CHAPTER 13

ENVIRONMENTAL SUSTAINABILITY AND CLIMATE CHANGE

13.1 Introduction

Asia’s economic transformation over the past half century has been dramatic. This has also meant that rapid industrialization, more material and energy consumption, and a larger, more urban population have exerted escalating pressure on the environment. The focus of policies in the region for most of the earlier part of the past 50 years has been “growth first, cleanup later,” in which environmental considerations had low salience and low policy priority. This led to the deterioration of forests, soil quality, freshwater ecosystems, ocean health, air quality, and biodiversity. The result has been millions of premature deaths\(^1\) annually from pollution, declining natural capital to sustain future production, increased ecosystem fragility, and other environmental imbalances.

Climate change has emerged as a critical global issue. Although developing Asia, historically, was not a major source of greenhouse gas (GHG) emissions (carbon dioxide plus nitrous oxide, methane, and others) on a per capita basis, emissions have been growing much more

---

rapidly than the global average as Asia’s growth accelerated, and energy systems have been fossil fuel dependent and carbon intensive. In 2014, Asia produced 44% of global carbon dioxide (CO₂) equivalent emissions, well above its share of global gross domestic product (GDP) (21%) and close to its share of global population (54%). In the same year, the annual per capita CO₂ emissions based on primary energy consumption were 11.6 tons for the Republic of Korea (ROK), 9.5 tons for Japan, and 7.5 tons for the People’s Republic of China (PRC), as compared with 16.5 tons for the United States and 9.6 tons for the Organisation for Economic Co-operation and Development (OECD) average (Chapter 8, Table 8.1). Asia’s natural resources are facing additional risks due to climate change, as rising global temperatures and acidification have worsened resource degradation and water stress. Asia is especially susceptible to extreme weather events such as droughts, hurricanes, and floods, as well as rising sea levels, loss of glacial water reserves, and coastal erosion.

As the effects of environmental problems and climate change amplified, Asian policy makers have taken steps to respond. Key environmental policies have been adopted across the region, including framework legislation, safeguard policies, and air and water quality standards. Environmental and climate change policies have made greater use of market-based instruments. Asia deepened its engagement in international environmental agreements, including submissions of ambitious “nationally determined contributions” (NDCs) under the Paris Agreement on climate change. The region is also becoming a leading exporter of green products and services, which help environmental performance globally.

Despite important steps to addressing environmental and climate change challenges, many gaps remain. Countries in Asia and the Pacific need appropriate price signals and stronger governance and institutions to make environmental policies work. Greater investment needs to be mobilized in infrastructure including for wastewater and solid waste management, air quality, clean energy and public transport, and sustainable land and water management practices (Chapter 8).

This chapter presents an overview of Asia’s environmental history, its current situation, and options for the future. Section 13.2 reviews key environmental subsectors, including terrestrial ecosystems, water resources, ocean health, solid waste, and air pollution. Section 13.3 looks at the issue of climate change. Section 13.4 discusses Asia’s environmental policy responses, including framework legislation,
standards, regulations, and market-based approaches. Section 13.5 describes Asia’s engagement in international environmental and climate change agreements. Section 13.6 assesses the green industry’s role in environmental solutions. Section 13.7 concludes and presents remaining challenges to enhance Asia’s transition to sustainability.

13.2 Increased environmental pressure

**Forests and land**

Forests and terrestrial ecosystems (such as wetlands, grasslands, and riverine systems) have faced pressure during Asia’s development. Forest transition theory posits that in the early stages of economic development and high levels of forest cover, deforestation is most rapid.\(^2\) With widespread forests, timber is accessible and has low transport costs, so that profits from extraction can be substantial. At that stage, agriculture has a high share of economic activity, and its relative returns are high, so there is incentive to expand cultivation into new areas. This is compounded by traditional extensive and shifting slash-and-burn cultivation practices, as well as rising population and food demand.

According to this theory, as economic development progresses, incentives for deforestation should fall. With technological improvements, labor and capital serve as more effective substitutes for land in agriculture. At the same time, structural transformation draws people out of agricultural production and rural areas. When accessible timber becomes depleted, transportation costs for extraction and transport rise, reducing deforestation benefits. At the same time, high income elasticity for recreation in natural areas can increase demand for forest preservation and visitation. The combination of these dynamics means that forest cover is often expected to follow a U-shaped pattern relative to economic development, with a rapid initial decline followed by reducing rates of decline and eventual afforestation.

Asia has experienced this pattern in part, but with strong regional differences (Figure 13.1). The PRC and Viet Nam have made reforestation efforts for several decades, starting at low levels of GDP. National logging bans, coupled with intensive state-driven reforestation policies from the 1980s onward, have helped increase forest cover and preserve natural forest in the countries. Yet this

---

has also led to increased demand for timber from neighboring countries with looser harvesting controls.\textsuperscript{3} In South Asia, forest cover has largely stabilized, with little change over recent decades. However, Southeast Asia has had continuing deforestation, as loss of natural forest cover was substantial at 41.6 million hectares from 1990 to 2015. Issuance of forest concessions on public land has been an important driver of this loss, much of which has been in areas of high biodiversity and carbon storage.\textsuperscript{4} These concessions have transferred valuable timber to concessionaires who often have reimbursed the state less than the market value of wood that is harvested, so that forest clearance is implicitly subsidized.

Forestlands allocated for concessions are often inhabited by indigenous populations without recognized tenure, so that the

---


allocation often leads to conflicting claims of ownership and loss of customary lands. Many populations who customarily used concession areas practiced slash-and-burn cultivation, which entails cycles of forest burning followed by cropping and fallow periods for natural forest regeneration that are sustainable if carried out at low frequency. However, for those pushed aside by concessions, regeneration cycles become compressed on their remaining areas, making slash-and-burn cultivation unsustainable.

With ownership contested, concessionaires also faced uncertainty about the ability to capture future returns from forests, and this uncertainty incentivizes rapid timber extraction. Improved infrastructure also lowered transport costs to forest areas over time, further raising the value of standing timber and incentives for logging. As a result, although planted and secondary forest cover has expanded in Asia overall, reforestation has not restored the ecological functions of natural forests in terms of biodiversity and carbon storage.

Where deforestation is widespread, biodiversity has been lost rapidly. However, even where overall natural forest cover remained stable, biodiversity is still threatened due to climate change, pollution, and destruction of other important ecosystems. Projected levels of mean species abundance are falling across the region (Figure 13.2).

Beyond forests, land has been increasingly degraded, via loss of productive potential through removal of nutrients, topsoil erosion, or contamination, with Asia accounting for more degraded land than any other world region. The region also has a higher share of rural population residing on degrading agricultural land than the rest of the world, with particularly high shares in East Asia, Southeast Asia, and Central Asia (Table 13.1).

---

Land degradation includes human-induced processes that reduce the productivity of land or level of environmental services. Erosion is the most widespread process, and water is the main mechanism of erosion, followed by wind. Agriculture is a major driver of erosion, as most crop production in the region remains under intensive tillage with limited use of cover crops or other soil conservation techniques, and large areas of public pasture remain with limited governance of livestock density. Many riparian areas have been highly degraded and eroded due to urban encroachment and unregulated cropping. Wetland area declined in Asia by 30% from 1970.

to 2015.\textsuperscript{11} This accumulated impact from degradation has made much of developing Asia more vulnerable to water stress and flooding, with reduced agricultural productivity potential.

Table 13.1: Rural Population Residing on Degrading Agricultural Land by Region, 2010 (million)

<table>
<thead>
<tr>
<th>Regional Classification</th>
<th>Total Population</th>
<th>Rural Population</th>
<th>Rural Population on Degrading Agricultural Land</th>
<th>Percentage Share of Rural Population on Degrading Agricultural Land (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developing Asia</td>
<td>3,669.0</td>
<td>2,824.3</td>
<td>1,121.6</td>
<td>39.7</td>
</tr>
<tr>
<td>Central Asia</td>
<td>79.4</td>
<td>50.2</td>
<td>23.0</td>
<td>45.8</td>
</tr>
<tr>
<td>East Asia</td>
<td>1,395.7</td>
<td>1,068.3</td>
<td>595.2</td>
<td>55.7</td>
</tr>
<tr>
<td>South Asia</td>
<td>1,597.3</td>
<td>1,284.0</td>
<td>336.1</td>
<td>26.2</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>588.9</td>
<td>414.8</td>
<td>166.9</td>
<td>40.2</td>
</tr>
<tr>
<td>The Pacific</td>
<td>7.7</td>
<td>7.0</td>
<td>0.4</td>
<td>5.9</td>
</tr>
<tr>
<td>Developed Asia</td>
<td>153.3</td>
<td>33.9</td>
<td>4.5</td>
<td>13.1</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>592.2</td>
<td>335.7</td>
<td>48.2</td>
<td>14.4</td>
</tr>
<tr>
<td>Africa</td>
<td>994.1</td>
<td>812.0</td>
<td>184.0</td>
<td>22.7</td>
</tr>
<tr>
<td>North America</td>
<td>346.1</td>
<td>71.5</td>
<td>11.4</td>
<td>15.9</td>
</tr>
<tr>
<td>Europe</td>
<td>778.1</td>
<td>375.0</td>
<td>90.7</td>
<td>24.2</td>
</tr>
</tbody>
</table>

Note: Africa includes both Sub-Saharan Africa and North Africa.

Chemical contamination of land has increased dramatically.\textsuperscript{12} This occurred through several processes. Uncontrolled dumping of hazardous waste occurred due to both poor regulatory enforcement


and by accidents, and watercourses and wind have carried this waste over large areas of land. As agriculture became more input intensive, pesticide and fertilizer application rates rose to levels far above the world average in many Asian countries, which spread chemical contamination problems to large areas.

Quantities of untreated sewage in Asia’s waterways have grown rapidly, along with use of sewage wastewater for irrigation, which has introduced heavy metal contamination problems. Irrigation using groundwater in arid conditions also led to substantial soil salinization in South Asia and Central Asia.

**Water resources**

In Asia, water supply has improved over time to better meet agricultural, household, and industrial demand. Irrigated area has expanded greatly, contributing to agricultural development, and water supply infrastructure has expanded. Improved water access has meant that water withdrawal also rapidly increased, with growing competition for consumption among agricultural, energy, industrial, and household users. Rising withdrawals have led a number of countries, especially in Central Asia, to use more water resources than are renewed each year.

A majority of water supply, especially for irrigation, is under direct and indirect subsidies, which further encourages overuse. Water-intensive activities, such as rice cultivation, have also been subsidized, intensifying demand. In arid and semiarid areas of South Asia, wells are a primary source of fresh water, and they often operate under electricity subsidies. Overextraction of groundwater has led to arsenic contamination of groundwater resources, and excess use of irrigation has led to soil salinization. It has also caused falling groundwater tables, increasing economic costs for water access, and greater scarcity.

Pollution pressure on surface fresh water has been rising. Overuse of chemical fertilizers, encouraged by subsidies, has led to nutrient runoff, driving freshwater eutrophication. Industries developed with little effluent control also deteriorated water quality.

---


Even with growing household water supply and wastewater collection, only one-third of wastewater is treated (Table 13.2). This means that severe pathogen pollution is estimated to affect about one-third to one-half of Asian river stretches.

Table 13.2: Proportion of Wastewater Receiving Treatment, Selected Economies, Developing Asia, 2011

<table>
<thead>
<tr>
<th>0%–5%</th>
<th>6%–19%</th>
<th>20%–60%</th>
<th>61%–90%</th>
<th>91%–100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>Fiji</td>
<td>Azerbaijan</td>
<td>Malaysia</td>
<td>Hong Kong, China</td>
</tr>
<tr>
<td>Armenia</td>
<td>Mongolia</td>
<td>India</td>
<td>India</td>
<td>Palau</td>
</tr>
<tr>
<td>Cambodia</td>
<td>Philippines</td>
<td>People’s Republic of China</td>
<td>Republic of Korea</td>
<td></td>
</tr>
<tr>
<td>Bangladesh</td>
<td>Viet Nam</td>
<td>Taipei, China</td>
<td>Thaïland</td>
<td>Singapore</td>
</tr>
<tr>
<td>Bhutan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Indonesia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lao PDR</td>
<td>Myanmar</td>
<td>Malaysia</td>
<td>Malaysia</td>
<td></td>
</tr>
<tr>
<td>Mongolia</td>
<td>Nepal</td>
<td>Pakistan</td>
<td>Pakistan</td>
<td></td>
</tr>
<tr>
<td>Papua</td>
<td>New Guinea</td>
<td>Philippines</td>
<td>Republic of China</td>
<td></td>
</tr>
<tr>
<td>Solomon Islands</td>
<td>Sri Lanka</td>
<td>Tajikistan</td>
<td>Turkmenistan</td>
<td></td>
</tr>
<tr>
<td>Timor-Leste</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uzbekistan</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Lao PDR = Lao People’s Democratic Republic.

Notes: Only economies with available data are included. Reporting year is latest year with available data from 2006 to 2015. Most data are from 2011.


---


**Ocean health**

With rising incomes, Asia’s demand for fish and seafood rose rapidly, even as marine resources have deteriorated. Although fish farming also expanded quickly, most fish supply originates from capture fisheries, which face falling maximum sustainable yields. Annual fish catches have grown nine times over the past 50 years, and have utilized increasingly effective techniques (Figure 13.3). This is further compounded by increasingly globalized fishing fleets that operate in areas far from their countries of registration, so that there is more competition to harvest fish from open-access common marine resources.

![Figure 13.3: Capture Fisheries Production, Developing Asia, 1960–2017](image)

**Notes:** Data availability varies across countries over time. Fish catches are reported by country of the vessel performing the catch.

By 2013, 90% of marine areas globally were considered overfished, and global fish catches peaked in the 1990s, even as fishing effort intensified. The decline in fish production has been particularly pronounced in East Asia, with the decline driving fleets from the subregion into other Asian and Pacific waters to capture fish. Underreporting of fish catches in the region hampers governance of fisheries. Enforcement of regulations has proven difficult, particularly in areas beyond national jurisdictions.

Capture fisheries have relied partially on the use of indiscriminate nets (often prohibited) and illegal explosives in blast fishing, which have destroyed ocean habitat and coral resources. Coastal developments and pollution have further aggravated the loss of key habitats and biodiversity areas.

Ocean health continues to suffer from uncollected and inappropriately disposed waste, leading to accumulated plastic and other waste materials that threaten marine ecosystems. By one estimate, nearly 25% of plastic waste in the oceans is deposited by 10 river systems, of which seven are in developing Asia. Another set of estimates (Figure 13.4) show that 55%–60% of the 8 million tons of plastic entering oceans annually comes from five developing Asian countries. These plastics degrade into microplastics that threaten a range of organisms when ingested and passed through the food chain. This is of particular risk to plankton, as microplastics displace normally ingested food sources and reduce reproductive ability, and loss of plankton has effects that cascade across marine food chains.

**Solid waste**

As rapid growth and urbanization led to increasing material production and consumption, the ability to deal with the collection, disposal, and treatment of waste by-products has not kept pace. The result is a mounting solid waste problem, especially in urban areas. Waste

---


pressure has grown rapidly, as material consumption escalated in the region from 15 billion tons of material in 1992 to 52 billion tons in 2017. As of 2010, only around half of waste was collected in the region with a small share disposed of appropriately (Figure 13.5).

Generation of hazardous waste, such as those in disposed electronics, has grown even faster than overall waste levels. Recycling rates of collected municipal solid waste have also remained low. These statistics show how far the region remains from a “circular economy.” The social costs of waste are rarely recovered from user charges, so that excess waste generation is implicitly subsidized.

Figure 13.4: Plastic Waste Disposal in Oceans, 2010
(million tons)

PRC = People’s Republic of China.

---

Air pollution

Much of Asia’s economic growth has been fueled by increasing reliance on coal, oil, and gas-based energy for an expanding array of uses. Until recently, most fossil fuel consumption was combusted with limited pollution control, with large amounts of sulfur dioxide (SO2), nitrogen oxides (NOx), volatile organic compounds, ozone, carbon monoxide, and particulate matter released. These emissions were most intense in urban areas, where high population densities live in close proximity to pollution.

In developing Asia, fine particulate matter (PM2.5) emissions increased by 121% from 1970 to 2010 (Figure 13.6), while NOx rose 168% and SO2 grew by 238%. Overall, in low- and middle-income countries, 97% of cities with more than 100,000 inhabitants do not meet the air quality guidelines of the World Health Organization.25 Asian cities in

---

Bangladesh, India, Pakistan, and the PRC are among the world’s most polluted.\textsuperscript{26}

Trends are slightly better for coarser particulate matter (PM10), as improved roads reduced dust, and indoor air pollution dropped due to greater ventilation and greater use of cooking gas. However, the overall health impact of air pollution has risen, with 4.2 million premature deaths estimated in 2016 in developing Asia.\textsuperscript{27} In addition, SO\textsubscript{2} and NO\textsubscript{x} have driven escalating levels of acid rain, which damaged forests and aquatic ecosystems in the region.\textsuperscript{28}

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure13_6.png}
\caption{PM2.5 Emissions by Region, Developing Asia, 1970–2010}
\end{figure}

PM2.5 = fine particulate matter.

Note: Data availability varies across countries over time.

13.3 Climate change

A more fossil fuel-intensive energy mix has meant that GHG emissions have risen rapidly with economic growth (Chapter 8). This was driven by expanded electrification, coal’s dominance in power generation mixes, and expanded use of gasoline-powered transport. These trends have been underpinned by subsidies given for fossil fuels during much of the past 50 years, although progress has been made in subsidy reduction during the past decade. More recently, many countries have developed ambitious plans for renewable energy development, but as in many developed countries, power development patterns often remain more fossil fuel-based in practice. In Southeast Asia, deforestation also became a major source of emissions, as a substantial share of forest clearance occurred on peatlands that contain thousands of tons of carbon per hectare, which are emitted as the forest is lost.

As a result, GHG emissions rose faster in developing Asia than in any other region globally between 1990 and 2014 (Figure 13.7), with its share in global emissions increasing from 23% to 44% during the same period (Figure 13.8). Developing Asia is projected to increase this to half of global emissions by 2030.29 Historically, per capita emissions in developing Asia were well below the rest of the world, although by 2014, they were approaching the global average.30

Developing Asia is one of the world’s most vulnerable regions to the impact of climate change, so these trends place the region’s future at peril.31 Asia’s substantial population dependent on agriculture and natural resources will be affected by more droughts, floods, salinity intrusion, and pest and disease epidemics for crop production under climate change. Reduced water availability for irrigation and increased water demand under higher temperatures will increasingly constrain production. Hundreds of millions of people in the region work in manual labor that is already limited by temperatures during hot seasons. As peak temperatures rise even further, productivity will be lost in sectors where cooling is not possible, and elsewhere additional cooling will be at the expense of substantial energy consumption.

Human health will also be impacted by increased cardiovascular mortality from heat stress and the induced spread of mosquito-borne diseases such as malaria and dengue.

Asia has very densely populated lowland delta areas that are at high risk from sea-level rise, as are low-lying atolls in the Pacific. Increased storm surges during high magnitude cyclones, which are expected to increase in frequency under climate change, will compound these effects and salinize fresh water, including groundwater. More frequent floods and landslides from intensified rainfall and storms will expose other populations to increased disaster risk as well.

Rising global temperatures have exacerbated natural resource degradation. Approximately 95% of coral reef area in Southeast Asia is considered highly threatened by rising ocean temperatures and acidification. Tropical Asian forests will be severely affected by increasing frequency of fires and by water stress. Under climate

---


change projections, water scarcity will likely rise from affecting 1.2 billion people in Asia in 2010 to 1.9 billion by 2050, as rainfall declines over large portions of already semiarid South Asia. Rainfall will become more concentrated and variable in other regions.

Asian Development Bank (ADB) estimates of potential climate change impacts in developing Asia range from annual losses of 5% of

---

GDP by 2100 in East Asia to 9% in South Asia and 11% in Southeast Asia. A recent ADB econometric analysis, based on historical relationships between temperature fluctuations and growth, suggests potential losses of 10% of GDP annually for developing Asia, as a whole, by 2100 in the absence of policies to mitigate climate change.

13.4 Asian efforts to address environmental and climate challenges

Drivers of policy development

Although Asia’s environment has many negative trends, problems could have been even worse without the concerted actions of countries in the region. Important improvements have come from improved environmental governance that addresses market and institutional failures, such as externalities, inadequate regulatory and enforcement capacities, and other policy constraints.

The positioning of a country with regard to environmental policies can logically be related to the costs and benefits that the country experiences from environmental protection actions. When environmental problems are not perceived as having large detrimental effects and abatement costs are considered high, environmental action appears unwarranted, and this may induce environmental policies that are neither ambitious nor binding. Conversely, the larger the perceived effects, and the lower the abatement costs, the more environmental action will be justified with environmental policies expected to have greater effect.

Over time, these two elements have shifted in Asia. The effects of environmental problems have grown dramatically, with more populations exposed to air and water pollution, and are increasingly recognized by the public. Increased demand for environmental amenities as superior goods (meaning income increases led to greater demand) amplifies how environmental effects are perceived and valued. At the same time, technological improvement has reduced the cost of many environmental protection measures, especially those implemented by adopting technologies already available in developed markets. Thus, the shift in perceived costs and benefits of


environmental policies induced a transition toward more meaningful environmental protection in the region.

This dynamic was initially most visible in the most advanced economies of Asia. Japan in the 1960s experienced a number of high-profile mercury and cadmium poisoning incidents that drew serious attention to industrial pollution problems. Affected people, including many mothers, advocated for action. Within a decade or so, important court decisions were issued, major environmental legislation was passed, and polluting industries were liable to compensate those affected. In the 1970s, action moved on to air pollution and wastewater effluents, and progressively tackled more complex challenges. The ROK and Taipei, China also began to forcefully implement similar environmental measures in the 1980s.

In parallel to these domestic developments, a series of international events drew increasing attention to environmental problems and helped spur responses. In 1972, the Club of Rome released *Limits to Growth*, which showed the consequences of natural resource depletion, and in the same year, the United Nations (UN) Conference on the Human Environment resulted in the first international declaration on the environment. The Brundtland Commission released *Our Common Future* in 1987, which provided the first internationally recognized definition of “sustainable development” and agreement on a multilateral approach to environmental policy.

At the UN Conference on Environment and Development in Rio de Janeiro in 1992, the Convention on Biological Diversity, UN Framework Convention on Climate Change, and UN Convention to Combat Desertification were signed, and Agenda 21 was agreed. This laid the foundation for intensified actions and agreements at the Earth summits in 2002 and 2012, the 1997 Kyoto Protocol and 2015 Paris Agreement on climate change, and the Millennium Development Goals (2000) and Sustainable Development Goals (2015).

Throughout these international processes, representatives from Asia and the Pacific played active roles. For example, since 2015, the Philippines, Fiji, and the Marshall Islands have successively chaired the Climate Vulnerable Forum that advocates ambitious climate action under the Paris Agreement.

---

Progress in implementing key policies and measures

International developments and the recognition of both the benefits of environmental action and costs of inaction helped spur improvements in developing Asia. Starting in the 1970s, developing Asian countries established laws, regulations, risk-appraisal procedures, and administrative agencies focused on environmental protection. Most of the early approaches focused on defining aspirational goals and creating command-and-control regulations in what may be termed a “do no harm” approach. However, uncoordinated regulations, weak incentives, and limited enforcement capacity reduced the effectiveness of environmental policies.

To address this, environmental laws and policies were revised, reformed, and strengthened from the early 1990s onward, although the process still remains partial and ongoing. By early 1990s, nearly all developing Asian economies had framework environmental legislation (Table 13.3). In parallel to the establishment of this legislation, line ministries on the environment also emerged and enforcement capacity was strengthened. Approaches became more proactive and included increasing numbers of incentives for environmentally friendly actions, in addition to restrictions on activities with greater environmental risks.

Environmental quality standards have been established by almost all developing Asian economies. For air quality, standards are almost universal for SO₂ and NOₓ, and most economies have standards for ozone and fine particulate matter (PM2.5). Most standards were introduced in the 1990s. Water quality standards were adopted after air quality standards in much of the region. However, almost all of the standards are less strict than those recommended by the World Health Organization.

The diffusion of environmental safeguard policies for infrastructure investments has followed a similar path. While only 11 economies in developing Asia had environmental impact assessment requirements before 1990, most had established these requirements a decade later.

The threat of climate change has also been recognized by all economies in the region, as they quickly established national climate change policies. Within developing Asia, the ROK was the only country in 1999 that had established overarching cross-sectoral climate policies,

---

in addition to climate change-related policies for particular sectors such as energy. By 2012, a majority of developing economies in Asia and the Pacific had adopted climate change policies.

Economies in the region have proactively engaged in international climate finance mechanisms such as the Clean Development Mechanism (CDM) (which enabled selling of emission reduction offsets from mitigation projects in developing countries to help developed countries meet Kyoto Protocol commitments). Almost 80% of certified emission reduction credits under the CDM have originated from the region. The CDM is the first international market-based mechanism that incentivized the private sector in developing Asia to invest in climate action. Going forward, countries have also committed ambitious climate targets under the Paris Agreement, including peaking their GHG emissions (for example, the PRC by 2030), and aiming for up to 100% renewable energy electricity generation (the Cook Islands by 2020, Tuvalu by 2025, and Fiji and Vanuatu by 2030) and carbon neutrality (Bhutan).

**Evolving approaches to environmental policy**

Policy makers in the region have increasingly mainstreamed attention to the environment in their development strategies. For example, the Government of Indonesia put environmental sustainability as one of its three development pillars in its 2010–2014 Medium-Term Development Plan. Similarly, the PRC’s 13th Five-Year Plan (2016–2020) also placed “eco-civilization” at the center of its development path. The Government of India made sustainable development a core pillar in its 2017–2020 Action Agenda, creating a new central body to oversee achievement of the Sustainable Development Goals.

As environmental regulation matured in developing Asia, market-based policy instruments emerged as a means of directly addressing incentive problems related to outcomes, in addition to regulations. Market-based instruments used in the region include taxes, fees, or charges; subsidies; tradable permits; cap-and-trade and emission trading schemes; payments for ecosystem services; and information provision, labels, and voluntary agreements.

For air pollution and climate change mitigation, market-based policy instruments are already used by some countries to control emissions, and promote energy efficiency and renewable energy. For example, tradable permit schemes are in place to control CO₂ and
Table 13.3: Water and Air Quality Standards, and Establishment of Environmental Ministries in Developing Asia

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment of water quality standards</td>
<td>Brunei Darussalam</td>
<td>India</td>
<td>Malaysia</td>
<td>Philippines</td>
<td>Taipei, China</td>
<td>Hong Kong, China</td>
</tr>
<tr>
<td>Establishment of air quality standards</td>
<td>Hong Kong, China</td>
<td>Taipei, China</td>
<td>India</td>
<td>Armenia</td>
<td>Cambodia</td>
<td>Georgia</td>
</tr>
</tbody>
</table>

continued on next page
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Establishment of dedicated environment ministries and/or departments</td>
<td>Bangladesh</td>
<td>Hong Kong, China</td>
<td>Armenia</td>
<td>Afghanistan</td>
<td>Cambodia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Indonesia</td>
<td>India</td>
<td>Bhutan</td>
<td>Azerbaijan</td>
<td>Federated States</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marshall Islands</td>
<td>Papua New Guinea</td>
<td>Georgia</td>
<td>Cook Islands</td>
<td>of Micronesia</td>
<td></td>
</tr>
<tr>
<td></td>
<td>People’s Republic of China</td>
<td>Philippines</td>
<td>Kyrgyz Republic</td>
<td>Kazakhstan</td>
<td>Lao PDR</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Singapore</td>
<td>Samoa</td>
<td>Pakistan</td>
<td>Malaysia</td>
<td>Mongolia</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sri Lanka</td>
<td>Republic of Korea</td>
<td>Myanmar</td>
<td>Turkmenistan</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Taipei, China</td>
<td>Palau</td>
<td>Palau</td>
<td>Uzbekistan</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tajikistan</td>
<td>Solomon Islands</td>
<td>Thailand</td>
<td>Viet Nam</td>
<td></td>
</tr>
</tbody>
</table>

Lao PDR = Lao People’s Democratic Republic.

Notes: Economies with environment ministries merged with other functions and those with unclear establishment dates are not included. Year used for legislation is the year when separate legislation was adopted for air quality and water quality.

Sources: Environment ministry websites of listed governments, various sources; primary source materials from available databases in environment legislation.
SO₂ emissions in the PRC, while taxes are put on coal inputs in India. Kazakhstan and the PRC are introducing national or subnational greenhouse gas emissions trading schemes. For water resources management, volumetric pricing and markets for irrigation water have developed in selected locations. Tradable discharge permits are being piloted in the PRC. Successful eco-compensation schemes have also emerged in the PRC and Viet Nam. Extended producer responsibility policies are emerging to reduce waste at the source. By obligating producers and importers of electrical and electronic equipment to pay for related waste disposal costs, the PRC increased the quantities of recycling of iron, copper, aluminum, and plastics by more than three times between 2013 and 2016.39

Civil society has been increasingly playing the role of monitoring environmental actions. For example, in the 1990s, Indonesia, the ROK, and Thailand gave official status to environmental nongovernment organizations in their framework legislation.40 Courts in developing Asia have more stringently interpreted environmental regulations and the rights of affected parties over time to support enforcement.41

**Effectiveness of policy measures and remaining challenges**

Although many policy steps have been taken to address environmental problems, the steps often remain partial. Many strategies and plans contain ambitious targets that do not necessarily correspond with sector plans or actions, and policies have important gaps.

At the most basic level, an important question is whether Asia is able to have “decoupling” or whether environmental degradation is slowing relative to economic development. Trends suggest this is happening, even though it may be masked when worsening environmental outcomes are considered in isolation. As shown in Figure 13.9, developing Asia’s use of energy and material per unit of GDP has been in decline over time.


41 For example, a 1993 Philippine Supreme Court ruling reinforced “intergenerational equity” by recognizing future generations as legal persons, and a 2013 ruling of Indonesia’s Constitutional Court ruled that customary forests should belong to indigenous peoples rather than the State.
Decoupling, however, is not sufficient to reverse environmental degradation. A stronger test is the Environmental Kuznets Curve (EKC) hypothesis, which posits that degradation may slow and ultimately reverse after a per capita income turning point. This could occur if development over time is associated with stronger regulations and institutions.42

A new analysis estimates the EKC for major developing countries in Asia for four outcomes: (i) deforestation (natural forest loss), (ii) PM2.5 air pollution, (iii) SO2 air pollution, and (iv) and GHG emissions (CO2 equivalent). The analysis finds turning point estimates for PM2.5 at a relatively low $8,400 per capita GDP in purchasing power parity terms and SO2 emissions at $10,800, which is consistent with many previous studies globally and in other regions.44 The analysis also finds increasing effects of regulations over time on SO2 and NOx pollution, which is consistent with the EKC findings.

However, there is no evidence of an EKC or effects of regulatory improvements for CO2 equivalent emissions or loss of natural forest cover in developing Asia, which mirrors patterns in the rest of the world. This difference in results suggests that Asia is increasingly able to address environmental challenges with mature technological solutions, but that more complex challenges require more fundamental shifts such as natural ecosystem preservation. Furthermore, climate change mitigation falls behind measures to address pollution and needs additional efforts.

13.5 Engagement in international agreements and roles of development partners

Engagement in international agreements

Developing Asia has been increasingly engaged in international efforts to solve global environmental challenges, most notably climate change. This is critically important, as the region can benefit substantially from coordinated approaches to global climate challenges (Box 13.1). Nearly all countries in the region are party to the three major conventions and agreements on climate change—the 1992 UN Framework Convention on Climate Change (UNFCCC), the 1997 Kyoto Protocol, and the 2015 Paris Agreement. Under the nationally determined contributions to the Paris Agreement,
Box 13.1: Benefits of International Cooperation on Climate Change

Effective international cooperation is important to address climate change for several reasons. First, as each country only internalizes a small share of the global effects of their actions, each has little incentive to solve global problems unless it is assured that other countries act as well. Second, the marginal costs of mitigating emissions problems are often different across countries and actors. An effective international cooperation mechanism can help abatement occur where these costs are lowest, increasing efficiency. Third, international cooperation can help realize important economies of scale in technological development and piloting.

Modeling climate mitigation costs illustrates the potential gains of effective international cooperation. In one recent study, developing a coordinated global carbon market under the Paris Agreement was found to potentially reduce the 2050 policy costs of limiting global warming to 2°C Celsius by nearly 50% for Asia (Box Figure). This is because abatement can occur where it is least expensive, there are potential synergies in deploying advanced low-carbon energy technologies, and there is potential for the region to export carbon credit.

Box Figure: Asian Policy Costs of Global Emissions Pathways Relative to Business as Usual (% of GDP)

C = Celsius, GDP = gross domestic product, INDC = intended nationally determined contribution.
Notes: “Business as usual” refers to a scenario absent of specific climate policies post-2015, with economic development according to unconstrained optimal growth. The emissions trajectory is slightly lower than the Representative Concentration Pathway 8.5 of the Intergovernmental Panel on Climate Change.
89% of Asia’s developing countries identified adaptation and mitigation contributions, while 11% identified only mitigation contributions.\textsuperscript{45}

Developing Asia has become an active participant in many other international environmental agreements and processes, including the Ramsar Convention on Wetlands, the Montreal Protocol (for the ozone layer), and the Aichi Targets of the Convention on Biological Diversity. The Sustainable Development Goals, which integrate environmental goals into national and subnational policies, plans, and programs, are shared objectives in national strategies across Asia.

Asia also has a long history of transboundary agreements within the region related to natural resources, such as the 1960 Indus Water Treaty, which coordinated water resource development between Pakistan and India. The Mekong River Commission in Southeast Asia is an intergovernmental organization devoted to coordinating water resource use among Cambodia, the Lao People’s Democratic Republic, Thailand, and Viet Nam. At the same time, these bodies and their agreements have struggled to balance rising competition for water and other resources among members as domestic demand has grown. There have been regional treaties established to tackle more recent problems such as transboundary haze, but supporting international bodies still need to be created to support actions.

**Role of bilateral and multilateral development partners**

Support from the international community to help address environmental and climate challenges has played a critical role in shaping the evolution of the region’s policies. International nongovernment organizations have often been instrumental in raising awareness on specific environmental issues and climate change, and spurring domestic advocacy. Environmental impact assessment requirements and environmental quality standards have been developed with international technical assistance. In addition, the development of climate policies has benefited from both bilateral and multilateral support.

Multilateral development banks, including ADB, and bilateral development partners have increasingly aligned their strategies to support environment and climate change goals and have provided financial support for investing in climate change mitigation and

\textsuperscript{45} ADB analysis of submission of nationally determined contributions to the UNFCCC Secretariat.
adaptation. Of the $43.1 billion in climate finance from multilateral development banks in 2018, about a third went to countries in Asia and the Pacific.46

ADB has long prioritized addressing environmental and climate challenges. Its Strategy 2030, adopted in 2018, further expands finance targets for both climate change mitigation and adaptation. Together with other multilateral and bilateral partners, ADB has been supporting developing Asia by (i) providing a range of financial assistance including policy-based lending with policy matrices of a country’s climate actions; (ii) replenishing lending resources by issuing green bonds; (iii) helping mobilize private sector resources for climate investment; (iv) supporting countries in implementing nationally determined contributions; and (v) providing technical assistance for policies, regulations, and judicial system regarding environment and climate change. In 2019, ADB launched an action plan to promote ocean health.

### 13.6 Green industry contribution to environmental solutions

Asia’s private sector also plays an increasingly important role in generating environmental solutions via green industries, particularly for renewable energy, energy efficiency, GHG mitigation, pollution abatement, and material recycling. The size of the environmental market in Asia and the Pacific is growing faster than that of other regions globally, both in terms of actual value and as a share of global trade, with Japan and the PRC as the largest contributors.47

In addition, Asian countries show large potential for leading green innovation, with major investments in deploying green technologies. Asia accounted for 44% of global exports of climate change mitigation technologies—such as solar panels and efficient lighting—and filed more high-value patents for these technologies than Europe and Latin America combined.

---


Globally, the PRC and India are making the largest investments in renewables and receive the largest inflows of greenfield foreign direct investment. There is growing pressure from consumers and nongovernment organizations for corporations, especially multinationals, to adopt “green supply chains.” Many companies in the region use environmental management systems, and modify processes and products to reduce environmental impact. This is increasingly accompanied by certification and eco-labeling of products as part of their international trade strategy.

Private sector investment in environmental projects will be increased by addressing the risks associated with the changes of policies and technological uncertainties. Green finance is emerging as a way to accelerate environmentally oriented investment. Green investment by financial institutions in the region has grown steadily over the past few years. To accelerate this, environmental concerns are being mainstreamed into banking systems.48

Green or climate-aligned bonds are important green financing instruments, and developing Asia is at the forefront of their use. These bonds seek to raise capital for environment-related projects. They may be “labeled” and subjected to third-party certification concerning their environmental contributions. Asia was the largest region in outstanding climate-aligned bonds with a 2017 global market share of 42%. This was dominated by issuance from the PRC, which accounts for 82% of the region’s total.49 Indonesia pioneered the use of sovereign Islamic green bonds with an issue in early 2018, and Fiji pioneered the use of green bonds for climate resilience.

13.7 Looking ahead

Developing Asia has begun to take important steps toward addressing its profound environmental challenges. At the same time, the pace of progress has not yet matched the enormity of the threats facing the region. If trends continue, the region will not be able to sustain the economic progress achieved over the past 50 years far into the 21st century, as resources will be too depleted and degraded and ecological systems too disrupted. Although the region’s energy and carbon intensity

of economic output have fallen, further efforts are needed to align with the Paris Agreement goals to keep mean global warming below 2°C Celsius above preindustrial levels.

To put the region on a sustainable path, it needs to redouble the following policy efforts.

First, ensure prices reflect the costs of environment and climate change externalities. “Perverse” price signals that encourage the unsustainable use of natural capital and ecosystem services remain a major impediment to green growth. Removing fossil fuel and other perverse subsidies and replacing them with progressive alternatives such as means-tested household subsidies is an essential first step. Both environmental taxes and fees, such as timber royalties and water charges, are important to reform.

Second, enhance governance for better environmental management. Environmental problems are essentially externalities, and thus appropriate public intervention is needed to resolve them. Further strengthening regulations and enforcement is crucial. Regulations can benefit from higher levels of ambition and scope. Monitoring by civil society may help to augment limited governance capacity.

Third, substantially invest in environmentally friendly, low-carbon, and climate-resilient infrastructure. This includes investing in renewable energy, energy efficiency, and sustainable public transport, and also fortifying existing infrastructure to be climate-friendly. Effective collection, disposal, and treatment of waste depends on new investment in new and existing facilities using the latest technologies to avoid pollution.

Fourth, attract private investment in sustainability. More investment is needed than the public sector can offer. The viability of private investment often depends on the incentives set by governments and political risk. Public investors can signal their public commitment to private investors. Governments and multilateral development banks can offer products such as risk guarantees for technological, contractual, and political risks. Expansion of green bonds and green banks can help mobilize environmentally friendly finance.

Fifth, advance transformative technologies. The successful transition to low-carbon development depends on technologies such as advanced biofuels and energy storage. Managing Asia's waste
requires innovations in recycling, composting, and disposal. Intelligent transport systems have the potential to reduce the environmental impact in urban centers. Governments can support innovation by investing in research, pilot, and demonstration projects, and enhancing access to finance.

Finally, intensify international cooperation. Many of the region’s most pressing environmental challenges are transboundary. Governments can further strengthen cross-border collaboration and collective action in areas such as air and water pollution, ocean health and fisheries management, water resources management, biodiversity, disaster risk management, and coastal protection. They can also enhance cooperation in addressing the global agenda of climate mitigation and adaptation and can collaborate to exploit economies of scale in developing technological solutions.