

Chapter 2

China-ASEAN Green Development Status

Abstract This chapter gives a detailed narrative and comparison of the green development status of China and ASEAN Member States in areas of green development history, social and economic development, industrial development transition, water and land resource conservation and utilization, air and water pollution treatment, solid waste management, environmental protection input and corresponding industrial development, energy use and climate change, ecosystem and biodiversity, as well as sustainable production and consumption. Given the data availability, the time frame of data for China is between 2001 and 2014, and between 2006 and 2013 for ASEAN. The comparative results are presented at the end, arguing that the level of green development process and priorities differs greatly between China and ASEAN, especially among ASEAN Member States. Economic development is relatively decoupled from resources and environment, but the challenge is still grim. Both China and ASEAN are faced with multifaceted challenge, including severe air and water pollution, growing energy use, biodiversity loss, and increasing waste discharge.

2.1 China

2.1.1 *Review of the Green Development Course*

Aiming at balancing the relationship between the environment and economic growth, China's policy researchers and leadership have, in the past decade, advanced the understanding of and practices related to green development. To promote green development in China, they have introduced relevant laws, regulations, and policy instruments, which have shown outstanding effects and provided valuable experience. The transition of economic development model was first presented as a piece of key policy information in the Ninth Five-Year Plan for National Economic and Social Development and Vision 2010 released in 1996. Table 2.1 expresses the course of green economic development in China from 1996.

Table 2.1 The course of green economic development in China (milestones upon 1996)

Year	Keywords	Description
1996	9th FYP for National Economic Development	“...emphasis of economic work should be attached practically to the transition of economic growth mode...” as stated clearly in the Ninth Five-Year Plan for National Economic and Social Development and Outline of Vision 2010
1997	Energy Conservation Law	Implemented upon 1998, it aimed at promoting energy conservation nationwide, improving energy utilization efficiency and economic benefit, protecting the environment and securing national economic and social development by means of legislation
2002	Cleaner Production Promotion Law	Implemented upon January 1, 2003, it marked the start of the comprehensive promotion of cleaner production in China
2003	Scientific Outlook on Development	The Scientific Outlook on Development was presented as “sticking to putting people first, establishing a comprehensive, coordinated and sustainable development outlook and promoting the comprehensive development of economy, society and people”
2005	Renewable Energy Law	It marked that China resorts to legislation to promote and develop renewable energy, safeguard national energy security, prevent and control environmental pollution and ecological damage caused by energy utilization and accelerate the new energy revolution of renewable energy utilization
2006	Energy conservation and emission reduction	To reduce the energy consumption per unit of GDP by around 20% and total emission of major pollutants by 10% during the 11th Five-Year Plan
2007	Ecological civilization development	“Efforts should be made to construct ecological civilization, basically form an industrial structure, growth mode and consumption pattern where energy and resources are conserved and ecology and environment are protected” as specified in the report of the 17th National People’s Congress
2007	Energy Conservation Law	Implemented upon 2008, it states clearly that “the central government should implement the basic national policy of resource conservation as well as the energy development strategy of promoting conservation and development simultaneously and putting conservation first”
2008	Circular Economy Promotion Law	Implemented upon 2009, it marked the start of the comprehensive promotion of circular economy in China
2009	CO ₂ emission reduction	The Chinese government determined to incorporate reducing the CO ₂ emission per unit of GDP by 40–45% by 2020, compared with 2005, as an

(continued)

Table 2.1 (continued)

Year	Keywords	Description
		obligatory target into the long-term planning of national economic and social development during and after the 12th Five-Year Plan
2010	12th FYP for National Economic Development	The Outline of the Twelfth Five-Year Plan for National Economic and Social Development proposes “promoting green development and building a resource-saving and environment-friendly society”
2010	Revision of Renewable Energy Law	It presents regulations on the overall planning of the development and utilization of various kinds of renewable energy and establishes the important system of full-amount indemnificatory purchase
2012	Report of 18th CPC National Congress	The 18th CPC National Congress proposed “putting ecological civilization construction in a prominent position and integrating it into all aspects and overall processes of economic construction, political construction, cultural construction and social construction and striving to build a beautiful China and realize the sustainable development of the Chinese nation”
2013	3rd Plenary Session of the 18th CPC Central Committee	The 3rd Plenary Session of the 18th CPC Central Committee said further that efforts should be made to improve the development achievements examination and assessment system, correct deviation that assesses official performance by economic growth rate alone, and increase the weight of resource consumption, environmental damage and ecological benefit indexes
2013	Air Pollution Prevention and Control Action Plan	The Plan states that over five years of efforts, the overall air quality nationwide should improve and days with heavy air pollution should decrease significantly; air quality of such regions as the Beijing-Tianjin-Hebei Region, Yangtze River Delta and Pearl River Delta should improve apparently. Every endeavor should be made to gradually eliminate heavy pollution weather and achieve an evident improvement in nationwide air quality with another five or more years
2015	Water Pollution Prevention and Control Action Plan	The Action Plan proposes that there shall be a periodical improvement of the water environment quality by 2020, dramatic reduction of seriously polluted water bodies, continuous improvement of drinking water guarantee, and strict control of groundwater over extraction
2015	5th Plenary Session of the 18th CPC Central Committee	The 5th Plenary Session of the 18th CPC Central Committee put forward the development philosophy of being innovative, coordinated, green, open and shared

(continued)

Table 2.1 (continued)

Year	Keywords	Description
2016	13th FYP for National Economic Development	The 13th Five-Year Plan for National Economic and Social Development requires that during the 13th FYP period, China will focus on the improvement of environment quality, highlight solution to key ecological and environmental issues, beef up efforts to protect the ecology and environment, improve resource use efficiency, provide more high quality ecological products and work toward a strong and beautiful China with its people living in affluence
2016	Action Plan for the Prevention and Control Soil Pollution	By 2020, the exacerbating trend of soil pollution across the country shall be checked initially and the soil environment quality shall be overall stable



Fig. 2.1 China’s economic development upon the reform and opening-up. *Source* NBS Website, <http://data.stats.gov.cn/ks.htm?cn=C01&zb=A0501>; International Monetary Fund (IMF) Database (<http://databank.worldbank.org/data/home.aspx>). China’s economic data all takes RMB as the monetary unit (Exchange rate: 1 RMB = 0.1496 USD)

2.1.2 Economic and Social Development

2.1.2.1 Economic Growth

Since the founding of P.R. China, the country’s economy has grown at an annual average growth rate of around 7.8%. China’s annual average GDP growth has reached as high as 9.76%, especially over the 30 years of reform since 1978 (see Fig. 2.1). China’s economy has maintained a high-speed growth for more than 30 years, much higher than the average GDP growth rate of the world. China is the

largest exporter and manufacturer and the second biggest economy. While its economy develops rapidly, China's poverty rate has also dropped from 65% to less than 10%, with more than 500 million people lifted out of poverty [1].

2.1.2.2 Income of Urban and Rural Residents

Along with the economic development, living quality indexes of urban and rural residents and their consumption standard have improved significantly (see Fig. 2.2). However, there is still a big gap between urban income and rural income. Since the reform and opening-up, the food expenses-to-consumption expenditure, i.e., Engel coefficient, of urban households has declined from 57.5% in 1978 to 35% in 2013, and that of rural households dropped from 67.7 to 37.7%. In 2012, rural Engel coefficient fell below the threshold of 40% for the first time [1].

2.1.3 Transition of Industrial Development

2.1.3.1 Adjustment of Industrial Structure

Over the past three decades, improvements in terms of the ratio of the three levels of industries with GDP have improved from 27.9:47.6:24.59 in 1978 to 9.2:42.7:48.1 in 2014 (see Fig. 2.3). The ratio of tertiary industry has apparently increased, the first industry tends to decline year on year while the secondary industry has witnessed fluctuations in its proportion and tended to decline after the 1980s, has started an evident rising tendency since the 1990s and registered a small and slowed growth in the first decade of this century [1].

Industry serves as the backbone of China's modernization as well as an important engine for its economic development. Jointly promoted by government policies and market forces, China, formerly with a poor industrial foundation and closed economy, has grown into an industrial power that leads industrial output of major products and plays a decisive role in the international market. The Made-in-China phenomenon has been globally recognized (see Table 2.2). At present, China maintains the economic growth driven by the secondary industry. Seen from economic structure, economic transition signifies the optimization of structure. Under the new normal status, more industrial attention is paid to activating new potentialities through technological transformation and speeding up structural adjustment [1].

2.1.3.2 Strategic Emerging Industries

Issued in 2010, the Decision of the State Council on Accelerating the Fostering and Development of Strategic Emerging Industries (hereinafter referred to as the

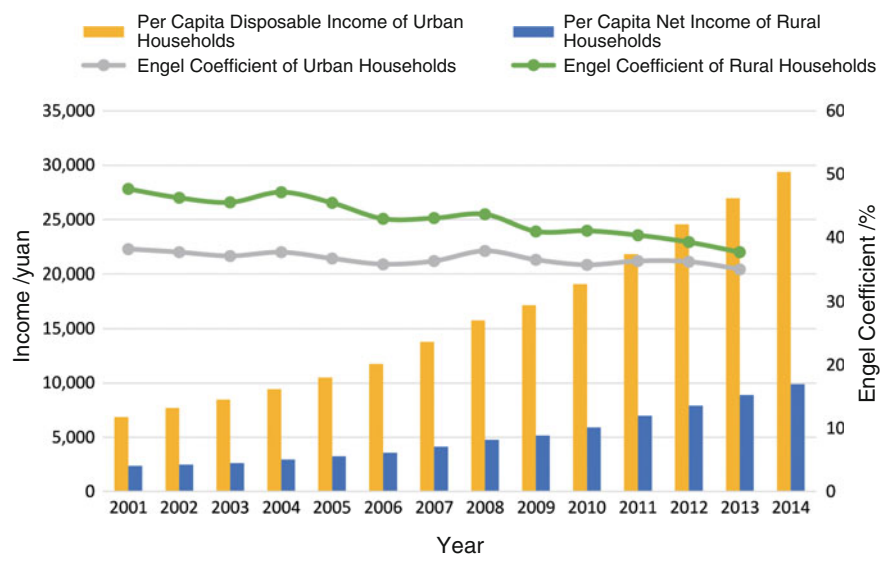


Fig. 2.2 Yearly income and Engel coefficient of urban and rural residents. *Source* China Statistical Yearbook 2015. *Note* The Engel coefficient of resident households expresses the proportion of food expenses in the total consumption expenditure. UN establishes a standard for assessing the living standard of all countries based on the Engel coefficient, i.e. a country is evaluated as poor if its average household Engel coefficient is bigger than 60%; having enough to survive if its average household Engel coefficient is 50–60%; fairly well-off if its average household Engel coefficient is 40–50%; relatively affluent if its average household Engel coefficient is 30–40%; affluent if its average household Engel coefficient is 20–30%; and extremely affluent if its average household Engel coefficient is smaller than 20%

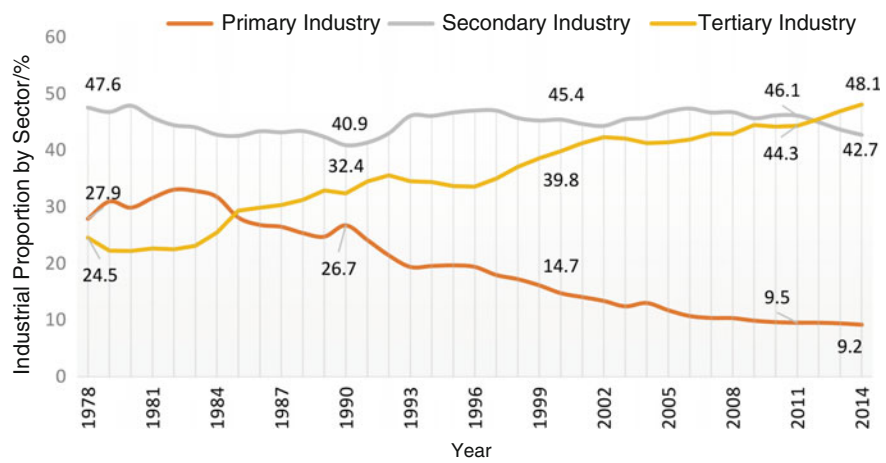


Fig. 2.3 Changes in China's industrial structure, 1978–2014. *Source* China Statistical Yearbook 2015

Table 2.2 Changes in China's leading industries, 2001–2014

Rank	2001		2006		2014	
	Industry	Ratio (%)	Industry	Ratio (%)	Industry	Ratio (%)
1	Electric power and thermal power production and supply	9.90	Manufacturing of telecommunication equipment, computers and other electronic equipment	8.24	Manufacturing of telecommunication equipment, computers and other electronic equipment	7.81
2	Manufacturing of telecommunication equipment, computers and other electronic equipment	7.47	Ferrous metal smelting, rolling and processing	8.14	Transport and communication equipment manufacturing	7.78
3	Petroleum and natural gas exploitation	7.41	Electric power and thermal power production and supply	8.04	Manufacturing of chemical raw materials and chemicals	7.54
4	Transport and communication equipment manufacturing	6.00	Petroleum and natural gas exploitation	6.96	Ferrous metal smelting, rolling and processing	6.50
5	Manufacturing of chemical raw materials and chemicals	5.88	Manufacturing of chemical raw materials and chemicals	6.28	Electrical apparatus and equipment manufacturing	6.13
6	Ferrous metal smelting, rolling and processing	5.62	Transport and communication equipment manufacturing	5.74	Agricultural and sideline food processing	5.82
7	Textile	5.09	Electrical apparatus and equipment manufacturing	5.37	Nonmetallic mineral products	5.33
8	Electrical apparatus and equipment manufacturing	5.06	Textile	4.61	Electric power and thermal power production and supply	5.17

Decision) specifies the emphasis for the development of strategic emerging industries at the present stage (see Table 2.3). At the end of 2010, added value of strategic emerging industries had accounted for 4% of GDP. In 2012, the State Council released the Twelfth National Five-Year Plan for the Development of Strategic Emerging Industries, promulgating a group of policy measures and indicating the direction for the fostering and development of strategic emerging industries. In 2014, China achieved a rapid development of strategic emerging industries, with the main business income and total profit of enterprises above the designated scale in the 18 key industries increased by 13.5 and 17.6%, respectively, evidently higher than the industrial average. Gradually, strategic emerging

Table 2.3 Emphasis of the development of seven strategic emerging industries

Industry	Key fields of development
New-generation information technology	New-generation mobile communications, integration of broadcast and television network, telecommunication network and the Internet, Internet of Things, cloud computing, integrated circuit, new-type display, high-end software, high-end server
Energy conservation and environmental protection	Energy-efficient, circular utilization of resources, advanced environmental protection technology
High-end equipment manufacturing	Aeronautic equipment, railway transportation equipment, ocean engineering equipment, high-end smart equipment
New energy	Nuclear energy, solar energy, wind energy, smart power grid, biomass energy
New material	New-type functional materials and structural materials, high- performance composite materials
Biology	Biological medicine, biological breeding, biological agriculture
New energy automobile	Plug-in hybrid electric vehicles and blade electric vehicles

industries have serviced as an import force driving the adjustment of structure, the transition of mode and the benefiting of the people, and guided and driven, as an important role, economic and social development.¹

2.1.4 Conservation and Utilization of Resources

2.1.4.1 Land Resources and Exploitation Intensity

China covers an area of 9.6 million km² of land and 4.73 million km² of waters. As a great power of land resources, the country’s land area ranks third in the world. The complex topography and climate and the various types of land provide favorable conditions for the diversified operation and comprehensive development of agriculture, forestry, husbandry, sideline production, and fishery. In China, the utilization of land resources is quite complicated and confronted with such problems as the uneven distribution and the contradiction between protection and exploitation (see Fig. 2.4).

Since the founding of P.R. China, uncontrolled exploitation has been the norm and has not abated despite the introduction of sustainable development concepts. In recent years, China’s national land development intensity has kept rising, with uneven fluctuations on the annual increment.

¹National Development and Reform Commission (NDRC): Strategic Emerging Industries Developed Rapidly in 2014 in China, <http://futures.hexun.com/2015-03-16/174085901.html>.

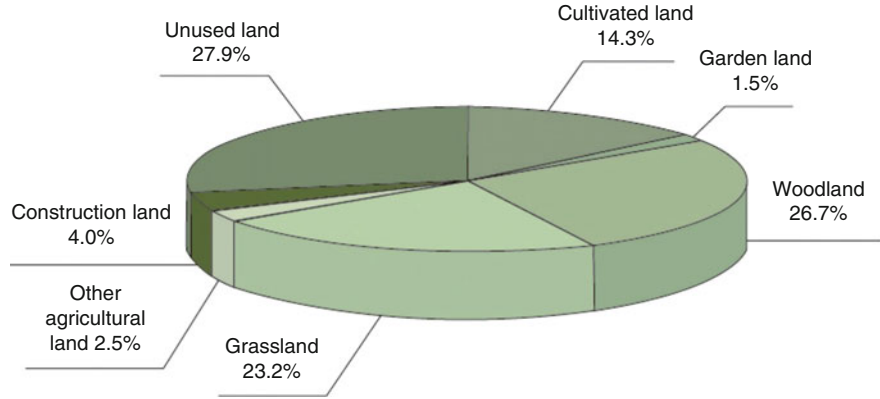


Fig. 2.4 Land utilization in China, 2013. *Source* Communiqué on Land and Resources of China 2014

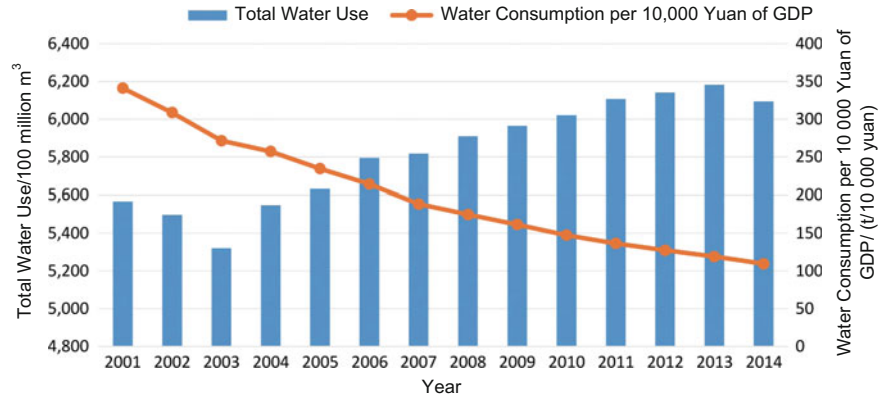


Fig. 2.5 Changes in water-use efficiency in China, 2001–2014. *Source* China Statistical Yearbook 2015, at the prices of 2010

2.1.4.2 Water Resources and Water-Use Efficiency

In 2014, China’s total water resources amounted to 2726.69 billion m³, about 6% of the world’s freshwater resources, ranking fourth. In average, China’s precipitation and precipitation-converted water resources are lower than that of USA and European countries. Though among the best in terms of total water resources, China registers a small quantity of water resources per capita, 1998.6 m³, merely 28% of the global average. Utilization of water resources tends to rise. In 2014, China’s total water supply accounted for 22.4% of its total water resources for the year. Despite of the improvement (Fig. 2.5), the country’s water-use efficiency remains lower than that of developed countries. Water resources are distributed unevenly and do not match the land resources and economic layout of China [2].

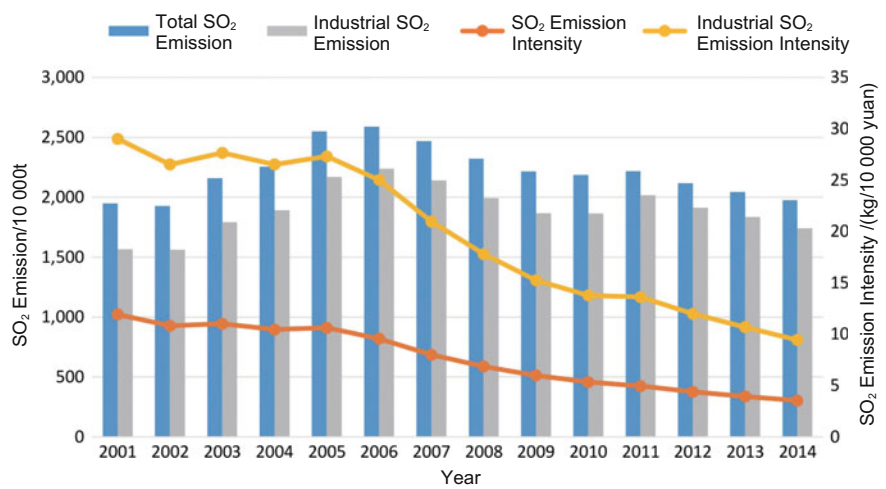


Fig. 2.6 Analysis on SO₂ emission and emission intensity trends, 2001–2014. *Source* Data on pollutants are derived from Annual Statistic Report on Environment in China over years; GDP data are derived from China Statistical Yearbook 2013, at the prices of 2010

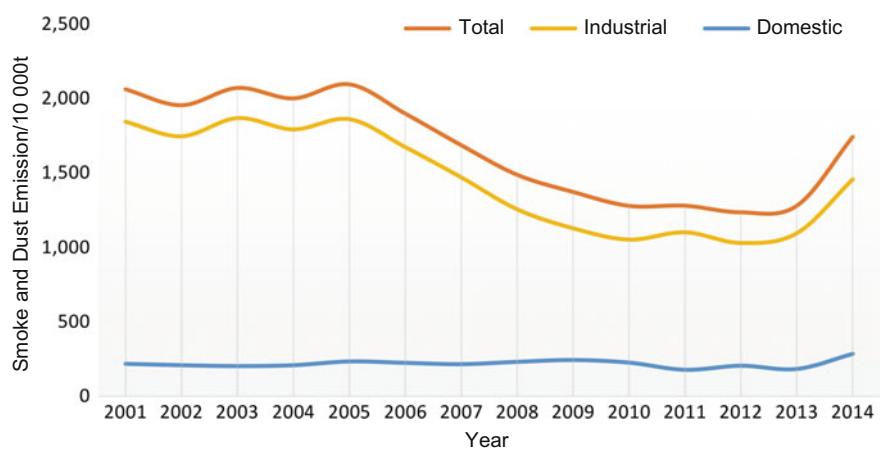


Fig. 2.7 Smoke and dust emissions in China, 2001–2014. *Source* Annual Statistic Report on Environment in China 2001–2014

2.1.5 Environmental Protection

China’s industrialization and urbanization have developed rapidly since the reform and opening-up, putting great strains on environmental protection. Hence, the contradiction between economic and social development and ecological and environmental protection has grown increasingly prominent. China has ranked top for the emissions of such major pollutants as COD, SO₂, NO_x, POPs, THP, EDS, and Hg [2].

2.1.5.1 Atmospheric Environment

China's SO_2 emission peaked at 25.888 million tons in 2006, two times that of the USA. Although SO_2 emission intensity has been on a decline in the past decade (Fig. 2.6), it is still much higher than developed countries, even 5–10 times that of USA, U.K., and Japan, and higher than the global average. There's still a long way to control SO_2 emission, as the coal-focused energy consumption structure is hard to change and the space for the decline of emission intensity shrinks gradually. Industrial SO_2 removal rate has witnessed a quick rise, to 73% in 2014 [2].

China's total smoke and dust emission witnesses a small drop in fluctuations (see Fig. 2.7). From 2001 to 2013, total industrial smoke and dust emission tended to decline in fluctuations. In 2014, however, industrial and domestic smoke and dust largely increased. Along with the surging quantity of motor vehicles in China, highway traffic imposes a non-negligible pressure on air environment pollution. Industrial smoke and dust removal rate has remained high, to 98.2% in 2014.

In China, the emission of NO_x , a kind of major air pollutants, tends to keep rising (see Fig. 2.8). However, a sharp growth of 30% was witnessed in 2011, owing to the change of the specifications of environmental statistics. Industrial NO_x removal rate is low, but keeps rising, reaching 27% in 2014, higher than the 19% in 2013 and 7.5% in 2012 [2].

Inhalable particles have been among the major air pollutants of China since the reform and opening-up. In the past decade, urban air quality has improved judging by normal pollutants. However, some cities are still bothered by heavy pollution (see Fig. 2.9). The pollution incurred by such composite pollutants as ozone and particulate matters grows increasingly serious, city clusters has witnessed compound pollution, and local rural areas registered a degradation of air quality. In 2014, air quality monitoring based on new standards was carried out in 161 cities at

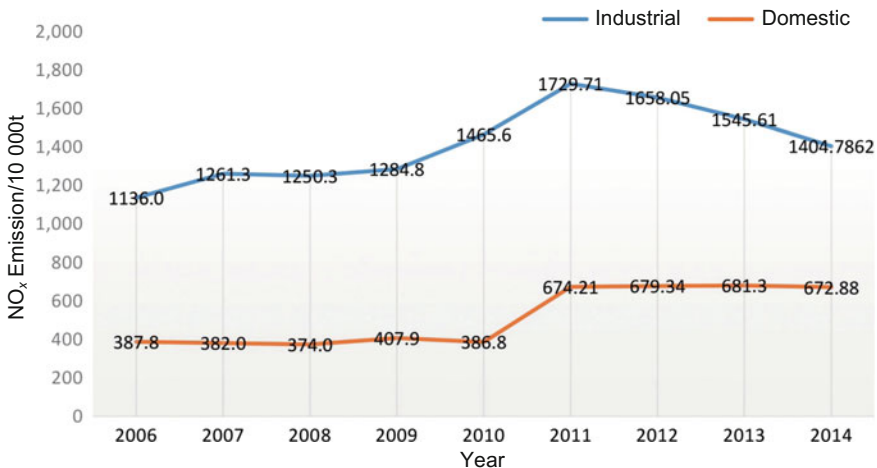


Fig. 2.8 NO_x emission in China, 2006–2014. *Source* Annual Statistic Report on Environment in China 2006–2014

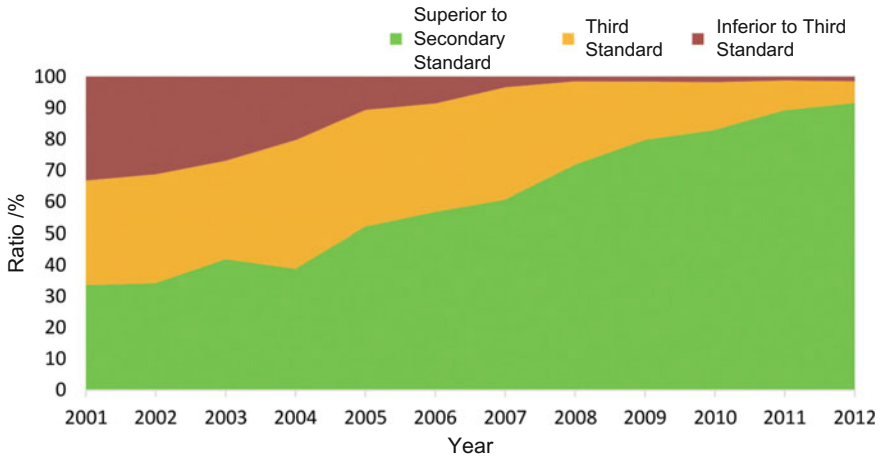


Fig. 2.9 Changes in the ratios of cities by the level of air quality, 2001–2012. *Source* 2001–2012 Communiqué on Environmental Status in China, and Ambient Air Quality Standard (GB 3095–1996)

prefectural level and above, of which only 16 cities, 9.9% of the total, attained the standard of air quality, and 145 cities, 90.1% of the total, exceeded the standard [2].

2.1.5.2 Water Environment

In China, total wastewater emission has increased year on year in the recent decade, of which the ratio of industrial wastewater emission has witnessed a year-on-year decline while domestic wastewater emission rate registered a year-on-year rise, from 52 to 71% in 2013, being a major source of wastewater emissions (see Fig. 2.10). From 2001 to 2014, wastewater emission intensity declined steadily by 52%; industrial wastewater emission intensity saw a more evident drop, from 37.5 tons/10,000 yuan to 11.1 tons/10,000 yuan, nearly a cut by 70% [2].

Main wastewater pollutants COD emission exhibited an inverted U-shaped curve from 2001 to 2010 (see Fig. 2.11), with the peak witnessed in 2006 and then a year-on-year decrease after that. In 2011, agricultural sources and centralized sources were added to the statistics. Agriculture is a major source of COD emission. Registering the largest emission of COD, China is faced with huge pressure of reduction in wastewater pollutant emission. In 2014, industrial COD removal rate was 85% [2].

NH₃-N emission also witnessed an inverted U-shaped change from 2001 to 2010, peaking in 2005 and then declining. On the one hand, China's NH₃-N emission is largely from domestic sources, whose proportion is on a year-on-year rise. On the other hand, its comprehensive NH₃-N emission intensity has also declined year by year in the recent decade. In 2011, agricultural sources and centralized sources were added to the statistics, with the former being the second

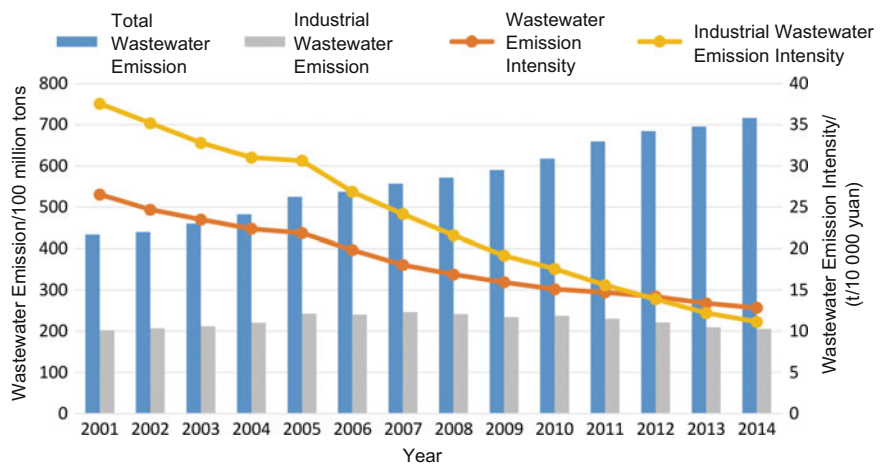


Fig. 2.10 Wastewater and industrial wastewater emission and emission intensity in China, 2001–2014. *Source* Data on pollutants are derived from 2014 Annual Statistic Report on Environment in China; GDP data are derived from China Statistical Yearbook 2015, at the prices of 2010

largest source of NH₃-N emission and domestic sources ranking top. In 2012, county-level wastewater treatment rate approached 80%, but that of designated towns was smaller than 30%. Industrial NH₃-N removal rate was 82% in 2014 (see Fig. 2.12) [1, 2].

In the past decade, main heavy metal emission from industrial wastewater has been on a year-on-year decline in China (see Fig. 2.13). Industrial lead and arsenic emission accounts for the largest share, but is on a decline, from 80% in 2001 to 77% in 2014. Despite of the small proportion, industrial hexavalent chromium emission tends to rise, from 10% in 2001 to 15% in 2014. The proportion of industrial cadmium emission witnesses few changes, staying between 7 and 10% [2].

Water environment and pollution of the main river systems in China are under effective management. In 2014, state-controlled sections of surface water were mildly contaminated. Among China’s seven most important river systems including the Yangtze River system, Yellow River system, Pearl River system, Huaihe River system, Liaohe River system, Haihe River system, and Songhua River system, the Haihe River system and the Liaohe River system have always been the highly contaminated ones in recent decades. In 2014, statistics showed that 96.2% of the water sources for centralized drinking water supply in 329 cities above the pre-fectural level met the standards. For surface water sources, total phosphorus, manganese, and iron exceeded the allowed limits, while iron, manganese, and NH₃-N exceeded the allowed limits for underground water sources (see Fig. 2.15) [2].

Rich in marine resources, China boasts a continental coastline as long as 18,000 km, a continental shelf covering over 200 km² and more than 6500 islands and administers a sea area of nearly 3 million km². 2014 Communique on Marine

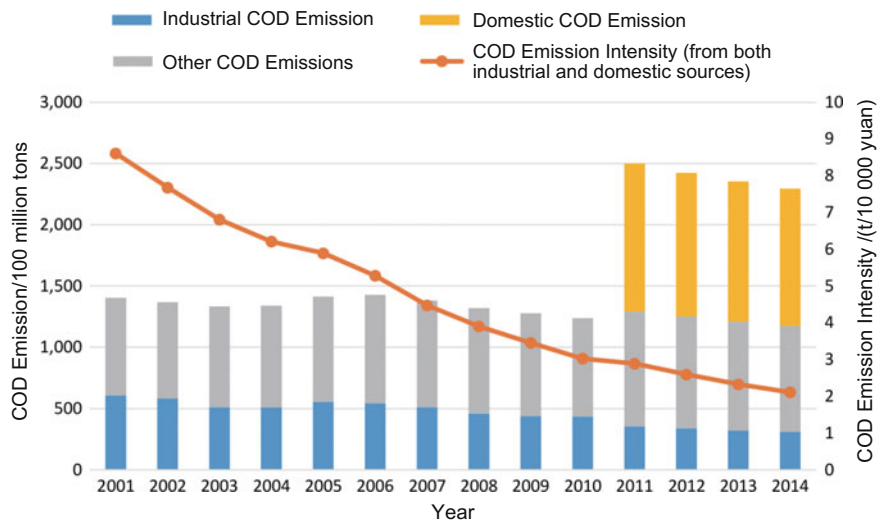


Fig. 2.11 COD emission and emission intensity in China, 2001–2014. *Source* Data on pollutants are derived from 2014 Annual Statistic Report on Environment in China; GDP data are derived from China Statistical Yearbook 2015, at the prices of 2010

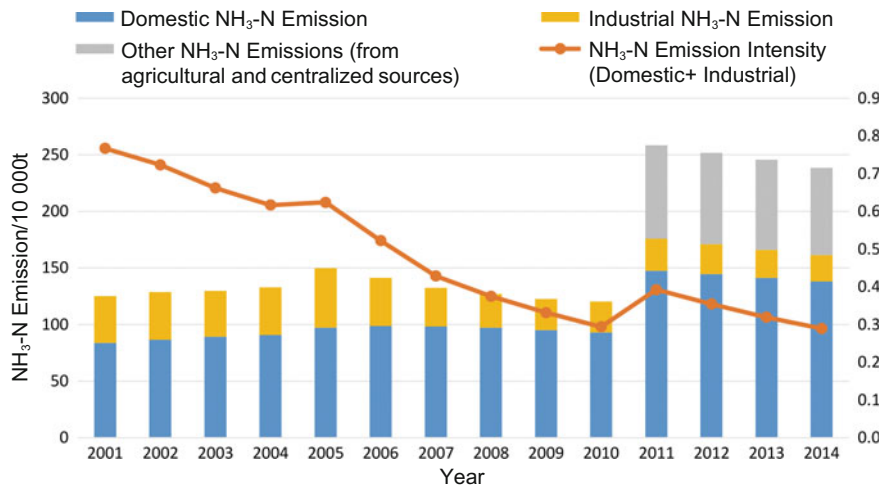


Fig. 2.12 NH₃-N emission and emission intensity in China, 2001–2014. *Source* Data on pollutants are derived from 2014 Annual Statistic Report on Environment in China; GDP data are derived from China Statistical Yearbook 2015, at the prices of 2010

Environment Quality in China indicates that in 2014, the sea area under the jurisdiction of China was good on the whole, with the sea area up to Category I of seawater quality standard accounting for nearly 94%. Ocean sediments witnessed

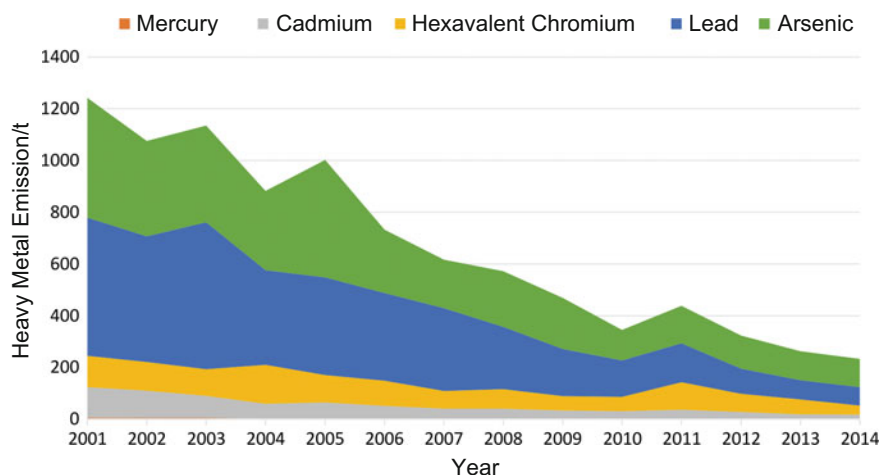


Fig. 2.13 Changes in heavy metal emission from industrial wastewater in China, 2001–2014.
Source Data on pollutants are derived from 2014 Annual Statistic Report on Environment in China

good quality. State-level marine conservation areas registered good quality on the whole. However, offshore areas were still bothered by such prominent problems as ocean water pollution, ecological damage, and frequent occurrence of disasters. For offshore areas, main pollutants are inorganic nitrogen, labile phosphate, and petroleum (Fig. 2.14).

2.1.5.3 Solid Wastes

As industrial consumption of resources grows further in China, increasingly more solid wastes, mainly including gangue, coal ash, slag, residue, tailings, and hazardous wastes, are generated by the exploitation and utilization of resources (see Table 2.4). In addition, the influx of population in cities and the improvement of living standard also bring about serious discharge of household garbage, putting many cities under the “garbage siege” crisis. Owing to the development of the emerging electronic industry and the improvement of residents’ consumption level, the generation of electronic wastes is accelerated by the upgrading of residents’ electronic products, especially computers and mobile phones. China is still confronted with severe challenges in the level and mode of solid waste treatment due to the rapid increase of newly increased pollutants, though its innocent treatment of solid wastes and relevant plan and facilities are improving constantly [2].

Despite the year-on-year rise of industrial solid waste generation, the comprehensive utilization and treatment have kept rising, the emission has been on a

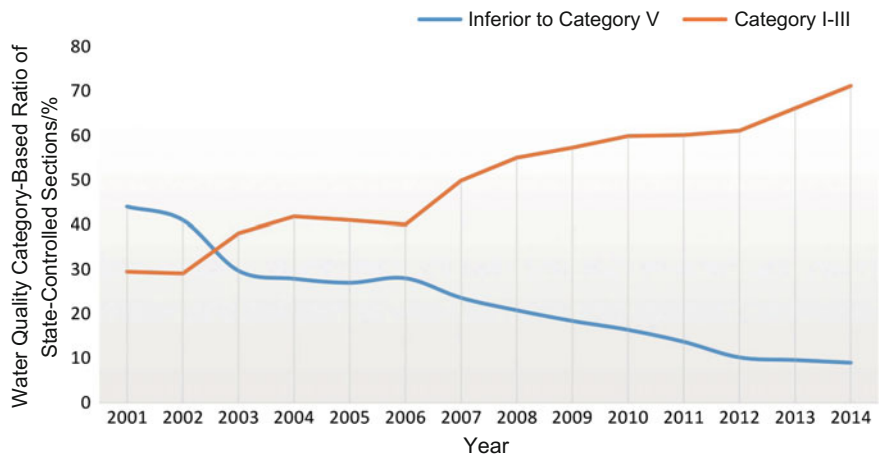


Fig. 2.14 Changes in surface water quality in China, 2001–2014. *Source* 2001–2014 Communiqué on Environmental Status in China

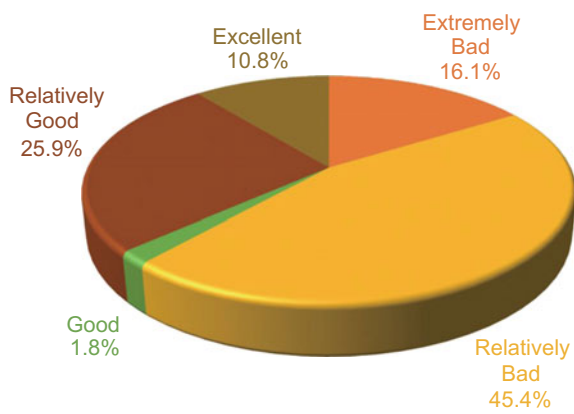


Fig. 2.15 Underground water quality in China, 2014

decline, and the treatment rate has maintained at around 20% since 2001 (see Fig. 2.16).

2.1.5.4 Environmental Protection Input

According to the experience of developed countries, a country’s pollution won’t be controlled effectively until its environmental protection input stays steadily between

Table 2.4 Generation of four main kinds of solid wastes in China, 2006–2014

	Generation of industrial solid wastes/100 million tons	Cleanup of urban household garbage/100 million tons	Generation of electronic wastes/10,000 tons	Urban sludge generation/10,000 tons
2006	15.15	1.48	207.74	1104
2007	17.56	1.52	232.53	1517
2008	19.01	1.54	262.89	1452
2009	20.39	1.57	286.35	1655
2010	24.09	1.58	337.24	2116
2011	32.62	1.64	394.34	2268
2012	32.90	1.68	–	2418
2013	32.77	1.73	–	2635
2014	32.56	1.79	–	2801

Source 2001–2014 Communique on Environmental Status in China

1 and 1.5% of its GDP in a period of time when its economy grows at a high speed, and its environmental quality will improve evidently when that share reaches 3.0%. Since 2001, China’s environmental protection input has kept increasing, at an annual average growth rate of 18%. In the meantime, the share of environmental protection input in GDP has been also on a rise, reaching 2.20% in 2014. During the 11th Five-Year Plan period, a rapider growth was witnessed, the entire inputs (including environmental investments and operation expenditure) totaling 2852.1 billion yuan (at the prices of current year) from 2006 to 2010. As a result, important material security has been provided for enhancing pollution mitigation, promoting environmental improvement, and relieving pollution trend (see Fig. 2.17). At the

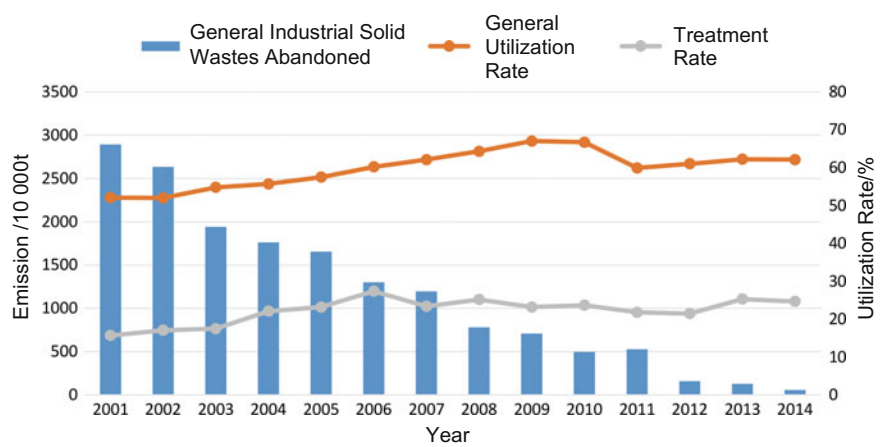


Fig. 2.16 Emission, comprehensive utilization rate and treatment rate of industrial solid wastes in China, 2001–2014. Source 2001–2014 Communique on Environmental Status in China

earlier stage of the 12th Five-Year Plan (2011–2013), China’s environmental protection input totaled 2.33 trillion yuan [2].

2.1.5.5 Development of Environmental Protection Industry

From 2000 to 2008, China’s annual average growth of environmental protection industry exceeded 20%, much higher than the GDP growth. In 2008, the gross income from environmental protection industry (including the comprehensive utilization of resources) amounted to 820 billion yuan, accounting for 2.76% of the GDP. Since the 11th Five-Year Plan period, China has created a huge demand for the environmental protection industry by promoting vigorously energy conservation and emission reduction, developing circular economy, and building a resource-saving and environment-friendly society. Hence, the environmental protection industry has grown rapidly and begun to take shape. Formerly focusing on the treatment of waste gas, wastewater, and solid wastes in the early stage, it has been a multi-industry, trans-regional system covering environmental protection products, environmental service, clean products, recycling of wastes, and ecological protection. In 2011, environmental protection-related industries involved 23,820 units and 3.195 million employees and obtained an annual operating revenue of 3075.25 billion yuan, an annual operating profit of 277.72 billion yuan and an annual contract amount of export of 33.38 billion US dollars. A full-category

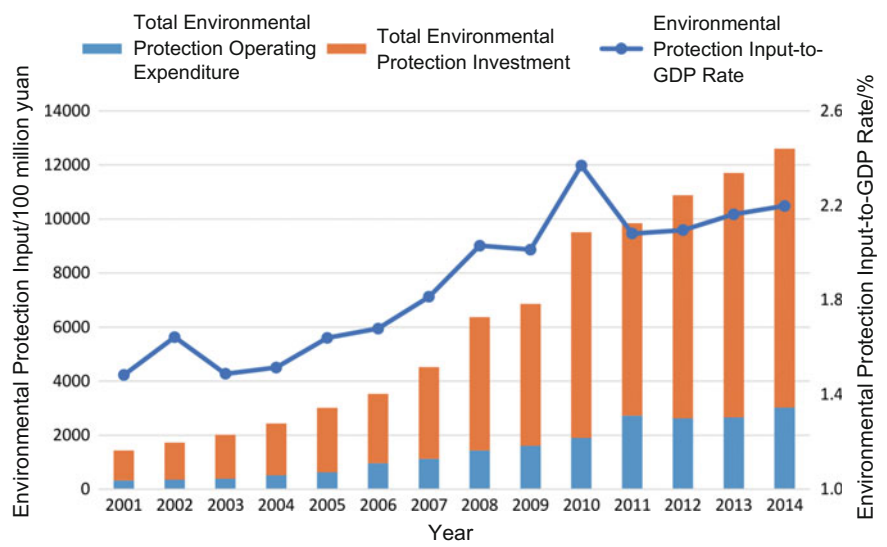


Fig. 2.17 Total environmental protection input and its proportion in GDP of China over Years. *Note* Environmental protection input consists mainly of environmental protection operating expenditure and environmental protection investment; relevant data are derived from 2001–2014 Annual Statistic Report on Environment in China and China Statistical Yearbook 2002–2015

industrial system has taken the initial shape along with the constant extension of its industrial field, the rapid upgrading of technology and equipment, the continuous increase of product categories, and the evident improvement of service.

2.1.6 Energy and Climate Change

2.1.6.1 Energy Consumption

Along with the speeding-up of industrialization and urbanization, China's energy consumption has witnessed a rapid growth since the reform and opening-up. The energy consumption was merely 603 million tons of standard coal in 1980 and increased to 1.47 billion tons of standard coal in 2000, at an annual average rate of 4.6% (see Fig. 2.18). In 2001, as China joined WTO, its national economy ushered in a new stage of development. With a surging increase, the energy consumption had totaled 4.26 billion tons of standard coal in 2014, up 190% than 2000 and at an annual average rate of 7.9%.

Coal has always accounted for a big share, around 70%, of the primary energy consumption structure in China. As the relatively clean natural gas and other energy resources (hydropower, nuclear power, wind power, etc.) are applied gradually, coal consumption-to-total energy consumption rate has dropped, to 66.0% in 2014, while natural gas and other energy resources (hydropower, nuclear power, wind power, etc.) have registered a bigger proportion, 16.9% in 2014. Compared with developed countries, China witnesses an excessively small ratio of petroleum and natural gas in its energy consumption and the coal-focused energy consumption structure has intensified the need for environmental and ecological protection (see Fig. 2.19).

Seen from the intensity of energy consumption, per capita energy consumption has been rising since the reform and opening-up, along with the increasing improvement of living standard (see Fig. 2.20). After 2001, per capita energy consumption quickened its growth, with a rise of 169% from 2000 to 2014. On the other hand, China's energy consumption per unit of GDP is on a decline, as industrialization and urbanization keep speeding up and industrial technology and energy utilization efficiency improve constantly [1].

2.1.6.2 Climate Change

Climate warming in China is consistent with the global tendency. According to the monitoring results released by China Meteorological Administration, China witnessed a rise of 1.1 in its surface temperature in the past century (1908–2007) and experienced 21 mild winters since 1986, with 2007 being the warmest year since 1961 under systematic meteorological observation. Based on the global CO₂ emission tendency report 2015, China's CO₂ emission has been on a rise, but at a

Fig. 2.18 Total Energy Consumption, 1978–2014.
Source China Statistical Yearbook 2015

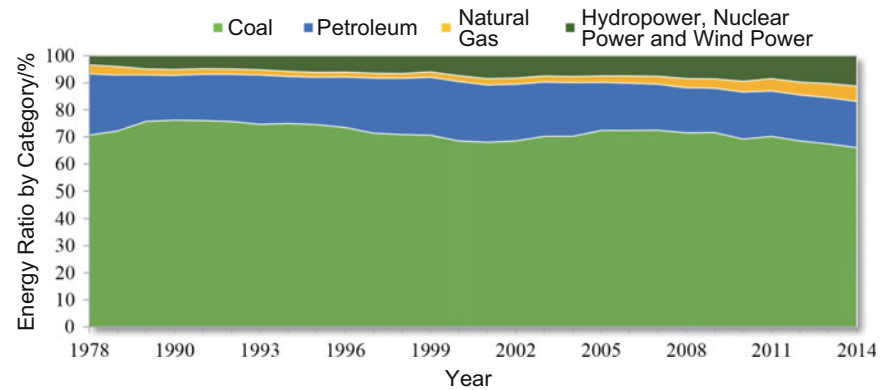
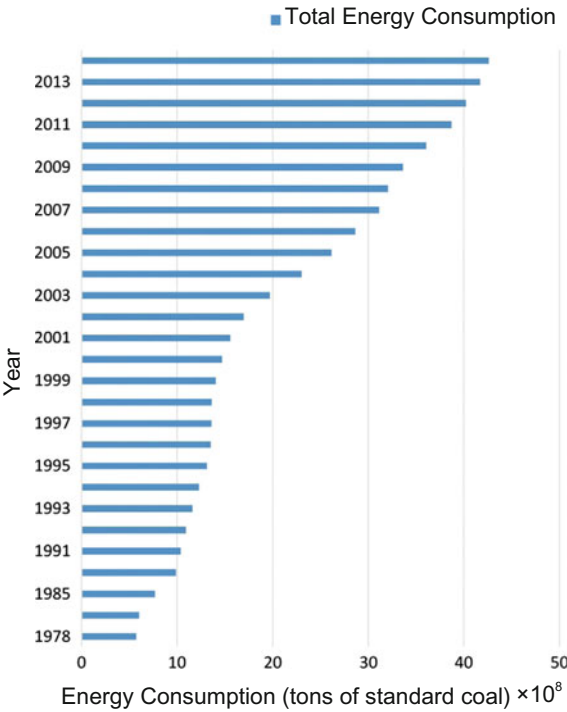


Fig. 2.19 Energy Consumption Structure, 1978–2014

smaller rate; per capita CO₂ emission has increased year on year and the increase quickened after 2002 and slowed down after 2011; China’s carbon emission intensity has declined remarkably, at a bigger speed than other countries (see Figs. 2.21 and 2.22) [3].

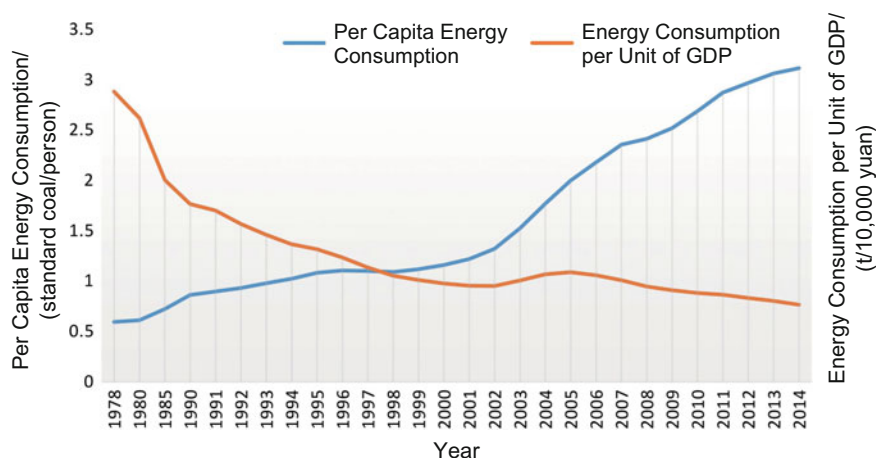


Fig. 2.20 Energy consumption per unit of GDP and per capita energy consumption, 1980–2014.
Source China Statistical Yearbook 2015

China has always been very active in promoting global climate control. In November 2009, China announced the action plan of reducing its CO₂ emission per unit GDP by 40–45% in 2020 relative to 2005 levels and incorporated it into its mid- and long-term planning for national economic and social development as a binding indicator. In June 2015, China submitted its Intended Nationally Determined Contribution to address climate change to the Secretariat of the United Nations Framework Convention on Climate Change, pledging to reduce its CO₂ emission per unit GDP by 60–65% in 2030 relative to 2005 levels. This is not only the required work of China as a contracting party, but also the biggest effort China can make to hit the target of the convention. The report of 18 non-governmental organizations including World Wide Fund said that China’s climate action target has exceeded its “fair share.”

2.1.7 Ecosystem and Biodiversity

2.1.7.1 Natural Reserves and Biodiversity

By the end of 2014, China has established 2792 natural reserves, covering an area of 146.992 million ha, 14.8% of national territorial area, and 12% higher than the world average. Among them are 407 state-level natural reserves, covering an area of 96.516 million ha. A local protection network of biodiversity, centering on natural reserves, has taken shape basically (see Fig. 2.23) [1, 4].

Covering a vast area, China possesses complex climate and topography, a rich variety of endemic species, anciently rooted floras and complicated spatial

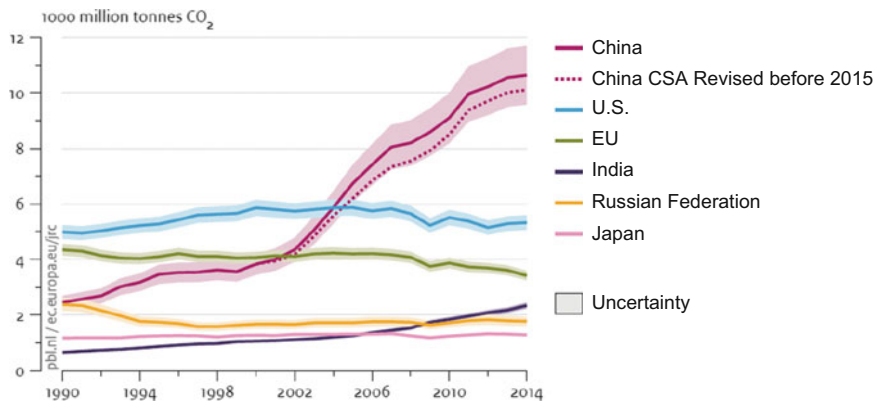


Fig. 2.21 Great emission countries and EU CO₂ emission tendency. *Source of picture* Trends in Global CO₂ Emissions: 2015 Report

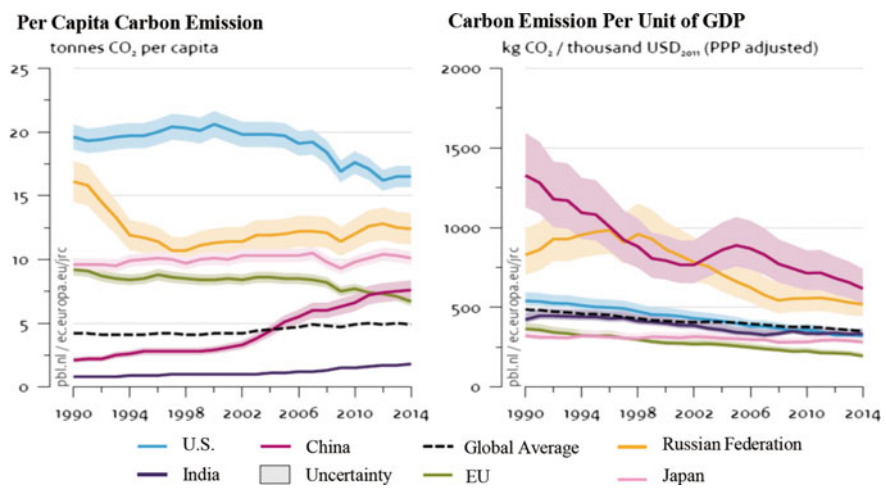


Fig. 2.22 Great emission countries and trends in EU per capita CO₂ emission and CO₂ emission per unit of GDP. *Source of pictures* Trends in Global CO₂ Emissions: 2015 Report

distribution of biodiversity. It is one of the 12 mega-diversity countries, the 8 centers of origin of crops, and the 4 centers of origin of cultivated plants. The Chinese government and relevant sectoral administrations have implemented a group of plans and programs in the protection of natural reserve, wetland, aquatic organism, as well as livestock and poultry genetic resources and combined the development of biotechnology and the promotion of the sustainable utilization of biological resources. China's 5th national report submitted in March 2014 on the

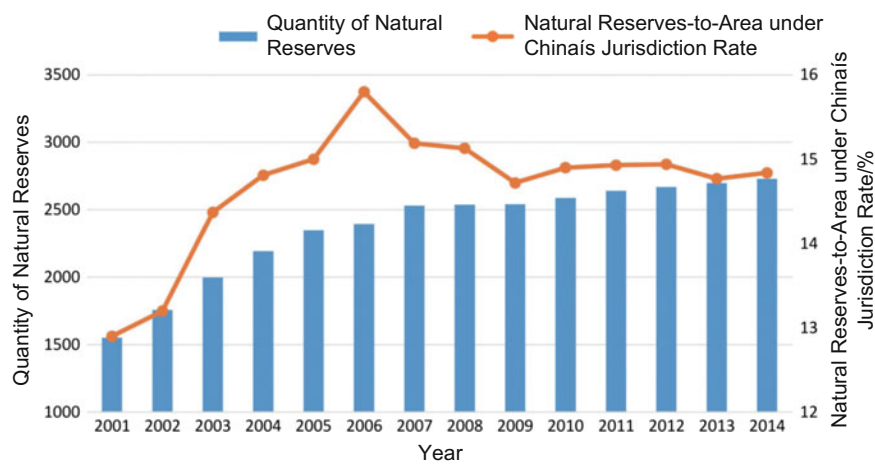


Fig. 2.23 Quantity and area of natural reserves in China. *Source* China Statistical Yearbook 2002–2015

implementation of Convention on Biological Diversity summarized the status quo and trend of China’s biodiversity.

The endangered rate (critically endangered, endangered, and vulnerable animals) of invertebrate animals is 34.7% and vertebrate 35.9%. China currently has 3767 endangered plants, accounting for 10.9% of the higher plants of the country. The total number of higher plants which need attention and protection reached 10,102, accounting for 29.3% of the total. China’s genetic resource loss is very serious. Results of the second national survey for husbandry genetic resources show that 15 local varieties disappeared and the number of local varieties above general level is decreasing.

The pressure for biodiversity conversation mainly comes from fast population growth and accelerated industrialization and urbanization which lead to the degeneration of wild species and loss of their habitats. Other threats are over development of natural resources, environmental pollution, large-scale plantation of single species and invaded alien species, and climate change.²

2.1.7.2 Protection of Forest and Wetland

Forest, grassland, and wetland play a significant role in improving environmental quality, regulating air temperature, preventing wind, fixing sand, protecting water and soil, and maintaining ecological balance. According to the 8th national forest resources inventory (2009–2013), forests cover an area of 208 million ha

²CAEC, Implementation Progress of China-ASEAN Biodiversity Strategy and Action Plan, China Environmental Science Press, 2016.

Table 2.5 Forest resources inventory of China over years

Inventory and its time	Forest area/10,000 km ²	Forest coverage rate/%	Forest stock/100 M m ³	Standing forest stock/100 M m ³
1949	76.0	7.9		
The first inventory (1973–1976)	122.0	12.7	86.56	95.3
The second inventory (1977–1981)	115.2	12.0	90.28	102.6
The third inventory (1984–1988)	124.6	12.98	91.41	105.7
The fourth inventory (1989–1993)	133.6	13.92	101.37	117.85
The fifth inventory (1994–1998)	158.94	16.55	112.67	124.88
The sixth inventory (1999–2003)	174.91	18.21	124.56	136.18
The seventh inventory (2004–2008)	195.6	20.36	137.21	149.13
The eighth inventory (2009–2013)	208	21.63	151.37	164.3

nationwide, with a forest coverage rate of 21.63% (see Table 2.5). China ranks fifth for forest area, sixth for forest stock, and still top for the area of planted forest. In China, forest resources witness a constant increase in quantity, a steady improvement in quality, and a continuous rise of efficiency. While global forest resources decrease on the whole, China witnesses a constant growth and registers the biggest speed of growth [5, 6].

The forest ecosystem is fragile. China's forest coverage rate remains much lower than the world average, 31%. Moreover, forest quality is poor, with a forest growing stock of 89 m³ per ha, while the number is 300–320 m³ per ha or even higher in some developed EU countries. Besides, China's per capita forest resources available are merely one-sixth of the global average, and its per capita grassland available is only half the world average. Grassland quality declines gradually, and grassland ecosystem is damaged severely due to the long-term irrational utilization and development of land. At present, desertification land accounts for 18% of China's national territorial area (see Fig. 2.24). Area of soil erosion is about 30.7%.

The first national wetland resources inventory (1995–2003) indicates China's wetland covers an area of 38.48 million ha, accounting for 4.01% of its national territorial area, for which China ranks top in Asia and fourth in the world. With a rich biodiversity of wetland, China possesses as many as 271 species of waterfowl and is an important area for the world's protection of rare and endangered

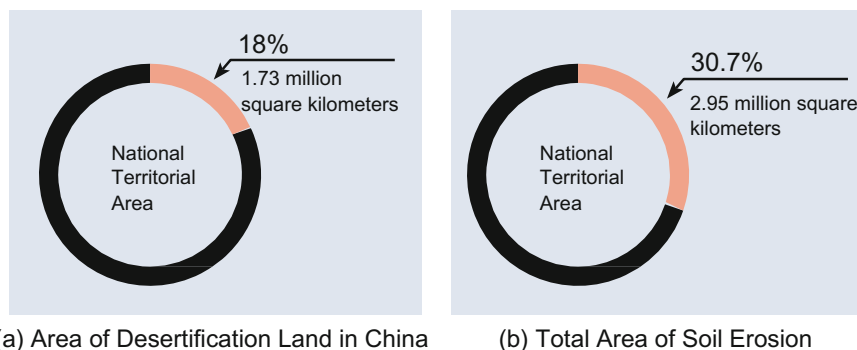


Fig. 2.24 Land resources damage in China. *Source* China Statistical Yearbook 2015

waterfowl. Up to now, wetland damage remains hard to contain. In the recent 50 years, China's wetland damage rate has reached 21.6%, according to long-term researches and statistics.

2.1.8 Sustainable Production and Consumption

2.1.8.1 Eco-Label

In China, eco-labeling is referred to as “environmental label system.” In August 1993, the Chinese government confirmed officially that the environmental label should be composed of a mountain, water, a sun and ten rings, namely the “ten-ring label.” Up to now, China has built up the environmental labeling system for agricultural products, represented by green food mark and organic food mark; the environmental labeling system for manufacturing and building products, represented by China environmental level; and the energy efficiency labeling system, represented by the energy efficiency label (see Fig. 2.25).

2.1.8.2 Environmental Awareness

As demonstrated by the issuance of the country's first National Ecological Civilization Awareness Survey and Research Report in 2014, China witnesses “high recognition, poor knowledge and insufficient practice” in the public awareness of ecological civilization, with the public recognition, knowledge, and practice rates being 74.8, 48.2, and 60.1%, respectively (see Fig. 2.26). As public awareness of ecological civilization features high “dependence on the government,” the respondents agree widely that government and environmental departments should be solely responsible for developing ecological civilization. The report finds out



Fig. 2.25 China environmental labels

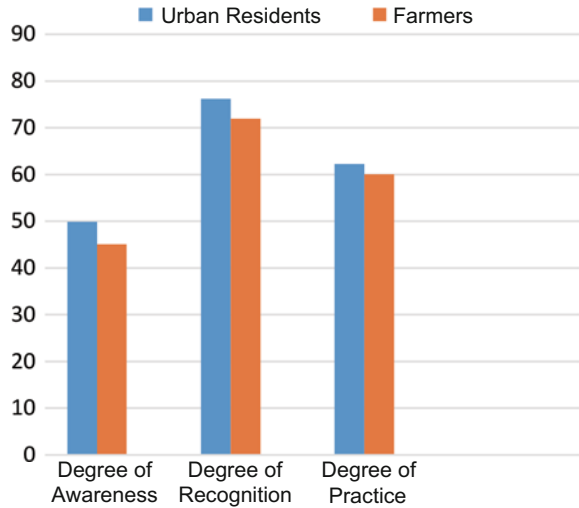
that people’s economic status and educational background greatly affect their awareness and knowledge of ecological civilization. Moreover, the respondents are quite worried about the current status of environment. Their biggest concerns include haze, drinking water safety, heavy metal pollution, etc.

2.1.8.3 Modes of Life and Consumption

China is among the largest and most potential consumption markets. It remains at the stage of development, with a lower per capita consumption capacity. In China, the largest pressure on sustainable consumption is derived from the increasing discharge of wastes. In recent years, China has witnessed a rapid decline in green travel sharing rate, especially for bicycles and walk, with a decrease of even above 10% in many cities in the past decade.³ In the recent five years, growth of cars has exceeded 20% in many cities. Presently, government departments and officials are less capable of understanding and using new media to satisfy the realistic demand, though new media has been an important way for the general public to acquire environmental information, express their will, participate in environmental decision making, supervise environmental management and law enforcement, and express their green selections. Along with the gradual improvement of living standard, people have raised new appeals for environmental quality, so efforts should be made to seek and establish resource-saving and environment-friendly modes of life and consumption.

³Source: CCICED Special Policy Study on “Promoting Urban Green Travel”.

Fig. 2.26 Comparison between urban residents and rural residents by scores of ecological civilization awareness. *Source* National Ecological Civilization Awareness Survey and Research Report



2.2 ASEAN

2.2.1 Review of ASEAN Green Development Course

ASEAN is rich in natural resources and among the most populous regions in the world. Its economy depends largely on industry, service, and agriculture, of which industry and service register the largest contribution to GDP. The ASEAN suffers from impacts of unsustainable development, over exploitation of natural resources, and the degradation of environmental and ecosystem services. The ASEAN economies are fully aware of these threats and impacts brought about by traditional development and have thus mobilized the transition toward sustainable industrial development.

In the 1990s, the Environmental Impact Agency of Indonesia issued Indonesia Environmental Protection Strategy Plan (1994–1998). In 2007, the Indonesian government formulated a “national action plan” specific to the fight against climate change. At present, the country is striving to establish a low-carbon economy. Singapore is rich in the experience of practice. The government developed the Singapore Green Plan 2012 (SGP 2012) in 2001 and has formulated Sustainable Singapore Blueprint 2015. In Brunei, environmental protection strategy was included into the eight strategies in the “2035 long-term outlook” as specified in the Long-term Development Plan of Negara Brunei Darussalam released in 2008. In 2009, Myanmar started to implement the sustainable development strategy, which aims to realize the happiness and joy of the Burmese people and sets up three objectives for green development transition from the perspectives of environment, economy, and society, including the sustainable management of natural resources, the comprehensive development of economy, and the sustainable development of

society. In 2010, Malaysia promulgated the 10th national development plan, presenting “ten concepts,” including “cherishing natural resources and environment” and “five strategies,” of which an important one is building a good environment and improving living quality. In 2013, to realize green development, relevant departments of Cambodia formulated and implemented the 2013–2030 Green Growth Framework Strategy, which ensures a balance between economic growth, environmental protection, and social development while promoting economic growth, through standardizing national policies and strategic development plans for green development, in order to help government officials with the management of natural resources. As for Thailand, environmental protection is among the 6 key points of the 11th Five-Year Plan for National Economic and Social Development (2012–2016). Besides, the country has released the Strategic Plan of Green Growth. The Laotian government has presented the vision of “clean, green and beautiful cities” in its National Environmental Action Plan (2011–2015).

ASEAN Member States have launched cleaner production plan in manufacturing successively. For instance, Malaysia has released a roadmap of cleaner production; Vietnam has promulgated a national clean production action plan and in 1998 founded the National Clean Production Center; the Thailand government issued the National Clean Production Development Plan (2002–2011) in January 2002; the government of the Philippines unveiled the Philippines Environmental Partnership Plan and estimated the implementation of pollution management projects by private enterprises so as to attain environmental standards better. The Singapore government has established an energy efficiency improvement aid program to provide 50% of the capital needed by energy audit, encourage enterprises to calculate their energy consumption, and tap the potentialities of energy efficiency improvement. Other ASEAN Member States have also implemented the environmental label plan to encourage sustainable development. For instance, the Singapore Green Label Scheme (SGLS) was launched in 1992; Thailand Business Council for Sustainable Development initiated the country’s green label plan in 1993; Indonesia launched the ecological label authentication and permission plan on the World Environment Day of 2004; and Vietnam approved its national ecological label plan in 2009.

ASEAN also makes efforts in various respects to fulfill its promise to promote green development at regional level and has promulgated a great many declarations and proposals relating to environment since it placed environmental issues on the agenda over 30 years ago. Presently, ASEAN plays an important role in promoting the sustainable development of regional environment and the implementation of multilateral environmental agreements. In 1977, under UNEP promotion and support, ASEAN formulated the first ASEAN Sub-regional Environment Plan [ASEP-I (1978–1982)], including 6 prior fields and more than 100 environmental projects implemented by ASEAN Expert Group on the Environment (AEGE) under ASEAN Science and Technology Committee. In 1981, ASEAN established the ministerial meeting mechanism on environment. In the Manila Declaration on the ASEAN Environment in 1981, the objective is defined as “to ensure the protection of the ASEAN environment and the sustainability of its natural resources so that it can sustain continued development with the aim of eradicating poverty and

attaining the highest possible quality life for the people of the ASEAN countries.”⁴ Subsequently, ASEAN formulated and implemented the 2nd and the 3rd subregional environment plan, laying a foundation for the subregional environmental cooperation mechanism of ASEAN. After 1989, ASEAN Summit and ASEAN Ministerial Meeting on Environment were established. In 1992, ASEAN Summit was held in Singapore, when ASEAN Member States reached agreed unanimously with environmental issues and sustainable development and ASEAN Member States promised to respond positively to the Agenda 21. At the ASEAN 2020 Vision Forum held in Kuala Lumpur in 1997, ASEAN heads approved the ASEAN 2020 Long-term Objectives. In 1998, Hanoi Action Plan (1999–2004), namely ASEAN Strategic Action Plan on Environment (1999–2004), was approved in Hanoi. In November 2002, the Framework Agreement on Comprehensive Economic Cooperation between the People’s Republic of China and the Association of Southeast Asian Nations was signed at the 6th China-ASEAN Summit. In 2007, the 13th ASEAN Summit approved unanimously the ASEAN Socio-Cultural Community Blueprint 2009–2015. In 2009, the Ministry of Environmental Protection of P.R. China and ASEAN Member States formulated jointly the China-ASEAN Environmental Protection Cooperation Strategy (2009–2015). In the Manila Declaration on Green Industry, main developing economies of ASEAN and other Asian countries promised jointly to establish a framework of policies, monitoring, and regulations so as to promote the low-carbon and efficient transition of industry. In 2009, in particular, the ASEAN Day took “green development” as the theme, demonstrating ASEAN’s firm commitment to exercising sustainable development. In 2010, China-ASEAN Environmental Cooperation Center (CAEC) was founded.

Environmental protection is presented among the four important challenges in the ASEAN 2030 published in 2014 [7, 8].

At present, the important action plans for the implementation of ASEAN-China, Japan, and South Korea leadership project on sustainable production and consumption, ASEAN ecological school project, and ASEAN sustainable city plan have shown ASEAN’s solid commitment to promoting green development. ASEAN Member States and other stakeholders have facilitated further regional green development through multilateral coordination, cooperation, and exchange. Presently, ASEAN is striving for the objective of building up the ASEAN Community by 2015.

⁴Source: Manila Declaration on the ASEAN Environment, <http://environment.asean.org/manila-declaration-on-the-asean-environment/>.

2.2.2 Economic and Social Development

ASEAN economies differ in terms of scale (gross domestic product, GDP). For instance, Indonesia was the largest economy and Singapore the smallest one in 2013, which is closely related to population size. Indonesia registers the largest population in ASEAN and Brunei the smallest. In 2013, Singapore, Brunei, and Malaysia were in the development leaders, with the per capita GDP being 10,000 US dollars or more, which was 4000–8000 US dollars for other member states. In recent years, ASEAN Member States have experienced a steady economic growth (see Fig. 2.27).

In 2014, ASEAN Member States witnessed a steady development of economy on the whole. In the recent decade, ASEAN has achieved an average annual growth rate of 5–7%. Laos witnessed the fastest growth in 2006–2013, with an average growth rate of 9.3%, and Brunei was on the contrary, with a negative growth of economic aggregate in 2013 (see Fig. 2.28) [9].

Seen from the industrial structure, agriculture accounts for a bigger proportion, over 20%, in Cambodia, Laos, and Myanmar than that of other ASEAN Member States. The rate reached 17.5% in Vietnam in 2013 and is nearly zero in Singapore and Brunei. Thailand and Brunei register a higher rate of industry, around 50%, and service accounts for over 50% in Malaysia and Philippines (see Fig. 2.29).

ASEAN suffers a serious explosion of population. The most populated countries have a high speed of growth. Distribution of population is uneven, and a large number of population are located in coastal areas. Few reside in inland mountainous areas, and there is an imbalance between males and females.

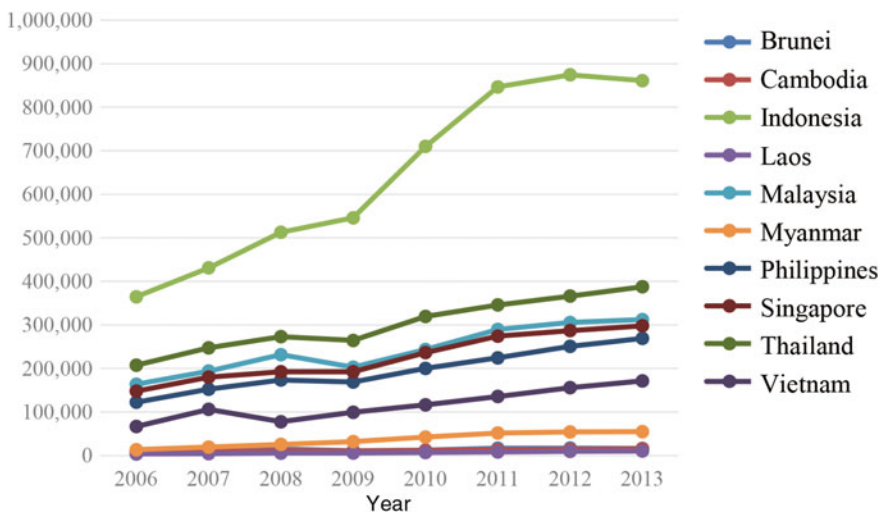


Fig. 2.27 Economic aggregate of ASEAN Member States. GDP at Current Prices/Million US Dollars. *Source* ASEAN Statistical Yearbook 2014

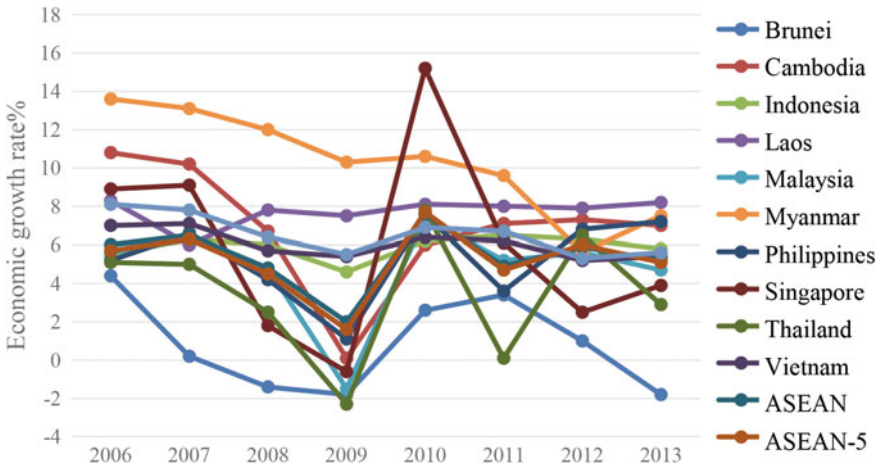


Fig. 2.28 Economic growth of ASEAN Member States. *Note* ASEAN GDP growth rate is figured out by the weighted average of the PPP-GDP rate adopted in October, 2014 of the IMF-WEO database. ASEAN-5 includes Indonesia, Malaysia, the Philippines, Singapore and Thailand. BCLMV represents Brunei Darussalam, Cambodia, Lao People's Democratic Republic, Myanmar and Vietnam. *Source* ASEAN statistical Yearbook 2014

2.2.3 Conservation and Utilization of Resources

2.2.3.1 Land Resources

Possessing rich land resources, ASEAN covers an area of more than 4.43 million km², about 3% of the global land area. Among ASEAN Member States, Indonesia registers the largest national territorial area, 1.86 million km², and Singapore the smallest one, 710 km². Agricultural land in ASEAN amounts to 117,272,000 ha, about 27.1% of its land area, of which the Philippines, Thailand, Vietnam, and Cambodia account for more than 30%, with the Philippines and Thailand ranking top by 39.6 and 38.5%, respectively. The agricultural land-to-land area rate is lower than 10% for Brunei and Laos and merely 1% for Singapore.

Seen from the protection of land resources,⁵ 13.2% of ASEAN land is under protection (see Fig. 2.30), of which Brunei accounts for 49.77%, the largest one, Cambodia 26.65%, Thailand 20.36%, and Malaysia 18.28%, and it's lower than 10% for Vietnam, Singapore, and Myanmar, and merely 4.57% for Singapore. Land under protection accounts for only 14.89% of the national territorial area in Indonesia, but 42% of the ASEAN area [10].

Despite the imbalance in the area of land protected, ASEAN Member States have witnessed a growth in the recent decade. Additional land has been protected,

⁵Source: Peng Bin, Liu Xiaoxue, Yang Zhenzhong, ASEAN State of Resources and Environment and Potential of Cooperation, Beijing, Social Sciences Academic Press, 2013.

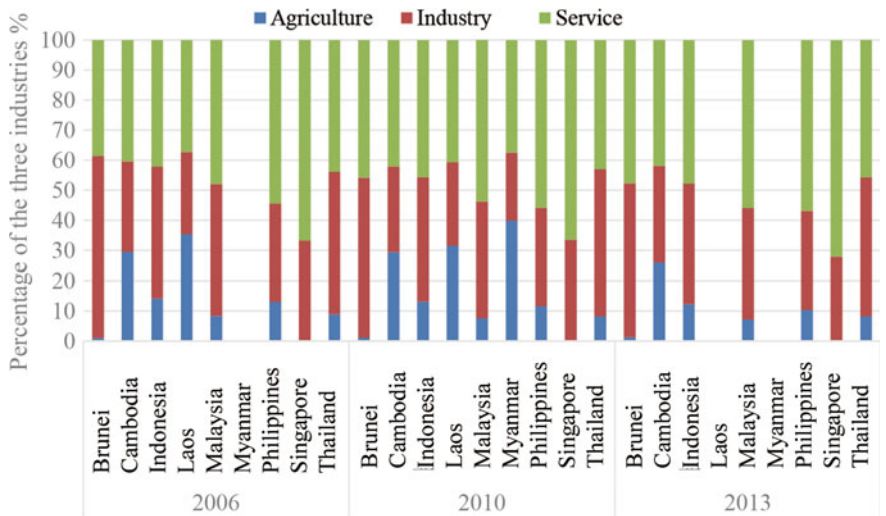


Fig. 2.29 Industrial structure of ASEAN Member States. *Source* ASEAN Statistical Yearbook 2014

and national heritage park projects have been implemented in Laos, the Philippines, Myanmar, Thailand, Malaysia, and Vietnam, with the aim to protect land and obtain the 2010 biodiversity convention goals.

2.2.3.2 Water Resources

According to Fourth World Water Development Report issued by the United Nations Educational, Scientific and Cultural Organization (UNESCO) in March 2012, 70% of the earth surface is covered by ocean, and freshwater resources are limited and unevenly distributed, with only 2.5% available for the mankind, animals, and plants. Located in the tropics, ASEAN boasts a great many rivers and lakes and rich freshwater resources.

Statistics indicates in 2007, ASEAN possessed 5674.5 billion m³ of renewable water resources (see Table 2.6). Among the member states, Indonesia, Myanmar, and Malaysia rank top, with the total freshwater resources being 2838 billion m³. However, Laos, Brunei, and Malaysia take the leading position for per capita freshwater resources, and Laos ranks top with 33,063 m³/person·a. The demand for water resources rises along with the increase of population and the development of economy. ASEAN water consumption is expected to double in the second half of the twenty-first century.

Marine protected areas (MPAs) are established. In the past decades, MPAs have witnessed an increase in their quantity and area in ASEAN. According to UN statistics, ASEAN Member States possessed 87,778 km² of MPAs in 2007, 119.4%

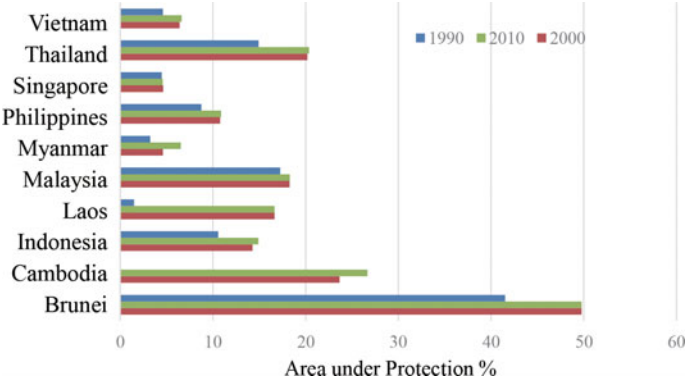


Fig. 2.30 Ratios of land under protection. *Source* FAO Database, <http://faostat.fao.org/site/684/default.asp> ASEAN Statistical Yearbook 2014

higher than the 40,000 km² in 1995. Especially in 2001–2003, ASEAN’s area of MPAs increased rapidly. Up to September 2009, the Philippines has established 339 MPAs, including 7000 islands, ranking first in terms of MPA quantity; Indonesia has 129 MPAs, ranking the second; the third was Malaysia, with 83 MPAs; Cambodia, Singapore, and Myanmar possessed few MPAs; and there was no MPA in Brunei, although two areas with coral reefs, Pelong Rocks and Pulau Punyit, are managed as wildlife sanctuaries (see Table 2.7). Seen from the area of a single MPA, the Savu Sea Marine National Park of Indonesia is the largest one in ASEAN, with an area of 35,000 km² [11].

Table 2.6 Renewable freshwater resources of ASEAN Member States, 2007

Country	Gross freshwater resources/Million m ³	Freshwater resources per capita/[m ³ / (person·a)]
Brunei	85	22,254
Cambodia	1206	8493
Indonesia	28380	15,500
Laos	1904	33,063
Malaysia	5800	22,211
Myanmar	8806	18,202
Philippines	4790	5553
Singapore	9	194
Thailand	2100	3310
Vietnam	3665	4251
ASEAN	56745	57,385

Source Food and Agriculture Organization of the United Nations (FAO)

Table 2.7 ASEAN Member States' MPAs

Country	Number of MPAs	Country	Number of MPAs
Brunei	0	Philippines	339
Cambodia	2	Singapore	2
Indonesia	129	Thailand	23
Malaysia	83	Vietnam	36
Myanmar	6	ASEAN	620

Source Fourth ASEAN State of the Environment Report 2009

2.2.4 Environmental Protection

2.2.4.1 Atmospheric Environment

Air quality of some ASEAN Member States is worrying along with the use of biomass for energy, the increase of population, and the quickening of urbanization. In particular, transport vehicles, similar with industry, have been among the main sources of air pollution in ASEAN Member States.

In Indonesia, air quality was “unhealthy” for 49 days in Djakarta, 18 days in Medan, and 7 days in Surabaya in 2007. In other densely populated cities, the increase of motor vehicles has brought up the concentration of nitrogen compounds up 30 ppm in average. Moreover, another main reason for the air quality degradation in Indonesia is the development of industry, especially the sectors of food, chemicals, petroleum, coal, rubber, plastics, papermaking, and textile.

In Brunei, PM₁₀ concentration grew from 12.3 µg/m³ in 2006 to 18.1 µg/m³ in 2008, though its air quality was defined “good” for every day of 2008.⁶

In Malaysia, air pollutants include mainly nitrides, sulfides, and suspended substances (PM). Since the end of the 1990s, Malaysia has achieved a significant improvement in air quality, with average SO₂ concentration dropping from 0.0074 ppm in 1998 to 0.0019 ppm in 2007, and PM₁₀ basically consistent with state standard between 2000 and 2008. Traffic and electric power sectors are major sources of air pollutants, with nitrides from the former and sulfides and suspended substances from the latter. According to statistics, the electric power sector contributes 60% of SO₂ and 50% of PM, and the traffic sector contributes most nitrides and 35% of PM.

In Thailand, urban air pollution is largely owing to transport vehicles, and 50% of the fuel is consumed in Bangkok. Statistics indicates in 2007, the overall air quality of Thailand was “good” for 141 days, “medium” for 197 days, and “unhealthy” for 27 days; moreover, most pollutants in Bangkok, the capital, were particulate matters, especially inhalable ones, and the content of CO, NO_x, SO₂, HC, lead, and black smoke exceeded the state standard. According to statistics, in the pollutants of Bangkok, 54% of hydrocarbons and 88.2% of carbon compounds

⁶The state standard is 50 µg/m³ in Brunei.

are discharged from motorcycles. Total particulate matter concentration of Bangkok is far higher than the state standard, 50 ppm, though it has improved since 1995.

In the Philippines, air pollution is attributed largely to the emissions of transport vehicles. According to the prediction, 65% of the pollutants are derived from mobile sources, 21% from fixed sources, and the other 14% from regional sources. Despite the drop, TSP concentration remains higher than the state standard 90 ppm.

Singapore registers good air quality. In 2008, the air quality was “medium” for 353 days, and other indexes, except PM_{2.5}, were consistent with the UN standard. In Vietnam, air pollution is caused largely by traffic and industrial sectors. As the largest source, traffic contributes about 70% of urban air pollution. Across the country, transport vehicles discharge 85% of the CO and 95% of the VOCs.

Air quality management

ASEAN and ASEAN Member States have formulated relevant laws, promulgated pertinent policies, and implemented various measures, with the aim to control air pollution and improve air quality. To prevent the further worsening of air quality, Malaysia, Singapore, and Thailand introduced measures for restricting the use of lead-containing petrol as early as 1991, and Thailand completed the objective and stated to stop the use of lead-containing petrol in 1996. Indonesia started to bring in the measure in 2001 and completed the task in 2006. At present, all ASEAN Member States have stopped using lead-containing petrol, except Cambodia, Laos, and Myanmar.

ASEAN Member States adopt differentiated policy measures to control air pollution and improve air quality. For instance, Cambodia lays particular emphasis on clean energy and energy efficiency; Laos focuses on the mitigation of the excessive reliance on traditional energy and then the improvement of utilization rate of renewable energy; Thailand stresses the reduction of pollutants emitted from transport vehicles and takes the improvement of renewable energy utilization rate through the development of ethanol industry as a national strategy; and Singapore controls air quality through conducting monitoring strictly, formulating land use plans prudently, separating industrial zones from residential areas, and introducing European transport vehicle emissions standard compulsorily and etc.

To monitor air quality better, most ASEAN Member States have established a monitoring network to get the air quality status in real time. Singapore has set up the first air quality monitoring station (in 1971), followed by Malaysia (in 1978). Myanmar also built up the network in 2008. Up to 2009, there had been 177 air quality monitoring stations in ASEAN Member States for monitoring the atmospheric pollutants, such as PM, CO, NO_x, SO_x, Pb, O₃, and TSP.

ASEAN Agreement on Transboundary Haze Pollution (ASEAN 2002) aims to monitor and prevent the haze pollution caused by land and/ or forest fire and approves the adoption of the zero-burning policy. ASEAN Agreement on Transboundary Haze Pollution is among the international agreements intended to avoid the international communication of particulate matters generated in forest combustion [12].

2.2.4.2 Water Environment

ASEAN Member States are bothered with both water pollution and the increasing demand for water (see Table 2.8).

In 2007, 27 of the over 30 rivers monitored in Indonesia were contaminated; and in 2008, 54% of the rivers monitored were polluted. In Thailand, rivers also suffer heavy pollution. In 2005, 29% of the rivers there witnessed “poor” water quality and the rate rose to 48% in 2008. In Malaysia, mildly contaminated rivers are largely located where agricultural and industrial production activities concentrate, and most contaminated rivers are situated in ports and industrial production-concentrated areas. Few rivers are polluted where forest coverage is high and industrial development does not pick up the pace. In Philippines, water quality of all the rivers monitored is unoptimistic and many waters are under the state standard regarding COD and BOD. Water pollution is serious as well in Vietnam.

According to the ASEAN Statistical Yearbook 2014, ASEAN Member States differ a lot from one another in terms of the ratio of safe drinking water-available population (see Fig. 2.31), which is 100% for Brunei, Singapore, and Thailand, 94% for Malaysia, 91% for Vietnam, 83% for the Philippines and Myanmar, 70% for Laos, 54% for Cambodia, and 41% for Indonesia.

Table 2.8 Water quality in selected ASEAN Member States

Country	Year	Water quality
Indonesia	2008	54% of 33 rivers monitored were heavily polluted
Philippines	2008	14–28% of the rivers exceeded the BOD emission limit
Thailand	2008	Quality of 48% of the rivers was poor in 2007 and 29% in 2005
Vietnam	1996–2001	BOD emission of the rivers was 2–3.8 times the state standard

BOD = Biological Oxygen Demand

Note BOD is the amount of dissolved oxygen needed for the aerobic biological tissues in a water to resolve the organic substances in a water sample in a certain term and at a specific temperature. Usually, BOD value is used to indicate the organic contamination degree of waters

Source ^aASEAN Secretariat, 2009. The Fourth ASEAN State of the Environment Report. <http://www.aseansec.org/publications/SoER4-Report.pdf>. ^bAsian Development Bank, 2007. 2007 Asian Water Development Outlook. Manila. <http://www.adb.org/publications/asian-water-development-outlook-2007>; ^cWorld Health Organization (WHO) and United Nations International Children’s Emergency Fund. 2010. Health and Drinking Water Development Report. Geneva: World Health Organization. <http://www.unicef.org/eapro/JMP-2010Final.pdf> (Access Date, November, 2013)

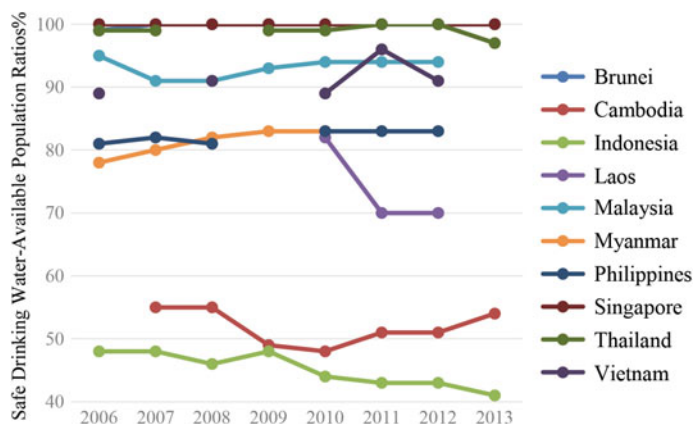


Fig. 2.31 Safe drinking water-available population ratios of ASEAN Member States, 2006–2013. *Source* Data that AMS submitted for ASEAN Statistical Yearbook and ACPMS Report; Cambodia—Cambodia Social and Economic Survey and Cambodia Demographic and Health Survey; Malaysia—Water Works Department, Rural Environment Sanitation Project (RESP), Population and Housing Census; The Philippines—National Demographic and Health Survey; Singapore—Public Utilities Board and administrative records; Thailand—Population and Housing Census; Vietnam—Living Standard Survey, Multiple Indicator Cluster Survey and Multi-purpose Household Survey. Key indexes of Asian Development Bank for 2006–2014; UN Statistics Division-population and social database, 2009 Asian-Pacific Economic and Social Yearbook. *Note* ‘—’ No information was available at the time of publication. ASEAN Statistical Yearbook 2014

2.2.4.3 Solid Wastes

Municipal solid wastes

Municipal solid wastes (MSWs) are generally defined as household garbage and harmless wastes, such as commercial and institutional wastes, street sweepings and building rubbish, human feces, dust from incinerators, and sludge of digestion tanks and sewage treatment works.

MSWs are a major part in the wastes of most ASEAN Member States (see Table 2.9). MSWs account for approximately 67% of the gross wastes in Thailand. In Bangkok, the metropolitan area and surrounding provinces generate 30% of its total MSWs. Favorable progress has been achieved in the reduction of wastes through garbage recycling projects and the provision of safe and efficient garbage collection and treatment systems. From 2005 to 2007, MSWs in Thailand decreased by 13% every day on average.

Annual output of wastes in urban areas of Myanmar remained basically unchanged in the past four years, steadily at 700,000 tons. However, daily generation of wastes of Rangoon tripled, from 564 tons in 1990 to 1324 tons in 2007. Over the past few years, Singapore formulated various strategies for reducing and recycling wastes, with the aim to bring down the quantity of wastes buried. The

Table 2.9 Municipal solid wastes generation in selected ASEAN Member States, 2005–2008

Country	2005	2006	2007	2008
Malaysia ^a	32.90	26.50	11.40	11.40
Burma ^b	0.69*	0.70*	0.69*	0.71*
Philippines ^c	–	–	12.15	–
Singapore ^d	5.01^	5.22^	5.60^	5.97^
Thailand ^e	7.64	6.82	6.64	

Source ^aMinistry of Environmental Protection of Indonesia

^bMinistry of Forestry of Myanmar

^cPhilippines National Solid Waste Management Committee

^dMinistry of Environment and Water Resources of Singapore

^eMinistry of Pollution Control of Thailand

Note *Data of Rangoon and 238 towns (exc. Mandalay and Naypyidaw) of Myanmar

^Including the quantity of wastes recycled, incinerated and buried

capital of Philippines generates the most solid wastes (24% or 2.86 tons). According to the prediction, MSWs in Philippines would amount to 13.67 million tons by 2010. In 2005–2008, Indonesia witnessed a remarkable reduction in MSWs. The MSW management regulations Indonesia has issued recently are helpful in promoting 3Rs and the treatment and utilization of wastes, identifying the role of communities, introducing incentive and inhibition mechanisms, and clarifying authority and division of work.

In the ASEAN region, WSMs mainly include organic wastes, plastics, paper and paperboards, textiles, rubber and leather, timber, glass, and metal (see Table 2.10). On average, organic wastes account for a proportion of 46%, followed by plastics (18%) and paper (14%). The composition is expected to change, along with the rise of urbanization rate and income level.

Most MSWs are buried in a sanitary manner or stacked in the open air (see Fig. 2.32). However, manure mixture for fertilizing, incineration, and other methods are increasingly applied, including material recycling facilities (MRFs) and refuse-derived fuel plants (RDFPs). In Malaysia, there are 10 sanitary landfills and 188 open garbage dumps as well as 5 waste recycling centers and 1 refuse-derived fuel facility. Up to 2007, there had been 700–800 open garbage dumps in Philippines. Many local governments have determined to replace open dumps with sanitary landfills. In 2007, there were 2200 MRFs serving 2473 towns. In Singapore, about 56% of the solid wastes (including industrial wastes) are recycled and 41% are burned in wastes-based power plants. The other 3%, incombustible wastes, are delivered to Pulau Semakau Offshore Refuse Landfill for treatment. According to the policies, all combustible wastes must be burned in Singapore, which can reduce the quantity of wastes by 90%. Meanwhile, the heat from the burning is used to generate electricity, accounting for 2% of the electricity supply in the country.

Table 2.10 MSW components in selected ASEAN Member States

Country	Components/%								
	Organics	Plastics	Paper/Paperboards	Textiles	Rubber and Leather	Timber	Glass	Metal	Other
Brunei ^a	42	16	18	0	0	0	3	4	17
Indonesia ^b	58	14	9	2	2	2	2	2	6
Laos ^c	30	30	15	0	0	0	25	0	
Malaysia ^d	49	17	10	0	0	0	4	2	0
Burma ^e	73	2	18	2	0	4	0	0	1
Philippines ^f	50	25	13	0	0		3	5	5
Singapore ^g	24	24	25	3	3	2	2	17	
Thailand ^h	42	14	16	3	1	7	5	3	9
Vietnam ⁱ	49	16	2	1	7	6	19		

Source ^aMinistry of Environment, Parks and Recreation and Ministry of Development, Brunei

^bMinistry of Environment, Indonesia

^cEnvironmental monitoring of Laos in 2005

^dMinistry of Solid Wastes Management, Malaysia

^eMinistry of Forestry, Myanmar

^fEnvironmental Administration Bureau and Ministry of Environment and Natural Resources, Philippines

^gMinistry of Environment and Water Resources, Singapore

^hBureau of Natural Resources and Environmental Policies and Planning, Thailand

ⁱMinistry of Natural Resources and Environment, Vietnam

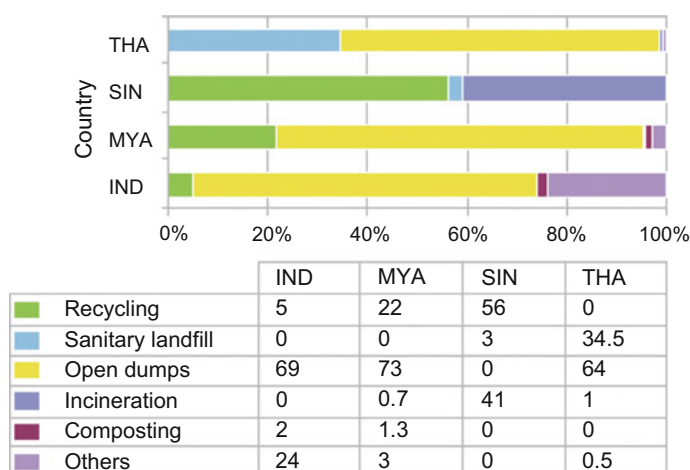


Fig. 2.32 MSW treatment and disposal methods in selected ASEAN Member States. *Source* Ministry of Environment, Indonesia; Ministry of Forestry, Myanmar; Ministry of Environment and Water Resources, Singapore; Natural Resources and Environment Policies and Planning Bureau, Thailand. *Note* Data of Singapore are about all types of wastes. Recycling methods include manure mixture for fertilizing and material recycling facilities

Industrial solid wastes

The largest source of industrial wastes is the manufacturing of basic metals, tobacco, timber and woodware, and paper and paper products in Thailand, Singapore, and Malaysia (see Fig. 2.33). In 2000, ASEAN is projected to produce 19 million tons of industrial wastes.

Between 2002 and 2008, Thailand generated 1.45 million tons of industrial wastes every year on average. Singapore treated merely 1 million tons of industrial wastes annually, though its total generation of industrial wastes was 3 million–4.5 million tons, mainly due to the implementation of many recycling measures in the country. In 2008, Malaysia produced 1.3 million tons of industrial wastes.

Hazardous wastes account for 1–3% of the wastes generated in ASEAN Member States. It's estimated that hazardous wastes amounted to 3 million tons in 2000, which is much higher now, because manufacturing and agricultural sectors generated nearly 4 million tons of hazardous wastes in 2007. Besides, domestic and commercial activities will also generate a handful of hazardous wastes.

In some ASEAN Member States, industrial wastes are still collected, transported, treated, and disposed as MSWs. Finally, they get mixed with household wastes and discarded at open dumps and landfills. There is still illegal dumping in some states due to insufficient facilities and high cost of treatment. However, some ASEAN Member States have established industrial waste treatment facilities. For instance, about 51% of industrial wastes are treated locally before disposal in Malaysia. Other main methods include refuse-derived fuel plants, sanitary landfills, and incineration.

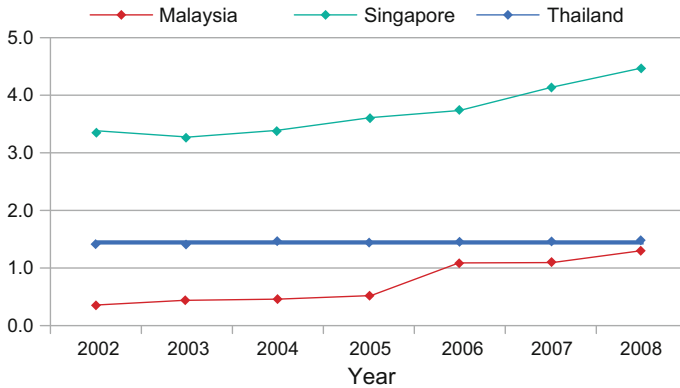


Fig. 2.33 Generation of industrial wastes in Thailand, Singapore and Malaysia. *Source* Ministry of Environment, Malaysia; Ministry of Environment and Water Resources, Singapore; and Ministry of Pollution Prevention and Control, Thailand

2.2.5 Energy and Climate Change

2.2.5.1 Energy Consumption

According to the BP Statistical Review of World Energy 2012, among the petroleum reserves detected in ASEAN Member States, Malaysia possesses the largest reserve, which is 5.9 billion barrels, followed by Vietnam, Indonesia, Brunei, and Thailand in succession. Up to the end of 2011, natural gas reserves were concentrated in Indonesia, Malaysia, Vietnam, Brunei, Thailand, and Myanmar. Coal resources are located mainly in Indonesia, Thailand, and Vietnam. Indonesia boasts of producing 5.529 billion tons of coal, 0.6% of the global reserve. In addition, there are also coal reserves in Malaysia, Laos, and Philippines. In addition to coal reserve, the ASEAN region possesses abundant hydropower resources and wood fuel resources.

On the whole, fossil fuel continues to dominate the energy structure of ASEAN. Gross energy use keeps growing along with the constant increase of population, and GDP and its growth stays consistent with the increase of per capita income and the middle class emerging in the region. From 1990 to 2007, gross energy use of ASEAN doubled, from 253 million tons of oil equivalent to 511 million tons of oil equivalent. In the meanwhile, the use of coal and natural gas increased and the fossil fuel-to-gross energy demand rate rose from 55.7 to 72.4% while the ratio of petroleum remained basically unchanged. The use of non-fossil fuel witnessed a decrease because commercial fuel substituted traditional energy and the proportion of biomass fuel (generally including forest and agricultural residue) dropped from 40.7 to 23.5%.

The growth of economy and the improvement of living standards have increased the demand for electricity. Therefore, investment is needed to develop

electrification in rural areas and the most undeveloped states and provinces of ASEAN. In 2010, the electrification rate exceeded 90% for the rural areas of ASEAN and 55% for rural areas. However, the rate dropped to 66% for urban areas and merely 12.5% for rural areas in Cambodia. Besides, power grid should be expanded so as to provide sufficient, reliable, and properly managed electric power system consistent with the expected development scale.

The expansion of commercial energy has promoted economic growth and poverty reduction. However, it has also intensified constantly the reliance on fossil fuel, aggravated global warming further, and increased ASEAN risks of exposure to world petroleum prices. In the past decades, petroleum prices experienced several increases, which not only burdened consumers but also delayed the development. A reason lies in the surging demand from Asian countries, though the demand from developed markets remains weak. In the future, it is unlikely that petroleum prices tend to stabilize. Brunei and Malaysia, who are net oil exporters, may get benefited from the high prices, and most Southeast Asian countries will be on the contrary. On the whole, import outgrows export. In 2009, the net import volume of oil was 42.5% of the gross consumption. To make things worse, several governments have increased the subsidies for the retail prices of oil, incurring a financial burden and reducing the energy conservation pressure of enterprises and households. For long-term development, the fully market-oriented fuel pricing mechanism should be adopted, though policy makers have decreased relevant subsidies.

ASEAN primary energy structure see Fig. 2.34.

The prices of petroleum and other fossil fuels staying high give an impetus to the development of renewable energy, especially biofuel, geothermal energy, hydro-power, solar energy, and wind energy. ASEAN Member States are exploring proactively the use of renewable energy or other alternative energy and have put forward the renewable energy development plan. For instance, Indonesia is projected to raise the renewable energy-to-national energy structure rate from 4.79% in 2011 to 25% in 2025; the Philippines hopes to be able to satisfy half the demand for electricity with renewable energy by 2030; the renewable energy goal of Malaysia is to raise the renewable energy-to-energy mix rate to 11% by 2020; Vietnam plans to increase the proportion of new energy and renewable energy to about 5% by 2020 and to 11% by 2050. ASEAN's switch from the reliance on fossil fuel and the traditional "black economy" will impose great influence on the oil-dependent countries. The local production and supply of renewable energy, such as biofuel, can help to mitigate the reliance on crude oil. However, under the influence of such factors as technological restriction, financing constraint, and insufficient financial arrangement, ASEAN Member States are confronted with various barriers for the development of renewable energy so that their actual action lags always behind the objectives [13].

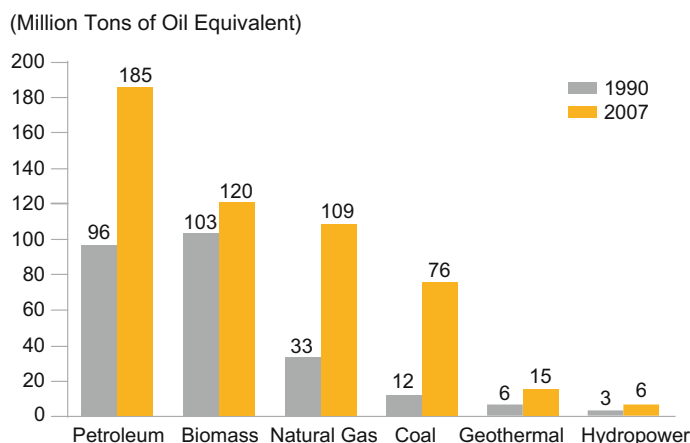


Fig. 2.34 ASEAN primary energy structure. ASEAN = Association of Southeast Asian Nations. *Note* Ton of oil equipment represents the amount of energy released in the burning of 1 ton of crude oil. *Source* Chira Achayuthukan and Weerakom Ongsakul. 2012. ASEAN 2030 Energy Demand. Background documents for the ASEAN 2030 research and formulation

2.2.5.2 Climate Change

According to *The Economics of Climate Change in Southeast Asia: A Regional Review* by Asian Development Bank, Southeast Asia is the most vulnerable to climate change. The report indicates that in the past 50 years, the average temperature of Southeast Asia has risen by 0.1–0.3 °C every 10 years and its sea level increases by 1–3 mm every year. Compared with other regions, the ASEAN region witnesses a small increase and a slow growth in its annual average emission of greenhouse gases (for a major reason of global warming) (see Table 2.11). For instance, the annual average increment of N₂O and CH₄ was lower in 2010 than the years before.

2.2.6 Ecosystem and Biodiversity

2.2.6.1 Change in Forest

Located in the tropics, the ASEAN region is among the regions with the most dense and most extensive forest coverage. The abundant forest resources bring forth the ample reserves of timber, biodiversity, and carbon resources and also play an important role in improving the ecology, environment, and climate of the region. In the ASEAN region, forests cover an area of nearly 213 million ha, for which Indonesia, Myanmar, and Malaysia rank top (Table 2.12) [14].

Table 2.11 ASEAN greenhouse gas emissions

Emission of atmospheric pollutants		1995	2000	2005	2010
N ₂ O	CO ₂ equivalent/1000 metric ton	16,313	18,029	20,229	20,633
	Annual average growth after the previous period/%		2.1	2.4	2.0
CH ₄	CO ₂ equivalent/1000 metric ton	48,135	517,670	527,670	53,030
	Annual average growth after the previous period/%		1.5	0.4	0.1
CFCs	Ozone consumption potential/metric ton	21,944	14,318	1037	1025
	Annual average growth after the previous period/%		-7.0	-18.6	-0.2

CH₄ = methane; CO₂ = carbon dioxide; N₂O = nitrogen dioxide

Source Intergovernmental Panel on Climate Change (IPCC), 2007. Climate Change 2007: Synthesis Report. Geneva. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr.pdf (Access Date: October, 2013)

Table 2.12 ASEAN forest area and woodland area

Country	Forest/1000 hm ²	Other woodland/1000 hm ²	Total/1000 hm ²	Coverage rate/%
Brunei	380			
Singapore	2			
Cambodia	10,094	133	10,227	57.9
Indonesia	94,432	21,003	115,435	63.7
Laos	15,751	4834	20,585	89.2
Malaysia	20,456	0	20,456	62.3
Myanmar	31,773	20,113	51,886	79.4
The Philippines	7665	10,128	17,793	59.7
Thailand	18,972	0	18,972	37.1
Vietnam	13,797	1124	14,921	48.1
ASEAN	213,322	57,385	271,449	62.7

Note Coverage rate denotes the proportion in the national gross of woodland area

Source Food and Agriculture Organization of the United Nations (FAO), 2010. World Forest Resources Assessment

Forest area decrease

Forest is the most abundant resource of ASEAN, but is also faced with similar challenges (see Fig. 2.35). The increasing demand for timber, fuel wood, and other forest products as a result of fast population growth and the conversion of forest land to agricultural lands are damaging the forests in this region. The rapid destruction of forests in Southeast Asia reduces the region's resilience to and exposes it to the impacts of global warming. Between 1990 and 2010, the forest area of ASEAN decreased by 2%. As for Cambodia, the forest coverage rate has

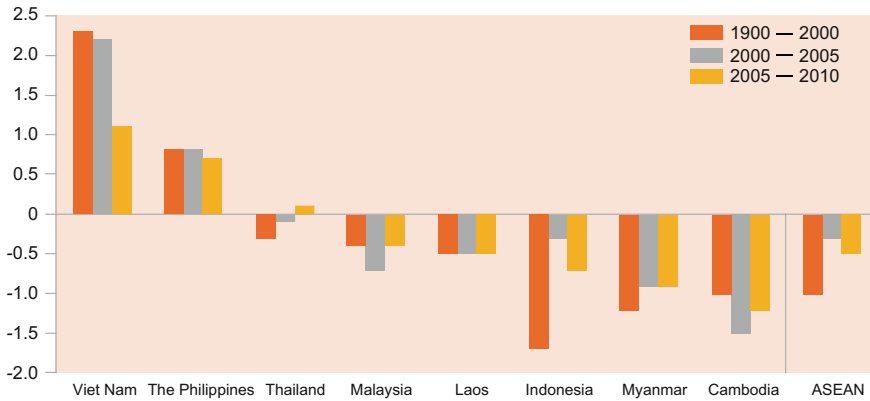


Fig. 2.35 ASEAN forest area variation, 1990–2010. ASEAN = Association of Southeast Asian Nations. *Source* Food and Agriculture Organization of the United Nations (FAO), 2010. World Forest Resources Assessment. Rome. <http://www.fao.org/docrep/013/i1757e/i1757e.pdf> (Access Date: November, 2013)

fallen to 52%, from 73% in 1965. The drop results in the decrease of species and indirectly causes the reduction of contribution to CO₂ emission reduction [15].

The decrease in ASEAN forest area is largely attributable to the growing population, the increase of agricultural production, logging and mining, for the foreign exchange earning of many ASEAN Member States depends still heavily on the export of timber and agricultural products. Furthermore, ASEAN Member States have been always threatened with illegal logging owing to the lack of adequate resources allocated to monitoring and law enforcement. They witness decreases in the area of mangrove, except Brunei, basically unchanged. ASEAN region has very rich mangrove resources, but its decrease rate tops the world. In the past several decades, mangroves are decreasing by 628 km² each year from 63,850 km² in total in 1980 to 46,971 in 2005, with a total reduction of 26% in 25 years.⁷

2.2.6.2 Biodiversity

ASEAN accounts for a measly 3% of the global land area but is among the regions with the most abundant biological resources. It hosts close to 18% of the species assessed by the IUCN. 3 of the top 17 countries with rich biodiversity are situated in ASEAN (Indonesia, Malaysia, and the Philippines), with above 70% of world biodiversity. However, such severe problems as the damage to natural resources and the degeneration of species and their habitats are confronting ASEAN. Preliminary calculation indicates more than 1000 species have been put in

⁷China-ASEAN Environmental Cooperation Center, Implementation Progress of China-ASEAN Biodiversity Strategy and Action Plan, China Environmental Science Press, 2016.

imminent danger by the damage to forest vegetation, species degeneration, the variation and over-use of habitats, illegal logging of forest, and illegal wildlife trade. ASEAN Member States have been aware of the severity of these threats and have started to launch and formulate green development plans and established ASEAN Center for Biodiversity and the ASEAN Center for Energy. ASEAN Biodiversity Outlook (ABO) gives snapshot introduction of the biodiversity situation in ASEAN region⁸:

- There has been a general decline in the coral reefs in the ASEAN region between 1994 and 2008. Although the region hosts the largest coral reef areas in the world, it also has the highest rate of loss, which today stands at 40%.
- Bottom-trawling, extensive coastline destruction and modification, decline in coastal water quality, and human-induced development have endangered seagrass beds in the ASEAN region. Indonesia, the Philippines, Singapore, and Thailand have each experienced from 30 up to 50% losses of seagrass habitats, compounded by the fact that the loss figures for other Southeast Asian countries remain largely unknown.

2.2.6.3 Ecological Footprint

Ecological footprint (EF) is an index for measuring human demand for global ecosystem services and nature's capacity to meet these demands. According to the analysis done by Global Footprint Network (GFN) in 2005, ASEAN region's EF is merely 4% of the global footprint, which indicates that ASEAN's share of global resource consumption is lower than its share of global population (9%) (see Fig. 2.36). However, ecological deficits occur in 5 ASEAN Member States, while the number was only 3 when the 3rd ASEAN State of the Environment Report was issued. Measures should be taken to make a changeover to ensure a more sustainable future of the ASEAN region.

Evidently, ASEAN economy needs a transition in the modes of production and consumption. ASEAN is capable of initiating actions for realizing green economic transition. The action includes formulating further sustainable measures and popularizing environmental products and service. Along with the continuous development of ASEAN, various measures are expected to stimulate the development of green cities, the use of clean and efficient techniques and the application of renewable energy and thereby ensure the integrity of the ecosystems.

⁸China-ASEAN Environmental Cooperation Center, Implementation Progress of China-ASEAN Biodiversity Strategy and Action Plan, China Environmental Science Press, 2016.

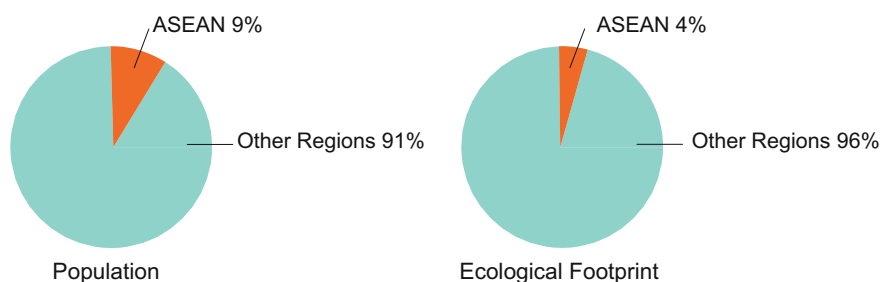


Fig. 2.36 ASEAN population and ecological footprint. *Source* Global Footprint Network (GFN)

2.2.7 Sustainable Production and Consumption

2.2.7.1 Eco-Label

The eco-label plan has been implemented in many ASEAN Member States to encourage sustainable production. On June 5, 2004, Indonesia initiated the eco-label certification and accreditation scheme on the World Environment Day, with the certification authority approved by the national accreditation service committee and the standard based on ISO 14024, other eco-label plans, legal requirements, relevant international conventions and yield and quality standards.

In 2009, Vietnam approved its national eco-label plan, with the objectives of:

- Protecting and efficiently using available natural resources;
- Encouraging environmental improvement; and
- Encouraging clients to make wiser decisions.

It plans to make 100% of imported products and 50% of domestically made products printed with the ISO 14021 environmental label.

Singapore Green Label Scheme (SGLS) was initiated by the Ministry of Environment in May 1992 and is applicable to most products, excluding foods, drinks, and pharmaceuticals. Green labels are applicable to the products consistent with the ecological standard as stated in SGLS or mutually recognized and supported by SGLS, for which the authentication by other member institutions is allowed. Singapore Environment Council (SEC) has implemented it since June 1999, and a new SCLS standard has been established according to the markets of Singapore and foreign countries and consumers' demand for products. Green label access standard is established by:

- The advisory committee made up of representatives of governments, private sector, academic institutions, and statutory organs;
- The uniform standards formulated by the committee based on the industrial investigation conducted by manufacturing enterprises that give an active response; and

- The opinions given by GEN20 and its member institutions on standard formulation and the agreement on the mutual recognition of eco-labels.

In October 1993, the Commercial Sustainable Development Committee of Thailand initiated the green label scheme, which was launched officially by its Environmental Research Institute of Ministry of Industry in August 1994. The scheme aims to generalize the concepts of resources conservation, pollution reduction, and wastes management. Green labels are granted for the purpose of:

- Providing reliable information to guide customers how to select products;
- Providing consumers with the opportunity of making environmental decisions and developing and providing more environment-friendly products and establishing a market incentive mechanism for production enterprises; and
- Reducing the environmental influence that may arise from the production, utilization, consumption, and disposal of products.

The green label scheme of Thailand is applicable to products and services, excluding foods, drinks, and pharmaceuticals. Any product or service that meets the green label standards will be labelled accordingly. Participation in the scheme is on a voluntary basis.

2.2.7.2 Sustainable Production

Sustainable production will be helpful in reducing the use of resources and energy in the production of products and services while minimizing the impact on the environment. In addition, it will make products safe, ecologically harmless, durable, repairable, recyclable, fertilizing, and degradable.

In the meantime, the entire life cycle—from the extraction of natural resources to the production, distribution, and disposal of products and services—is involved. The sustainable production in key economic sectors, i.e., agriculture, manufacturing, forestry, and energy, will help conserve sufficient resources for future generations.

Sustainable agriculture

The intensification of agricultural production has given rise to various environmental problems, such as soil erosion and degradation, the increase of greenhouse gas emission, biodiversity loss, and pollution aggravation. It is urgently necessary to adopt sustainable modes of agricultural production so as to maintain environmental health and promote social and economic justice while guaranteeing economic profit. As agriculture serves as the foundation of many ASEAN economies, society, enterprises, and environment will benefit substantially from the participation in such agricultural certification projects as Roundtable on Sustainable Palm Oil (RSPO) and Rainforest Alliance.

Over three decades, oil palm industry has grown into a major engine for economy, especially in Malaysia and Indonesia. In recent years, the sustainable

production of palm oil has speeded up as a mass of planting enterprises participate in RSPO certification. RSPO aims to promote the sustainable production and use of oil palm products and the participation of stakeholders in the supply chain through reliable global standards (embodied in its principles and standards). The emphasis of RSPO principles and standards is attached to environmental protection and also the well-being of local communities and planting workers. The standards include protecting forests and peatland with a high value, supporting the land right of local communities, improving health and the right to education, etc.

Producers of crops, besides oil palm, can also apply for such certificates as Reforest Alliance certification. To obtain the certification of the Rainforest Alliance, agricultural producers should abide by the best social and environmental practices as specified in sustainable agricultural network (SAN) standard. Once passing the certification, they can apply the Rainforest Alliance certification label to their products. The label indicates the producers' reduced ecological footprint and less adverse impacts on human beings and wildlife.

Manufacturing—cleaner production

Manufacturing is an important sector consuming resources and producing wastes in ASEAN region. However, it can be transformed into a driving force for sustainability by cleaner production and design of products and services with a better environmental performance. Heavily stressed by the strict environmental laws and regulations, manufacturing makes active efforts to reduce emissions and pollutants by adopting various control and treatment measures. Recently, actions improving environmental performance have shifted gradually to the transformation of lifestyles and the implementation of comprehensive environmental strategies and management regulations. Manufacturing enterprises also start to perform bigger environmental responsibilities in its whole value chain. The adoption of the comprehensive and systematic methods for improving sustainable performance lays a foundation for new operating modes or supply modes, and the latter are expected to bring forth remarkable environmental benefits.

Sustainable forestry

Forestry is an important economic activity of many ASEAN Member States, especially those rich in forests and commercial timber. Traditionally speaking, forest will provide people with clean water resources, food and medical materials as well as important social and cultural relations, especially for the indigenous people. In addition, forests play an important role in improving air quality and mitigating climate change. With proper management, forest and tree planting industry will benefit forestry-based populations and the overall global community. Therefore, it is necessary to make forestry activities (from logging to final products) sustainable [16].

The Forest Stewardship Council (FSC) has established the standard for sustainable forest production. It resorts to certification to promote local participation in forestry market, improve the awareness of forest value and thereby improve social and environmental standards in global forest management. ASEAN is striving to

improve forest management and timber harvesting by reducing the adverse impact of illegal logging and recognizing forests' social, economic, and environmental values.

The enterprises intending to acquire FSC certification must adjust their management and operation so as to meet the social and environmental standards of FSC. FSC establishes 10 best practices to satisfy the social, economic, ecological, cultural, and spiritual demands of the present and future generations.

FSC follows the following principles in forest management:

- Compliance with laws and FSC principles;
- Tenure and use rights and responsibilities;
- Indigenous people's rights;
- Community relations and workers' rights;
- Benefits from the forest;
- Environmental impact;
- Management plan;
- Monitoring and assessment;
- Maintenance of high conservation value forests;
- Plantations (Accountable plantation management).

FSC audits each holder of its certificate once a year at least. ASEAN Member States have acquired FSC certification for 1,323,781 ha of forest in total (see Table 2.13), for which Indonesia ranks top, followed by Malaysia.

Reduce, reuse, and recycle (3R)

The 3R method is becoming popular. Most ASEAN Member States have launched activities to improve national awareness so as to win the recognition of the general public and encourage them to take part in 3R activities.

In Indonesia, many government institutions are committed to carrying out such activities as the reduction, reuse, and management capacity improvement of wastes. The management methods including manure mixture for fertilizing, recycling, and the redevelopment of recyclable package material have been implemented step by step. In Singapore, foods, paper, plastics, construction and demolition wastes, timber and gardening wastes, metals, residues, glass, textiles, and tires are recycled for domestic use or export. All unrecoverable combustible wastes will be collected

Table 2.13 FSC certified area of forest

Country	Quantity of certificates	Area of certified forest/hm ²
Indonesia	9	1,090,062
Laos	1	12,452
Malaysia	5	203,842
Thailand	4	7643
Vietnam	1	9782
Total	20	1,323,781

Source Fourth ASEAN State of the Environment Report 2009

and delivered to be burned in wastes-based power generation plants, while all unrecoverable and incombustible wastes will be delivered to Pulau Semakau Offshore Refuse Landfill.

Usually, 3R materials include waste paper, plastic wastes, scrap tires, glass, timber, nonferrous and ferrous metals, and building rubbish. Some ASEAN Member States have always separated and recovered material sources as a matter of practice, exercised by small enterprises and individual garbage pickers including women and children. Recycling in ASEAN is quite selective, driven by the market. The disposal of the un-selected recoverable wastes remains a big problem for many ASEAN Member States.

Informal separation or pickup of wastes takes place:

- At the source of wastes: separated or picked before the arrival of the collection vehicle;
- During collection: separated by collection staff during the loading; or
- At a disposal site: recoverable materials are collected by garbage pickers at a landfill or an open dump.

Garbage pickup can hardly provide a stable income source, although it is a daily activity of some communities in the ASEAN region. Therefore, some ASEAN Member States provide garbage pickers with financial and technical assistance with the aim to help improve the methods for collecting recoverable wastes and thereby increase their income. Meanwhile, they have provided measures to temper threats to the health and safety of garbage pickers.

Waste recycling will bring forth more job opportunities while easing the government's financial burden for solid wastes management.

2.2.7.3 Trade of Environmental Goods and Services

Many international forums such as *Millennium Declaration*, *Monterrey Consensus*, *Doha Ministerial Declaration* as well as *Plan of Implementation of the World Summit on Sustainable Development* have presented discussions on the trade of environmental goods and services (EGS). Their commitments are helpful in supporting EGS liberalization and market expansion, which can serve as an important strategy favoring sustainable development. It would be helpful for ASEAN to tackle challenges and opportunities with regard to the EGS trade in the process of building itself into an efficient global economic zone.

A separated section is established for EGS in the negotiation tasks approved at the 4th WTO Ministerial Conference held in November 2001. The improvement in EGS availability and use will undoubtedly bring about numerous benefits, including reducing air and water pollution, raising the efficiency of energy and resources, and promoting the treatment of solid wastes.

It is predicted that the gradual trade liberalization and prudently controlled market of these industries will create job opportunities vigorously and promote the transfer of precious skills and techniques and thereby promote the economic growth

of ASEAN indirectly. In short, the properly managed liberalization of EGS trade will help to promote the realization of sustainable development in the ASEAN region.

2.3 Comparative Results on China-ASEAN Green Development

The previous facts show that both China and ASEAN are making constant efforts to boost green development. However, the level of green development differs between China and ASEAN, especially among ASEAN Member States.

- (1) China and ASEAN are both honoring their green development commitment with various efforts; however, due to the differences between economic development and natural resource endowment, their green development process and priority is also different.
 - China's green development process started quite early. Situations are different among ASEAN countries. Several decades ago, attention to water and air pollution and solid waste treatment was very limited due to need for poverty reduction. As developing countries, the governments of many countries in Southeast Asia were inclined to boost GDP increase at the expense of environment and natural resources. Short-term trade-offs do exist between environment protection and business costs; however, lack of proper management in this regard will lead to the loss of competitiveness for economies in the region in the long run.
 - Priorities of different ASEAN countries for green development are different. For example, Brunei is a high-income country, and its attention for environmental issue is largely going to global environmental issues and emerging issues. Due to shortage of water resources, Brunei is very active in sustainable management of water resources and achieved good results. Cambodia is one of the least developed countries but with very rich natural resources. Agriculture is its pillar industry, and its industrial base is very weak. Its environment suffered great damage during years of civil war, and the establishment of large number of new timber factories and coastal marine shrimp farming also led to the overdevelopment of forests.
- (2) It is an arduous and multi-aspect challenge for both China and ASEAN to manage the natural resource endowment through maintaining a balance between protection and exploitation.
 - Compared with developed countries, the resource utilization efficiency is still quite low in China and ASEAN Member States. Relative to population and economy, China's natural resources are not sufficient. Though ASEAN economies enjoy rich natural resources (forest, freshwater, marine

resources, and rich biodiversity) on the whole, appropriate resource management has turned out to be top priority.

- In ASEAN Member States, their forest, river, and marine resources are encountering pressure from unsustainable practice. Their freshwater system is degrading. Without timely and bold measures, many areas in this region will suffer clean water shortage by 2030. Their renewable energy sector is faced with technological and political challenges. In the future, the demand for water resource in China will continue to rise. The spatial-temporal difference will be even more obvious, and the supply–demand conflict will be serious.

- (3) China and ASEAN Member States all made certain progress in economic growth and pollution control, but due to increasing population, urbanization and the influence from such factors as industrial production activities, they are also generally faced with severe air and water pollution.

ASEAN is a region with the most dynamic economies. However, fast economic development and inadequate attention to environmental protection led to serious ecological damages (see Figs. 2.37 and 2.38). Fast expanding urban centers posed challenges for the government to develop, implement, and maintain “green” strategies and policies. Urbanization usually goes hand in hand with intense industrial production in limited areas and dense population, all of which are the culprits of air and water pollution and people’s health issue. Pollution will also increase the cost of production.

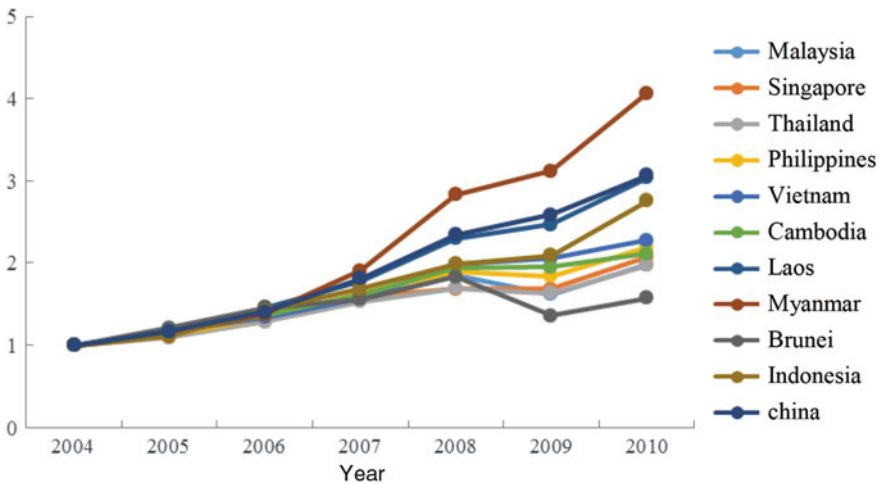


Fig. 2.37 Comparison between China and ASEAN Member States by GDP growth. *Note* Growth of GDP for the period of observation is indicated by the value over the years divided by 2004 value

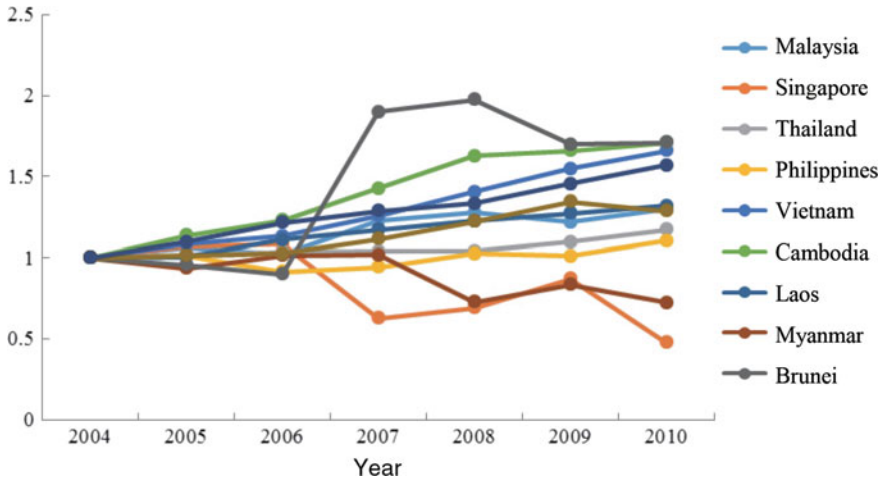


Fig. 2.38 Comparison between China and ASEAN Member States by SO₂ emission growth. *Note* Growth of SO₂ for the period of observation is indicated by the value over the years divided by 2004 value

- The megacities of ASEAN are dramatically different in air quality. Many ASEAN cities are shrouded in smog—most is health-threatening particulate matter. In certain situations, smog has turned out a regional issue for Indonesia, Malaysia, and Singapore. Large-scale forest or agriculture land burning in order to open up new plantation area caused cross-border haze pollution, in particular in Sumatra Island and Borneo Island. Though China and ASEAN Member States reached consensus on controlling air quality, different countries have different policy measure priorities.
 - Inappropriate solid waste treatment exacerbated the issue of clean water supply and air quality and triggered large-scale drainage issue in urban areas. Inappropriate environment practice further aggravated the burden of poor population, most of whom are exposed to unsafe drinking water, flood, and means of livelihood.
- (4) Similar to China, the energy mix of ASEAN is also focused on fossil energy, and its renewable energy is increasing gradually. The gross energy consumption keeps growing along with the unceasing expansion of population, and GDP and energy mix is adjusted step by step. The difference is that ASEAN energy mix is based on petroleum consumption while China's coal-focused structure can be hardly changed in a short term.
- China's total energy consumption kept increasing with outstanding supply-demand conflicts. Though coal still takes the dominating share in the energy mix, the percentage of fossil fuel gets further lowered. In ASEAN countries, due to more coal and natural gas use, the percentage of fossil fuel in the

energy mix increased from 55.7% in 1990 to 72.4% in 2007 and the share of petroleum keeps the same at between 36 and 38%.

- ASEAN Member States pay special attention to the issue of climate change vulnerability and its impact as countries in Southeast Asia are especially prone to the impact of climate change. In the past years, ASEAN has taken various moves to address climate change, and climate change adaptation and mitigation have become important means to fight climate change.
- (5) ASEAN is among the regions with the densest and most extensive forest resources, with a regional average coverage rate of 47%, much higher than that of China, 21.63%. However, the forest area is decreasing in several ASEAN Member States, along with the increasing population, the growth of agricultural production, logging and mining.
- The rich forest resource of ASEAN not only shaped its rich timber reserve, regional biodiversity with rich carbon resources, but also played important role in improving the ecological environment and climate in the region. Malaysia is one of the largest timber exporters in the world.
 - For individual ASEAN Member States, Malaysia has long been short of the method for sustainable development, and its pollution management started quite late which led to the conflict of environment sustainability and economic development. Indonesia's social transition caused a serious of issues including environment deterioration, serious air, freshwater and marine pollution, coral reef degradation, and deforestation of primitive forest. In Thailand, urbanization incurred greater environmental pressure. Wild life and their living environment are threatened. In the Philippines, population pressure and damages of natural disasters lead to many environmental issues, e.g. shrinking forest area, land erosion, water and air pollution, large-scale destruction of coastal mangrove and wetland, and the damage of coral reef. The shrinking forest area in ASEAN region is mainly a result of increasing population, more agricultural production activities, lumbering and mining as many ASEAN countries are still relying on timber and agriculture export for foreign exchange earnings.
- (6) For China and ASEAN, the greatest strains for sustainable consumption are attributable to the increasing emissions of wastes.
- Management of wastes has been a major challenge for China and ASEAN. Urban areas witness a big rate of wastes generation, which is aggravated further by other environmental problems arising from there.
 - The most common waste management approach in China is incineration and landfill, and China is practicing strict and scientific water resource management system and encourages circular economy. Most of ASEAN Member States treat urban wastes with sanitary landfill or air storage and compost and incineration are also being adopted gradually.
 - Reduction, Recycle, and Reuse (3R) of the wastes is getting popular in ASEAN. Most of ASEAN Member States have started different plants to

encourage 3R, including awareness raising and encouraging local communities to participate in waste management.

- ASEAN Member States adopted the concept of sustainable consumption and production which will promote a green economic transition without sabotaging their competitiveness. In contrast, China's overall consumption level is quite low, and people's awareness of environmental protection and green consumption has not been in shape yet.

References

1. National Bureau of Statistics: China Statistical Yearbook 2002–2015. China Statistics Press, Beijing
2. Ministry of Environmental Protection: Annual Statistic Report on Environment in China 2001–2014. China Statistics Press; China Environment Press, Beijing
3. Olivier, J.G.J., Janssens-Maenhout, G., Muntean, M., Peters, J.A.H.W.: Trends in Global CO₂ Emissions: 2015 Report (2015)
4. Zhang, S.: Chinese scientists did first China-ASEAN regional ecological benchmark survey. http://www.chinageoss.org/gee/2014/D/D1/D1_1/. 2015-06-05/2015-11-12
5. National Remote Sensing Center of China: 2014 Annual Report on Remote Sensing Monitoring of Global Ecosystem and Environment (Eco-environmental Status in China-ASEAN Region). (2015)
6. China-ASEAN Environmental Cooperation Center: China-ASEAN Environmental Cooperation—Biodiversity and Regional Green Development. China Environment Press, Beijing (2013)
7. China-ASEAN Environmental Cooperation Center, Environmental Protection Bureau of Guangxi Zhuang Autonomous Region: ASEAN-China Environmental Cooperation: Innovation for Green Development. China Environmental Science Press, Beijing (2012)
8. China-ASEAN Environmental Cooperation Center: China-ASEAN Environmental Cooperation—Building up Partnership for Regional Green Transformation. China Environment Press, Beijing (2014)
9. Asian Development Bank Institute: ASEAN 2030. (2014)
10. Peng, B., Liu, X., Yang, Z.: Status of Resources and Environment and Potential of Cooperation in ASEAN. Social Sciences Academic Press, Beijing (2013)
11. ASEAN Secretariat: Fourth ASEAN State of the Environment Report 2009. (2014)
12. ASEAN Secretariat: ASEAN Documents Series 2011. Jakarta (2012)
13. “Green” energy development in ASEAN faced “Brown” barriers. Guangxi Energy Conserv. (3), 37–38 (2015)
14. ASEAN Centre for Biodiversity: ASEAN Biodiversity Outlook. Dolmar Press Inc. (2010)
15. China-ASEAN Environmental Cooperation Center: Progress of Implementing National Biodiversity Strategy and Actions Plans in China and ASEAN. China Environment Press, Beijing (2016)
16. APPF-SEApeat: Enhancing Sustainability of Forestry Practices on Peatlands. Global Environment Centre, Kuala Lumpur (2014)

China-ASEAN Environment Outlook 1 (CAEO-1)

Towards Green Development

2018, LI, 234 p. 51 illus., 29 illus. in color., Hardcover

ISBN: 978-981-10-6210-0