

# Ecological Conservation and Construction in China: Progress and Situation

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## ABSTRACT

Since late 1990s, China has made smooth progress in ecological conservation and construction. Now, the following characteristics of ecological protection are presented: 1) China is still facing severe challenges in ecological conservation and construction; 2) The advanced areas with extensive growth model and the underdeveloped areas that are ecologically sensitive co-exist in China; and 3) As a country in transition, China needs to explore national pathway for ecological protection, while facing the trends of being institutionalized, integrated and necessitated for the global ecological protection efforts. The key of ecological protection in China is to seek an optimal model and an effective pathway which can balance economic growth and environmental protection, to recognize the difference and non-replicability of ecosystems, and to effectively combine the institutional development and engineering construction of ecological protection.

## KEYWORDS

Ecological; Conservation and Construction; Regional Development; International Process; China

## 1. Introduction

The United Nations Conference on Environment and Development (UNCED) held in Rio in 1992 reached a principle of “common but differentiated responsibilities”, as well as a series of international conventions on climate change, biodiversity and environmental protection. In the crucial time of socio-economic transformation and against a backdrop of increasingly institutionalized, integrated and necessitated environmental protection efforts worldwide, China has been exploring the strategies, pathways and measures on ecological conservation and construction. Although many aspects still need to be improved, some progress has been made in this effort and significantly ecological, economic and social benefits have been achieved. As the largest emerging economy globally, China needs to summarize the experiences and lessons learned in time, which will not only benefit China itself, but also contribute to the ecological protection in other countries, particularly the developing ones. In this article, the eco-

logical conservation progress was described (Part 1) which was followed by the characteristic analysis of Chinese ecological conservation and construction (Part 2). Then the article explained serious situation from two important aspects: unbalanced regional development (Part 3) and complicated international background (Part 4). At last, suggestions of Chinese ecological strategy were pointed out (Part 5).

## 2. Ecological Conservation and Construction in China

The concept and practice of eco-environmental protection in China has a long history. The largest-scale ecological protection efforts took place in end 1990s. China has made huge investment in terms of ecological conservation and construction programs. The relevant statistics indicate that, in the past ten years, more than 700 billion RMB has been invested in key ecological programs in the areas of forest, grassland and wetland [1]. Since the catastrophic flood occurred in 1998, the Chinese central government has been working very hard to promote the

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ecological development at an unprecedented level. In March 2000, the project of “Grain for Green” in the upper and middle reaches of Yangtze River and Yellow River was jointly launched by the State Forestry Administration, Ministry of Finance and National Development and Reform Commission, indicating that China has fully started its national ecological conservation and construction efforts. The central government has made a comprehensive arrangement and significantly increased its input in terms of natural forest conservation, afforestation, soil erosion control. The implementation process of the ecological conservation and construction programs in China since 1990s is shown in **Figure 1** [2].

China has made great achievements in terms of ecological conservation and construction. As for forest resources management, 26.867 million hectares of farmlands have been returned to forests in China from 1999 to 2008, with a total national input of 191.8 billion RMB. The overall forest coverage rate in the project sites has increased by more than 3%, making China become the country with the fastest growth of forest resources worldwide [3].

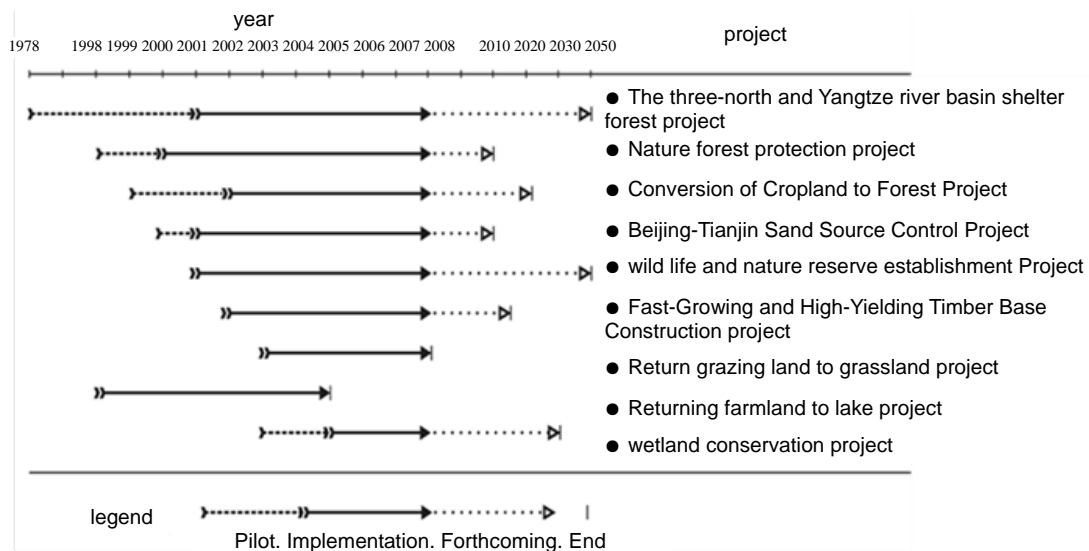
In terms of biodiversity conservation, China has developed China’s Action Plan in the International Year of Biodiversity in 2010. Regarding *in-situ* conservation, by the end of 2009, 2541 nature reserves have been established, which covers 14.7% of the total land area in China. A diversified nature reserve network with appropriate layout has been taken shape. In terms of *ex-situ* conservation, more than 230 zoos, 234 botanies, as well as many artificial breeding sites for rare and endangered species, have been developed. The survey on the biological species resources is being implemented, and inventory of some key species resources has been completed [4]. In terms of grassland ecological restoration, the

deterioration of the grassland environment has been initially controlled. The biodiversity has been significantly enhanced, and the regional ecological conditions have been greatly improved. Compared with the conditions in 2000, the proportion of degraded grasslands in northern Xinjiang dropped by 2.4 percentage in 2010, while the production of pastures in Qinghai grew by 48.8% thanks to the prohibition of grazing [5].

### 3. The Characteristics of Ecological Conditions in China and Tasks of Ecological Conservation and Construction

China has maintained a fast economic growth since 1978. However, the fast economic growth is accompanied by over-exploitation of natural resources, which has, in turn, led to large-scale ecological degradation and environmental problems. Whether the limited natural resources and the fragile ecosystems can support the sustainable socio-economic development in China has become an inevitable challenge. Around 1998, the ecological degradation in China became very serious and is likely to further deteriorate. The conditions of soil erosion and desertification became increasingly severe [2]. The natural disasters frequently occurred, with the size and rate of areas covered and affected by disasters rising sharply [6].

Since 1990s, thanks to many years of economic transformation, environmental control and ecological development projects, the environmental conditions in China have kept stable and improved to some extent [7], although the ecological conservation and construction efforts still remain challenging. The surface water pollution is still serious. Specifically, the overall water quality in the seven major river systems in China was moderately polluted. The problem of eutrophication constitutes a



**Figure 1.** Progress of China ecological conservation projects since the late 1990s.

serious threat to the major lakes, while the overall water quality in coastal areas is slightly polluted. In 2008, 47.7% surface water of the 746 state-controlled sections in China was recorded as Category I-III, while 23% were Category V or inferior Category V. The environmental quality of water bodies in the densely-populated areas as drinking water source has not yet been significantly improved. China is still a country with a low forest coverage rate, which is even below the world average level. The area of desertification lands across the country reached up to 2.6362 million km<sup>2</sup>. A research based on MODIS remote sensing data found that, the potential economic losses due to grassland ecological degradation in China from 2003 to 2005 amounted to 6.66 billion US dollars, 78.41% of which were from seven provinces (autonomous regions) in western China, *i.e.*, Inner Mongolia, Xinjiang, Tibet, Qinghai, Gansu, Yunnan and Sichuan. Inner Mongolia suffered the most, representing 25.89% of the total economic losses [8]. In addition, China is also vulnerable to climatic disasters, which is shown in **Table 1**. Each year China suffers an economic loss of 200 to 300 billion RMB, about 3% of its GDP, due to the meteorological disasters [9].

As Chinese ecological conservation and construction project are entering a new stage, it is facing many new challenges:

1) The systematic implementation of ecological projects. These ecological projects, focusing on ecological control, include the ecological resettlement, follow-up industry development, and the maintenance of ecological conservation results. Due to insufficient early-stage demonstration and planning, and lack of coordination among sub-systems, these projects often result in low implementation efficiency or even fail. Additionally, because an integrated assessment and monitoring system has not been available, it is difficult to ensure the efficiency and sustainability in implementing the ecological conservation and construction projects.

2) The institutional transformation of ecological pro-

tection. It is difficult to transform from the ecological construction to ecological management with the existing organizational model. Under the current administration system of ecosystem management, the standing committee of NPC and its Committee of Environmental Protection and Natural Resources Conservation serve as the authority of legislative supervision, while the State Forestry Administration and Ministry of Agriculture act as the sector administration department, the Ministry of Water Resources and State Oceanic Administration serve as resources administration department, the Ministry of Environmental Protection (MEP) and the National Development and Reform Commission serve as the authorities for environmental supervision and integrated management respectively. As a matter of fact, the complexity and integrity of ecosystems call for the integrated and coordinated management. Therefore, it is necessary to gradually promote the development of a cross-sector coordination mechanism that is institutionalized, law-based and standard between and among MEP and other sector administration departments.

3) Enforceability of the legal system related to ecological protection. China has already developed a basic framework and system on environmental protection, providing legal justification for the use, protection and management of diverse ecosystems [10]. However, the detailed and practical provisions need to be defined in existing law system, as while as the rights and responsibilities of each subject need to be specified.

#### 4. Ecological Conservation and Construction with Challenge of Unbalanced Regional Development

As an emerging economy, China is in the period of social economic transition. Its unbalanced regional development leads to the co-existing of advanced areas with extensive growth and underdeveloped areas with ecologically sensitive. Nearly all the regions are faced with

**Table 1. Disasters in China.**

Years	Areas covered by disasters (10 <sup>4</sup> ha/year)	Areas affected by disasters (10 <sup>4</sup> ha/year)	Rate of areas covered by disasters (%)	Rate of areas affected by disasters (%)
1952-1959	2499.8	1046.6	16.7	41.9
1960-1966	3760.3	1773.1	26.0	47.2
1970-1979	3766.8	1158.4	25.3	30.8
1980-1989	4154.8	2038.0	28.6	49.1
1990-1999	4955.2	2517.7	32.8	50.8
2000-2009	4615.7	2553.2	29.7	55.3

**Note:** Rate of areas covered by disasters is the proportion of the areas covered by disasters to those planted by crops; while the rate of areas affected by disasters is the proportion of the areas affected by disasters to those covered by disasters. **Source:** China Statistical Yearbook and Reference [6].

severe challenges in ecological restoration, whether areas of economically developed or areas of ecologically sensitive.

#### 4.1. The Economically Advanced Regions with Extensive Growth

On the background of global economic integration, China was in the downstream of social division of labor as a backward developing country and faced the task of transforming from the backward agricultural production to industrialization. The extensive economic growth model has become a natural option when reform and opening up policy was adopted. However, such growth model with high consumption and high input has caused severe damage to the eco-environment system and made them become more vulnerable. In general, China has adopted a practice of "treatment after pollution", and the fast speed of economic growth has been achieved at the high cost of eco-environment pollution. According to the World Bank, in 1998, the economic losses due to atmospheric and water pollution (not including solid waste pollution and ecological damage) in China accounted for 7.18% of the GDP. Assuming the economic losses due to ecological damage double those due to pollution, the accumulated economic losses due to ecological damage took up approximately 23% of China's GDP. In this way, the actual growth rate of GDP in China in 1998 was revised from 7.18% to 6.10%, down 1.18% [11]. So far, ecological degradation has become a key factor constraining the sustainable socio-economic development in the country.

At present, as the traditional industries with low added values and high energy consumption still take up a large proportion, the environmental protection and development efforts in China are closely associated with the economic growth mode and industrial structure [12]. The impact of the global financial crisis is still being felt in China. The population distribution pattern remains unchanged, with the southeastern region whose area represents 43% of the total land area in China supporting 91% of the total population in the country. At the middle stage of industrialization and urbanization, China is working hard to achieve its goal of comprehensively building a well-off society by 2020. Within the current industrial pattern, two types of industries will still be important part of Chinese economy, even though the discharge of pollutants per unit output are at a higher level. The first is industries with obvious advantages in market and scale economy, such as the iron and steel, nonferrous metal and chemical industries. The second is industries based on labor intensive and with advantages in R&D design, marketing and brand, such as the light industry, textile and apparel, and electronic industry [7]. Under the impact of the global financial crisis, it is extremely urgent

for China to speed up its industrial restructuring and transformation.

#### 4.2. The Underdeveloped Regions with Ecological Sensitivity

The ecological sensitivity refers to the extent of ecosystems response to human disturbance and environmental change, indicating the severity and possibility of regional eco-environmental problems [13]. Different from the economically advanced eastern regions in China, the underdeveloped regions are both poverty-stricken and ecologically sensitive. Therefore, the ecologically sensitive areas in China are highly related to the economic poverty [14]. These underdeveloped areas are quite different from developed areas and the advanced western countries in underlying causes of ecological damage, development stages of regional economy and society, and options of ecosystem optimization. The ecological damage in these underdeveloped areas is due to irrational utilization of ecological resources. For economic development, ecological resources were over-exploited, which exceeded the threshold of the carrying capacity of the ecosystems. As a result, the overuse of ecological resource further constrained the sustainable development of these areas. So, it is necessary to break out the bad loop and increase the external energy input. Eventually, growth model transformation can be realized.

Any ecosystems have the capacity of providing ecosystem services. Over the years, they can basically meet the needs of social development. However, with the ongoing social progress, the gap between the capacity of the ecosystems in providing ecosystem services and the human needs is widening. Since mid-20<sup>th</sup> century, due to fast growth of population, 60% of the ecosystem services worldwide have become degraded, making the ecosystems far from being able to meet the human needs [15]. Take the western grasslands in China as an example. Since 1950s, nearly 20 million hectares of high quality grasslands have been converted to farmlands, accounting for 18.2% of the total farmland in China. Currently, as for the big stretch grassland of more than 25 hectares, only 330 million hectares remain. The deterioration of grassland ecological conditions has also reduced the productivity of grassland, with the grass yield falling by 30% - 50% compared with 1950s [16]. In this sense, the degradation of ecosystem services has become a major factor constraining the regional sustainable development in the western grasslands in China.

In the economically underdeveloped and ecologically sensitive regions, ecological conservation and construction should be based on the two facts: the specific characteristics of the ecosystems and regional climate, and the underdeveloped regional economy. The ecological and climatic characteristics should be precondition of human

activities. For example, it is difficult to improve the natural conditions in farming-pastoral ecotone. One of the major reasons for the widespread poverty in these areas is the ignorance of the fact that the local highly-variable climate is inappropriate for the planting industry which depends strongly on seasons and climate.

Among the 592 national level poverty-stricken countries determined in 1994, 344 counties located in the 10 western provinces, accounting for 58% [17]. Nearly all the 592 poverty-stricken counties are environmentally sensitive regions, such as mountainous areas and plateaus. Because of severe survival pressure, natural resource was over exploited, which, in turn, exacerbate the restriction of fragile eco-environment on the human living and production. The environmental degradation is closely associated with poverty. A vicious cycle exists between them, leading to a “poverty trap”. In the process of implementing China’s Western Development Program, it is necessary to break the vicious cycle between poverty and environmental degradation and achieve the sustainable development. In the field of ecological economics research, the ecological deterioration under the absolute shortage (or insufficient basic consumption) is one of the most important differences between China and other countries. The pre-conditions of steady-state economy and zero-growth theory can’t be satisfied in poverty-stricken regions [18]. Theoretical innovations are urgent in this field.

## 5. Ecological Conservation and Construction Efforts against Background of Complicated International Situation

Amid the international eco-environmental protection process, Chinese eco-environmental system plays a key role in improving the global ecosystems, while China is at a key stage of socio-economic transformation. The global environmental control efforts are increasingly institutionalized, integrated and necessitated. While complying with the relevant international conventions and agreements, China needs to explore the own pathway on

ecological conservation and construction based on its actual conditions.

### 5.1. Play Key Role in Improving Global Ecosystems

Chinese eco-environmental systems have a major effect on the global ecosystem security. As **Table 2** shows, China ranks the second in terms of national nature reserve (1.438 million km<sup>2</sup>) and the percentage (15.4%) in total land areas worldwide, only next to Brazil (1.515 million km<sup>2</sup> and 17.9%). In terms of animal species, bird species, and plant species, China has much more than other countries, such as India, Japan, USA, and Russia. Therefore, the ecosystem security and biodiversity conservation in China will play a key role on the global ecosystem health.

As the second largest economy in the world, China has a major impact on the global eco-environmental issues. In 1990s, China became one of the eight countries which have significant impacts on the global environment, ranking the second in terms of carbon emissions. Since then, the total carbon emissions in China have kept rising rapidly, and its contribution to the global total carbon emissions has increased significantly. As shown in **Table 3**, Chinese carbon emission has become one of the major targets in international negotiations on energy conservation and emission reduction, although its per-capital emissions are still low compared with other countries.

### 5.2. Experience Critical Period of Economic Transformation

The major topics for Rio +20 were the green economy and poverty eradication, which are common tasks for all the countries. China needs to fulfill its objectives on energy conservation, emission reduction and reduction of carbon intensity during the period of the 12<sup>th</sup> Five-Year Plan (2011-2015). It is also confronted with many severe challenges in achieving green transformation, developing green and emerging industries, and building well-off

**Table 2. National protected areas and biological diversity in China.**

Country	National nature reserve		Animals		Birds		Higher plants	
	A(10 <sup>4</sup> sq:km <sup>2</sup> ) 2006	P(%) 2006	S 2004	T 2008	S 2004	T 2004	S 2004	T 2008
China	143.8	15.4	1801	351	1221	82	32200	446
India	15.2	5.1	1602	313	1180	79	18664	246
Brazil	151.5	17.9	2290	343	1712	120	56215	382
Japan	3.5	9.5	763	190	592	53	5565	12
United States	37.9	15.1	1356	937	888	71	19473	244
Russian. Fed	111.3	6.8	941	153	645	47	11400	7

Source: International statistical yearbook, 2010. A: Area P: as percentage of total land S: Species T: Threatened species.

**Table 3. Carbon dioxide emissions of key countries.**

Country	Total emissions (10 <sup>6</sup> t)		Per-capita emissions (t)	
	2000	2005	2000	2005
World			4.1	4.5
China	3337.7	5547.8	2.6	4.3
India	1160.8	1402.4	1.1	1.3
Japan	1204.1	1230.0	9.5	9.6
United States	5646.3	5776.4	20.0	19.5
Russian. Fed	1435.0	1503.3	9.8	10.5
Germany	798.3	784.0	9.7	9.5
United Kingdom	546	546.4	9.3	9.1
Canada	518.3	537.5	16.8	16.6

Source: compiled according to international statistical yearbook 2010.

society. As for Chinese sustainable development strategy, the following two factors have to be taken into account.

First, with one fifth of the global population, China needs to solve the poverty problem on its own. China made most significant achievements in reducing poverty [19], gained rich experiences in eliminating poverty, and developed its own systematic poverty alleviation theory [20]. However, according to the World Bank's standard on poverty line (below 1.25 US dollars per day), China had 200 million people living under the poverty line in 2005 [21]. Therefore, China still has a long way to go in reducing poverty. The top priority for the poverty alleviation efforts during the 12<sup>th</sup> Five-Year Plan period is to eradicate absolute poverty.

Second, transformation period is difficult to achieve in a short time. Some industries make up a high proportion in China economy structure, and take relative advantage in global economic structure, which is shown in [Table 4](#). China should develop those industries instead of abandon them in the long period of industrialization and urbanization, especially whose per-unit product energy consumption takes the lead in domestic or foreign markets. Furthermore, it needs to improve the technological level of these industries, and extend industrial chains to achieve the low-carbon development of such industries.

From international development environment, a principle of "common but differentiated responsibilities", reached in United Nations Conference on Environment and Development(UNCED), requested developed countries to provide financial and technological support to the developing ones. However, since 1990s, the official aid to the developing countries has been declining, not only in absolute value of the donation funds, but also in the percentage of the donation funds to the developing countries' GDP [22]. The outbreak of financial crisis leads many developed countries unwilling to provide more financial support to the developing countries. In addition, complicated procedure of technological transfer and lack

of talents also prevent the developing countries from achieving their sustainable development targets [23].

### 5.3. Comply with International Environment Conventions and Agreements

The integrity and the interdependence of ecosystems lead the whole world confronted with common challenges in climate change. A global mechanism on ecoenvironmental control has been gradually taking shape through international conventions and laws. At the United Nations Conference on Human Environment (UNCHE), the first international conference on environmental protection held in Stockholm in June 1972, two declarations were adopted: Declaration of the United Nations Conference on Human Environment, and the Declaration for Action. At the United Nations Conference on Environment and Development, held in Rio in 1992, Rio Declaration and 21<sup>st</sup> Century Agenda were adopted. These two documents defined principles of environmental responsibility. A blueprint of rethinking the economic growth, promoting social equality and ensuring the environmental protection has been developed, and the concept on sustainable development is being gradually shaped. The first World Summit on Sustainable Development, convened in Johannesburg, South Africa in August 2002, fully reviewed and assessed the implementation of the 21<sup>st</sup> Century Agenda. The United Nations Conference on Sustainable Development (Rio+20), held in Rio in 2012, assessed the progress worldwide on sustainable development, promoted green economy transition focusing on poverty eradication.

Since 1972 when UNCHE was held, the international environmental laws enter a rapid development period. The international environmental conventions and treaties have become the major legal basis to address global environmental problems [24]. Under this background, a sound global system on environmental control is formed

**Table 4. World ranking of the output of China's major industrial products.**

Item	1978	1980	1990	2000	2006	2007	2008
Crude steel	5	5	4	1	1	1	1
Coal	3	3	1	1	1	1	1
Crude oil	8	6	5	5	5	5	5
Electricity	7	6	4	2	2	2	2
Cement	4	4	1	1	1	1	1
Fertilizer	3	3	3	1	1	1	
Woven cotton fabrics	1	1	1	2	1	1	1

Source: international statistical yearbook, 2010.

gradually. At present, the international efforts on environmental control exhibit a trend of being institutionalized, integrated and necessitated, and are affecting or being affected by the economic, political and cultural factors. China should also be involved in this process. On one hand, as the contracting party of a number of international environmental conventions and laws, China needs to comply with such standards and regulations, and takes corresponding responsibility in global environmental protection. On the other hand, as a developing country, China can only take international responsibilities that match its development stage and international status in regional and global environmental challenges.

## 6. The Strategic Option of Ecological Conservation and Construction in China

With pressures both from economic development and environmental protection, China has been constantly exploring effective models on ecology protection. From the analysis above, more attention should be paid to the following points for Chinese strategic option of ecological conservation and construction.

1) The target of the ecological conservation and construction is trying to find the most effective models that couple economic growth and environmental protection. China has to achieve ecological protection in the process of socio-economic development, which is quite different from the advanced countries and has to be taken into account in environmental protection and development strategy.

2) It is difficult to replicate the ecosystem management model because of ecosystems diversity. Ecosystem management is implemented at specific time and space. We should avoid just copying the models of other countries or just disseminating the experience of some other ecosystem management. It is important to research into and provide guidance according to different types of ecosystems.

3) It is important to combine ecological project construction with institution improvement. Project constructions are effective measures to address ecological issues

at crucial areas and times. While ecological protection is a systematic and long-term task. The long-term sound mechanism of institution and legal system are fundamental needed.

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