

## Chapter 2

# Environmental Struggles and Innovations in China: A Historical Perspective

Shikui Dong

**Abstract** This chapter presents and updates the information about the situational contexts, threats, problems, challenges, and solutions for environmental sustainability in China. This has been taken in temporal scale with a historical lens to show the environmental wisdoms, struggles, and innovations from ancient times to modern era. Chinese civilization with long history has rooted the ecological wisdoms and developed institutional arrangements for sustainable development. The “harmony between the heaven and human” in ancient China was an important philosophy and outlook on human–nature relationships for sustainable development. Yuheng functioned as the internal institution to develop and implement the relevant policies for protecting and utilizing the natural resources in a sustainable manner in ancient China. However, deforestation associated with war, fire, construction, reclamation, etc. in ancient times led to destruction of massive natural resources and serious degradation and territory land. Environmental pollution and land degradation associated with human population growth, economic development, land-use changes, and climate change are challenging the sustainable future of China. The historical lessons and the existing challenges have urged China to seek innovative ways to solve the environmental problems. China has made great efforts to take integrated measures and multiple actions to cope with the complex issues of environmental risks. These efforts include institutional innovations of empowering environmental protection agency, political innovations of reforming natural resource and environmental management strategies, economic innovations of adjusting development patterns, social innovations of promoting public participation, as well as technological innovations of developing new approaches for pollution control and ecological restoration.

**Keywords** Environmental history in China • Environment governance • Environment protection • Natural resources • Economic innovations • Political innovations • Social innovations

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## 2.1 Practice and Challenges of Environmental Management in Ancient China

Chinese civilization has been maintaining sustained development over the past thousands of years. Traditional Chinese culture contains rich thoughts and ideas on environmental protection and utilization of natural resources. For environment and resources management, ancient Chinese have developed ecological wisdoms based on harmonious relationships between human and nature, which was consistent with the modern concept of sustainable development. These thoughts and ideas were fixed by ruling class through legal system and establishment of government institution to guide people's practice, constrain people's behavior, and standardize social production activities. This effectively prevented excessive materialization of man and curbs unbridled plunder of nature and ensured sustainability of civilization development in ancient China, although there existed some insignificant environment problems due to natural disasters or inappropriate human activities in Chinese history.

### 2.1.1 *Use of Ecological Wisdom in Environmental Management*

The “harmony between the heaven and human” in ancient China is an important philosophy and outlook on nature. Different from “God” of western countries, “heaven” here refers to nature and objective law of nature. The relationship between man and nature is called the “relationship between heaven and man.” The ecological idea of “harmony between the heaven and human” is rooted deeply in the minds of the most representative Taoist school and Confucian school in ancient China.

Taoist school is an ancient school of philosophy in China with Lao Tzu (571–471 BC) and Zhuangzi (369–286 BC) as the representatives. The book *Yi Jing* described the Taoist philosophy, which systematically expounded the relationship between heaven and man (Fig. 2.1). Man and universe are an inseparable unity, “the Tao of heaven” and “Tao of human” are in harmony and unity. “Tao” is both the law that universe complies with and the rule that human conduct should observe. It recognizes that man is part of nature, imposing deep influence on the development of ancient environmental ethics of China. Lao Tzu said: “Tao begets the One. The One consists of Two in opposition (the Yin and Yang). The Two begets the Three. The Three begets all things of the world.” He stresses that “Tao” is the origin of man and everything in the world and universal law of the universe and reflects harmony and unity between man and nature.

The Confucian school is the mainstream of traditional Chinese culture. Fundamentally, the attitude of Confucian school to nature was consistent with that of Taoist school. Confucians (551–479 BC) believed that man was part of nature. Man should take obedient and friendly attitude toward nature and take seeking the harmony between man and nature as the ultimate goal. However, there were some



Fig. 2.1 Imitated bamboo slip book of *Yi Jing* (photo by Shikui Dong)

differences between Confucian school and Taoist school. The main concern of Confucian school is people. Although recognizing that the way of man is based on the way of heaven, Confucian school believed that as the wisest of all creatures, man could do his best and correlate with nature. On this basis, Confucian school forwarded the rich thoughts on appropriate development, utilization, and protection of natural environment. These thoughts contain traditional Chinese environmental ethics. Confucian school believed that “the benevolent takes the universe as a whole”; respecting nature is respecting human himself and cherishing the life of others is cherishing his own life. Confucius, the representative of Confucian school believed that heaven has moral tendency and inseparable relation with human beings. The meaning of the “heaven” in “harmony between the heaven and human” refers to natural law. The core of the “harmony” between man and nature refers to complying with nature. Xun Zi (313–238 BC), another representative of Confucian school pointed out in his article *Xun Zi-Tian Lun* (Fig. 2.2): “Although heaven has changes, earth has rich resources, man has his methods to govern nature and society and create opportunities according to law of nature.” Xun Zi believed that only let nature take its course can human beings take opportunity and utilize everything. He stressed that man cannot influence and facilitate the forces of creation of the universe until he was able to get to the bottom of laws of human beings and physical nature. His thought “man’s will, not heaven, decides” also is based on the understanding of the “harmony between the heaven and human” and that man should comply with nature and not go against timing.

Among various schools of thought of ancient philosophers in China, the thoughts on observing law of nature, protection of eco-environment, and sustainable utilization of resources as an important force run through the development process of



Fig. 2.2 Modern copy of the book, *Tian Lun* (on Heaven), written by Xun Zi (photo by Shikui Dong)

Chinese civilization. As a result, the Chinese civilization still goes on after going through all kinds of hardships of the past several thousand years and benefits future generations. This principle of harmony between man and nature played an important role.

As early as Zhou Dynasty (1046–256 BC) of China, the book *Yi Zhou Shu-Ju Pian* (Fig. 2.3) stated: “People should not cut trees in early spring to facilitate growth of grass and trees. People should not employ fishnet in rivers and lakes in summer time to facilitate growth of fish and turtles.” The book *Guo Yu-Lu Yu* attaches importance to the protection of animal and plant resources with relatively strong specific measures. Guan Zhong (719–645 BC) in East Zhou Dynasty (770–256 BC) understood the importance of protecting eco-environment; advocated state monopoly on mountains, forests, rivers, and lakes; and regarded the protection of mountains, forests, rivers, and lakes as a moral obligation for kings. In the book *Shi Ji (Yin Ben Ji)* (122 BC), it contained the bud of the concept of environmental protection. It notes the importance of not carrying out destructive hunting. In the book *Yi Wu Zhi* written by Yang Fu in Han Dynasty (206 BC–220 AD), the authors advocated wide protection of rare and precious wild plant and animal species in order to better protect natural resources and eco-environment. These ideas fully reflected the ecological civilization thoughts on complying with natural law and protecting eco-environment.

In addition, ancient Chinese philosophers understood the close relations between production and environmental protection. They presented the idea of maintaining the regeneration capacity of natural resources, advocated appropriate development of natural resources, and opposed the adoption of extinct approach. It was written in the book of *Lü Shi Chun Qiu* (Fig. 2.4) published in 239 BC “You could catch fish in current year if you drain the pond to get fish. But you cannot catch fish in the next

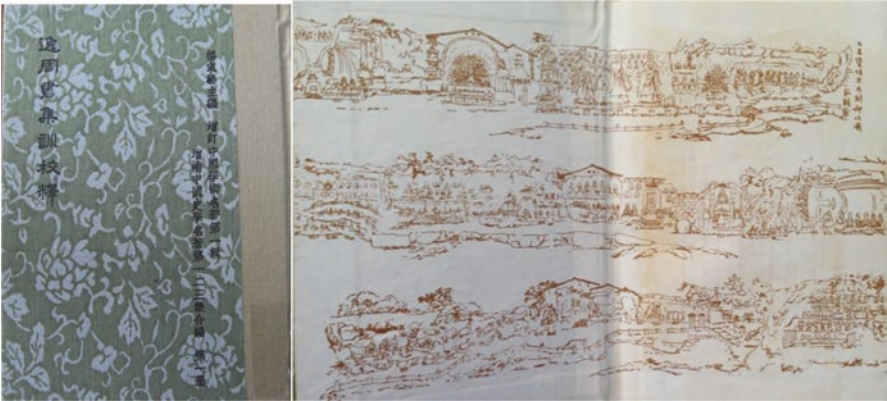


Fig. 2.3 Modern copy of the book, *Yi Zhou Shu* (photo by Shikui Dong)

Fig. 2.4 Modern copy of the book, *Lü Shi Chun Qiu* (photo by Shikui Dong)



year. You could catch wild animals in the current year if you burn forests, but you cannot find any wild animals here next year.” In the book of *Huai Nan Zi* (Fig. 2.5), Liu An (180–123 BC) in Han Dynasty (206 BC–220 AD) stated “People should not kill pregnant animals, collect the eggs, catch fish in shallow water less than 1/3 meter, or eat baby swine.” It stressed that human production activities should be based on maintaining regeneration capacity of environments and natural resources. These

**Fig. 2.5** Modern copy of the book, *Huai Nan Zi* (photo by Shikui Dong)



insightful thoughts stressed that human production activities should be based on maintaining regeneration capacity of resources and reflecting ecological civilization thoughts on protecting eco-environment, maintaining ecological balance, and sustaining use of natural resources.

### ***2.1.2 Implementation of Legislation for Natural Resources and Environment Protection***

Each dynasty of ancient China promulgated a series of government policies on protecting natural resources and eco-environment. With legal system, the ruling class turned a series of thoughts and views on harmony between human and nature into law or act to constrain human behaviors and regulate production activities.

Act of *Fa Chong Ling*, known as the earliest environmental protection act in the world, promulgated in West Zhou Dynasty (1046–771 BC) stated: “People shall not destroy house, drain the well, cut down the trees or kill wildlife without permission. Any one in violation shall be sentenced to death without mercy.” In addition, the policies of natural resources and environmental protection such as *Ye Jin* (Wildness Ban) and *Si Shi Zhi Jin* (Ban in four different seasons) were developed and imple-





Fig. 2.6 Imitated bamboo slip of *Tian Lü* act (photo by Shikui Dong)

mented. In Qin Dynasty (221–206 BC), *Tian Lü* (Fig. 2.6), the most complete act of environmental protection law in ancient China was promulgated. This act (*Tian Lü*) expounded the strict protection of natural resources and the environment, including all kinds of biological resources. For example, it stressed that farmers cannot cut down trees on mountain slope for cultivation, fisherman cannot catch fish with poison, and hunters cannot catch and kill young birds and animals.

The theory and practices of natural resources and eco-environment protection policies were well in Han Dynasty (206 BC–220 AD) and Tang Dynasty (618 AD–907 AD) of ancient China. The ruling class stressed the importance of appropriate land management and environmental protection in social development. Especially in Tang Dynasty, mountain forests, wetlands, grazing pastures for live-stock, hunting, urban greening, sewage discharge, suburb temples, altars, and the famous mountains were well managed by government administration. *Tang Lü* (The Law of Tang Dynasty) presented detailed measures for protecting natural environment and living environment and punishment for violator. According to the book of *Jiu Tang Shu* (Old Book of Tang History), which was completed between 940 and 945 AD, the Tang Dynasty's government identified the areas including Jingzhao (it is called Xi'an presently) and Henan with diameter of 300 km as the preserved areas, which were banned for logging or hunting. The government at that time initiated 'Nature Reserve' to protect natural resources and ecological environment, and the environmental protection regulations played big roles in protecting the beauti-

ful landscape. The economic and cultural prosperity and development made Tang Dynasty of ancient China a famous empire with unprecedented prosperity in ancient feudal economy. It is clear that ecological protection idea and environmental protection measures of the Tang Dynasty played significant roles in economic development.

In Song Dynasty (960–1279 AD) and Yuan Dynasty (1271–1368 AD), especially North Song Dynasty (960–1127 AD) of ancient China, the governments paid great attentions to make legislation and law on natural resources and eco-environmental protection. The governments promulgated decrees several times with aims at protecting mountains, forests, vegetation, rivers, lakes, bird, mammals, fish, and turtle. The governments of Ming Dynasty (1368–1644 AD) and Qing Dynasty (1644–1911 AD) in ancient China copied mostly the acts and laws of Tang Dynasty to protect the natural resources and eco-environment.

### ***2.1.3 Development of Institutions for Natural Resource and Environment Protection***

*Yu Heng* was the internal institution of feudal dynasty in ancient China, responsible especially for the administration of mountains, forests, rivers, and lakes. This institution functioned in developing and implementing the relevant policies for protecting and utilizing the natural resources such as birds, animals, fish and turtles, wild fruit trees and vegetables in mountains, forests, rivers, and lakes in a sustainable manner. Collecting (fruits, seeds, etc.) and hunting were permitted by this institution only in certain seasons. Collecting and hunting were banned at the time when fish, mammals, and trees were on breeding and reproducing (Figs. 2.7 and 2.8). The name, rank and responsibility of *Yu Heng* varied slightly among different dynasties. The names of *Yu Heng* varied as *Shan Yu* (responsible for governing mountains), *Ze Yu* (responsible for governing lakes), *Ye Yu* (responsible for governing wildland), *Shou Yu* (responsible for governing wildlife), *Shui Yu* (responsible for governing water), and so on, in terms of natural environments they are responsible for.

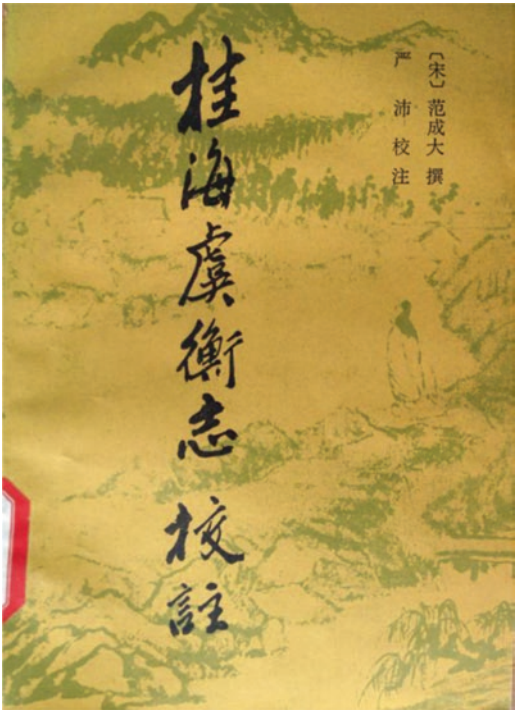
According to the record in the book of *Shang Shu* (the history of Shang Dynasty), the earliest Yuheng in China appeared in Emperor Shun period, and the first Yu official is Bo Yi. The Yuheng system in Zhou Dynasty was recorded in *Zhou Li* with clear description of the official post and functions of Yuheng. In Qin Dynasty and Han Dynasty, Yuheng was called Shaofu, which was still in charge of mountains, forests, rivers, and lakes. In Sui Dynasty and Tang Dynasty, the functions of Yuheng were further expanded with wider administration scope. According to the record of *Jiu Tang Shu* (the history of Shang Dynasty), “the post of Lang Wai Yuan Zhong Lang in Yubu is in charge of planting along the streets and lanes in capital, mountains, rivers, lakes, gardens, grass, trees and firewood, farmland and hunting. Collecting, grazing, fishing and hunting shall be at the right time. No collection and hunting are permitted within 150 km with Jingzhao City and Henan City as centers.”



**Fig. 2.7** Drawing of *Yu Heng* official judging the case (photo by Shikui Dong)



**Fig. 2.8** Modern copy of *Yu Heng* history in Guihai (photo by Shikui Dong)



According to the book “History of Song Dynasty,” the responsibility of Yubu included mainly implementation of government decrees on mountains, forests, rivers, lakes, pastures for raising animals, mining, and smelting. The responsibilities of Yuheng in Ming Dynasty recorded in the book “History of Ming Dynasty” also included protection of agricultural lands and historic scenic places. The responsibilities of Qinlisi of Yuheng in Qing Dynasty were similar to those in Ming Dynasty.

In sum, it can be concluded Yuheng system of ancient China combined the environmental protection with socioeconomic development, and should be the embryonic form of harmony between protection and development, which has some implications to improve environmental protection nowadays.

### ***2.1.4 Environmental Destructions and Problems in Historical China***

Although ancient Chinese have developed very good ecological wisdoms (environmental protection thoughts), environmental protection laws and regulations, environmental governing institutions, there were also some environmental problems in Chinese history, especially modern China. Several cases showed that inappropriate human activities such as stationing troops at bordering areas, hunting, elaborate funeral and construction of palaces in ancient times led to destruction of massive forests and grassland. The famous ancient poet Du Mu (803–852 AD) in his prose *Er Pang Gong Fu* described that all trees on Mount Shu were cut down to construct Epang Palace with the order from Emperor Qin Shihuang (Fig. 2.9). Although there was some exaggeration, this description indicated the destructive deforestation at that time. It can also be seen from the tomb paintings of Han Dynasty unearthed in Yan'an that vegetation cover of the Loess Plateau was good from Western Zhou Dynasty to Han Dynasty. However, the Loess Plateau with rich vegetation and wildlife had been turned into barren hills due to replacement of grasslands by farming lands after Han Dynasty, leading to serious water and soil erosion, which was lasting till to modern era.

The environmental problems in more recent history of China (Ming and Qing Dynasties) were mainly degradation and deterioration of ecological environment due to expansion of human activities. In the Loess Plateau, farmers losing land migrated to the northern slope areas of Qing Ling Mountain due to rapid population growth and they destroyed a lot of forests for reclaiming the farming lands. When the land became infertile after several years, they abandoned and moved to the new lands. This practice lasted year after year. As a result, most forests in mid and upper reaches of the Weihe River and forests in northern Shaanxi, Inner Mongolia, and Shanxi Province were destructed in the end of Qing Dynasty (early twentieth century). The forests in Beijing and lower reaches of the Xiangjiang River (Pearl Delta) in Southern China were also destructed in that period. Timber consumption for construction of palaces and logging for resident's firewood in Beijing in Ming



**Fig. 2.9** The relics of Epang Palace (photo by Shikui Dong)

Dynasty and Qing Dynasty nearly depleted forest resources in Western Mountain areas in Beijing. As a result of forests destruction in key watershed regions, water and soil erosion, land desertification became the serious environmental problems in the short term.

In Chinese modern history, which refers to the historical period from the Opium War (occurred in 1848 AD) to the foundation of People's Republic of China (in 1949 AD). It was the period when Chinese society was suffering from natural and man-made calamities, foreign invasion, political instability, and many difficulties. During that period, population of China grew rapidly, while arable land area did not change very much. Rapid population growth exceeded the land productivity and carrying capacity of eco-environment; thus, deforestation and land-use changes became inevitable. With the development of modern agricultural production technologies, human beings altered greatly the capacity in interfering with natural environment at larger scale. The adverse impacts of population growth on the environment became increasingly obvious, gradually making the relations between population and the environment in vicious circle. In addition, the invasion and plunder of imperialist countries aggravate environmental deterioration of China. For example, the invasion of the Czar Russia and Japanese imperialism in northeastern part of China led to predatory logging and destruction of the virgin forest resources in this region in late nineteenth century to early twentieth century. The findings of many scholars' studies on environmental history show that the development of grassland desertification in northwest part of China and mountain environment degradation in eastern part of Guangdong Province in Southern China and mountainous areas of Yunnan Province in Southwestern basi-

cally began in Ming Dynasty and Qing Dynasty, accelerated in the mid and late nineteenth century. Ecological environment of modern China suffered greatly from serious water and soil erosion, land desertification, frequent natural disasters, and loss of biodiversity due to many drivers such as rapid population growth, damage of forest and grassland vegetation due to agricultural activities, excessive development of mineral resources, wars, and political instability.

During the period of Republic of China (1911–1949 AD), agricultural economy dominated socioeconomic system, although there was some development of modern industry in coastal regions. At that time, China was semicolonial and semifeudal society with turbulent political situation and frequent wars. The government was too poor and weak to pay much attention on environmental protection. Environmental pollution resulting from industrial production caused serious natural resources degradation and water and soil erosion in some coastal regions. There were hardly any laws and regulations on preventing and controlling pollution. The government promulgated only several laws on conservation of natural resources such as Fishery Law (1929 AD), Land Law (1930 AD), Forest Law (1932 AD), Poaching Law (1932 AD), and Water Resource Law (1942 AD). Indeed, these laws didn't function well in natural resource and environment management due to poor implementation. In addition, in the revolution bases ruled by Communist Party of China (CPC) before foundation of People's Republic of China (1949 AD), the Red government developed and implemented some regulations on protection of natural environment such as Act of the Soviet Area in Western Fujian Province on Nature Conservation of Mountains (1930 AD), Measures of Shanxi-Chahar-Hebei Border Area on Conservation of Mountain Vegetation (1939 AD), Regulations of Shanxi-Chahar-Hebei Border Area on Reclamation of Wasteland (1938 AD), Regulations on Shaanxi-Gansu-Ningxia Border Area on Forest Protection (1941 AD), Regulations of Shanxi-Chahar-Hebei Border Area Construction of Rural Water Conservancy Facilities (1943 AD), and Provisional Regulations of Liberated Area of Northeast China on Protection of Forests (1949 AD). These legislations on natural resources aimed to develop economy and ensure sustained use of resources. However, due to impacts of anti-Japanese war and War of Liberation (Civil war), these regulations were not been effectively implemented and natural environment in those regions were not well protected.

## **2.2 Practice and Challenges of Environmental Management in Contemporary China**

Although environmental issues in China can be traced back to 2000 years ago, the environmental destruction did not badly affect the people's lives in the history due to ancient Chinese's ecological wisdoms, which stressed the harmony between human and nature. Since the foundation of People's Republic of China (in October of 1949), contemporary China experienced undergoing economic, social, and environmental changes unprecedented for any nation at any time in world history. The development

model of economic development prioritized over environmental protection associated with population, social transformation, political changes, and land-use change in contemporary China has increasingly accelerated environmental deterioration, making China as some of the most polluted skies and waterways in the world (He et al. 2012). However, poor environmental governance across different social–political transformation periods of contemporary China has intensified the environmental problems. In the development of environmental governance in contemporary China, four phases can be distinguished in terms of social–political transformation features. Phase I lasted from 1949 to 1971, which was characterized as No Environment Governance, Severe Environment Damage. Phase II from 1972 to 1991, which was characterized by Growing Environment Governance, Increasing Environment Damage. Phase III from 1992 to 2011, which was characterized as Strengthening Environment Governance, Decreasing Environment Destruction. Phase IV from 2012 onward, Prioritizing Environment Governance, Minimizing Environment Destruction.

### ***2.2.1 Phase I (1949–1971): No Environment Governance, Severe Environment Damage***

When People’s Republic of China was established in October of 1949, the nation followed Soviet-style plans for rapid development of heavy industry, which caused a serious of environmental problems in whole country. The rapid development strategy of Soviet style totally eroded Chinese traditional ecological belief “Harmony between Human and Nature.” As stated by Shapiro (2001) in her book “Mao’s war against Nature”: “Numerous campaigns suppressed elite scientific knowledge and traditional grass-roots practices concerning the physical world, stifling dissent through political labels, ostracism, and labor camp sentences... Less well known is their effort to reshape the nonhuman world, with severe consequences both for human beings and for the natural environment.” In late 1950s, Anti-Rightist Movement discouraged and even suppressed many experts who were concerning much about the sustainable development. For example, the famous economist Ma Yinchu who cautioned against unchecked population growth, and the hydroengineer Huang Wanli who opposed the Sanmenxia Dam on the main stream of the Yellow River were overthrew as the Rightists. Actually, many evidences show the overpopulation in late 1950s intensified struggles over land and resources and Sanmenxia Dam project was an environmental and economic mistake (Shapiro 2001). In February of 1958, Central Committee of Chinese Communist Party and the State Council of China released the instructions “Eliminating four pests (rats, sparrow/bug, Mosquito and flies), keeping the hygiene.” A lot of chemicals applied to control these “pests,” which caused the serious destruction of natural ecosystem (Fig. 2.10).



**Fig. 2.10** Drawing of movements for eliminating four pests, rats, sparrow/bug, mosquito, and flies (photo by Shikui Dong)



During 1958–1960 Great Leap Forward, urgency to achieve utopian socialism without planning led to massive environmental problems and widespread human starvation. As stated by Shapiro (2001) in her book “Mao’s War Against Nature”: “With urgent tasks of overtaking Britain in steel production within 15 years, as a lot of trees were cut to fuel ‘backyard furnaces’ for steel smelt, leading to widespread deforestation... Despite limited success in water conservancy and irrigation projects, huge hydropower projects removed millions from their homes but were useless or caused disastrous floods when poorly constructed dams broke... Fanciful agricultural schemes and competitions to produce impossible yields by combining rural collectives into vast People’s Communes sapped farmers’ energy, impoverished the land’s productivity, and contributed to the greatest human-made famine in history.” Decreased land productivity, increased population, massive food waste, together with natural disasters contributed to the greatest famine in China, from which many people died (Dikötter 2010). As people starved throughout China, living creatures on whom they depended were hunted down and eaten. “There were no birds left in the trees, and the trees themselves had been stripped of their leaves and bark” stated by Dikötter (2010) in his book “Mao’s Great Famine.”

During the Cultural Revolution in late 1960s and early 1970s, the coercion and chaos associated with massive political movements led to the collapse of national

economy and the degradation of ecosystem and environment. Suffered from the great famine in Three Hard Years (1959, 1960, 1961), the national set the feeding China's growing population as the first priority, and "Take Grain as the Key Link" [*Yi Liang Wei Gang*] dominated the national development strategies. To increase the grain production, the nation launched the project of "Learning agricultural production from Dazhai (model)" [*Nong Ye Xue Da Zhai*] in whole country without thinking about the differences of topography and climate across the regions. Encouraged by the spirit of "Old Man" in an ancient Chinese Tale "The Foolish Old Man Who Removed the Mountains," a story about the effectiveness of concerted manual labor, many people were involved in earth-transforming campaigns to reshape the physical world radically within short time. A lot of improper land reclamation slogans, as stated Shapiro (2001), were invented to include a range of geographic possibilities: "Encircle the rivers, build land" [*weihe zaodi*]; "encircle the lakes, build farmland" [*weihu zaotian*]; "destroy the forests, open the wastelands" [*huilin kaihuang*]; "on steep slopes, open the wastelands" [*doupo kai huang*]; "destroy the pasturelands, open the wastelands" [*huimu kaihuang*]; "on flat-lands, construct terraces" [*pingyuan zao tian*]; "plant sprouts in the center of lakes" [*chayang cha dao huxin*]; "Squeeze land from rock peaks, get grain from rocks" [*cong shitou fengli ji di, xiang shitou yao liang*]. These misbehaviors produced some disastrous environmental consequences such as landslides, erosion, flooding, desertification, drought, and biodiversity loss. Most importantly, these disastrous movements have devalued and in some cases eliminated indigenous knowledge and practices with great ecological wisdoms among ethnic communities (such as Dai, Yi, Naxi, Tibetan in Southwestern China), who have effectively managed their environment by using indigenous knowledge and practices over a long time (Xu et al. 2005)

During the war preparation campaign of the late 1960s and early 1970s, the strategic industries were transferred by administrative fiat to the interior to form a defensive "Third Front" against the American "imperialists" and Russian "revisionists," millions of "educated youth" in urban areas were sent to the countryside and frontiers for farming and construction (Shapiro 2001). The urban people were forced to migrate into the wild lands or sparsely populated lands which they were not familiar of had no connections, and these relocated urban people were induced to reclaim the wild lands and resulted in the impoverished land productivity and the degraded natural environments (Shapiro 2001). The earth-transforming campaigns of land reclamation such as "destroy the forests, open the wastelands" [*huilin kaihuang*], "destroy the pasturelands, open the wastelands" [*huimu kaihuang*], "plant sprouts in the center of lakes" [*chayang cha dao huxin*] were continued without consideration of environmental costs. In the leadership vacuum that followed Red Guard attacks on government officials and scientists (Shapiro 2001), natural resources became more and more overexploited as the poem said:

"Let's attack here!  
Drive away the mountain gods,  
Break down the stone walls  
To bring out those 200 million tons of coal.  
Let's strike here!  
Let the Dragon King change his job,

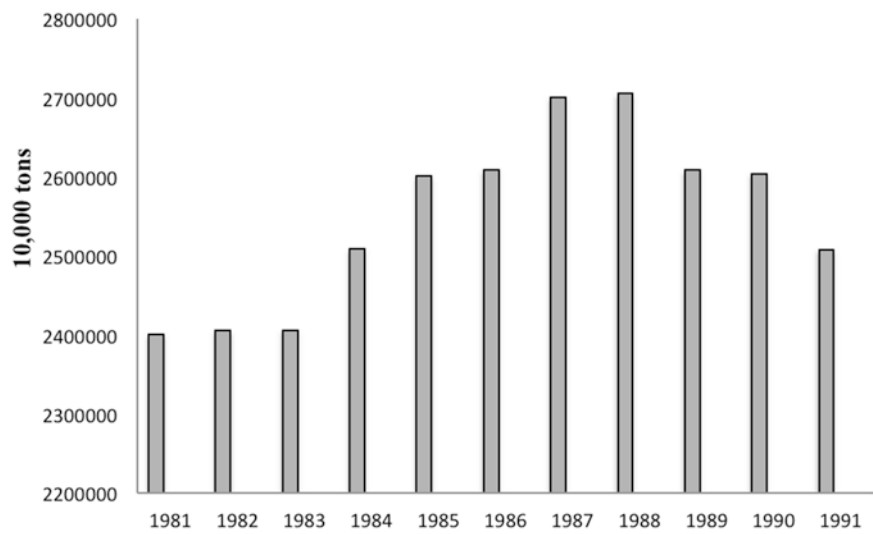
Let the river climb the hills,  
 Let us ask it for 8000 *mu* (533 ha) of rice paddies.  
 Let that valley open its bosom  
 To yield 500 *jin* (250 kg) (half kg) of oats every year.  
 Cut down the knoll  
 To make a plain over there...  
 Let's wage war against the great earth!  
 Let the mountains and rivers surrender under our feet.  
 March on Nature,  
 Let's take over the power of rain and wind.  
 We shall not tolerate a single inch of unused land!  
 Nor a single place harassed by disaster.  
 Make wet rice, wheat, and yellow corn grow on top of the mountain,  
 And beans, peanuts, and red gaoliang rise on rocks..."  
 —Zhang Zhimin, *Personalities in the Commune*

During the war preparation campaign, massive infrastructures such as railroads were built by ignoring resource overexploitation and labor cost, resulting in serious environmental problems and economic loss. Industries were promoted in rural areas as a way to eradicate social differences, carry out a policy of regional and national self-reliance, and protect national security; however, air and water pollution were becoming serious environmental problems.

### 2.2.2 Phase II (1972–1991): Growing Environment Governance, Increasing Environment Damage

Before United Nations Conference on the Human Environment (UNCHE) was held in Stockholm of Sweden in 1972, China was under the influence of left socialism, in which the prevailing ideology was to reject western capitalist countries' development strategies with the belief of "no pollution in socialist countries." At the beginning, Chinese government was not going to send any delegations to the UNCHE. Fortunately, former Premier Zhou Enlai realized the seriousness of environmental problems derived from coercion and chaos during Culture Revolution in later 1960s to early 1970s. He insisted to send a delegation to Stockholm of Sweden for attending the UNCHE. After this conference, China's State Council held the First National Conference on Environmental Protection in August of 1973, forwarding the environmental policy of "Overall plan, appropriate layout, comprehensive use, recycling waste, depending on the public, public participation, protecting environment and benefiting the people." However, little progress was actually made in environmental protection across whole nation. For example, land desertification in arid and semiarid China was dramatically increasing every year from 1970s to 1990s, the potential lands threatened by desertification were 2,566,000 km<sup>2</sup>, accounting for 26.7 % of nation's territory in late 1990s.

In December of 1978, just after end of Culture Revolution, new leader in China, Deng Xiaoping made a remarkable address "Emancipating the mind, seeking the truth from the facts and uniting as one in looking forward to the future" at the Third

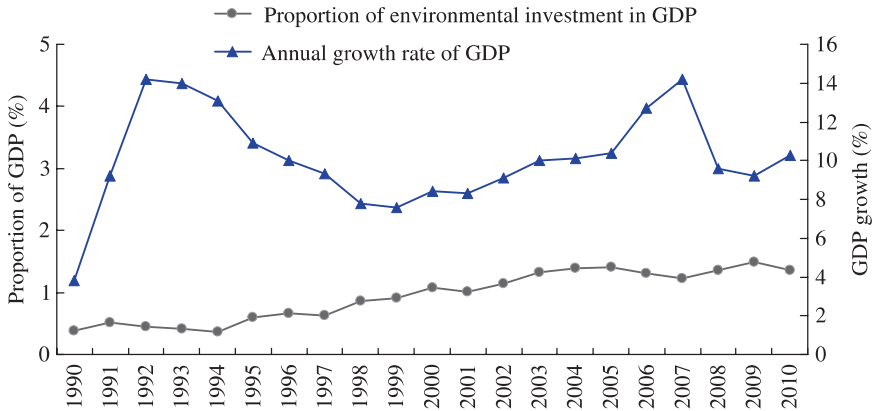


**Fig. 2.11** Industrial wastewater discharges from 1981 to 1991 (sources: NBS, 1981–1991. *China Statistical Yearbook 1981–1991*)

Session of the 11th Central Committee of the Communist Party of China (CCCPC). At the 11th CCCPC, Opening-up and Reform were defined as key approaches to achieving the goal of Socialist Modernization Construction /Economic Development. The rapid economic development with China’s Opening-up pushed the people turn toward materialism, short-term profits, and environment-unfriendly life, which resulted in rapid and unsustainable exploitation of natural resources and massive discharge of waste (Fig. 2.11), growing land degradation, and increased environment pollution in urban areas. Meanwhile, the population control policy led to a rapid increase of rural population, which greatly increased the pressures on rural environments. Environmental pollution and ecosystem degradation associated with nationwide industrialization and quick population growth challenged the sustainable development of the nation, although China made great efforts in policy instruments, science and technology, and public participation to promote the environmental protection.

**2.2.3 Phase III (1992–2012): Strengthening Environment Governance, Decreasing Environment Destruction**

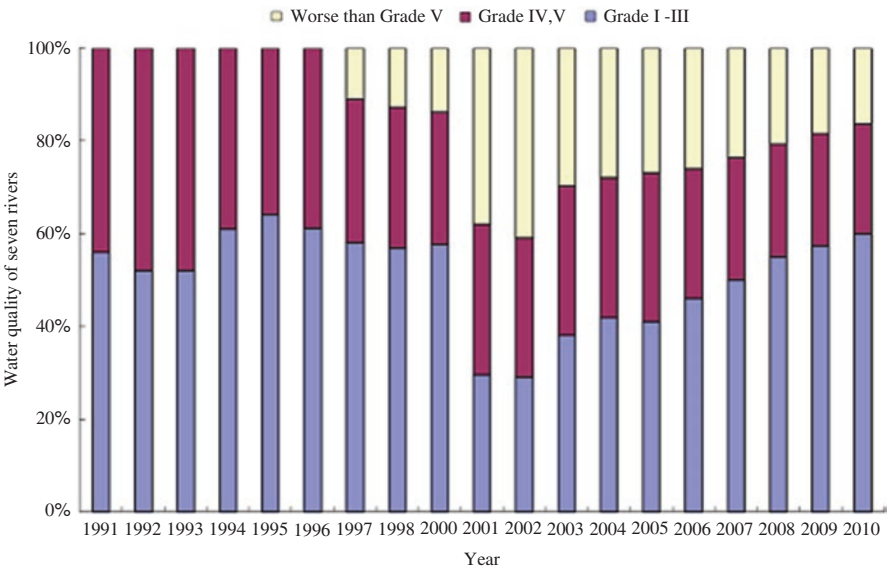
Just after United Nations Conference on Environment and Development (UNCED), which is also termed as Earth Summit or Rio Summit, was held in Rio de Janeiro of Brazil in June of 1992, the Chinese government defined the sustainable development as a national development strategy. With the objective of sustainable



**Fig. 2.12** China's growth rate of GDP and proportion of pollution control investment in GDP, 1990–2010 (source: He, 2012; data were collected from China Environmental Yearbook Committee (1991–2011))

development, China made great efforts to develop the Agenda 21, the action plan for sustainable development. In March of 1994, China released Agenda 21, which was defined by State Council of China as the guideline for mid- and long-term planning of national economic and social development government at all levels. With the implementation of China's Agenda 21, the government strengthened the Environmental Impact Assessment system on major projects and planning before implementation. Meanwhile, the Chinese government took numerous countermeasures to mitigate environmental impacts of social and economic development. In 1996, the State Council of China held the Fourth National Conference on Environmental Protection and released the Decision on Some Issues of Environmental Protection. With the rapid growth of National GDP, the Chinese government invested a great amount of money to initiate environmental protection projects and programs (Fig. 2.12). In late 1990s, the Chinese government started the control of total discharge of major pollutants and industrial wastes to meet national emission standard and environmental quality of different functional zones of major cities. At the same time, the Chinese government initiated some pollution control programs known as "33211 Project" [33211 gongcheng], which included water pollution controls for "3 Rivers" (Huaihe River, Haihe River, and Liaohe River), and "3 Lakes" (Taihu Lake, Dianchi Lake, and Chaohu Lake), air pollution controls for "2 Control Zones" (Acid rain control zone and SO<sub>2</sub> control zone), "1 City" (Beijing city), and "1 Sea" (Bohai Sea). At the end of twentieth century and the beginning of twenty-first century, the central and provincial governments of China launched a series of ecological protection projects such as "Natural Forest Protection" [tianranlin baohu], "Returning cultivated slope lands into forest and grasslands" [tui gen huan lin huan cao], "Returning Cultivated Lands into Wetlands and Lakes" [tui tian huan hu], "Retiring Livestock, Returning Grassland" [tui mu huan cao], etc., to mitigate the ecosystem degradation.





**Fig. 2.13** Water quality of seven rivers (Yangtze River, Yellow River, Pearl River, Songhua River, Huaihe River, Haihe River, and Liaohe River) in China, 1991–2010 (*source*: He, 2012; data were collected from MEP Report on the State of the Environment in China, 1991–2010). *Note*: According to Environmental Quality Standards for Surface Water (GB 3838-2002) in China, the function of surface water is classified into five categories as below. There are five grades of standard value to match the surface water functional area. Grade I stands for the best quality, while Grade V represents the worst

Although the Chinese government made great efforts in environmental protection and sustainable development, the accelerated industrialization, urbanization, globalization, and rapid economic growth brought huge pressures on the environment and natural resources in China. Fast economic development led to severe environment pollution and natural resource overexploitation, which in turn could become barriers to economic development and social stability (Wang 2011). It was stated by the authorities such as China’s Ministry of Environmental Protection that environmental condition in China “improved as a whole, but deteriorated partially” [quan mian gai shan, ju bu bian cha] in past decades. According to China’s Millennium Development Goals (MDGs) Report (2010), there remained many challenges in natural resource use and environmental protection since 1992 (Wang 2011). The statistic data summarized by He et al. (2012) showed that the air quality was slightly improved as a whole in the past decades, while water quality still remained quite low, e.g., the water quality of seven major rivers in China in 2000s became even worse than that in the early 1990s (Fig. 2.13). The summary from He et al. (2012) also showed that the point-source pollutants of the water (COD, nutrients) and air (SO<sub>2</sub>, NO<sub>x</sub>, VOC) were moderately reduced, while the nonpoint-source pollutants of water and air were not lessened. In recent years, air pollution in mega cities like Beijing became more and more serious. In 2010, only 3.6 % of the 471

major cities in China were recorded for top ratings of clean air according to National Environmental Monitoring reports (Ministry of Environmental Protection MEP 2011). Meanwhile, greenhouse gas (GHG) emissions were dramatically promoted due to increased energy consumption for boomed economic development. According to the report from The Climate Change Group (2007), annually average growth rate of GHG emission in China was around 4 % from 1994 to 2004. During that period, the contribution of carbon dioxide to the total GHG in China increased from 76 to 83 % (Xinhua News 2007). In July of 2010, China went beyond USA to become largest energy consumer and the biggest GHG emitter in the world, the share of China's GHG emissions associated with industrial and agricultural activities rose to 8.33 billion tons, accounting to 10.4 % of the world total (He et al. 2012). Although the growing programs of ecological conservation such as development of natural reserve, restoration of degraded ecosystems, promotion of logging and grazing bans led to increased vegetation cover and primary productivity, most of ecosystem functions such as biodiversity protection, flood control, climate regulation, and cultural maintenance were not improved due to uniformed monoculture plantation, insufficient public participation, low capacity for restoration, and insufficient efforts in afforestation.

#### ***2.2.4 Phase IV (2012 Onward): Prioritizing Environment Governance, Minimizing Environment Destruction***

To eradicate the serious environmental problems, which limited the sustainable development of China, Chinese government announced a shift to a new development model and a new green governance approach in China's 12th Five-Year Plan (2011–2015). Chinese governments at all levels were calling for circular economy, green economy, and low-carbon economy development in the new era. With the guidance of [United Nations Conference on Sustainable Development](#) in Rio de Janeiro of Brazil in Rio in June of 2012 (also called Rio+20 or Rio Earth Summit 2012), the 18th National Congress of Communist Party of China (NCCPC, held in November of 2012) prioritized ecological civilization in the movement toward socialist road with Chinese characteristics and in the processes of economic, political, cultural, and social developments in the nation. With the prioritization of ecological civilization, the revival of ancient Chinese ecological wisdom, severe environmental damages have been gradually reduced in recent years.

### **2.3 Innovations of Environmental Management in China**

The environmental degradation has challenged the sustainable development of China, especially in contemporary era, many lessons and experiences have urged China to seek innovative ways to solve the environmental problems. Indeed,

China has made great efforts to take integrated measures and multiple actions to cope with the complex issues of environmental risks since 1972. These efforts can be assorted into institutional innovations of empowering environmental protection agency, political innovations of reforming natural resource and environmental management strategies, economic innovations of adjusting development patterns, social innovations of promoting public participation and technological innovations of developing new approaches for pollution control and ecological restoration.

### ***2.3.1 Institutional Innovation: Empowering the Environmental Protection Agency***

There was no national institution on environmental protection until the year of 1974, when the State Council established the first leading institution on environmental protection in China, the Leading Group of the State Council on Environmental Protection, which was composed of the representatives from the State Planning Commission, State Construction Commission, as well as the ministries of industry, agriculture, transportation, water resources, and health. This organization was responsible for developing guidelines, policies, and regulations on environmental protection, reviewing national plan for environmental protection, urging the supervision on environmental protection work of each region and department. Thereafter, the governments of province, autonomous region, and municipality established their environmental protection institutions in the name of Leading Group of Environmental Protection at local level.

In 1982, the Standing Committee of National People's Congress (NPC) issued the Decision on the Implementation Program on Institutional Reform of Ministries and Commissions of the State Council, by which the State Council established the first environmental protection administrative agency, Environmental Protection Bureau under the Ministry of Urban-Rural Construction and Environmental Protection. Accordingly, province, autonomous region and municipality established their Environmental Protection Bureau in the governmental body. This institutional reform ended the history of lacking environmental protection authorities in China over past decades. In 1984, the Circular on Establishment of National Environmental Protection Agency released by the General Office of the State Council and the Environmental Protection Bureau in Ministry of Urban-Rural Construction and Environmental Protection was changed into "State Environmental Protection Agency." However, it was not yet an independent administrative body for environmental protection at the national level. In 1988s Institutional Reform of the State Council issued by NPC, the State Environmental Protection Agency was separated from Ministry of Urban-Rural Construction and Environmental Protection and became an independent government body. The State Environmental Protection Agency was an upgraded vice ministry level administrative agency in charge of overall supervision and administration of envi-

ronmental protection work of the country. Meanwhile, the environmental protection agencies at province, autonomous region, and municipality level were upgraded accordingly. This upgrading strengthened the functions of Environmental Protection Administrations on environmental supervision and management, as the State Environmental Protection Agency appeared as a department under the direct lead of State Council and formed solid organization foundations for the implementation of national guidelines, policies, laws, and regulations on environmental protection.

In 2008, Institutional Reform of the State Council issued by NPC decided to establish Ministry of Environmental Protection to strengthen the overall coordination of policies, plans, and key issues on environmental protection. The main functions of Ministry of Environmental Protection are developing environmental protection plans, policies, and standards and organizing their implementation; supervising the prevention and control of environmental pollution and coordinating the solution to major environmental problems. The newly established Ministry of Environmental Protection becomes a formal member of the executive meeting of the State Council. Like the previous Environmental Protection Agency, Ministry of Environmental Protection kept on unified supervision and administration on environmental protection across the country. In addition, it gained the more responsibilities for enhancement of overall coordination of environmental policies, plans, and major issues; participation in comprehensive decision making on environment and development according to environmental function zoning. Accordingly, all provinces, autonomous regions, and municipalities upgraded their environmental protection agencies as the departments of provincial government responsible for comprehensive decision making for environment and development issues. The process of institutional reform in the past decades has empowered the Environmental Protection Authorities across different administrative levels, which can provide solid and reliable institutional foundations for implementing national and local strategies and programs of environmental protection.

In addition to empowering the administrative institutions, Chinese governments have been striving to develop the legislative institutions in charge of environmental issues, in order to implement or enforce the environmental protection policies and projects more efficiently and powerfully. In 2005, the State Council of China issued a decision on environmental protection, which outlined how China would benefit the creation of specialized court systems for environmental protection and management. Since then, the environmental protection courts/tribunals have been developed gradually from the low to high level in 4-level court systems, grass-root court at county level, intermediated court at district level, high court at provincial level, and supreme court at national level. Till July 3rd of 2014, the environmental protection tribunal was established in the supreme court of China, meaning that the environmental justice in China has been promoted to a completely specialized court system (Xinhua News [2014a](#)).

2.3.2 Political Innovations: Reforming Natural Resource and Environmental Management Strategies

Environmental protection laws and regulations in contemporary China experienced the process from zero to quite a number of laws and regulations. China developed, enacted, and amended several specific laws on environmental protection and resource laws in relation to environmental protection since 1949. Apart from general requirement for environmental protection in the Constitution, China has developed and implemented nearly 30 laws relating to environmental pollution since 1979 such as Environmental Protection Law (first issued in 1989, revised in 2014 as shown in Fig. 2.14, Environmental Impact Assessment Law (first issued in 2002), Marine Environment Protection Law (first issued in 1999), Law on Prevention and Control of Atmospheric Pollution (first issued in 2000), Law on Prevention and Control of Water Pollution (first issued in 2008), Law on Prevention and Control of Pollution from Environmental Noise (first issued in 1996), Law on Prevention and Control of Environmental Pollution by Solid Waste (first issued in 2004), Law on Prevention and Control of Radioactive Pollution (first issued in 2003), Land Management Law (first issued in 1986, revised in 2004), Water Law (first

Fig. 2.14 Publication of Revised Law of the People’s Republic of China on the Environmental Protection (photo by Shikui Dong)





issued in 2002), Law on Protection of Wildlife (First issued in 2004), Mineral Resources Law (first issued in 1986, revised in 1996), Forest Law (first issued in 1984, revised in 1998), Grassland Law (first issued in 1985, revised in 2002), Fishery Law (first issued in 1986, revised in 2013), Law on Prevention and Control of Desertification (first issued in 2001), Law on Promotion of Clean Production (first issued in 2002), Law on Conservation of Energy and Law on Promotion of Circular Economy (first issued in 2009), accounting for about 1/10 of the total legislations established by National People's Congress and its standing committee.

Meanwhile, the State Council has also developed over 60 administrative regulations on environmental protection to facilitate law implementation or fill out vague blank of laws. To carry out national laws and administrative regulations on environmental protection, relevant departments of the State Council, local people's congress, and local governments have developed and promulgated over 600 environmental regulations and local regulations based on their functions. China has developed large amount of environmental standards to support the implementation of these environmental laws and regulations. Up to November 23, 2010, China had released a total of 1397 various kinds of national environmental standards, including 1286 existing national environmental standards and 111 nullified standards. With establishment of complete environmental laws and regulations, enhancement of environmental law enforcement and justice as well as public participation in many channels, China has partly curbed and mitigated environmental pollution and ecosystem degradation with Rapid economic growth over past decades.

With fast social-economic transformations, many environmental problems have intensive outbreak in very short period in China, leading to the failure of environmental protection laws in meeting current demands. To this end, China has conducted relatively frequent amendments of environmental protection laws. For instance, China has completed the revision of 1989s Environmental Protection Law into "The Strictest Environmental Law in the World" in April of 2014 (Xinhua News 2014b). With these amendments, environmental protection laws of China are adapting to practical requirements, improving legislation quality and enhancing their relevance and effectiveness. These laws and regulations have been playing important roles in constraining activities on damaging natural resources and resulting in environment pollutions.

### ***2.3.3 Social Innovations: Promoting Public Participation in Environmental Management***

Serious environmental problems have not only promoted the Chinese governments to strengthen the environmental supervision and management through improving institutional and political instruments, but also motivated a lot of civil societies to participate in environmental protection. A growing numbers of environmental non-government organizations (ENGOS) appeared like "bamboo shoots after spring rain" [yu hou chun song] to appeal the environmental movements and protections

across the nation. From 1994, when the first Chinese ENGOs, Friends of Nature were founded in Beijing, to 2008 when the Olympic Game held in Beijing, China, the numbers of ENGOs were increased to over 4000 and the capacity of ENGOs were empowered to monitor the governmental activities on environmental protection. Currently, All-China Environment Federation is a top Chinese ENGOs, which plays important roles in leading public environmental movements. These Chinese ENGOs, along with international ENGOs, mobilize the publics to protect the environment and conserve the natural resources, launch volunteer activities to stop any activities of companies and industries that may damage or destruct the environment, supervise and monitor the government-led environmental movements such as environmental impact assessment, environmental policy implementation, etc., facilitate and execute public educations on environmental protections.

Grass-root people's participations have been promoted in recent years with the launching of new concept of "Ecological Civilization" advocated by Chinese government. The values of indigenous knowledge and traditional practices on protecting land, forests, and water catchments, preserving biodiversity and recycling resources through religious beliefs, inherited traditions, and cultural practices have been assessed and advocated by Chinese government. For example, the Organic Law of 1998 granted villages the legal right to self-government and gave indigenous communities greater responsibility for land and resource use. The relationship between natural environment and indigenous people has been integrated within religious, moral, cultural, political, economic, and ecological boundaries in government planning, e.g., timber trees have been protected and were harvested only with village consent, upstream vegetation was preserved by local people, and grassland grazing was monitored by the pastoral community (Xu et al. 2005).

In addition to civil societies and grass-root communities, medias are playing more and more important roles in supervising government environmental activities, promoting the public environmental movement. With increasing public participation in environmental protection, China has been continuously promoting publicity and popularization of scientific knowledge on environmental protection, encouraging broad-range public participation in environmental movements, strengthening school and nonschool education to raise public awareness and advocate the whole society to protect environment by adapting environment-friendly behavior and low carbon life style.

### ***2.3.4 Technological Innovations: Developing new Approaches for Pollution Control and Ecological Restoration***

China has developed innovative technologies on resource and energy saving, resource circular use, zero emission in industrial chain, natural resource protection, and ecological restoration. In the tenth (2001–2005) and 11th Five-Year Plan (2006–2010) periods, the Chinese government took energy saving and emission reduction as a key indicator in assessing national economic and social development

and developed a series of innovative technical measures on reducing total emission of pollutants and mitigating ecological degradation. The official data show that there were about 59, 72, 42, 55, and 39 % of decreases in the discharges of industrial sewage, COD, SO<sub>2</sub>, Smoke, and Dust for per GDP in 2004, in contrast to 1995. In 2010, the total discharge was 12.381 million t for COD and 21.851 million t for SO<sub>2</sub>, going down by 12.45 and 14.29 % in comparison with those of 2005. In whole nation, the cities with air quality better than Grade II increased about 31 % and those with air quality worse than Grade III decreased 39 % from 1996 to 2005. There were about 810, 000 km<sup>2</sup> of newly protected watersheds along major rivers and lakes for clean water production from 1995 to 2006. In whole country, the forest cover increased from 13.92 % in 1993 to 20.36 % in 2008. Up to the year of 2008, 20 % of degraded grasslands have been restored and land desertification have been reduced by 245, 900 km<sup>2</sup>. Till the year of 2012, 2349 Nature Reserves (parks) have been established with a total area of 1500,000 km<sup>2</sup>, accounting to 15 % of total nation's lands. Around 85 % of nation's territorial ecosystems and 85 % of wildlife and 65 % of native vegetation have been well protected. Through technological innovations, great achievements have been made to improve country's environment and promote the nation's sustainability.

### ***2.3.5 Economic Innovations: Adjusting Development Modes and Patterns***

To reduce the risks of environmental pollution and ecological degradation, the Chinese government attempted to transform the extensive economic development mode featured as “high consumption of energy and resources, high emissions of pollutants and GHG” into the intensive one characterized as “low consumption of energy and resources, low emissions of pollutants and GHG.” The experiences show that transformation of the traditional economic development mode in China was key solution to mitigate the contradictions between economic growth and natural resources and environment protection. At the 17th National Congress of Communist Party of China (NCCPC) in October of 2007, the concept of “Scientific Development” was defined to create an “environment-friendly” society in China through adjusting the development modes. The 17th NCCPC highlighted to take environmental protection as an important means for adjusting economic structure; transforming economic growth mode; and achieving sustained, healthy, fast, and coordinated economic development. Since then, China has made more efforts in industrial structure adjustment and facilitated industrial upgrading, firmly curbed too fast growth of the industries with high energy consumption and high emissions. Since 2009, development of green economy has been integrated into China's development strategy. To address the problems of high-energy consumption and heavy pollution, China has made more efforts in developing clean energy industry, renewable energy industry, and environmental industry. Taking circular economy as an important instrument for adjusting economic structure and transforming development mode,

China has explored effective modes for enterprises, group business, or industrial parks and society to develop circular economy. China has accelerated the development of resource recycling and reuse industries; strengthened comprehensive utilization of mineral resources; promoted recycling and reuse of industrial wastes; improved renewable resource recycling system and facilitated commercialization of recycling and reuse of resources. Development of low carbon economy is being experimented in China for economic structure adjustment and development mode transformation. China has released comprehensive policy documents to guide the development of low carbon economy and publicizing policy potential in guaranteeing the development of low carbon economy. China has carried out local and regional action plans for developing low carbon economy, e.g., development of renewable energy such as hydropower, wind energy, biomass, and solar energy with clean use of coal.

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