to human health, increasing the burdens of stroke; heart disease; lung cancer; and both chronic and acute respiratory diseases, including asthma. The lower the air pollution, the better the cardiovascular and respiratory health of a population. Economic and health impacts due to air pollution include the cost of medical treatment for respiratory diseases, income loss due to absence from work, and the necessity of missing work to care for sick family members. Further, the increase in acid rain in major cities is causing a health hazard and damaging buildings and vegetation.

Myanmar responded to outdoor air pollution by promoting the use of liquefied petroleum gas as a fuel for public transportation and by replacing very old cars with newer and less polluting models through the liberalization of vehicle imports. The Government of Myanmar issued National Environmental Quality (Emission) Guidelines in 2015 to manage source emissions of nitrogen and sulfur oxides and PM, including from thermal power plants.

Responses in Thailand included progressively adopting some of the strictest standards in Southeast Asia. For example, Euro II equivalents were introduced for passenger vehicles in 2001 and Euro III standards for light-duty vehicles in 2004; in addition, low-sulfur Euro IV standards were adopted in 2012 for gasoil and gasoline.⁸ Improvements in fuel quality and the implementation of more stringent vehicle emission standards have helped reduce concentrations of ambient and roadside air pollutants. Additionally, improved public transport is helping to reduce the number of vehicles on the road in major cities such as Bangkok.

Responses in Viet Nam included revising their regulatory framework of environmental protection laws and strategy; implementing emission standards for road vehicles and motorcycles; and improving public transport in large cities, including new subway systems in Ha Noi and Ho Chi Minh City. In Ha Noi, a ban on motorcycles has been proposed.

Guangxi and Yunnan made similar investments in public transportation and have introduced stricter controls on industrial emissions; they have promoted the adoption of clean energy technologies, including the use of low-sulfur coal and alternative fuels (such as natural gas) in order to reduce sulfur dioxide emissions.

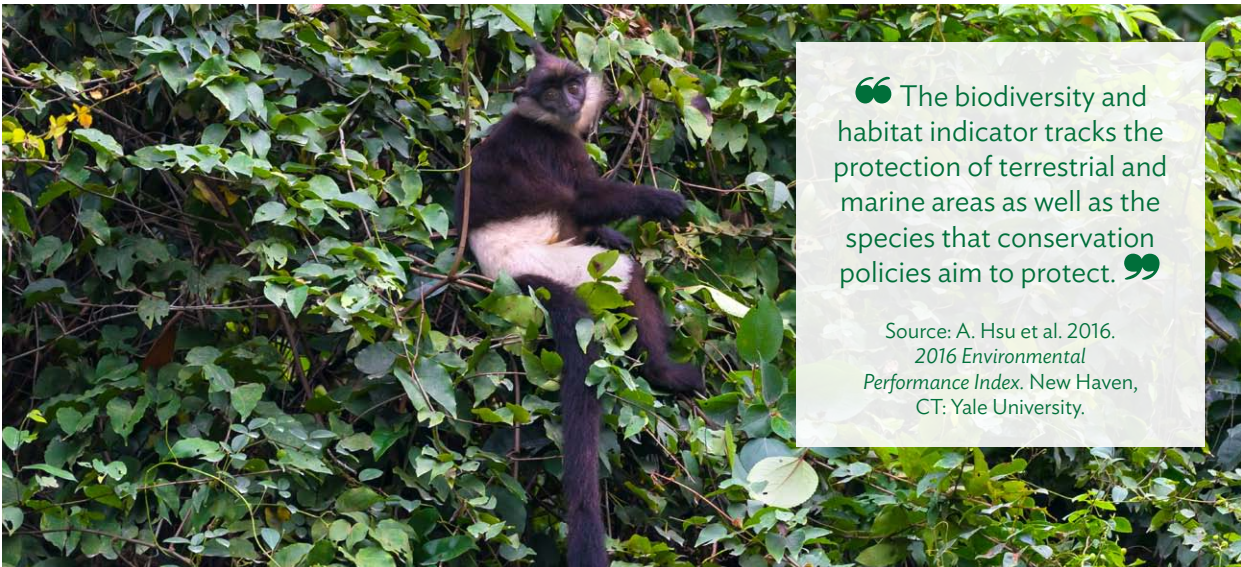
Biodiversity and Habitats

The GMS is one of the world's richest biodiversity hot spots. It harbors many endemic species, including 430 mammals, 800 reptiles and amphibians, 1,200 birds, and 20,000 plants. New species are regularly identified; 2,409 new species were discovered from 1997 to 2015.⁹ Many of these species are vulnerable, endangered, or critically endangered. Their fragility is demonstrated by the high proportion of the world's threatened species that live in the GMS.

All GMS countries consider biodiversity and habitats to be priority issues, emphasizing the loss of biodiversity from terrestrial forested areas, inland waters, and coastal zones. The main driver of biodiversity loss is the Asia-wide demand for wildlife, timber, and non-timber forest products. Other drivers include the loss or fragmentation of forests due to highway construction and the clearing of forests for mining and hydropower projects. High poverty levels, particularly in upland areas, are also leading to increased forest exploitation.

⁸ Euro II, III, and IV are iterations of European emission standards.

⁹ World Wide Fund for Nature. Wildlife of the Greater Mekong. http://greatermekong.panda.org/discovering_the_greater_mekong/species/.



▲ The critically endangered Delacour’s langur, in a nature reserve in Ninh Binh Province, Viet Nam (photo from Shutterstock.com).

Habitat loss is the main source of pressure on biodiversity, followed by trade in wildlife and forest products, and the introduction of invasive species. It is caused by a wide variety of human activities: forest logging, deforestation and land conversion for economic land concessions, shifting cultivation in upland areas, plantation forests, degradation of coastal zones, infrastructure development, and mine and hydropower development. The resulting pressures can be transferred between countries; for example, logging moratoriums in neighboring countries are causing the increased logging of forests in the Lao People’s Democratic Republic (Lao PDR).

The state of biodiversity in all the GMS countries is measured by the number or population size of threatened species. Most countries consult the International Union for Conservation of Nature (IUCN) Red List of Threatened Species to determine the percentage of globally threatened species that occur within their borders, and then use that percentage as the state indicator. Viet Nam uses the number of species in the Viet Nam’s Red Data Book. Yunnan tracks populations of four key species (black gibbon, Asian elephant, black-necked crane, and snub-nosed monkey), wildlife seizures, and product confiscations as its biodiversity state indicators. Available data suggest that the number of threatened species in the GMS as a percentage of all globally threatened species declined slightly from 2006 to 2016. The numbers of threatened species—birds, fish, plants, and mammals—in the GMS (excluding Guangxi and Yunnan) are shown in Table 3.

Table 3: The Numbers of Threatened Species in Greater Mekong Subregion Countries, 2016

Country	Birds	Fish	Plants	Mammals	Total
Cambodia	27	47	36	38	148
Lao PDR	24	55	41	45	165
Myanmar	48	50	61	48	207
Thailand	51	106	150	56	363
Viet Nam	46	86	204	55	391

Lao PDR = Lao People’s Democratic Republic.

Source: United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). Access Data. http://data.unescap.org/escap_stat/?#data/ (accessed 20 September 2017).

Viet Nam has the largest share of threatened species among the GMS countries, reflecting the large number of species, including many endemic species, found there. Loss of biodiversity in the GMS has ecosystem, human-livelihood, and economic impacts, such as reduced income and food security in local communities. In the Lao PDR, for example, more than 60% of the country's population lives in rural areas and is often highly dependent on harvesting wild plants, animals, and animal products for daily subsistence and income.¹⁰ Tourism is also an important revenue source for the Lao PDR, and ecotourism is steadily expanding. Continued loss of biodiversity will inevitably affect the appeal of the country as a tourist destination.¹¹

GMS country responses to biodiversity loss have primarily involved comprehensive policy frameworks; the establishment of protected areas; and the application of penalties for illegal activities in protected areas such as logging, wildlife poaching, and wildlife trade. All the countries are party to the Convention on Biological Diversity, and are committed to the Strategic Plan for Biodiversity 2011–2020 and its Aichi Targets, including Target 11, on protected areas and the identification of key biodiversity areas; and Target 12, on the conservation of species. Under Target 11, countries aim to conserve 17% of their terrestrial areas and 10% of their coastal and marine areas by 2020.

Five of the six GMS countries use protected areas as a percentage of total land area as their EPA response indicator. Compared to much of the world, the GMS countries did relatively well in protecting their terrestrial ecosystems during the EPA period, especially Cambodia and the Lao PDR. In contrast, the countries made significantly less progress toward achieving their coastal and marine targets. Overall, it is widely recognized in the subregion that more funding and human resources are needed to protect biodiversity and extend protection efforts outside the already designated conservation areas.

Cambodia increased the proportion of its protected areas of the country's total area to 26.1% by 2010—the highest percentage in the GMS.¹² In early 2017, Cambodia announced a new subdecree that protects almost 1.5 million hectares (ha) as biodiversity conservation corridors—areas of land that connect existing protected areas, allowing animals to move unimpeded between them. The Lao PDR uses the same indicator to gauge the results of its responses to biodiversity loss. By 2010, protected areas comprised 16.7% of its total land area.

Myanmar responded to the loss of biodiversity primarily by establishing marine and terrestrial protected areas. Terrestrial protected areas reached 6.5% of total land area by 2010, but marine protected areas represent only 0.3% of its territorial waters. Although Myanmar is a signatory to the Convention on International Trade in Endangered Species of Wild Fauna and Flora, ineffective control in border areas and limited enforcement enable trade in wildlife species with neighboring countries to persist.

Thailand has also primarily responded to terrestrial biodiversity loss by establishing marine and terrestrial protected areas. Terrestrial protected areas covered 20.4% of the country's total land area by 2010. More than half of the protected areas are national parks, followed by wildlife sanctuaries, no-hunting zones, and forest parks. Marine protected areas made up 5.2% of Thailand's total territorial waters in 2014. Other responses have included improving the capacity of rangers and park managers to control both the trade and trafficking of vulnerable species, and to protect these species.

10 GMS Environment Operations Center. 2014. *Lao PDR National Environmental Performance Assessment Report 2010*. Bangkok.

11 Government of the Lao PDR, Ministry of Natural Resources and Environment. 2012. *Lao Environmental Outlook 2012*. Vientiane.

12 GMS Environment Operations Center. 2014. *Cambodia National Environmental Performance Assessment Report 2010*. Bangkok.



▲ Mekong Delta ecotourism, An Giang Province, Viet Nam (photo from Shutterstock.com).

Viet Nam has responded to biodiversity loss by establishing protected areas, increasing ranger forces for forest protection, strengthening the role of environmental police in investigating and handling criminal activities related to wildlife trade, increasing forest cover, restoring degraded ecosystems, rehabilitating mangrove forests, and establishing Ramsar sites.¹³ The proportion of the terrestrial protected area in Viet Nam was 6.6% of its total land area in 2010.

Responses in Guangxi and Yunnan to biodiversity loss have focused on the establishment of nature reserves and the creation of a nature reserve network to protect rare and endangered animals and plants. The number of nature reserves has been increasing, but the percentage of reserve areas out of the total area has not yet met their targets. Other responses include natural forest protection, the protection of key species, and biodiversity conservation action plans.

All GMS countries have national wildlife policies, laws, and management strategies. For example, the Lao PDR Wildlife and Aquatic Law provides for the management, conservation, protection, development, and use of wildlife and aquatic life. Most GMS countries have a Biodiversity Strategy and Action Plan to integrate conservation with sustainable use of biodiversity. In Thailand, biodiversity and biodiversity habitats are protected under existing laws. Viet Nam has a specific Biodiversity Law, which provides for conservation of natural ecosystems and protection of wildlife and their natural habitats.

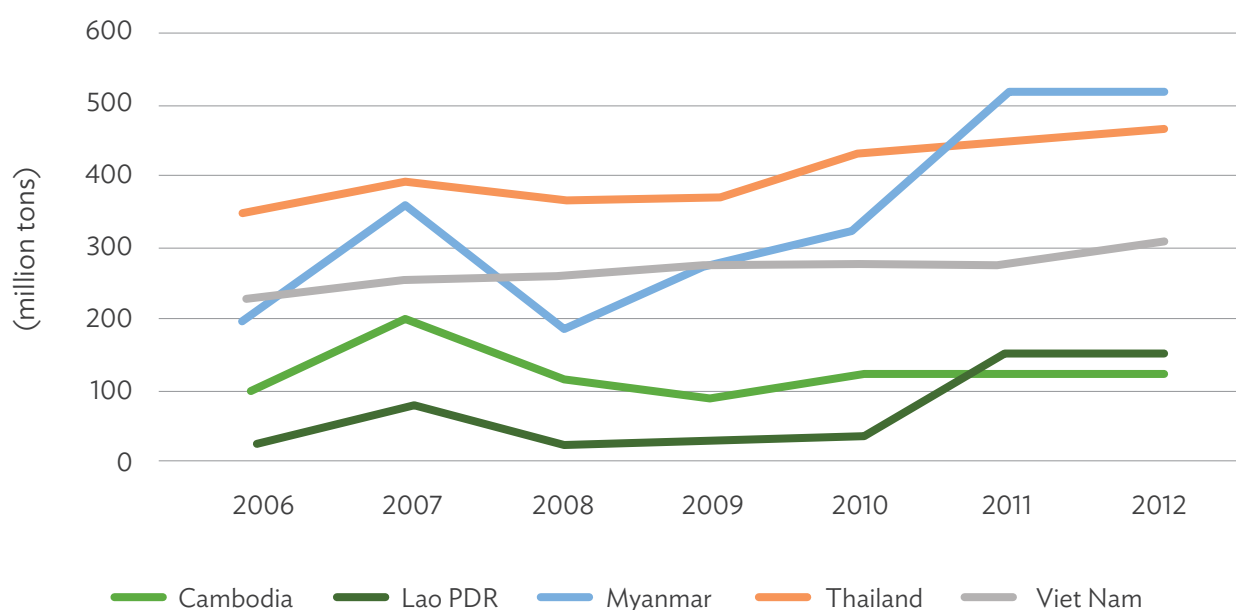
Climate Change

During 2006–2016, climate change progressively became a priority issue for GMS countries, as subregional greenhouse gas (GHG) emissions rose and negative impacts of climate change became more apparent. Although the subregion's contribution to global emissions remains low, increasing energy use, expanding transportation, deforestation, and land use changes are all contributing to accelerating GHG emissions. Climate change has important implications for economic development in the GMS, affecting both human well-being and ecosystem integrity. It is affecting infrastructure for energy and transport, in addition to life, property, and other assets across the GMS. Extreme weather events have had a significant impact on GMS countries and are likely to increase in frequency and intensity.

¹³ The Convention on Wetlands, called the "Ramsar Convention," is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

Key pressures contributing to increased GHG emissions in the GMS are fossil fuel consumption, hydropower generation, land use changes and intensified agriculture, and deforestation due to logging and forest fires. While per capita energy-related fossil fuel emissions remain among the lowest in the world, GHG emissions per capita in carbon dioxide equivalent increased rapidly in most GMS countries (excluding Guangxi and Yunnan, for which comparable data are not available) from 2006 to 2012 (Figure 7). During this period, the average increase in GHG emissions was 72%. The largest increases were in the Lao PDR (from 25.1 million tons to 161.7 million tons) and Myanmar (from 199.3 million to 528.4 million tons).

Figure 7: Greenhouse Gas Emissions in the Greater Mekong Subregion, in Carbon Dioxide Equivalent, 2006–2012



Lao PDR = Lao People’s Democratic Republic.

Source: The World Bank. Total Greenhouse Gas Emissions. <http://data.worldbank.org/indicator/EN.ATM.GHGT.KT.CE> (accessed 27 September 2017).

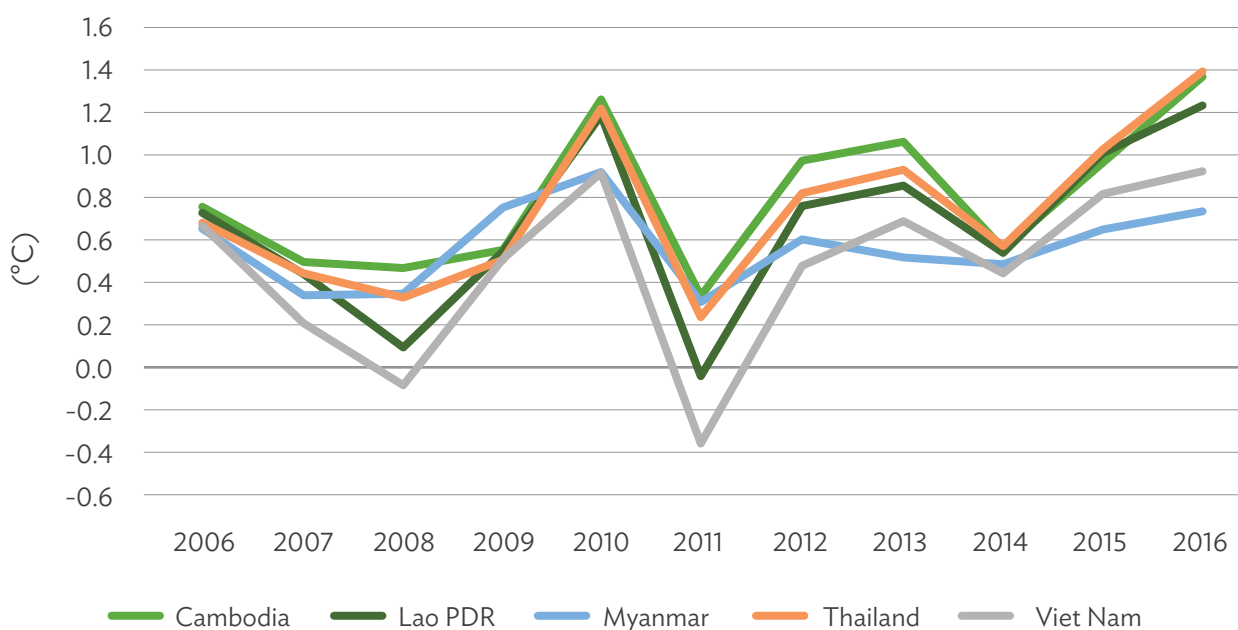
The rapid expansion of vehicle ownership in the subregion is associated with increasing GHG emissions from transport. This is predicted to further increase by 300%–500% by 2030 if no new policies are introduced to tackle these emissions. Rapidly expanded hydropower development in the GMS, particularly in the Lao PDR, has raised concerns about the potent GHG methane released from inundated reservoirs. Logging associated with such development schemes compounds the problem. Land use changes in general and deforestation in particular generate significant climate-change pressures in the GMS. Forest fires are also an important issue relating to human health, air pollution, and GHG emissions. All the GMS countries grow rain-fed and/or irrigated rice, and rice fields are a major source of atmospheric methane.

The state of climate change in the GMS countries is typically tracked by assessing the frequency of natural disasters and climate phenomena—rising temperature, shorter monsoon period, increasing rainfall with higher intensity, more severe cyclones affecting coastal areas, and increasing rate of sea-level rise. A commonly used indicator of climate change impact is change in land area prone to floods and droughts.

All the GMS countries are particularly vulnerable to climate change because their populations are largely agrarian; 64% of the GMS population (not including Guangxi and Yunnan) still lived in rural areas in 2016.

Across the subregion, temperatures rose by an average of 0.65°C during 2006–2016 (Figure 8). A particular concern for GMS countries as a consequence of this temperature change is the increase in wet season rainfall and the decrease in dry season rainfall.

Figure 8: Temperature Changes in the Greater Mekong Subregion, 2006–2016



C = centigrade, Lao PDR = Lao People’s Democratic Republic.

Source: Food and Agriculture Organization of the United Nations. FAOSTAT: Temperature Change. <http://www.fao.org/faostat/en/#data/ET> (accessed 8 October 2017).

The impacts of climate change in the GMS include injuries and loss of human life from extreme weather events, reduced agricultural production, and infrastructure damage. The cost of climate change in Thailand and Viet Nam by 2100 could reach nearly 7% of annual gross domestic product (GDP), which is significantly higher than the expected global average. In Cambodia, floods in 2011 alone caused an estimated \$451 million in damage and \$174 million in losses. A flood in the Lao PDR in 2008 caused a loss of \$58 million.

GMS country responses to climate change impacts include establishing policy frameworks and programs for adaptation and mitigation. All the countries consider ratification of the United Nations Framework Convention on Climate Change (UNFCCC) and its associated treaty and agreement requirements as the overarching context for policy targets. Country actions arising out of UNFCCC ratification have included the (i) national adaptation plans of action, (ii) action plans for disaster risk reduction, (iii) initiation of Clean Development Mechanism projects, and (iv) programs to reduce emissions from deforestation and forest degradation in developing countries (REDD+). All GMS countries have formally adopted the Paris climate agreement, having finalized their nationally determined contributions, which specify the post-2020 actions they will take to achieve the long-term climate change targets set under this agreement.

Adaptation responses on the ground have included the construction of water reservoirs, development of irrigation systems, and rehabilitation of coastal infrastructure. Mitigation measures include the management and exploitation of biomass (forest and agricultural residues), to carbon sequestration (capturing and storing carbon dioxide and other forms of carbon in the ground), and conservation of carbon in soils and forests. The GMS countries are additionally pursuing green growth initiatives such as efforts to achieve energy savings—and thus emission reductions—through more energy-efficient infrastructure and to encourage cleaner production technologies that emit less GHGs.

Fish

An estimated 1,100 freshwater fish species live in the six major GMS river basins—the Ayeyarwady, Thanlwin, Chao Phraya, Mekong, Red, and Pearl—and a further 250 marine species reside in coastal waters.¹⁴

Freshwater capture fisheries and aquaculture in the lower Mekong River Basin (MRB) alone totaled more than 3.9 million tons in 2008, comprising 1.9 million tons from capture and 2 million tons from aquaculture. The generally increasing trends in the productivity of inland fisheries in the GMS are presented in Figure 9, and that of the marine capture fisheries in Figure 10. Fisheries account for nearly 12% of Cambodia's GDP and contribute more to the country's economy than rice production. In the Lao PDR, fisheries account for 7% of the GDP. The Mekong River fishery sectors in Thailand and Viet Nam are not as important to the national economies, but contribute well over \$750 million to the GDPs each year. The total economic value of Mekong River fisheries is estimated at \$3.9 billion–\$7.0 billion per year.¹⁵

Key pressures on the fish population come from high harvesting levels, loss of habitat, and hindrances to migratory patterns.

Migratory fish species are particularly vulnerable to excess harvesting because large numbers of fish migrate at the same time and are subject to intensive fishing. Fishing pressure in Cambodia's Tonle Sap Lake, including from large-scale commercial operations, is thought to exceed sustainable catch levels, as evidenced by the decreasing size of the fish being caught. Several fish species in the subregion's rivers are already endangered, such as the Mekong giant catfish. This iconic species can grow up to 3 meters long and weigh more than 300 kilograms (kg). It is endemic to the Mekong River and migrates great distances to spawn in tributaries. Threats to the Mekong giant catfish and other species include excessive fishing and the obstruction of migratory routes by hydropower development; there are about 20,000 dams and weirs in the lower MRB alone.

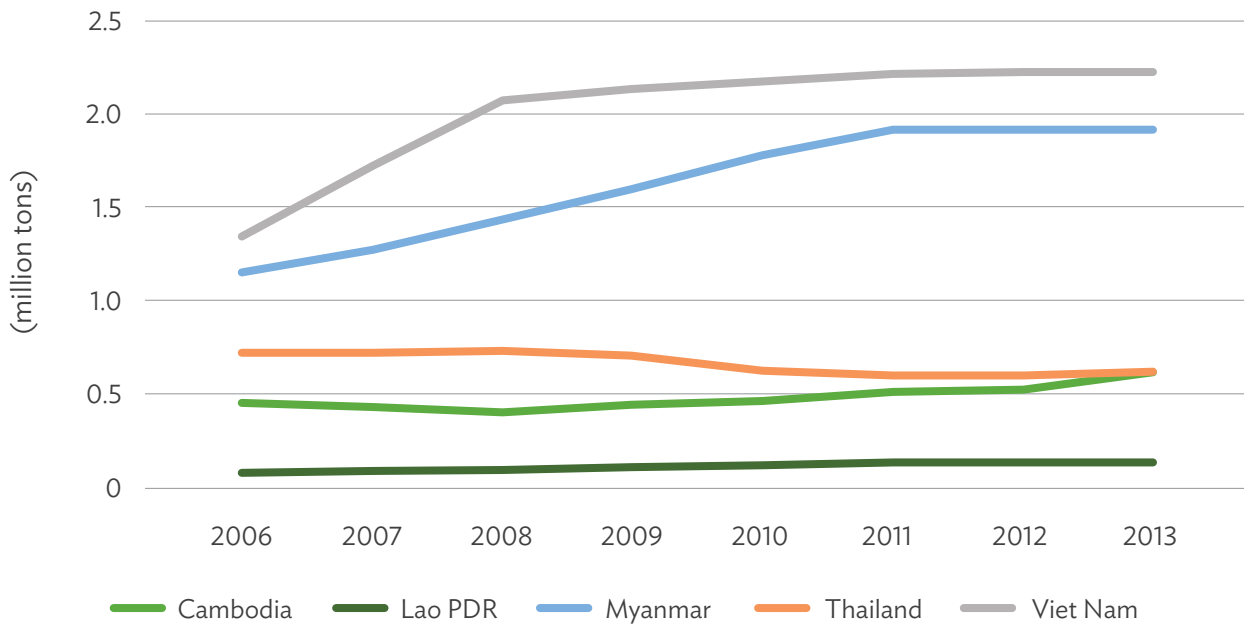


▲ A man feeding cobia at a fish farm in Ba Ria-Vung Tau Province, Viet Nam (photo from Shutterstock.com).

14 Asian Development Bank (ADB). 2012. *Greater Mekong Subregion: Atlas of the Environment* (2nd edition). Manila.

15 Mekong River Commission. 2010. *State of the Basin Report 2010*. Vientiane.

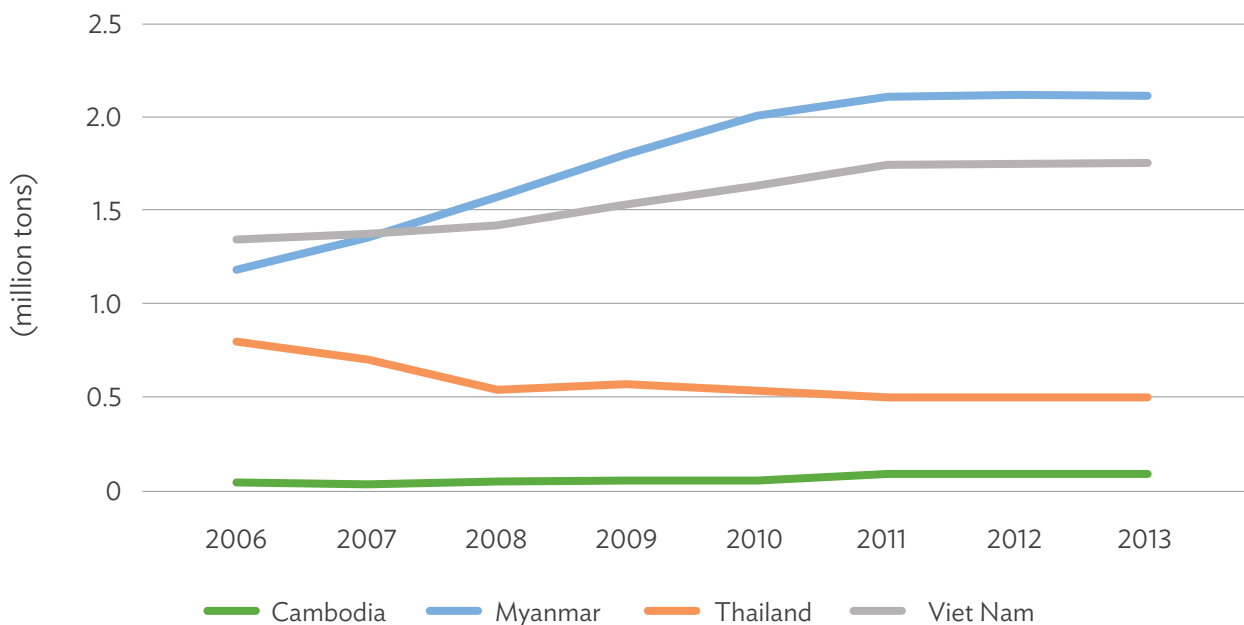
Figure 9: Inland Fish Catch in the Greater Mekong Subregion, 2006–2013



Lao PDR = Lao People’s Democratic Republic.

Source: Food and Agriculture Organization of the United Nations. FAOSTAT: Commodity Balances—Livestock and Fish Primary Equivalent. <http://www.fao.org/faostat/en/#data/BL> (accessed 22 September 2017).

Figure 10: Marine Fish Catch in the Greater Mekong Subregion, 2006–2013



Source: Food and Agriculture Organization of the United Nations. FAOSTAT: Commodity Balances—Livestock and Fish Primary Equivalent. <http://www.fao.org/faostat/en/#data/BL> (accessed 22 September 2017).

Myanmar, with a 2,800-kilometer coastline and extensive wetlands and mangrove areas, is endowed with abundant marine resources. Fish catches have increased substantially in recent years. The combined production from capture fisheries and aquaculture increased at an annual rate of 11% during 2004–2013. It is not clear whether Myanmar’s fish stocks can sustain such catches. Some 30% of harvested species are thought to be overfished, and overall fish stocks declined by 12.7% over the last decade. Another major concern in Myanmar is the loss of riparian vegetation cover and, in particular, the rapid loss of flooded forests, which provide crucial habitats for fishes. The loss of mangrove forests, which provide nursery habitats for some marine fish, due to coastal zone development is of particular concern in Cambodia, Myanmar, and Viet Nam.

Declines in wild fish populations have been partly offset by expanding aquaculture production, which doubled from 3 million tons to 6 million tons during 2000–2007, and expanded further to around 7 million tons in 2010, with Viet Nam showing the fastest growth.

Depleted fish populations have worrying implications for people dependent on fish for their diet and livelihoods. For example, in Cambodia, fish and rice production is the basis for food security. In other GMS countries, people rely heavily on fish as a source of protein. Fish processing and transporting, the marketing of fish-based products, and many other supporting industries provide people with full- or part-time work, and generate revenue for commercial operations. Local consumption surveys in the lower MRB imply an average consumption of freshwater fish and other aquatic organisms of 44 kg/person/year and marine fish consumption of 16 kg/person/year.¹⁶ However, statistics from the Food and Agriculture Organization of the United Nations (FAO) suggest average consumption rates of about 19 kg/person/year in Cambodia, 14 kg/person/year in the Lao PDR, and 7 kg/person/year in Thailand and Viet Nam. While the FAO figures are lower than local consumption estimates, it is clear that with a population of 60 million people, consumption of freshwater fish in the lower MRB is the highest in the world.

Country responses involve fishery management and habitat protection. Cambodia has focused predominantly on the establishment of community fisheries and investment in community-based sustainable fishery management. It has introduced reforms in commercial fishing lots and released fishing areas for community use in order to reduce illegal fishing, overfishing and destructive fishing, and the clearance of flooded forests for agriculture. The Lao PDR has continued to promote aquaculture by investing in government hatchery production, and is protecting wild fish by building passages that allow the fish to bypass irrigation weirs and small hydropower dams, as part of its integrated water resource management initiative. Myanmar has concentrated on aquaculture development and fishery stock management, with such measures as restrictions on fishing gear. While Myanmar’s stock management efforts appear to have been partly effective, enforcement is undermined by the lack of a system for regulating the catches of coastal fishing operators. Thailand’s efforts have focused on the protection of mangrove forests by maintaining shoreline integrity. The country’s expansion of designated protected areas is continuing, but is still not considered sufficiently effective in reducing threats to coastal and marine resources. Viet Nam has focused on improved fishery management through licensing, gear restrictions, and community co-management; and on strong support for aquaculture, partly through integration into coastal zone management.

Forest

The GMS is richly endowed with forest resources. The total forest coverage of the six GMS countries was estimated at 1.2 million square kilometers (km²) in 2015, or 52% of the subregion’s total land area. Myanmar has the largest forest area among the GMS countries, and the Lao PDR has the highest percentage of forest cover. According to country reports for FAO,¹⁷ all the GMS countries except Cambodia and Myanmar increased their forest cover during 2006–2015, with the Lao PDR reaching 81.3% of total land area.

¹⁶ Mekong River Commission, Basin Development Programme. 2011. *Planning Atlas of the Lower Mekong River Basin*. Phnom Penh and Vientiane.

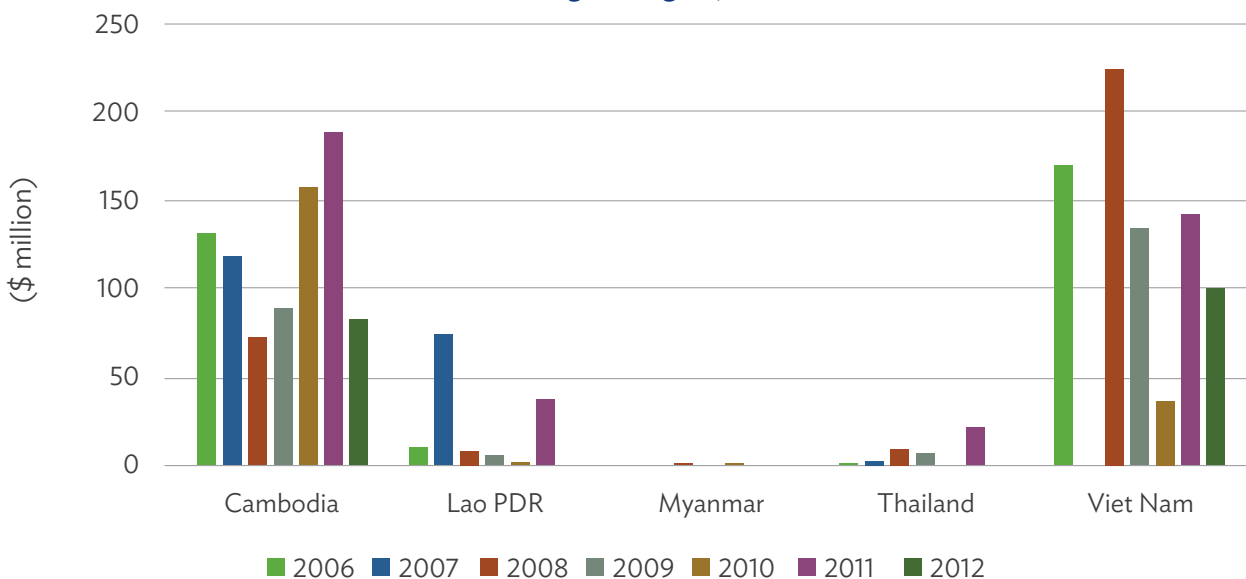
¹⁷ FAO. 2015. *Global Forest Resources Assessment 2015*. Rome.



▲ Deforestation near the Mekong River in the Lao PDR (photo from Shutterstock.com).

The drivers of deforestation and forest degradation in the GMS are poverty; weak governance; poor law enforcement; and international demand for timber, rubber, food, electricity, and minerals. The specific drivers of forest loss vary among the countries.¹⁸ In the Lao PDR, the demand for hydropower and expanding inflows of foreign direct investment (FDI) are key contributors to deforestation. FDI in the Lao PDR flows predominantly into agriculture, especially commercial tree plantations, and into mining and hydropower projects. The pattern of FDI in industrial agriculture across the subregion (Figure 11) shows that considerable investments have been made in Cambodia, Viet Nam, and, to a lesser extent, in the Lao PDR.

Figure 11: Foreign Direct Investment Inflows into Agriculture in the Greater Mekong Subregion, 2006–2012



Lao PDR = Lao People’s Democratic Republic.

Source: Food and Agriculture Organization of the United Nations. Foreign Direct Investment (FDI). <http://www.fao.org/faostat/en/#data/FDI> (accessed 14 October 2017).

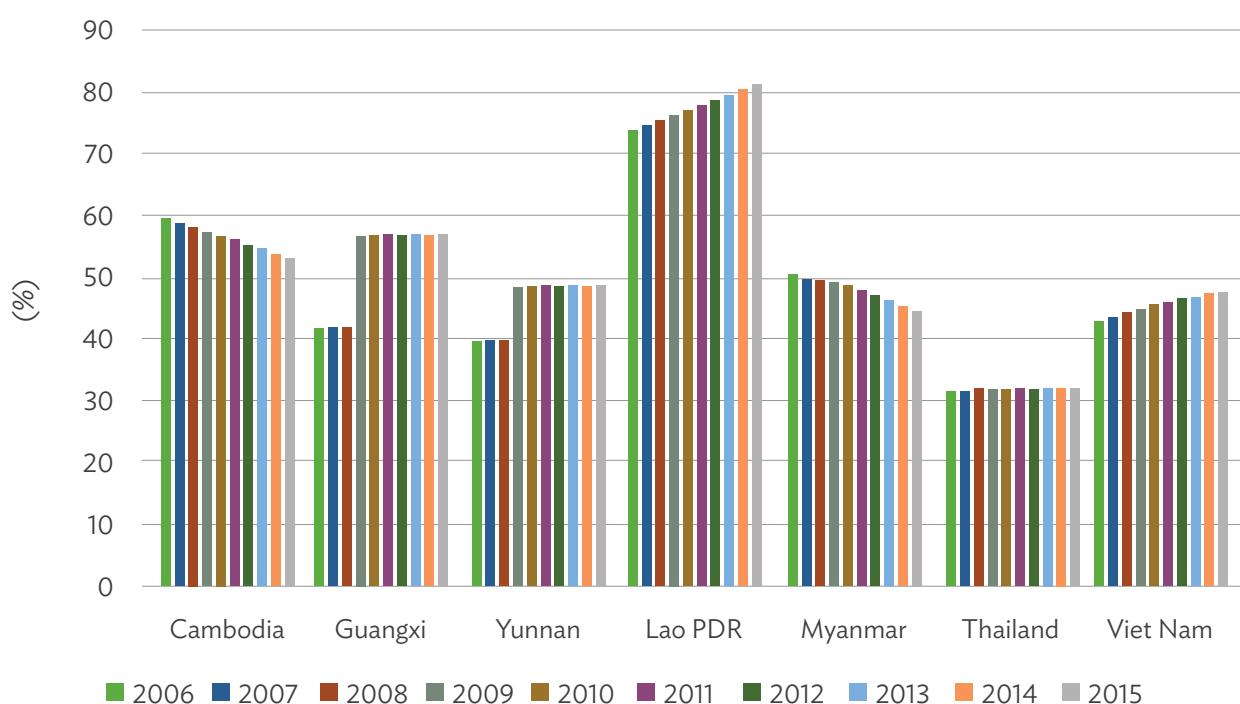
18 J. Costenbader et al. 2015. *Drivers Affecting Forest Change in the Greater Mekong Subregion: An Overview*. Policy Brief. Rome: FAO.

In Myanmar, the main driver of deforestation has recently been the government’s allocations of agribusiness concessions to areas with natural forest cover. Another driver is population growth, which has increased the demand for wood both for use in construction and as a fuel. Timber extraction, particularly of teak, often exceeds the annual allowable cut, thereby undermining sustainable forest-management efforts. In Viet Nam, drivers include both the increasing area dedicated to industrial crops and the high poverty rates in mountainous regions. In Yunnan, the commercial demand for wood and the demand for wood as an energy supply in rural areas are important drivers.

The pressures on forests in the GMS are generally high and increasing. In Cambodia and the Lao PDR, key pressures have been caused by forest conversion for agriculture, spurred on by government economic development policies. For example, Cambodia’s economic land concession (ELC) policy, which began in 1995, supported monoculture agro-industrial crops on plantations and forest clearing for agricultural expansion. Many concessions were subsequently cancelled as the government sought control over logging activities. What remained of the unpopular ELC policy was suspended in 2012 and curtailed in 2014. In the Lao PDR, the key sources of pressures leading to deforestation are shifting cultivation in upland areas, excessive logging, and land clearance for hydropower and mine development. In Myanmar, the key pressures come from wood removal for charcoal production and fuelwood, commercial logging operations that consistently exceed the annual allowable cut, and illegal logging in remote areas.

In general, the GMS countries use forest cover as a proportion of total land area as their state indicator. Yunnan also considers the quantity of forest stock by volume and by age. In all the countries except Cambodia and Myanmar, forest area as a percentage of total land area increased from 2006 to 2015 (Figure 12). Thailand and Viet Nam have reported the largest increases in monoculture forests, accounting for 80% of all forest plantations in GMS countries. Myanmar has seen the largest fall in forest cover and is ranked third-worst for forest loss in the world. Forest cover decreased from 50.5% to 44.5% of total land area from 2006 to 2015. The rate of forest loss in Myanmar is accelerating, rising from 0.9% annually during 2000–2010 to 1.8% annually during 2010–2015.

Figure 12: Forest Cover as a Percentage of Land Area in the Greater Mekong Subregion, 2006–2015



Lao PDR = Lao People’s Democratic Republic.

Source: Food and Agriculture Organization of the United Nations. FAOSTAT: Forest Land. <http://www.fao.org/faostat/en/#data/GF> (accessed 19 September 2017).

Forest cover statistics reported by GMS countries need to be carefully disaggregated to understand the relative contribution of forest resources to economic growth, in contrast to the importance of intact forests as biodiversity habitats. While reported forest cover includes primary forest, planted forest, and naturally regenerated forest, naturally regenerated forest predominates. Only in Thailand and Viet Nam does planted forest make a large contribution to the total forest area. Most of the changes in forest cover have been in naturally regenerated forests. Primary forests have decreased substantially in Cambodia, the Lao PDR, and Viet Nam, with worrying implications for dependent wildlife.¹⁹

It is important to note that the methodology for country reporting of forest cover has also changed, with forest cover now including plantation forests and calculated based on a 10% canopy cover as explained in Box 2. This change in methodology largely accounts for the significant changes in forest cover being reported by countries such as the Lao PDR, where forest cover doubled from 2010 to 2015.

The consequences of forest loss in the GMS, other than ecosystem-related impacts already covered in the section on Biodiversity and Habitat, include (i) the undermining of country efforts to achieve the MDGs and the SDGs, such as those relating to the livelihoods of forest-dependent households; (ii) infestations and disease associated with monocropping; (iii) the siltation of rivers and reservoirs; and (iv) weather-induced landslides on unstable slopes, with the ensuing fatalities and economic losses.

Box 2: Measuring Forest Cover

Forest resource statistics are complicated by the methodology used by countries in calculating and reporting forest cover. Forest quality and type vary greatly spatially, necessitating high-intensity surveys to collect accurate information. Many countries lack the financial and human resources required to collect such forest data. Measurement conventions and conversion factors additionally create difficulties in comparing statistics among countries and over time. Of particular interest is how forest resource definitions have contributed to significant increases in forest cover. Reported forest includes areas of different forest types (e.g., plantation forest, primary forest, agroforestry) and different species (e.g., bamboo, rubber), which are aggregated to give a figure of limited use in relation to the different values of forests. The inclusion of “potential” forests, as well as areas that are designated as forests but have no trees, may cause accounting problems in relation to forest values. Low forest-cover resolution may result in hidden deforestation. The Food and Agriculture Organization of the United Nations defines forest as any forested area with greater than 10% canopy cover; thus, changes in forest resources may not be captured until forests are very highly degraded.

Source: Food and Agriculture Organization of the United Nations (FAO). 2011. *Forests and Forestry in the Greater Mekong Subregion to 2020: Subregional Report of the Second Asia-Pacific Forest Sector Outlook Study*. Bangkok.

The establishment and management of protected or managed forest areas are a common response to forest loss in the GMS countries. Some countries have also promoted community forest management and introduced compensation schemes that support the efforts of farmers and local communities to protect their local forests.

Cambodia has focused on maintaining designated protected areas and recruiting additional forest rangers. The Lao PDR has taken a top-down approach, affirming state control over all forests, with centralized decision-making regarding who can use the forests and for what purposes. The government is increasingly trying to combat illegal logging and timber exports. It set a goal of 70% of total land area

¹⁹ Y. Yasmi et al. 2017. *Forest Change in the Greater Mekong Subregion (GMS): An Overview of Negative and Positive Drivers*. Bangkok: FAO.

under forest cover by 2020, with afforestation efforts concentrating both on reforestation and on the expansion of plantation forests (e.g., eucalyptus, rubber). This goal was achieved by 2015 following the reclassification of forest cover and type. The Lao PDR is receiving grant support from the Forest Carbon Partnership Facility's Carbon Fund to develop its National REDD+ Program and National REDD Strategy.

Myanmar has been focusing on setting up more forest reserves, called “permanent forest estates,” and has been spending more on forest management, reforestation, and on the natural regeneration of degraded forests. Thailand has focused on the maintenance and expansion of forest protected areas. Viet Nam has invested heavily in afforestation, including reforestation and rubber plantations, and has enacted policies on forest protection and development.

Viet Nam has a national Payment for Forest Ecosystem Services program, which compensates communities for sustainably managing and protecting their forests. It plans to link the program with REDD+, which rewards and compensates governments as well as communities for protecting forests and reducing emissions from deforestation and forest degradation.

Guangxi has also focused on reforestation, in order to satisfy the growing demand for industrial wood products, and requires logged areas to be quickly replanted. Yunnan is concentrating on controlling commercial logging operations, replanting forests in sloping areas, and promoting alternative energy sources to reduce household fuelwood use.

Land

Land degradation is of high concern in the GMS, affecting 10%–40% of land area there. Key contributors to land degradation vary among countries; they include forest loss, agricultural intensification, and growing upland populations and associated shifting cultivation. The resulting landscape changes have affected ecosystem services such as flood retention and erosion control.

The common drivers of land degradation are land use changes influenced by FDI, especially in Cambodia and the Lao PDR, in forestry, agriculture, hydropower, and mining development. In Yunnan, other factors contributing to land degradation include mountainous terrain with steep slopes containing poorly consolidated rocks and overlying red soils that erode easily and cause landslides and mudflows; and hazards that are exacerbated by the clearing of fields for agricultural use.

Key pressures on land vary across the subregion. The Lao PDR has become increasingly concerned about the effects that badly planned and mismanaged development projects can have on land. Foreign and domestic investments have involved concession arrangements between developers and the government whereby already degraded forests were replaced with rubber and eucalyptus plantations, rather than being regenerated with natural species. Mining concessions for gold, copper, iron ore, limestone, sand, and gravel have also caused land degradation. In Myanmar, growth in upland populations has increased upland farming and shifting agriculture to unsustainable levels in terms of land degradation. In Cambodia, Thailand, and Viet Nam high agricultural chemical inputs have been recognized as an unsustainable agricultural practice. In addition, Viet Nam is concerned that climate change is leading to intensifying desertification, salinization, leaching, erosion, and land loss due to sea level rises.

In Guangxi and Yunnan, the amount of cultivated land per capita and proportion of vegetation cover are used to gauge the impact of intensified cultivation of erosion-prone slopes and other fragile areas. For example, in Guangxi, 38% of the total land area is karst, of which 2.4 million hectares, or 29%, is subject to rocky desertification due to natural conditions and human activities. In Yunnan, 64% of the cultivated land is on slopes, creating a high potential for land degradation. Additionally, significant erosion is occurring in upland farmed areas.

Indicators of the amount or proportion of degraded land vary among the GMS countries. In Cambodia, rice yield has been improving, but the increased yields are mainly attributable to heavy agrochemical use, rather than to improved irrigation infrastructure and cultivation practices. Excessive chemical use is considered unsustainable and a cause of land degradation, among other negative impacts.

The Lao PDR categorizes land use changes for current forests, potential forest areas, other wooded areas, permanent agricultural land, and other non-forest areas. Trends show that natural forest areas have decreased since the late 1990s, while potential forests and permanent agricultural land area have increased. Myanmar tracks the proportion of vulnerable farmland of the total cultivated area, and has found it to be increasing. Thailand measures the area of various problem soils to track the threats from shallow and saline soils.



▲ A landslide caused by heavy rain in the Lao PDR (photo from Shutterstock.com).

Viet Nam uses two indicators to monitor land degradation: the area affected by desertification and the area of eroded soil or potential erosion. The country's rugged topography and high precipitation rates result in serious erosion on steep slopes, to the extent that about 28% of the country's total land area has become desert.

Guangxi also uses two indicators to assess land degradation: the total areas affected by soil erosion and rocky desertification; both are pointing to steadily deteriorating land conditions. Yunnan tracks the areas subject to soil erosion, the intensity of soil erosion, and the amount of sediment delivery by rivers. Data on all three indicators show that Yunnan has serious soil erosion problems.

Under-regulated land use changes in the Lao PDR, where the population is highly dependent on natural resources for food security and income, has affected household incomes and livelihoods. In Viet Nam and in Yunnan, land degradation has resulted in reduced crop productivity.

Country responses to land degradation include establishing policy frameworks, designating protected areas, rehabilitating soil, and introducing restrictions on chemical use.

Cambodia has focused on rehabilitating irrigation systems; regulating the importation and use of agricultural chemicals; and promoting integrated pest management, in which chemical control is minimized in favor of biological control and changes in farming practices.

The Lao PDR's response to land use changes has been in accordance with a land reform agenda, entailing allocating land for conservation, agriculture, and production forests; land titling; and a moratorium on ELCs.

Myanmar is undertaking land rehabilitation in cropping areas, promoting soil conservation methods to farmers, and establishing and managing forest reserves and protected public forests.

Thailand is rehabilitating degraded land according to the nature of the soil problem (i.e., acid soils, saline soils, infertile soils, and eroded surface soils), and is promoting organic cultivation techniques to decrease the misuse of chemical fertilizers and pesticides.

Viet Nam has worked to apply legal instruments and a policy framework for land preservation and conservation, involving the Land Law, Law on Environmental Protection, the National Strategy for Environmental Protection, and the Anti-Desertification National Program Act.

Guangxi responded to land degradation with efforts to preserve farmland-protection zones and to rehabilitate eroded areas. Yunnan is rehabilitating eroded areas, preventing soil erosion through investments in erosion treatment, and implementing the country's Natural Forest Protection Program.

Solid Waste Management

Countries undergoing rapid economic growth typically ignore problems associated with solid waste production and management until after they already pose a threat to human well-being and environmental health. The GMS countries are no exception.

In Cambodia, cities like Phnom Penh are struggling to respond to the volume of waste generated by a rising population, increased consumer consumption, and industrial development. The country is becoming progressively more urbanized, with the urban population increasing from 19.3% in 2006 to 20.9% in 2016. Phnom Penh's population is estimated to have grown from 1.3 million in 2008 to 2.2 million in 2014, an astonishing 41% increase. With economic growth and rising household incomes, waste generation per household has also increased. The expansion of tourism activities and development of industries are also major sources of solid waste. Because of poor waste-management infrastructure, uncollected waste has become a serious problem.

The situation in the Lao PDR is similar to that in Cambodia, with the continuing growth of the urban population, tourism, and industry creating increasingly large volumes of solid waste. The Lao PDR's urban population grew from 1.6 million in 2006 to 2.6 million in 2016. In Vientiane, the existing solid waste landfill site is adequately operated, but smaller cities and towns typically lack proper waste collection and disposal. The inadequacy of solid waste collection and disposal services has led households to rely mainly on burning or open dumping.

Myanmar's increasing population and accelerating pace of economic development are similarly generating increasing volumes of solid waste. In 2014, the urban population in Yangon was 5.2 million; 2.1 million in Mandalay, Myanmar's second-largest city; and 0.4 million in the administrative capital, Nay Pyi Taw. While solid waste generation per capita has remained constant or even declined in large cities, total waste generation is increasing as the urban population expands.

In Thailand, industrial development, population growth, urbanization, and changing lifestyles and consumer behavior have contributed to steadily increasing solid waste volumes. Thailand's population increased from 65.8 million in 2006 to 68.9 million in 2016. Daily waste generation per capita countrywide averages 0.64 kg. Waste generation is particularly high in major urban areas such as Bangkok and in tourist destinations such as Pattaya and Phuket. Waste generation steadily increased during 2006–2016, with some downward variation due to economic contraction.

In Viet Nam, investment in infrastructure, particularly for solid waste management, has lagged behind the country's socioeconomic development. Viet Nam's population increased by nearly 10 million during 2006–2016, from 82.9 million to 92.7 million. In urban areas, an improved standard of living has resulted in a more than 50% increase in average solid waste generation per household. Continued rapid industrial development has also resulted in increasing solid waste generation, including hazardous wastes. Urban expansion and renewal projects generate a lot of construction waste, much of which is not being properly disposed of.

Both Guangxi and Yunnan also face challenges in dealing with the high amount of waste generated by rapid population growth and urbanization. Moreover, waste treatment remains poor, and they are unable to effectively dispose of hazardous waste or deal with illegal and open dumping of large amounts of municipal solid waste.



▲ Refuse being sorted at a solid waste treatment plant in Thailand (photo from Shutterstock.com).

The main state indicator of solid waste management across the GMS countries is the percentage of waste collected (and properly disposed of). In Phnom Penh, a reported 63.9% of solid waste was collected in 2014, but this figure may not include waste generated in poorer parts of the city that are difficult to access by road. The waste is sent to a newer landfill opened in 2009 and expanded in 2015.

In the Lao PDR, waste collection efficiency has remained comparatively low. Less than 47% of solid waste is collected in cities and large towns. In Vientiane, with a 2013 population of about 0.8 million, 52% were served by municipal waste collection.

In Myanmar, waste collection capacity has generally been increasing in major cities. Yangon, for example, had a 92% collection rate in 2011–2012, but about 86% of the solid waste collected is disposed through traditional open dumping and the remainder recycled. While solid waste collection and disposal have improved considerably in Yangon and Mandalay over the last decade, the situation remains unsatisfactory in most of Myanmar's towns.

In Thailand, the ratio of generated to disposed solid waste shows significant differences, with a reported 100% of waste generated in major cities being disposed of in landfills, compared with less than 50% of municipal waste nationwide. Waste collection and disposal in nonmunicipal areas is less than 6%, reflecting the lack of collection systems and disposal sites in these areas.

Solid waste collection rates in Viet Nam rose from 60% to 82% in urban areas from 2002 to 2012, while collection rates in rural areas rose from 20% to 50% during the same period.

In Guangxi and Yunnan, the amount of domestic solid waste collected and transported has shown an overall increasing trend as waste collection and disposal systems continue to be improved. The amount of industrial and hazardous waste discharged outside designated disposal facilities and sites has decreased in response to government regulations requiring proper disposal.

Waste management in Phnom Penh has been improved through the implementation of environmental strategies and protection measures. The measures include establishing a comprehensive waste collection and disposal infrastructure; preventing pollution from toxic and hazardous waste (e.g., a dedicated landfill for industrial waste, incineration of medical waste); and adopting a reduce, reuse, recycle (3R) strategy. Despite efforts to improve garbage collection in the city, the responsible sole contractor has not been able to keep up with city growth and the ever-increasing volume of solid waste.

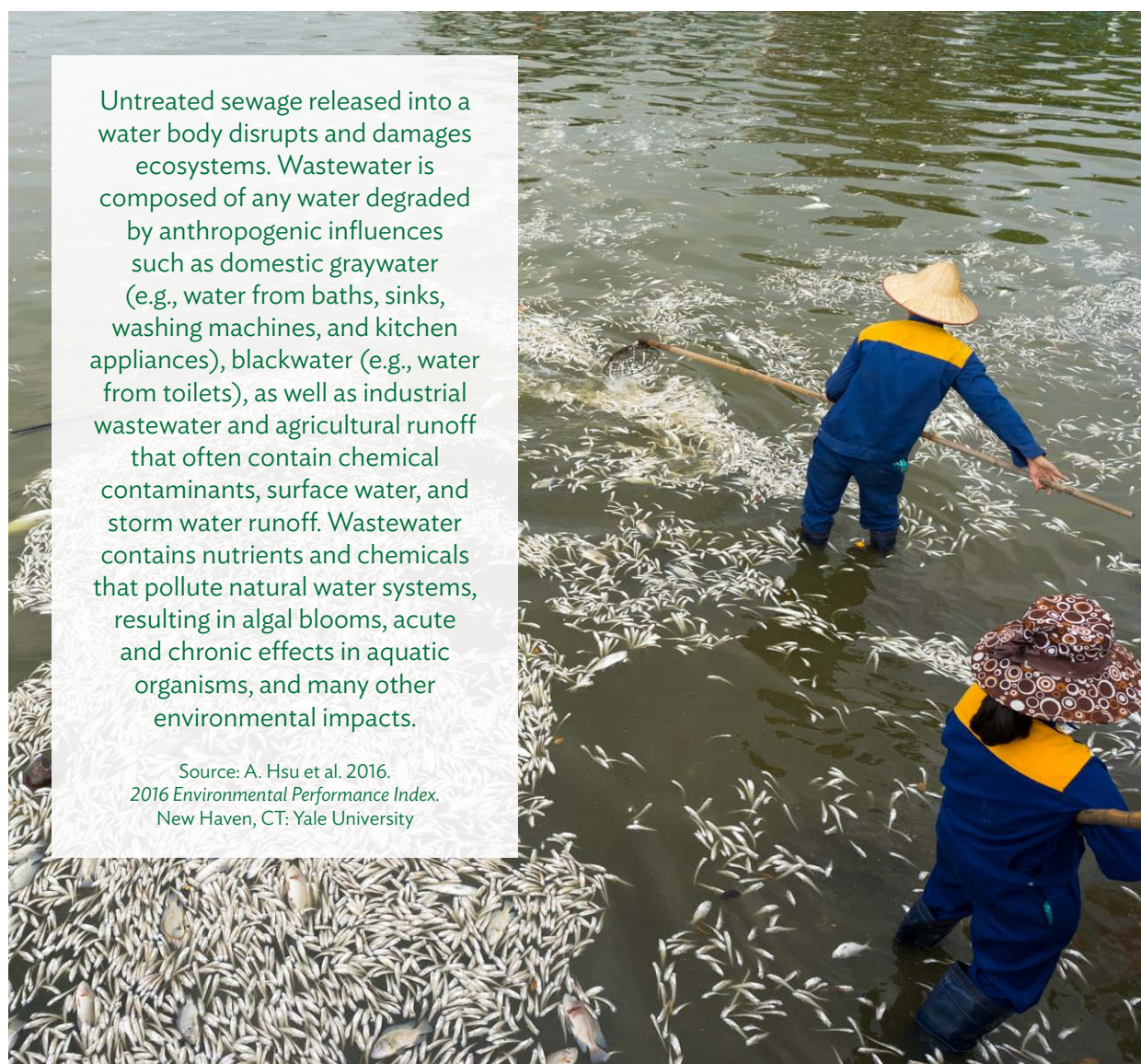
The Lao PDR introduced solid waste management facilities in five urban centers and improved waste collection systems through increased government expenditure, although the percentage of waste collected remains relatively low. Community involvement and the promotion of waste segregation and the 3R strategy have resulted in greater awareness and increased waste recycling. Myanmar recognizes the need for more efficient solid waste management systems as the country becomes more industrialized and urban populations and waste generation rates continue to grow. Additional solid waste management facilities are being established in Yangon and Mandalay. Thailand continues to invest in solid waste management systems and to promote a 3R strategy.

Responses in Viet Nam include revising their regulatory framework (environmental protection laws and strategy), introducing regulations for solid waste management, implementing plans to upgrade and build new solid waste treatment facilities in economic areas, and enforcing compliance with an existing environmental pollution regulation. Guangxi and Yunnan have made considerable investments in the construction of new waste-disposal facilities and improvements in collection and transportation systems in order to achieve the treatment capacity stipulated in their five-year plans; they have also invested in improvements in the control, storage, and disposal of industrial and hazardous wastes.

Water Resources

Water resources are a priority issue for most GMS countries, although they have different priorities regarding water quantity and quality. For the purposes of this assessment, the concerns about water resources center on (i) the pollution of water bodies due to release of wastewater from household, agricultural, and industrial sources; and (ii) the proportion of populations with access to safe drinking water and sanitation infrastructure.

The availability of renewable surface water resources varies widely in the GMS. In 2014, the Lao PDR had the largest per capita availability of water resources, at 28,952 m³/annum. Viet Nam had the highest per capita withdrawal rate of water resources, followed by Thailand. Over 90% of total annual freshwater withdrawal in the GMS countries is allocated to the agriculture sector, except in Guangxi (58.0%) and Yunnan (64.6%). Water withdrawal for domestic use, as a percentage of freshwater availability, is highest in Guangxi (23.4%), followed by Yunnan (15.5%), with the lowest in Viet Nam (1.5%). Although hydropower accounts for relatively little water consumption in the GMS, existing and planned hydropower development is probably the largest driver of change for water resources, as water is stored in reservoirs in the wet season and released in the dry season.



Untreated sewage released into a water body disrupts and damages ecosystems. Wastewater is composed of any water degraded by anthropogenic influences such as domestic graywater (e.g., water from baths, sinks, washing machines, and kitchen appliances), blackwater (e.g., water from toilets), as well as industrial wastewater and agricultural runoff that often contain chemical contaminants, surface water, and storm water runoff. Wastewater contains nutrients and chemicals that pollute natural water systems, resulting in algal blooms, acute and chronic effects in aquatic organisms, and many other environmental impacts.

Source: A. Hsu et al. 2016.
2016 Environmental Performance Index.
New Haven, CT: Yale University

▲ Dead fish being gathered from a lake in Ha Noi, Viet Nam (photo from Shutterstock.com).

Water Pollution

Common driver indicators of water pollution in the GMS countries include the size of the urban population, water consumption per capita, irrigation water consumption per hectare (ha), and the percent contributed by industry to the gross domestic product (GDP). The rate of GMS urbanization sharply increased from 28.8% to 36.2% during 2006–2016, without the concurrent development of wastewater treatment infrastructure, resulting in an increase in direct discharge of waste into water bodies. In 2006, GMS industries (not including Guangxi and Yunnan) contributed 28.5% of GDP and agriculture accounted for 30.2%. By 2016, industries contributed 33.2% of GDP while the share of agriculture fell to 20.2%. Although the amount of water used in agriculture may be decreasing somewhat, as is the total area under cultivation, the increasing amount of chemical fertilizers being used is causing corresponding increases in the pollution levels of discharges to receiving waters.

Pressure indicators vary among the GMS countries. Cambodia tracks agricultural and industrial water demand, chemicals in agricultural runoff, and industrial effluent discharges. Domestic wastewater discharges are also considered, in view of the rapidly growing urban areas where sewerage systems or wastewater treatment are deficient. The Lao PDR is less industrialized and less densely populated than the other GMS countries. However, it has been increasingly concerned about effluent discharges from industrial estates, surface water runoff from mining development, untreated domestic sewage from cities and towns, and increased chemicals in runoff due to intensified agricultural practices.

In Myanmar, rising urban populations, increasing industrialization, intensifying agriculture, and mining are the main sources of discharges containing nutrients, heavy metals, and organic pollutants. In Thailand, the deterioration of receiving water (e.g., rivers, lakes, coastal waters) quality is largely attributable to inadequate treatment of domestic wastewater. Industrial effluent discharges and agricultural runoff generate additional pressures, contributing toxic substances. Similar pressures occur in both Viet Nam and Yunnan, where water pollution is caused by discharges from domestic, agricultural, and industrial sources. In Guangxi, the rapid rate of urbanization has resulted in a significant rise in domestic wastewater discharges.

Although the GMS countries do not share common water quality standards, they are generally consistent in reporting the state of receiving waters. Countries with an established water quality monitoring network such as Cambodia, the Lao PDR, Thailand, and Viet Nam (which all participate in the Mekong River Commission Water Quality Monitoring Network) report annually on water quality using indices for the protection of human health and aquatic life. Myanmar currently monitors freshwater and marine water quality on a limited scale. Guangxi and Yunnan track the percentage of rivers meeting set standards for water pollution state. Water quality trends in the six major rivers in the GMS are summarized in Box 3.



▲ Turbines at a wastewater treatment plant in Thailand (photo from Shutterstock.com).

Box 3: Water Quality Trends in Major Rivers in the Greater Mekong Subregion

The Greater Mekong Subregion has six major rivers: the Ayeyarwady, Thanlwin, Chao Phraya, Mekong, Red, and Pearl. Apart from the Chao Phraya, these rivers originate in the mountainous terrain of the southwestern People's Republic of China (PRC). The combined catchments of these six rivers cover most of the subregion's land area.

Water quality in most of the subregion's rivers is generally good, but degradation exists, most prominently in river deltas and associated with high population densities and still inadequate domestic and industrial wastewater treatment. Water quality degradation is typically most prominent as rivers flow through large cities, where effluent and wastewater discharges cause increased pollution. Chemical pollution from agriculture is significant in the Chao Phraya, Mekong, and Red rivers. Irrigation-induced salinity affects parts of northeastern Thailand and the central Lao People's Democratic Republic (Lao PDR). Soil erosion, particularly in upland areas, also affects water quality.

The 2,170-kilometer (km) Ayeyarwady River runs the entire length of Myanmar, with a basin catchment area covering 413,710 square kilometers (km²), or roughly 61% of the total country area. Surface water quality indicates that conditions are partly satisfactory. Levels of nutrients, heavy metals, and organic pollutants indicate deteriorating water quality due to land-based discharges from agricultural, municipal, industrial, and mining sources.

The 2,815 km transboundary Thanlwin River has a basin catchment area of 271,914 km², of which 53% is in the PRC, 42% in Myanmar, and the remaining 5% in Thailand. Mining and deforestation, sometimes due to shifting cultivation, in the upper reaches of the river cause high sedimentation. Surface water quality indicates that conditions are partly satisfactory. Data on nutrients, heavy metals, and organic pollutants indicate deteriorating water quality due to land-based discharges from agricultural, municipal, industrial, and mining sources.

The Chao Phraya River is the most economically important river in Thailand, stretching 980 km. The basin catchment area is 178,785 km², covering 30% of the country's land area. While conditions in the upper and central reaches of the river are considered fair, water quality in the lower reaches has progressively worsened due to increasing discharges from domestic, industrial, and agricultural sources.

The Mekong River is 4,909 km in length from its source on the Tibetan Plateau in the PRC to its mouth in the Viet Nam delta. The basin has a catchment area of 795,000 km², extending over six countries—the PRC (21%), Myanmar (3%), the Lao PDR (25%), Thailand (23%), Cambodia (20%), and Viet Nam (8%). The population of the lower Mekong River Basin was approximately 65 million in 2016. The overall water quality in the river is good, although localized pollution occurs from agricultural, industrial, and urban sources. Water quality deteriorates progressively as the river flows downstream.

The Red River originates in Yunnan and flows 1,149 km through northern Viet Nam into the Gulf of Tonkin. The total basin catchment area is 169,000 km², of which 48% is in the PRC, 1% in the Lao PDR, and 51% in Viet Nam. The estimated basin population was 32 million in 2013. Water quality in the upper basin is generally acceptable, although localized deterioration occurs near urbanized areas. Water quality in the lower basin, where the river flows through intensively cultivated, industrialized, and urbanized areas, progressively deteriorates.

The Pearl River Basin comprises an extensive river system in the southern PRC and northeastern Viet Nam. The river is 2,210 km in length and has a total catchment drainage area of 409,480 km². Agriculture is the main use of the river's water in the PRC, accounting for an estimated 65% of water withdrawals, followed by 23% for industry, and 12% for municipal uses. The overall quality of the Pearl River is considered generally satisfactory, although some tributaries are considered extremely polluted.

Source: Asian Development Bank (ADB). 2012. *Greater Mekong Subregion: Atlas of the Environment* (2nd edition). Manila.

Degraded water quality can affect both human well-being and environmental health. Exposure of fish and aquatic organisms to polluted water causes both chronic and acute toxicity. Consumers of polluted water or fish containing high contaminant concentrations, and even persons exposed to polluted water, may suffer from chronic and potentially acute health conditions.

Country efforts to maintain acceptable water quality typically combine pollution-prevention strategies and control measures. Common GMS responses include public expenditure on domestic wastewater treatment; the introduction of stringent environmental quality standards for industry, along with penalties for noncompliance; and the regulation of agricultural chemical use combined with the promotion of integrated pest-management approaches. Corresponding response indicators include the total number and capacity of treatment facilities, enforcement of laws enacted to control the sources of the pollution, and investment in industrial wastewater treatment.

All GMS countries have environmental protection laws and pollution-control strategies. For example, in Cambodia the new National Environmental Strategy and Action Plan and forthcoming Environment and Natural Resources Code provide, among other things, strengthened environmental safeguards and pollution controls. Similarly, in the Lao PDR, the Environmental Protection Law and recently drafted National Pollution Control Strategy aim to prevent environmental degradation.

Drinking Water and Sanitation Access

All GMS countries prioritized access to safe drinking water and adequate sanitation, and committed to achieve the related MDG 7 target for this by 2015. A challenge faced by countries in achieving such targets has been the rising populations and changing population demographics. For example, in the Lao PDR, while the rural population has continued to outnumber the urban population, the proportions have shifted, with the rural numbers decreasing from 71.5% in 2006 to 60.3% in 2016. The increasing population and concentration of the population in urban areas represent pressures that will require effective and efficient responses to ensure that water and sanitation needs are met.

Good progress has been made in the GMS toward achieving MDG water and sanitation goals (Figures 13 and 14). For example, Cambodia aimed to improve access to safe water supplies from 30% of the population in 1998 to 58% in 2015. In 2006, access to safe drinking water was 55.1%, rising to 75.5% in 2015; far exceeding the modest target set. Cambodia did not achieve its sanitation target of 55%, with access to adequate sanitation rising from 26.6% in 2006 to 42.4% in 2015.

The Lao PDR's targets were to increase the proportion of the population with sustainable access to an improved water source from 58% in 2002 to 80% by 2015, and to increase the proportion of the urban population with access to improved sanitation from 42% in 1998 to 70% by 2015. In 2006, 59% of the total population had access to safe drinking water, which rose to 75.7% by 2015; 46.5% had access to adequate sanitation, rising to 70.9% in 2015.

Myanmar set a 90% target for both drinking water and access to sanitation by 2015. Access to safe drinking water increased from 73.5% to 80.6% of the population during 2006–2015, and access to adequate sanitation increased from 70.8% to 79.6%.

Despite these improvements, access to safe water and sanitation generally continues to be unequal. People living in rural areas and those from poor and marginalized groups are less likely to have access to improved water and sanitation facilities and less likely to enjoy piped water on premises (footnote 1).

Access to drinking water describes the proportion of a country's population with access to an "improved drinking water source," defined as a facility or delivery point that protects water from external contamination, particularly fecal contamination. This improved source could mean piped water into a dwelling or yard, a public tap or standpipe, a tubewell or borehole, a protected spring, or rainwater collection.

Access to sanitation describes the portion of a country's population that has access to toilets that provide the safe disposal of human waste. Improved sanitation sources include connection to a public sewer, septic system, pour-flush latrine, simple pit latrine, or ventilated pit latrine. The system is considered "improved" if it hygienically separates waste from human contact and is not a public or shared facility.

Source: A. Hsu et al. 2016.
2016 Environmental Performance Index.
New Haven, CT: Yale University.



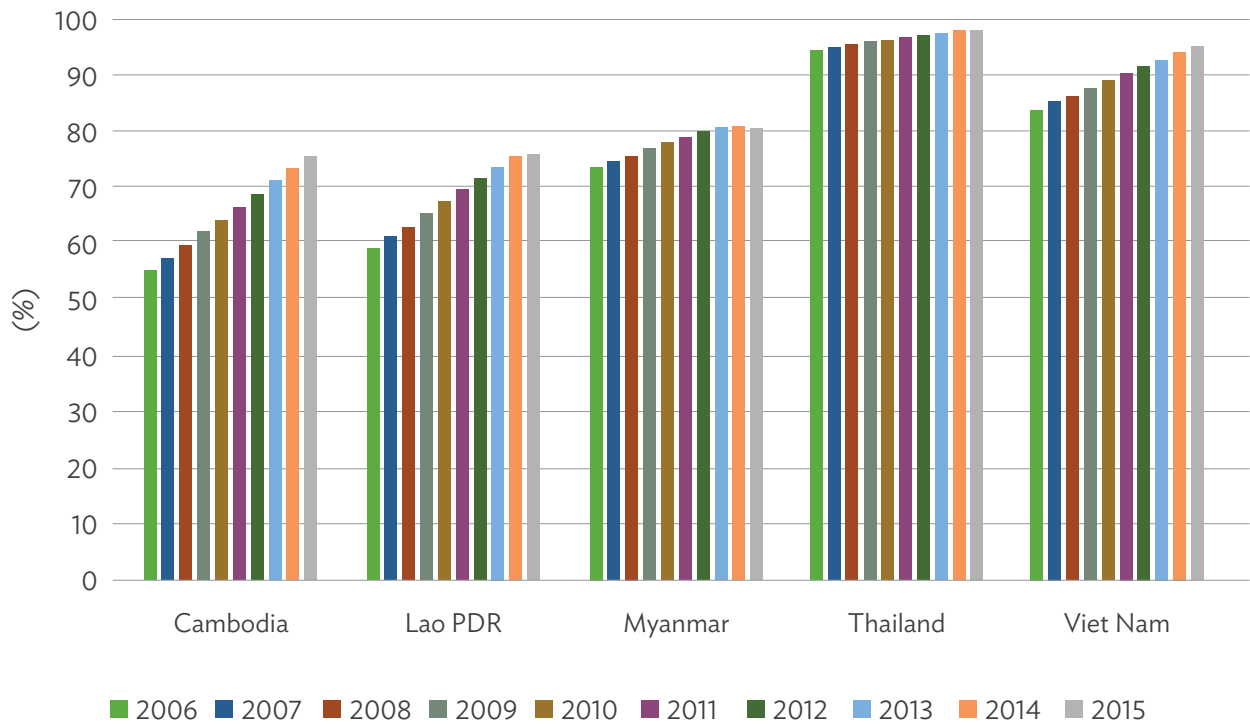
▲ A little girl drinking water from a well in the Central Highlands of Viet Nam (photo from Shutterstock.com).

Access to safe drinking water sources and adequate sanitation, particularly in rural areas, is a crucial consideration for households. Localized contamination of available water sources (e.g., multiple use of the same water source—for bathing, clothes washing, animal watering, and drinking water) is also a concern. Unsatisfactory drinking water and sanitation access have both high human health (i.e., morbidity and access time costs, typically borne by women and children) and economic costs. For example, in 2006, the Lao PDR lost an estimated \$193 million due to poor sanitation and hygiene, including spending on health care, loss of income or production and time losses associated with disease, and the value associated with premature loss of life.²⁰

The GMS countries used roughly the same response indicators to track progress toward drinking-water and sanitation MDG targets, variously reporting on urban and rural drinking water provision, and expenditure on drinking water supply and sanitation.

²⁰ The World Bank, Water and Sanitation Program. 2009. *Economic Impacts of Sanitation in Lao PDR*. Jakarta.

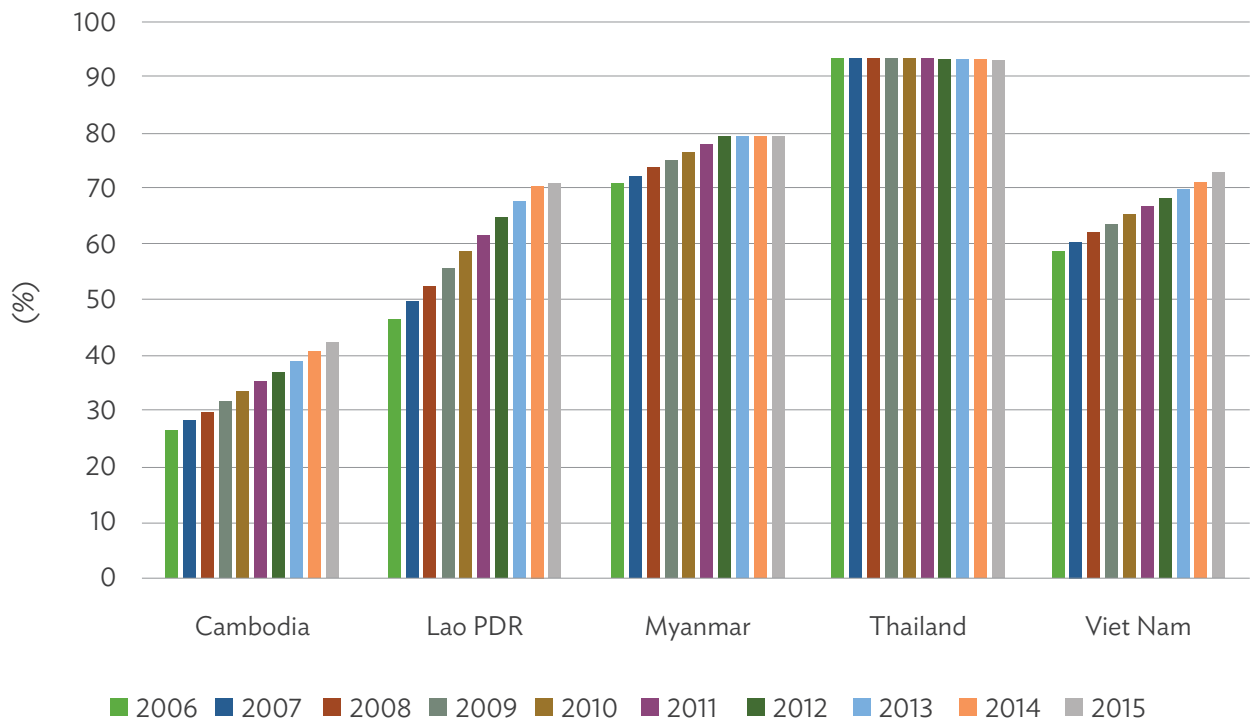
Figure 13: Percentage of Populations in the Greater Mekong Subregion with Access to Improved Drinking Water, 2006–2015



Lao PDR = Lao People’s Democratic Republic.

Source: The World Bank. People Using Safely Managed Drinking Water Services, Urban (% of Urban Population). <http://data.worldbank.org/indicator/SH.H2O.SAFE.UR.ZS> (accessed 14 October 2017).

Figure 14: Percentage of Populations in the Greater Mekong Subregion with Access to Adequate Sanitation Facilities, 2006–2015



Lao PDR = Lao People’s Democratic Republic.

Source: The World Bank. People Using Safely Managed Sanitation Services, Urban (% of Urban Population). <http://data.worldbank.org/indicator/SH.STA.ACSN> (accessed 14 October 2017).

5 LOOKING AHEAD IN PERFORMANCE ASSESSMENT

The GMS countries increasingly require robust data for assessing the sustainability of their development. Strengthening data production and using better data in policy making and monitoring are recognized as fundamental means of development. The monitoring of country progress toward achieving 2015 MDG targets and other natural-resource and environmental-protection targets clearly demonstrated that effective use of data can help to galvanize development efforts, implement targeted interventions, and track performance. Thus, “sustainable development demands a data revolution” to improve the availability, quality, timeliness, and disaggregation of data (footnote 1).

Despite improvements, key data needed for tracking Sustainable Development Goal (SDG) progress and for environmental performance assessment (EPA) reporting are still lacking. Poor data availability and quality can undermine country efforts to track future SDG progress and to assess the success of decisions and actions regarding natural resources and environmental management. Missing or poor-quality data represent a major limitation to indicator selection in EPA reporting, with the result that theoretically superior indicators are often overlooked in favor of indicators that are more readily quantifiable. The lack of timely data (e.g., the multiyear lag in forest-cover data updates) is an additional constraint that affects both the usefulness and relevance of the indicators being used.

Dissatisfaction with the availability and quality of existing data raises the question of what should and can be done. Country efforts to devote sufficient resources to the strengthening of statistical capacity are essential in this respect. To improve the availability, reliability, timeliness, and accessibility of data, national statistical capacities have to be enhanced. The strengthening and modernization of country statistical systems will require effective institutional arrangements, internal coordination, and technical coordination (footnote 1). An important finding of the EPA reporting experience in the GMS countries was that data and information are not being sufficiently shared, and that an effort needs to be made to reconcile conflicting or inconsistent data held by different government institutions. The development of data- and information-sharing platforms at the national and subregional levels in the GMS is making a major contribution to the tracking of SDG progress and to natural resource and environmental protection efforts. The GMS Information Portal, maintained by the GMS Environment Operations Center, provides charts, maps, tools, and geospatial data, and is a good example of a knowledge-sharing platform. Such platforms reflect the necessary direction for data and information sharing: toward a point where governments, international and regional organizations, the private sector, and civil society contribute data that are essential for evidence-based decision-making and accountability.

Greater Mekong Subregion Environmental Performance Assessment 2006–2016

This report presents the findings of an environmental performance assessment that covered the Greater Mekong Subregion (GMS) during 2006–2016. The GMS Environment Operations Center conducted the assessment, using the driver–pressure–state–impact–response model to examine the consequences of rapid economic development in the subregion, identify the major natural resource and environmental issues, and determine the effectiveness of responses by the GMS member countries. During the assessment period, the GMS Core Environment Program supported country efforts to address the subregion’s natural resources and environmental management challenges with its goal of creating an “environmentally friendly and climate-resilient GMS Economic Cooperation Program.”

About the Asian Development Bank

ADB is committed to achieving a prosperous, inclusive, resilient, and sustainable Asia and the Pacific, while sustaining its efforts to eradicate extreme poverty. Established in 1966, it is owned by 67 members—48 from the region. Its main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance.

About the Core Environment Program

The Core Environment Program (CEP) supports the Greater Mekong Subregion (GMS) in delivering environmentally friendly economic growth. Anchored on the ADB-supported GMS Economic Cooperation Program, the CEP promotes regional cooperation to improve development planning, safeguards, biodiversity conservation, and resilience to climate change—all of which are underpinned by capacity building. The CEP is overseen by the environment ministries of the six GMS countries and implemented by the ADB-administered Environment Operations Center. Cofinancing is provided by ADB, the Global Environment Facility, the Government of Sweden, and the Nordic Development Fund. Past cofinancing support was provided by the Government of Finland and the Government of the Netherlands.



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