

CURRENT STATUS, CAUSES AND REMEDIAL STRATEGIES OF CHINA'S ECOLOGY AND ENVIRONMENT

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ABSTRACT: The existence and development of the Chinese nation have been severely challenged by a sharp increase in population, a shortage of natural resources and damage to ecological system, since China began to industrialize in the 1950s. Based on long-term and in-depth research on the ecology and environment of China, this paper presents the background, basic status, characteristics, causes and remedial strategies, countermeasures.

KEY WORDS: ecological environment, environmental pollution, ecological degradation

I. ANALYSIS OF THE CURRENT STATUS OF THE ECOSYSTEMS AND THE ENVIRONMENT IN CHINA

China started the process of its industrialization in the 1950s. During the 35-year period from 1952 to 1987, China had a 17.2-fold increase in Gross Society Output Value and a 9.8-fold increase in national income. During the same period, however, serious problems of population growth, resources and environment came up.

China is a large country with typically low income. It is now halfway in the step in population increase. The population pyramid has the largest base, size and growth rate in the history now. Under these conditions wide-spread backward rural areas remain, where dominantly traditional modes of production are still widely used. At the same time the industrialization was promoted strongly, causing ecological degradation on a large scale and very serious environmental pollution. There are two different types of ecological and environmental issues in the world: a) ecological degradation due to the huge pressure for survival of increasingly numerous populations, mainly in developing countries; and b)

environmental pollution due to the release of pollutants as by-products of industrialization, mainly in developed countries. The situation which China faces is a mixture of both types.

The basic assessment of the conditions of ecosystems and environment in China is 1) an inherent shortage of resources without favorable condition; 2) anthropologic destruction leading to the present imbalance; 3) degradation coupled with pollution; 4) local improvement while deterioration continues elsewhere; and 5) ability to abate and control pollution and degradation far too insufficient. As a result the environmental quality goes from bad to worse. All these together have led to such an ecological degradation and environmental pollution which is the largest in scale, the widest spread, and the most serious in the history of China^[1-2].

It can be concluded that the ecological crisis consisting of sharp population growth, depletion of resources and environmental deterioration has become a serious challenge, which the Chinese nation has to face for its survival and development.

This considerably worrying and extremely anxious conclusion comes from the following objective data and sober-minded analysis:

China has a territory of 9,600,000 sq.km, of which mountainous regions, hilly areas and plateaus account for 65% , and all ecological fragileness zones for 9.7%. Misuse and inappropriate development of such lands will be prone to cause the wide ranges soil erosion, which speeds up the imbalance of ecosystems. For many years, the general situation on soil erosion in China has been as follow: only small patches of affected land are tackled while on a much wider range of land the situation is aggravated; upland soil erosion go with lowland siltation; natural disasters aggravate the vicious circle. The total area of soil erosion steadily increases. China has an increase by 38% in the area of soil erosion from 1,160,000 sq.km in the early 1950s to 1,600,000 sq.km at present, accounting for 16.7% of the territory. The land of soil erosion of plateau of 540,000 sq.km is up to 90% . In the Changjiang River basin, the area of soil erosion has been doubled over the last decade, and there is an more than 3-fold increase in affected areas in Sichuan, Jiangxi and Jiangsu provinces^[3].

Most areas of China are affected by monsoon, which causes many natural calamity. There is a historical saying that "there was a starvation every three years, a recession every six years, and a famine every 12 years". During the past 2,200 years, more than 1,600 times of greater floods and over 1,300 times of drought happened. The frequency of natural disasters increased with time. Particularly in the last four decades, the frequency became higher and the damage got heavier. In the country as a whole the disaster-affected area in the 1980s was 2.1 times that of the 1950s (more than 30% of reduction in crop production)^[4]. Furthermore, since the 1950s, there has been a trend for higher temperatures and lower precipitation, leading to a huge irreversible ecological effect. Obviously, all these are the consequence that anthropogeny destruction lead to an accelerated imbalance of the natural

ecosystems.

Although China is a large country, it is poor in forest: with only 12.98% of forest coverage, which is far below the world average level(31%), and ranks 120th in the world. Since the 1970s, the trend of sharp reduction in forest resources has become quite significant. In the late 1950s, the area of woodland in China increased to 125 million ha with a forest coverage of 13% . During the period of the Fifth Five-Year Plan, the area of woodland was reduced to 115 million ha with a forest coverage of 12% only. Now the forest coverage, measured by remote sensing, has been reduced to less than 10% ^[5]. Now there are only 1.4–1.5 billion cubic meters of timber reserve to be felled . The consumption has surpassed 97 million cubic meters more than the annual growth of timber: i.e., a big "forest deficit". If this situation continues, there will be no matured forest left for felling within 7 or 8 years.

China is also a large country being poor in grass: 224 million ha of grassland are now available for use. That means 3.2 mu per capita (1 mu = 1 / 15 ha), which is 1 / 3 of per capita level of the world. Since the 1950s, the exploitation pattern of the grasslands in China has been one of depletion by low inputs in combination with intensive use. For more than 30 years, the investment in grassland operation has been only about 1 yuan (RMB) per mu of grassland on an average while the area of grassland available to each livestock has been reduced from 115 mu more than 30 years ago to 34 mu at present. During the same period, up to 100 million mu of grassland have been reclaimed for agriculture with intensive cultivation. The reclamation of pasture land for cultivation and the over grazing have caused serious desertification and soil erosion. The grassland degradation has increased from 15% in the 1970s to more than 30% in the middle 1980s. Currently , the area of degraded grassland in China is up to 1.3 billion mu and is still extending at a rate of over 20 million mu per year.

China is also one of the countries suffering most from desertification in the world. According to the studies of Lanzhou Institute of Desert, Academia Sinica, in the northwest of China, the total area of deserts, gobi and desertified land has been up to 1,490,000 sq.km., accounting for 15.5% of the national territory, of which the area of desertified land is 334,000 sq.km, and has extended at a rate of 1,560 sq.km per year since the 1950s. In the region east of the Helan Mountains and the Wuqiaoling Ridges where the desertification is most seriously developed, currently 59,000,000 mu of farmland, 74,000,000 mu of grassland and more than 2,000 km of railway are being threatened by desertification. More than 60% of the impoverished counties in China are concentrated in the ecological fragile zone where it is very windy and dusty. Studies indicated that, if no special measures are taken to stop such irrational human behaviors as excessive use of land and other uses that will result in desertification, by the year 2000 China will have an additional 75,300 sq.km of its territory degraded into desert, which would be more than 2 times that of Taiwan Province.

China is a large country with a great demand for water. The total amount of its river

flow ranks the 6th in the world, runoff of 2,600 cubic meters per capita only ranks the 88th in the world and is at 1 / 3 of the world average level. Moreover, water resources have an uneven temporal and spatial distribution in China. The Changjiang River basin and its south region is an area with a relative shortage of land and a surplus of water, having 36% of the country's cultivated land and over 82% of the country's water resources. In contrast, the region north of the Changjiang River basin is an area with a relative shortage of water and a surplus of land, having 18% of the country's water resources and 64% of the country's cultivated land. The Huang-Huai-Hai Region in particular with the largest potential for increasing the food production has 41.8% of the country's cultivated land but only 5.7% of the country's water resources. Most cities in China have water shortages: 154 cities in 1979 and 183 cities in 1985 were short of water. Currently, 20% of the cities in China have difficulties with their water supply. In the past 30 years, the rapid rise in demand for and consumption of water has become ever more apparent. In the 1980s, 1 billion cubic meters of surface water were discharged into the sea in an average year, being only 5% of the volume in the 1950s. The water surface of lakes has also been shrinking continuously. Since 1954, the water surface of the water systems and other natural water bodies in the middle and lower reaches of the Changjiang River has shrunk by about 12,000 sq.km, of which the surface of Dongting Lake has reduced by 38%. In addition, water pollution in China significantly aggravated in recent years and the remaining clean water resources will be possibly lost. In 1987, 42% of the cities in China had their drinking water areas heavily polluted.

China has an extremely imbalanced distribution of its resources and great differences in resources carrying capacities between regions. The best ecological regions are in the southeastern coast of the country, then getting worse gradually towards the northwest, and are the poorest in the desertified areas of the west. In terms of land productivity and relation between supply and demand, those in great demand for resources include the developed areas, such as Beijing, Tianjin, Shanghai, Liaoning and Guangdong, and the backward areas, such as Fujian, Guangxi, Guizhou, Yunnan, Xizang(Tibet), Gansu and Qinghai. Areas which are in critical state with regard to resources and carrying capacity include Henan, Hebei, Shanxi, Inner Mongolia, Sichuan, Shaanxi, Ningxia and Xinjiang. Those areas where the available resources and carrying capacities exceed the present demands of population are the so called resources rich areas. Only provinces of Hebei, Hunan, Shandong, Jiangxi, Anhui, Zhejiang, Jiangsu, Heilongjiang, and Jilin fall into this category. Based on the total productivity of the land resources in the whole country, it seems that a population of 950,000,000 could be supported by the land appropriately. Currently, however China is in a critical state of over population^[6].

In China, atmospheric pollution is heavy; acid precipitation is getting more serious and extended; and there is an excessive amount of solid waste dumping. The refuse hills surrounding cities have become a prominent environmental issue. Atmospheric pollution is of

coal smoke type, exhibiting a trend of significant aggravation due to the industrial growth. The number of areas obviously affected by acid precipitation has increased from 2 several years ago to 4 at present. The amount of uncontrolled industrial solid waste dumping increased by 40% from 1981 to 1987 while the capacity for their safe and controlled disposal had only little increase. 2 / 3 of the cities in China are surrounded by refuse hills due to insufficient capacity for disposal.

In the rural areas of China, the environmental pollution is spreading from points to areas throughout the country. The rural industry contributes positively to the development of the rural economy while bringing simultaneously to the ecosystems and to the environment wide-spread pollution. According to a typical survey by Nanjing Institute of Environmental Science, the National Environmental Protection Agency, currently, up to 40% of township enterprises cause pollution and 10% of them cause heavy pollution. The discharge of wastes from township enterprises increases even faster than that from the state-operated industry.

Deterioration of the ecosystems and the environment in China has caused already huge economic losses, and the degraded ecological indexes have directly and significantly affected the economic target and economic trends. It was estimated that the economic losses caused by the ecological degradation in China amount to about 50 billion yuan (RMB) per year so the total material wealth in China suffered huge losses, particularly the cultivated land, water resources, forest grassland, and various mineral resources, which are difficult to quantify in the national economic accounting. Meanwhile, the serious emergent pollution accidents have happened one after another, with wide spread, and serious damage. The pollution accidents in the country increased from some 2,500 cases in 1983 to 3,700 cases in 1988.

In summary, human exploitation of natural resources in China exceeds what nature can sustain and has caused an imbalance in the ecosystems. This manifests itself in forest cutting surpassing forest growth, the loss of surface soil, discharge of pollutants surpassing the capacity of natural purification, etc. China's strong economic growth has caused an excessive consumption of resources and has inevitably damaged the ecological environment, continuously aggravating the ecological deficit. This gradual expansion of ecological deficit has a great influence on the existence and development of the Chinese nation.

II. ECOLOGICAL AND ENVIRONMENTAL ISSUES IN CHINA IS THE INTEGRAL PART OF THE GLOBAL ECOLOGICAL AND ENVIRONMENTAL CRISES

This problem has two main aspects . The first is that the global environmental issues will have a serious unpredictable effect on China.

The sea level rise will seriously affect the economically developed and densely popu-

lated areas in China, especially the coastal plains such as the Changjiang River delta, the Zhujiang River Delta and the Huanghe River Delta. For example, one half of the area of the Zhujiang River Delta is at less than 0.3 meter above sea level, and additionally, the surface is subsiding at a rate of 0.78 mm per year. If there would be a sea level rise of 15cm, it would flood 20–30% of the entire Delta. The sea level rise of 30 cm would cause flooding of one half of the delta.

Large cities in China, such as Shanghai, Guangzhou, and Tianjin, are usually threatened by floods during the flood seasons, and have serious surface subsidences due to the excessive extraction of their underground water. By the year 2030, they will sink below the local surface altitude of 0.4 meters. That will not only lead to the danger of the land inundation but also cause more threats by floods. Moreover, the sea level rise will make drainage of some coastal areas such as the Taihu Plain on the Changjiang River Delta more difficult so that it might become lakes and marshes.

According to an American study on the Delaware River, a sea level rise of 13 cm may cause upstream invasion of salt tidal water in a distance of 2–4km. The Zhujiang River in China a salt tidal sea water can reach Guangzhou City during the dry seasons, which is 130 km away from its estuary. It has already affected the water supply of Guangzhou. In addition, the area invaded by sea water in the coastal zone of Shandong Province has increased up to 1,000 sq.km. due to excessive extraction of ground water. This has caused extensive areas to be abandoned because of salinization. At the same time , a sea level rise will also have an effect on coastal life.

Long-term continuous observations by several tens of marine observatories and tide checking stations in China indicate that most of the offshore sea areas of China have exhibited significant increasing trends in the strength of sea water erosion and the sea level rise. Over the past 100 years, particularly since the 1960s, the offshore sea area of China had a sea level rise of 11.5cm (the global rise is 14.4cm). It is predicted that by the year 2000 the sea level of most offshore sea areas in China will continue to exhibit a rising trend. The sea levels of the offshore sea areas in Guangdong , Guangxi and Hainan will have the largest rise, more than 4.8 cm; those in the southern Jiangsu, Zhejiang and Fujian will have a rise between 2.0 and 4.64 cm; while those in the Bohai Sea, Shandong Peninsula and the northern Jiangsu will remain steady with only a slight rise or subsidence on some sections of the coast.

The second main aspect of the effect of China's environmental issues is that the environmental issues of China will have an essential effect on the global environment.

China is a country with the largest population in the world, its population accounts for 22% of the world population. It is predicted that by the year 2000 the population of China will exceed 1.3 billion, still accounting for 21% of the world population of about 6.2–6.3 billion. By the year 2020, the population of China will be up to 1.5 billion, still being about 20% of the world population. China will remain the champion of population in the world

until at least the year 2040 to 2050 , and then the population in India will possibly exceed the population of China.

China is also a country with the largest coal production and coal consumption in the world, having a considerable effect on the global climate warming. In 1986, China produced 894 million tons of coal , accounting for 20.2% of the total coal production in the world. In the structure of energy consumption in China, the proportion of coal consumption is about 3 / 4 . This structure is expected to remain for a long time. In 1980, China emitted 12 million tons of sulfur dioxide, ranking the third in the world, after USSR and the United States. In 1983, China released 440 million tons of carbon dioxide to the atmosphere, accounting for 9.2% of the world emission of carbon dioxide, following the United States and USSR^[7].

In brief, China is part of the world. China not only is subject to an international impact by the world environment, but also has a major impact on the global environment. The above—mentioned international background determines that China has to place tackling of ecosystems and environment in a very important, strategic position, and should joins immediately all countries in the world in protecting the environment.

III. ANALYSIS OF THE CAUSES OF THE ECOLOGICAL AND ENVIRONMENTAL ISSUES IN CHINA

The ecosystems and environment in China are increasingly deteriorating for many complicated reasons. It is the inevitable result of the interactions between natural factors and human factors. It is also the reflection of the superposition of historical extension and modern development.

At first, the ecosystems and environment in China have their own inherent vulnerabilities and are prone to become imbalanced. China is a mountainous country with a varied topography and a great difference in surface elevations. It is prone to soil erosion by the action of gravity and high hydraulic gradients . The climate in most parts of China is affected by monsoon, combining rain and heat in the same season. That does favor agriculture , at the same time, it also damages agriculture. Most parts of China are controlled by the East—Asian monsoon. The East—Asian monsoon's forward and backward shift, strength, duration and anomalies are the basic dynamic reason for the wide—covered droughts and flooding in China^[8]. Moreover, China is situated between the two major geological active belts in the world, where the creation of new geological structures is more active than elsewhere, leading to more frequent natural hazards such as earthquakes, landslides, mud—rock flow and other phenomena that strongly threaten the existence of human beings, life species and rare animal populations. There are also the wide—spread, diversified, and rapidly—changed eco—environmental vulnerable zones, which are both the major areas of ecological degradation and the major impoverished and backward areas in China.

Secondly, the constant population growth caused the huge pressure and persistent effect on the ecosystems and environment in China. From the historical trend of population in China over the past tens of hundred years, it can be seen that the population has been growing constantly. The multiplication of the population in the late period of the feudal society formed the basis for the modern and present population size. A new population growth step occurred after the founding of the People's Republic of China and it, in turn, forms the basic pattern of a huge population of China in the next century. China has increasingly expanded its resources of available land, which is close to the limit of the development meanwhile the per capita availability of agricultural resources is dropping to the historical low and far below the world per capita level. The ecosystems and the environment in China are constantly degraded with strongly insufficient natural supporting systems, such as cultivable land, fresh water, grasslands and forests. Each multiplication step of the population brings the ecosystems and the environment a serious degradation.

The major mistakes in the strategies for economic development, over-rapid growth of the economy, and frequent adjustments in the relations of production, are also the major reasons for the accelerated degradation of the ecosystems and environment in China. In the early period of industrialization, China selected the industry-oriented development strategy, giving top priority to the development of heavy industry with high material consumption and low efficiency. Central objectives were the rapid growth of gross national product (GNP), and catching up with and exceeding the advanced countries. This is a traditional strategy for development. During the period of "the Great Leap Forward", people carried out large scale deforestation for agriculture and other purposes and enclosed and drained lakes for cultivation. These actions formed the basic patterns of the ecological degradation at present. During the period of "the Cultural Revolution", diversified small-scale industries spread throughout the country, small but comprehensive industrial and mine enterprises were set up one after another, and heavy industry with serious pollution were developed unrealistically. These developments in turn formed the basic patterns of the environmental pollution in China. In the 1980s, there were expanded investments and overheated economic growth resulting in a further ecological degradation and environmental pollution at a large scale. While the per capita income level of China is still below the level of the developed countries in the middle of the last century, the environmental pollution in China has yet been at the general level of the same developed countries in the 1950s or the 1960s when they were in the most serious pollution; i.e. China has got into the industrialized trap of "environmental pollution" too early and too fast.

Additionally, serious ecological and environmental degradation is closely related to the current stage of economic and social development in China. And China is just in the primary state of industrialization. It is a large country which is typically with low-income and characterized by a dualistic structure. Some industrialized and modernized cities coexist with the vast rural area where people produce and live in a traditional mode. This dualistic

structure results in two different kinds of environmental issues, i.e. environmental pollution in the cities and ecological degradation in the rural areas. The development of township enterprises can be regarded as a sword with double blades: one blade is the serious waste of resources and the other blade is the spread of environmental pollution.

IV. COUNTERMEASURES FOR SOLVING THE ECOLOGICAL AND ENVIRONMENTAL ISSUES IN CHINA

The future development of China will be controlled by the following three basic situations:

The size, growth rate and quality of the population will determine the consumption basis, the extent of pressures on resources and environment, and the level of understanding to the balance of resources and environmental protection at present and in the future.

The development of land resources in China has been extended close to its limit. With the significant reduction of per capita resources, if the country is not going to develop itself to the regulation and control of its "intentions", it will unavoidably create a vicious circle of "resources—production—consumption—environment".

The basis of the ecosystems and the environment in China is characterized by an inherent vulnerability. The average altitude of the territory of China is about one time higher than the average altitude of the world continents. The rugged and rough topography, serious soil erosion, harsh habitat conditions for green vegetation, expensive costs of regional development, and other negative factors, imply that China has to pay an additional cost for its development.

Therefore, China neither has the condition to follow the traditional path of high consumption of resources and high living expenses as in industrialized countries, nor should follow the same old disastrous road of "considering the control after forming pollution" as in industrialized countries. The strategy for the future development in China can only select the general policy "to economize on its resources, to moderate consumption, to pay more attention to the intention development, to implement overall regulation and control, to devote major efforts to protecting the environment, and to carry out ecological reconstruction". This nontraditional path of modernization will allow an optimum use of our resources and environment. This choice of strategy not only meets our national situation, but also is commonly recognized as the trend in world economic development. This is consistent with the strategy for sustainable development, i.e. "development meets the needs of the present without harm to future generations", which has been recommended by international committees for many years^[9].

We suggest the following basic strategies for the economic development, while improving or at least without degrading the ecosystems and environment.

1. Formulation of A "Green Territory Program"

This program requires to comprehensively apply the technologies for regional management constructing the landscape, biological engineering, ecological engineering, chemical engineering, and information engineering, to the regional development of the territory of China in order to enhance the potential of land, to improve the ability to fight and prevent disasters, to stabilize the food supply, and to improve ecological conditions. Currently, eco-agriculture to which major efforts are being devoted in China is just a concrete measure which is crucial to this general objective.

2. Extensive Development of Packaged »Resources Economizing» Technologies

(1) Resources-economizing technological systems in industry, in particular in raw-material industry and in power production industry.

(2) Resources-economizing technological systems in agriculture, devoting major efforts to land-economizing, water-economizing, energy-economizing, fertilizer-economizing, pesticide-economizing, and others to gradually form the low-input and high-output sectors of the national economy.

(3) Resources-economizing technological systems in transportation, devoting major efforts to network structure, spatial patterns, and higher transport efficiency, reducing material and energy inputs.

(4) Resources-economizing technological systems in management, mainly to prevent wrong decision-making, raise coordination levels, raise planning levels, and fully use information resources in order to develop a package of management and technology in perfect harmony and of high quality.

3. Being Determined to Adjust the Energy Strategy

Currently, the structure of energy consumption in each country of the world takes fossil fuels as its major part. Particularly in China, coal is dominantly consumed energy. For this reason, it is necessary to control the use of fossil fuels. In addition to its more effective use, the proportion of clean energy should be increased to an appropriate extent. At the same time, coal gasification and the development of other alternative energy sources should be studied as well. An adjustment of the strategy for energy will act as a lever to push on the necessary changes in the overall ecosystem and environment.

4. Development of an Early Warning System for Ecosystems and Environment

It is necessary to gain a better understanding of the trends in ecological and environmental evolution in a country, a region, a province and even a county. It should allow to give early warnings as soon as some particular ecological or environmental indicators exceed their own critical values. If this would be the case, appropriate adjustments and remedies could be made in time. The following 12 general aspects that deal with damages to the ecosystems and environment in China should be taken into account in making a systematic dynamic analysis:

The ecological and environmental effects and the economic and social consequences caused by increasing carbon dioxide concentration.

The ecological and environmental effects and the economic and social consequences result from a sea level rise.

Possibility of burst of China's six major rivers and the ecological and environmental effects.

The ecological and environmental effects and the economic and social consequences from ozone layer depletion.

The ecological and environmental effects and the economic and social consequences of acid precipitation spreading in China.

The ecological and environmental effects and the economic and social consequences produced by soil erosion throughout the country.

The ecological and environmental effects and the economic and social consequences brought about by desertification throughout the country.

Zoning, classification, vulnerability assessment and evolutionary trends in the fragile ecological and environmental zones throughout the country.

Shifting patterns of the economic zones in China caused by global changes and the estimate of economic and social consequences of a shift of the entire structure.

The ecological and environmental effects and the economic and social consequences caused by the changes in forests and grasslands.

The change trend of frequent natural calamity (mainly floods, droughts, pests, forest fires, grassland fires, and coldness), and its economic and social consequences.

The ecological and environmental effects and the economic and social consequences produced by the irrational use of natural resources.

5. Enhancement of Public Awareness of Ecology

China has a very large population, with a low level of access to education, and has an imperfect legislation. Thus, most people still have a very superficial understanding of the importance and value of protecting the ecosystems and environment. Therefore, it is very important to create a nationwide education program on ecological conservation and environmental protection for public officers and the public, and to bring some of the most basic principles in the regional development. As a result of a correct understanding of the national situation and of the value of the ecosystems and environment, the full public participation in the maintenance and protection of the ecosystems and environment will radically solve some difficult problems.

To sum up, the mankind's future will be decided by present choices. Mankind may either blindly mould a disastrous future or consciously build a beautiful future.

Only by watching more closely the trends of contradiction's developments, by more deep understanding the basic features of the crises and by adopting longterm policies to ensure a rational development speed and a moderate consumption level, will it be possible to mitigate the alarming trend in degradation of China's ecological environment.

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