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ENVIRONMENTAL ACTION PLAN

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ABBREVIATIONS

ADB	Asian Development Bank
BAP	Biodiversity Action Plan (of China)
BOF	Bureau of Forestry
CRAES	Chinese Research Academy of Environmental Sciences
CRUE	comprehensive renovation of the urban environment
EAP	Environmental Action Plan (of China)
EIA	environmental impact assessment
EPBs	Environmental Protection Bureaus
FGD	flue gas desulphurisation
GEF	Global Environment Facility
GNP	gross national product
IDA	International Development Association (World Bank)
MOA	Ministry of Agriculture
MOC	Ministry of Construction
MOE	Ministry of Energy
MOF	Ministry of Forestry
MOWR	Ministry of Water Resources
NEPA	National Environmental Protection Agency
NPC	National People's Congress
QAC	quota for allowable cut
SLMA	State Land Management Agency
SO₂	sulphur dioxide
SO_x	sulphur oxides
SPC	State Planning Commission
SPM	suspended particulate matter
TCE	tons of coal equivalent
TSPs	total suspended particulates
TVIEs	town and village industrial enterprises
UNCED	United Nations Conference on Environment and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
WWT	waste water treatment

EXECUTIVE SUMMARY

Since 1992, China has been using funds from the International Development Association (IDA), a branch of the World Bank, to develop environmental protection projects. This cooperation is expected to continue a long time, and possibly the number of loans will be expanded gradually.

According to IDA requirements that all member state governments should submit an Environmental Action Plan (EAP) by mid-1993, the National Environmental Protection Agency of China and the State Planning Commission formulated the "Environmental Action Plan of China". It focuses on: (1) the concrete environmental objectives to be reached by the year 2000 in several fields, ranging from industry and urban environments, to forests and grasslands, to soil, water, and wildlife conservation; (2) the policies and measures needed to realize these objectives; (3) the environmental problems, priorities and major environmental projects in each sector (and the institutions responsible for implementation, institution building, training and educational programs); (4) the total funding requirements and possible funding sources; (5) the priorities among China's environmental concerns; and (6) a survey of areas where China is seeking international cooperation in environmental protection.

Overall Environmental Objectives

At the beginning of the 1980s, China formulated overall strategic objectives for economic development: to quadruple the gross national product (GNP) of 1980 by the year 2000 calculated in constant prices so as to make her people generally well-off and to raise her per capita GNP to the level of medium-developed countries by the middle of the next century. Corresponding to the national social and economic development objectives, China has set goals for environmental protection to be reached by the year 2000: environmental pollution will be basically brought under control; the environmental quality in major cities will be improved and ecological degradation will be alleviated; and environmental protection will catch up with the national economic and social development.

Policies

Family Planning. China has made achievements in environmental protection through adherence to some basic state policies, one of which is regarding family planning. The policy has fostered a series of measures for lowering the birth rate and thus alleviating pressure on the environment of an ever-expanding population.

China began her economic development under the constraints of an enormous population burden and a rather backward level of national economy, science and technology. With the growth in the nation's population, national economy and resource consumption, the pressure on the environment kept increasing. This serious challenge of ecological/environmental problems will long be felt in the process of China's development.

Environmental Management and Coordination. Many environmental problems in China are a result of poor management. In the 1990s and beyond, strengthening environmental management will remain the key link of the environmental protection policies system.

Environmental Regulations and Enforcement. The environmental protection regulations in China have taken shape and have played an important role in environmental protection. In the 1990s,

the legal system will be further improved. However, a current and serious problem is the impotence of law enforcement and this problem not only prevents the full force of the environmental protection regulations being brought into play, but also weakens the authority of the law. In the course of carrying on the building of democracy and legality, China's governments at all levels will take firm and effective measures to support the enforcement departments at all levels to deal resolutely with violations of the environmental law.

The Environmental Protection Bureaus (EPBs) at the provincial, municipal and county level are the enforcing departments. In March 1993, the National People's Congress set up a Committee on Environmental Protection, and this Committee will lead relevant government bodies to set up new laws and regulations and take measures to guarantee enforcement. The Committee is also responsible for supervising enforcement departments, and will inspect EPBs at every level (provincial, municipal and county). The Committee will form six groups for inspection of local enforcement departments; it will examine executive records and supervise the EPB's enforcement of government and related organizations at all levels, and provide enforcement expertise.

Industrial Policy. From now on, when formulating industrial policies, China will consider the environmental impact of every kind of industry and product, strictly controlling and forbidding the development of enterprises with high energy consumption, high raw material waste and serious pollution problems, while devoting major efforts to developing industries with beneficial qualities such as advanced technology and high resource utilization efficiency. Pollution control deadlines will be set for enterprises and industries in regions where serious pollution problems have occurred.

The pro-active way to solve Chinese environmental problems lies in scientific and technological advancement. In order to change scientific and technological achievements into realistic pollution prevention and treatment capability, China will lead and actively support the development of an indigenous environmental protection industry, giving it priority, and developing and spreading advanced equipment for environmental protection. The planning, scientific and technological departments at all levels will fully support the building of engineering pilot projects for pollution prevention and treatment, and grant priority consideration for the arrangement of project funds.

Problems, Priorities and Strategies in Each Sector

Industry. Comprehensive utilization is a key element in China's overall industrial and urban environmental protection strategy. The term comprehensive utilization includes programs that are also known as recycling, or resource conservation and recovery, in some countries. The Chinese program includes more features than are generally considered in recycling or resource conservation; as it includes the more efficient use of raw materials as well as waste streams. Comprehensive utilization pertains to three main programmes: (1) the multipurpose use of rejected mineral resources in the process of resource development; (2) reuse and full usage of waste water (effluent liquor), off-gas, waste residue, waste heat, residual pressure and water resources in the course of production; and (3) recovery, processing and utilization of discarded materials and scraps by consumers.

In the 1980s, China's industry developed rapidly. The gross industrial output value in 1990 was 3.3 times that of 1980 with the annual average increase rate of 12.6%. However, China's industry is still faced with the problems of backward technology, out-dated equipment, and enormous consumption of energy and big discharge of pollutants per unit product. The rapid increase in the number of small factories across the country and township and village enterprises (TVE) has created considerable difficulties in pollution control and management. Toxic wastes from the chemical and metallurgical industries are slowly accumulating and pose a latent menace.

Urban Environmental Protection. The first stage objective of urban environmental protection in China was the treatment of the sources of industrial pollution. The second stage target was the comprehensive prevention and treatment of industrial pollution. In the third and current stage, the objective is the comprehensive renovation of the urban environment (CRUE).

By the end of 1990, China had 467 cities with a total non-agricultural population of 150 million. It is estimated that the number of cities will reach 600 in 2000 and the urban population will further increase. China's industries mainly concentrate in urban areas, where the discharge of pollutants accounts for 80 percent of the country total. At present, the major urban environmental problems are: (1) Lack of clean drinking water. Establishing a sanitary drinking water supply is a major problem. In the 1980s more than 300 cities were facing water shortages, and in 100 of them the shortage was critical. Drinking water supply for about 25.4% of the entire population did not meet the sanitary standards. (2) Lack of sewers and municipal waste water treatment facilities. More than 40% of the newly-built urban areas have no sewer systems; and in many cities, rain water and urban sewer water flow through the same pipes into rivers (or into ground water). Since the rate of treatment is rather low, the rivers and lakes around the cities and half of the urban ground water resources are polluted to various degrees. (3) Air pollution. The city atmosphere is polluted by soot, motor exhaust gas and the industrial waste gas. (4) Urban solid waste. Urban garbage generation increases by 10% per year and due to lack of collection and treatment facilities, large quantities of solid waste and night soil is allowed to piled up or improperly buried. (5) Noise. In 1990, noise in active urban areas surpassed the national noise emission standards, and more than half of urban residents suffered from noise pollution.

The general goals of the urban environmental protection are: by the end of this century, the environmental quality of municipalities, large provincial cities, and tourist cities should reach national standards; the environmental quality of the coastal developing cities should reach national standards; and the environmental quality of the major industrial cities should be improved. Priority will be given to urban sewage disposal and reuse; popularization of central heating and the use of gas for cooking fuel in all urban areas; and urban garbage disposal.

Energy. China is one of the few countries in the world that use coal as chief energy source. Coal accounts for 70% of the non-renewable energy consumed in China. From 1980 to 1990, China's raw coal consumption increased from 620 million tons to 1.08 billion tons, and it is estimated that consumption will reach 1.4 billion tons by the year 2000. At present, China's energy production and utilization techniques are still backward and the country faces the dual problem of energy shortages and energy waste. Clean energy (hydroelectric power) and high-quality energy (electric energy) account for a small part of total energy supply.

The targets of the energy industry is that in the 1990s, the national non-renewable energy should increase by 3 percent per year and the electric power by 7 percent per year. In 1995, the national non-renewable energy output should reach 1.2 billion tons. In the 1990s, China will make great efforts to increase the supply of clean energy, such as hydroelectric power and nuclear power. China has already begun to use clean energy sources such as energy, solar energy, hydroelectric, and wind energy. The exploitation of these renewable energy sources have partially solved energy needs in some rural areas, ranch areas and islands.

Priority is given to the following areas: (1) Coal industry. Upgrading coal refining equipment; purifying and recycling coal-washing waste water and mine waste water; desulphurisation of coal of high sulphur content and the techniques of retrieving sulphur; comprehensive use of coal gangue; and land reclamation in collapsed coal mine areas. (2) Oil industry. Adopting advanced technology for

oil exploration and pollution control when developing oil fields in shallow sea, mudflats, desert and lake areas. (3) Power industry. Desulphurisation techniques and equipment of flue gas from thermal power plants, and comprehensive treatment and reuse of waste water. (4) Energy conservation. Upgrade old boilers and cogeneration; conservation programs in energy intensive industries, and conservation programs for consumer products.

Forests. China's forest covered areas are small, accounting for only 13.4% of the total territory in 1991. Moreover, forests are not evenly distributed, and the stock/area ratio and growth rate are both rather low. Forest resources and their development rate are far from adequate to meeting the needs of national economic development and the maintenance of ecological environment.

In order to balance the growth and consumption of the forest resources, the existing forests should be protected and the forested areas should be increased. With a vulnerable ecological environment, China frequently suffers from critical natural calamities. One of the most important targets of forestry development is therefore to increase forest vegetation to make it play a better role as a main part of the terrestrial ecosystem and contribute more to the Chinese people and mankind as a whole. The Chinese government has given priority to the establishment of the forest shelter belt systems. The Chinese government also attaches great importance to promoting forestry through science and technology, strengthening management through technically-sound measures, intensifying the establishment of local infrastructure, and protecting the existing forest resources. By the end of this century, the target of afforestation is to increase coverage 15-16% of the total territory. The implementation of this plan will greatly boost the development of forestry and the improvement of the environment.

Grasslands. Illegal reclamation has severely degraded grasslands. The problem of desiccation, desertification and salinization in grasslands has worsened and the yield of grass has dropped considerably. If no measures are taken, it is estimated that by the year 2000, 30% of the forage grasses will be lost, and the ecological conditions will further deteriorate.

Strategies and priority environmental programs for grasslands include: enhancement of the grasslands and improvement of degenerated pastures; improvement of the scientific management of animal husbandry; tapping new energy sources; enforcement of management by law; stepping up the establishment and management of natural reserves; and improvement of grassland through application of advanced science and technology.

Rural Areas and Ecological Agriculture. In China, the disparity between land resources supply and demand is very outstanding. The rapid loss of farmland has made it more urgent the task of protecting farmland. From 1981 to 1985, the yearly loss of farmland averaged about 480,000 hectares. The decrease of farmland and the increase of population constantly reduce the per capita share of farmland. Meanwhile, the additional pressure on farm land further degenerates the soil. In the drive toward modernization, all kinds of constructions are under way at an unprecedented speed and on an unprecedented scale. The pressure of demand for farmland will probably continue to increase.

Strategies and priority programs include: better planning for land use according to local conditions while an overall plan for land use is made at the national level; apply economic incentives; land reclamation programs; and enforcement of laws and regulations suitable for protection of farmlands.

Desertification. China is a country with vast deserts spreading in many parts of the country. It also faces a serious land desertification problem. From the 1950s to the 1970s, an average of 1,560 square kilometers of land had turned into desert every year; and in the 1980s, desertification rate had increased to 2,100 square kilometers per year.

The fight against desertification in the northwest, north, northeast of China is very important and a long term plan should be formulated to stop the expansion of deserts. At present, the protection and extension of the grass vegetation is the focal point to improve the desertified land. Combating desertification in a comprehensive way includes: creation of wind breaks, sand fixation, and protection of farmland. In the areas of deserts and gobis, emphasis should be put on protection of existing vegetation and prevention of drifting sand encroachment.

Water Loss and Soil Erosion. China has serious water loss and soil erosion problems which afflict large areas in both northern and southern parts of the country. In the 40 years after the founding of New China, 500,000 square kilometers of areas afflicted by erosion have been treated; however, the afflicted areas are still increasing because of the irrational use of land. Water loss and soil erosion reduce the productivity of land, and have resulted in the destruction of the Northwest Steppe and the Loess Plateau. Siltation raises river beds and increases the severity of flooding. Siltation also fills up lakes and reservoirs. Soil erosion has made some poor areas even poorer.

Targets for combating water loss and soil erosion include: adopt protective and preventive measures to gradually reduce soil erosion affected areas according to local conditions; and with the increasing financial power of the state, launch the movement of treating the water loss and soil erosion and strive to recover the 40,000 square kilometers afflicted area per year.

The focus of the strategy used by the Ministry of Water Resources is "micro-watershed treatment." At present, the micro-watershed treatment has been carried out in 27 provinces, autonomous regions and municipalities throughout China. The micro-watershed refers to the natural catchment of areas of less than 30 square kilometers, which are waterway junctures of large basins and vast areas. China will combine efforts of erosion treatment with poverty alleviation so as to accelerate increase of income for farmers in these areas. A micro-watershed will be regarded not only as a target for erosion treatment but also an economic development priority. Not only should the erosion be treated; but the ecological environment should be improved. The micro-watershed treatment relies on policies for stimulating the initiatives of the farmers to contract, control and invest. The policies should make sure the farmers have rights to control, responsibilities for management and maintenance, and receive profits from the development.

Land Degeneration and Pollution. Apart from the water and soil erosion and the land desertification, the land degeneration and pollution of various forms are rather serious in China. Due to the abuse of farmland and the reduction in the application of organic manure, the farmland's quality deteriorates. Salinization of farm land and secondary salinization caused by irrigation is serious, affecting 6 million hectares of farmland. Moreover, more than seven million hectares of farmland is polluted by industrial wastes. And the sharp increase in the application of chemical fertilizer has further accelerated the deterioration of farmland quality.

Targets for combating land degeneration and pollution include: improve 3 million hectares of red and yellow soil into fertile farmlands, treat 1.33 million hectares of saline-alkali land and 2.67 million hectares of water-logged land to increase crop productivity by 20-30%; treat the industrial pollution, especially the pollution from township enterprises; popularize the techniques of

comprehensive prevention and treatment of insect pests and crop disease; and control the chemical pollution of farmland.

In order to achieve these goals China will: (1) perfect the institutional structure of environmental protection in agriculture; (2) increase monitoring capability by installing monitoring equipment in existing agricultural environmental monitoring stations; (3) formulate policies to enforce soil protection; (4) develop and popularize the comprehensive treatment techniques of preventing plant disease, extensively apply biological measures, develop low-poison chemical and biological farming pesticides; (5) promote the use of organic fertilizer, popularize more efficient fertilizer application techniques; (6) develop techniques for treating soil salinization; and (7) strengthen the management of pollutant discharges at the ranches and feeding farms, set emission standards, develop the techniques and equipment of comprehensive use of wastes from ranches.

Rural Energy. Most of China's population (80%) inhabits rural areas where it has been a long tradition to use biomass resources such as crop straw and stem, firewood and cogongrass for cooking and other daily activities. The contradiction of energy supply and demand is an outstanding problem of rural environmental protection. Energy shortages in rural areas have resulted in over consumption of biomass energy and destruction of the forests, thus seriously damaging ecological balance. The use of crop residues (biomass) for energy decreases the organic components in soil, thus starting a vicious cycle in which damage to vegetation, water loss and soil erosion and land desertification, lead to further decreases in vegetation and the supply of biomass energy.

China is a country with rather low per capita share of energy resources. According to analysis by concerned departments and experts, even if the national economic development rate in China is controlled at 6-7% annually, there will still be a significant shortfall in energy supply. It is unrealistic to expect that the commodity energy supply in rural areas will be increased by a big margin, so the situation of energy scarcity will not be alleviated for a rather long time to come.

In rural China where 900 million people live, it is unrealistic and counter productive in terms of environmental pollution control, to allow the traditional energy policy to continue or simply to rely on increasing the consumption of fossil fuel to meet the energy demand so as to support a better lifestyle. The proposed strategies include: (1) fully implement the government policy on developing energy sources in rural areas; (2) renovate the existing rural energy enterprises; (3) develop energy-conservation techniques to reduce consumption in daily life and production; (4) strengthen research efforts to develop energy sources in rural areas; (5) strengthen the energy management in rural areas, train qualified personnel, disseminate the knowledge and promote the application of advanced techniques of using rural energy; and (6) raise funds through various sources for the rural energy construction.

Township and Village Enterprises (TVEs). In 1991, there were 19 million enterprises that employed 96 million workers and produced 1,100 billion yuan of output, accounting for one-third of the social industrial output value. While the industrial output of TVEs now totals 850 billion yuan, rural industries have also become a major polluting source.

In the Eighth Five-Year Plan period, pollution control efforts will concentrate on the following areas: protect urban and rural water sources and control the environmental pollution by TVEs along the coast and in the drought areas; control the atmospheric pollution in the urban residential areas, smelting industry areas and the agricultural production bases; and reduce pollution of the major polluting industries. From now to 2000, the objective is to improve environment in most urban residential areas to the same or better standards of the late Seventh Five-Year Plan period.

Strategies for controlling pollution produced by TVEs will include the following: (1) Adjust industrial structure according to sectoral policies, control the development of polluting industries and concentrate efforts on major polluting industries and factories. (2) Promote technical progress of TVEs and the application of new technologies so as to upgrade the backward production technologies of TVEs. (3) Develop and spread new techniques and equipment suitable for treating pollution produced by TVEs. (4) Enact laws to strengthen environmental protection management over TVEs. Gradually apply the successful methods of controlling the pollution of large and medium enterprises in TVEs such as the environmental impact assessment system and regulations on compulsory adoption of pollution control measures along with construction and production as well as correcting pollution problems within a time limit. (5) Formulate environmental protection plan for townships and plans of rational industrial allocation. In areas where TVEs are concentrated, more strict pollution control measures will be enforced.

Ecological Agriculture. In the 1980s, China started to set up test spots of ecological agriculture. The effort was designed to amplify and expand China's traditional organic farming and the policy of comprehensive and coordinated development of farming, forestry, animal husbandry, side-line production and fishery. " Ecological agriculture is also a pilot project to establish an efficient artificial ecological system with the fundamental principles of ecological balance. By the end of 1990, China had set up 1,100 demonstration farms of ecological agriculture of various types. At present, due to huge demands of science and technology input, ecological agriculture is not extended and still lingers in the trial stage. However, the experiences gained from the demonstration farms show that this is a feasible way of developing agriculture.

During the Eighth Five-Year Plan period, China will continue to reinforce, improve and promote the existing test spots of ecological agriculture to amplify their exemplary roles. On that basis, 50 successful counties will be selected as county level examples for the proliferation of ecological agriculture techniques in larger areas. Strategies for development of ecological agriculture will include: (1) strengthen research on various types of ecological farming and ecological monitoring methods, formulate the national plan of ecological agriculture, and develop the appraisal norms of ecological agriculture; (2) develop techniques of ecological agriculture; and (3) combine the ecological agriculture construction with the development of "green label food," and adopt market principles in the promotion of ecological farming.

Rivers and Inland Waters. China's rivers and inland waters are facing the following problems: (1) Pollution. The water quality of the main stream of big rivers is good, but the quality in catchments near cities and the branches of big rivers are polluted. (2) Flood Control. The flood-control level tends to be low. The major rivers can only prevent the normal year floods. Serious floods often cause big losses to people's lives and properties. The threat of major floods is an outstanding problem. (3) Irrigation. At present, one-fourth of the national water-conservancy facilities are in disrepair; the irrigation and drainage capability is not adequate. (4) Water Supply. Pollution sharpens the contradiction of water supply and demand. The water pollution has a serious impact on the water supply for industry, agriculture and urban residents.

Targets of overcoming these problems are: (1) Pollution control. By 2000, the quality of water sources will reach the first class standard; drinking water, fishing water, and water for entertainment will reach 2-3 class standards; water for industry, agriculture, and shipping will reach 3-5 class standards. (2) Flood Control. The general target by the end of this century is to ensure that major flood control dikes will not breach in case of floods whose peaks will reach the highest level in the past 40 years. (3) Irrigation. By 2000, irrigated areas will increase from 48.4 million hectares in 1990 to 53.0 million hectares. The improved irrigation zones should reach 26.7 million hectares. (4) Water Supply. In order to balance the water supply and demand, the national capacity of water

supply should increase from 500 billion cubic meters per year at present, to 650 billion cubic meters per year by the year 2000.

Priority projects during the periods of the Eighth Five-Year Plan and the Ninth Five-Year Plan will include water-conservation projects such as reservoirs, dikes, water supply facilities, irrigation projects, pumping stations and other conservancy projects.

Marine Environment. The water quality of most of China's seas is good, except for some offshore waters, river mouths and bays. Part of the South China Sea is seriously polluted by petroleum development activities, but the discharge of domestic sewage is the main source of pollution in China's seawater. The exploitation of resources and pollution have also threatened the marine environment of offshore waters. For example, only 17,300 hectares of mangrove forests exist in Guangdong, Guangxi, Fujian and Hainan; and the species of marine life have been reduced and "red tide" occurs more frequently.

The general goal of China's marine environmental protection is to control pollution and protect marine ecology. In five years, 15 to 25 national offshore and coastal natural reserves and 50 to 70 local-level reserves will be established. These reserves will cover a combined area of no less than 30,000 square kilometers, including 100 islands and a 400-500 kilometers of coastlines.

The Conservation of Nature. Confronting the threat to its natural resources brought about by the rapid population growth and economic development, China has devoted a great deal of efforts over the past two years to develop a national Biodiversity Action Plan (BAP). The plan is currently being refined for formal implementation at the beginning of 1994. The formulation of this plan had received financial support from GEF.

BAP contains the following recommendations:

- Update the lists of endangered species requiring domestic and international priority protection. Experts will determine the protection priority order of these species according to the generally accepted criteria, their biodiversity value (the rarity or the "keystone" status of an ecosystem or a source of medicine) and the degree of threat it is under (vulnerability, possibility of immediate extinction if no immediate action is taken). These lists will be further refined in ongoing research and continually updated to keep current with inherently dynamic systems.
- Special actions needed to protect these species. Such actions will be determined through detailed study of the following areas: (1) Identification of natural areas that support the endangered species and critical sites for biodiversity conservation. Once identified, these major ecosystems areas such as forests, wetlands, grasslands or steppes, farmlands, coastal areas and sea waters. As for those that have already been set aside as nature reserves or national parks, efforts will concentrate on studying their ability to protect the endangered species (size, management and the allowance of human activities such as hunting and fishing as well as resources exploitation). The findings will lead to proposals for strengthening and enlarging these reserves and the formulation of relevant regulations or policies. (2) The status of natural areas outside of protected areas. Protected areas alone -- particularly if they are islands in an otherwise hostile environment -- are not enough to protect species (most obviously because protected species do not stay within protected boundaries: animals roam and seeds blow at random). Recommendations on policies concerning, for example, pesticide use or wildlife trade can be expected in this regard. (3) Actions needed to provide conservation in ex-situ facilities (including zoos, arboreta, aquaria, and breeding farms).

Existing facilities of these sorts will require careful analysis and, probably, assistance to increase their effectiveness. (4) Institutionalization of actions. For example, biodiversity conservation must be included into national economic development plans; and nature conservation objectives must be achieved through institutional coordination. Besides, efforts must also be made in the following areas: widen scientific research (from the cataloguing of new species to the development of techniques for sustainable use of biological resources in fragile or sensitive areas); popularize technologies such as development of model or demonstration sites; disseminate knowledge of and intensify education on biodiversity conservation; develop funding sources; and coordinate with international organizations.

Biodiversity conservation is a dynamic endeavor and the action plan, therefore, will be expected to change with the changing conditions. As a sound foundation, however, this first national BAP has attempted to identify not only the long-term goals and the long-term actions needed to support them, but also the most cost-effective first steps to take now. The plan that has been developed and is currently being put in final form is a considerable achievement not only for the specific guidance on biodiversity conservation it will recommend to the government, but also as a very impressive example of collaboration among Chinese ministries, scientists and other professionals, and the international community; and it could very well become a model for other countries engaged in similar efforts.

Conservation of species. China's vast territory and complicated natural conditions gave rise to a rich diversity of flora and fauna. China is one of the countries with the most diverse varieties in animals and plants in the world; there are 4,400 species of vertebrates, accounting for over 10 percent of the total vertebrate species in the world. It is estimated that there are altogether 32,800 species of higher plants taking up over 12 percent of the world total, ranking China third in the world, second only to Malaysia and Brazil. Among the plants are 236 species of gymnosperm, (800 species in the world), and 25,000 species of angiosperm, (200,000 species in the world). Besides, China has kept many species that became extinct elsewhere in the northern hemisphere but survive only in China. China has 200 unique genera comprising over 10,000 species.

Conservation of wetlands. Wetlands of different types are found all over China, including the most important wetlands in the world. In China, there are about 25 million hectares of marshes, 12 million hectares of lakes (natural and artificial), and 2.1 million hectares of mudflats. For many years the Chinese government did not pay enough attention to the protection of wetlands, but recently it has begun to recognize their importance. Destruction of wetlands still occurs, however, since protection work started only recently and has lacked unified regulation and management. Strategies for conservation include: build a number of nature reserves including wetlands and some special reserves solely for wetlands, and strengthen public awareness about protection of wetlands through nationwide propaganda programmes.

Nature reserves. The construction of China's nature reserves, which started in the 1950s, has rapidly developed since 1978. By the end of 1991, the number of nature reserves reached 708 with an area of 30 million hectares, 5.5 percent of the total land area of China; if forest parks, scenic spots and historical sites are added, the total area increases to 60 million hectares. Although some achievements have been made in some aspects of nature reserves, many problems have also arisen simultaneously: with their small number, the nature reserves cover a very small part of the total land area; their structure and distribution is irrational; and their management is poor. The destruction of nature reserves has been eased but still exists. By the end of this century, China should complete the construction of a network of nature reserves with various types, rational distribution, different levels and adequate area coverage. The strategies for nature reserves will be to: (1) strengthen the legislation

and law-enforcing work of nature reserves; (2) perfect the management organs of nature reserves and strengthen the supervision; (3) train the management personnel; (4) enhance the scientific study of nature reserves; (5) rationally regulate and manage nature reserves; and (6) develop funding sources to ensure the construction of nature reserves.

Geological Environment Protection. China is a vast territory, whose geological conditions are extremely complicated. Various kinds of geological environment problems are outstanding and severe. The geological disasters that frequently occur in China include earthquake, land collapse, landslide, mud-rock flow, land subsidence, ground fissure, spontaneous burning of coal fields, gas explosion, rock avalanche, roof caving.

The following targets will be achieved by the year 2000: Strengthen the supervision and management of geology environment in order to protect it. The goal of geological environmental protection is to guarantee that in the process of land development and civil construction, adequate measures will be taken to rationally use and transform the ecological environment, prevent the geological environment from worsening, ensure the safety of people's lives and property, and promote the economic and social development. Geological disasters prevention and control measures must coordinate with the needs of national land development plan and economic construction. In the near future, priority should be given to major transportation trunk lines, large rivers, key cities, key projects, important economic zones and important areas earmarked for comprehensive land development.

Environmental Education in China. The strategic task in the field of environmental protection in China is to disseminate environmental knowledge, raise the national environmental consciousness and encourage the public to voluntarily participate in environmental protection efforts. The Communist Party and the government attach great importance to environmental education, which is an essential component of environmental protection drive with Chinese characteristics. NEPA and the State Education Commission are the leading bodies of environmental education programs in China.

Goals in environmental education include: training of management personnel, training of professional personnel, on-the-job training, environmental science education in middle schools, the publication of environment related literature, and education through mass media (television, films, etc.).

China's National Investment Plan for Pollution Control

During the Seventh Five-Year Plan period, the investment in pollution control was 47.7 billion yuan, accounting for 0.7 percent of the GNP. In the 1990s, investment in pollution control will be increased, and its ratio in the GNP will be 0.85 percent in the Eighth Five-Year Plan period and 1 percent in the Ninth Five-Year Plan; and the accumulative funds will be more than 100 billion yuan and 180 billion yuan, respectively. It is estimated that 40 percent of the investment will be used for air pollution control, 40 percent for water pollution control and 20 percent for solid waste and noise control.

Priorities of Environmental Concerns in China

China, with its vast territory, different natural conditions, and unbalanced economic and social development, is confronted with various environmental problems of different levels. Different regions may have different outstanding environmental problems. Therefore, the national priorities of

environmental concerns are based on the following two principles: (1) to select those which have wide ranges of impacts on and do great harm to economic and social development and human health; and (2) to select those which have the trends of being more serious, from a long-term view.

The seven priorities of environmental concerns in China include: (1) water pollution (key pollutants are organic); (2) urban air pollution (key pollutants are TSP and SO₂); (3) pollution of industrial toxic and hazardous solid wastes and urban refuse to air, water and land; (4) comparative shortage of surface-water resources in the north and serious lack of water in many cities; (5) serious and widely-distributed soil erosion; (6) low forest coverage rate, little area of natural forests, comparatively small wood reserves, and serious grassland degeneration; and (7) reduction of the area of primary environment and the species resources.

It should be noted that there are many other environmental problems in China, of which some also deserve serious attention. Those listed above should be considered as priorities. They are set forth here so as to provoke more concerns, suggest more definite working objectives and promote international society's understanding in respect of China's environmental problems.

International Cooperation in Environmental Fields

As a developing country confronted with equally pressuring tasks of economic development and environmental protection, China must mainly rely on its own efforts to try and solve environmental problems. However, since many of these environmental problems have serious global impacts, China hopes to maintain close cooperation with and obtain support from the international community in solving its environmental problems. Its success will be a significant contribution to the global community.

BACKGROUND

SINCE 1992, CHINA HAS BEEN USING FUNDS FROM THE INTERNATIONAL DEVELOPMENT ASSOCIATION (IDA), A BRANCH OF THE WORLD BANK, TO DEVELOP ENVIRONMENTAL PROTECTION PROJECTS. THIS COOPERATION IS EXPECTED TO CONTINUE A LONG TIME, AND POSSIBLY THE NUMBER OF LOANS WILL BE EXPANDED GRADUALLY. ACCORDING TO IDA REQUIREMENTS, ALL MEMBER STATE GOVERNMENTS SHOULD SUBMIT AN ENVIRONMENTAL ACTION PLAN (EAP) BY 1993. NEPA AND SPC FORMULATED THE ENVIRONMENTAL ACTION PLAN OF CHINA.

CHINA'S EAP HAS BEEN DRAFTED BASED PRIMARILY ON THE WORK OF TWO PREVIOUS DOCUMENTS. THE BASE OF THE REPORT IS THE "NATIONAL REPORT OF THE PEOPLE'S REPUBLIC OF CHINA ON ENVIRONMENT AND DEVELOPMENT" SUBMITTED TO THE UNITED NATIONS CONFERENCE ON ENVIRONMENT AND DEVELOPMENT (UNCED) IN 1992. IDA SUGGESTED THAT THIS NATIONAL REPORT OF THE PEOPLE'S REPUBLIC OF CHINA COULD BECOME THE CORE OF THE EAP. THE WORLD BANK CAREFULLY REVIEWED THE NATIONAL REPORT, AND RESPONDED BY LETTER IN DECEMBER 1991 PROPOSING THAT CHINA SUPPLEMENT THE NATIONAL REPORT. IN APRIL 1992, MR. SHAHID JAVED BURKI, THE DIRECTOR OF THE CHINA AND MONGOLIA DEPARTMENT OF THE WORLD BANK WROTE TO MR. QU GEPING, THE ADMINISTRATOR OF THE NATIONAL ENVIRONMENTAL PROTECTION AGENCY (NEPA) OF CHINA, AND PUT FORWARD SUGGESTIONS FOR THE CONTENTS OF THIS SUPPLEMENTARY REPORT.

BECAUSE OF THE SPACE LIMITATIONS OF THE NATIONAL REPORT, THE SPATIAL PLANNING AND REGIONAL ECONOMY DEPARTMENT OF THE STATE PLANNING COMMISSION, THE PLANNING DEPARTMENT OF NEPA, AND THE CHINESE ACADEMY OF GEOLOGY MINERALS INFORMATION COMPILED AND PUBLISHED MORE DETAILED INFORMATION IN "ENVIRONMENT AND DEVELOPMENT OF CHINA." THE REPORT AND THE BOOK ARE THE CORE OF THE CURRENT PLAN; BUT CHINA ALSO WISHES TO ACKNOWLEDGE THE BENEFIT GAINED FROM THE WORLD BANK'S 1991 PUBLICATION, "REPORT ON CHINA'S ENVIRONMENTAL PROTECTION." THE EMPHASIS OF THE PLAN IS ON SEVERAL ASPECTS NEEDED FOR REALIZING CHINA'S OVERALL ENVIRONMENTAL OBJECTIVES BY THE YEAR 2000: AN ANALYSIS OF ENVIRONMENTAL PROBLEMS, DETERMINATION OF THEIR PRIORITY ORDER, AND DEVELOPMENT OF MAJOR ENVIRONMENTAL PROJECTS; THE IDENTIFICATION OF CONCRETE ENVIRONMENTAL OBJECTIVES IN EVERY RELEVANT FIELD, INDUSTRY AND DEPARTMENT; THE CLARIFICATION OF POLICIES AND MEASURES NEEDED TO REALIZE THESE OBJECTIVES; THE DEVELOPMENT OF ACTIONS NEEDED TO CARRY OUT AND IMPROVE THESE MEASURES; AND THE DEVELOPMENT OF MECHANISMS FOR GENERATING FUNDS FROM FOREIGN COUNTRIES FOR ENVIRONMENTAL ISSUES. AS THIS EAP EMPHASIZES EFFORTS TOWARD ENVIRONMENTAL PROTECTION THROUGH THE NEXT DECADE, IT CAN BE REGARDED AS A SUPPLEMENT TO THE NATIONAL REPORT.

WITH THE SUPPORT OF THE GLOBAL ENVIRONMENT FACILITY (GEF), CHINA IS WORKING ON STRATEGIES FOR CONTROLLING GREENHOUSE GASES (GHGs), AND IS FORMULATING THE BIODIVERSITY ACTION PLAN (BAP). THE GHGs STUDY AND BAP WILL BE COMPLETED IN THE EARLY OF 1994. THE CHINESE GOVERNMENT APPROVED IN 1993 A "CHINA COUNTRY PROGRAMME FOR THE PHASEOUT OF OZONE DEPLETING SUBSTANCES UNDER THE MONTREAL PROTOCOL", AND THIS HAS BEEN APPRECIATED BY UNDP AND THE EXECUTIVE COMMITTEE OF THE MULTILATERAL FUND FOR THE IMPLEMENTATION OF THE MONTREAL PROTOCOL. THEREFORE, THE EAP WILL ONLY INCLUDE ONE OF GLOBAL ISSUES MENTIONED ABOVE, BIODIVERSITY CONSERVATION .

BOTH THE EAP AND THE BAP HAVE BEEN DEVELOPED TO GUIDE FUTURE WORK, AND THEREFORE SOME OF THE MEASURES AND PROJECTS DESCRIBED IN THEM REMAIN TO BE PUT INTO EFFECT.

1 CHINA'S ENVIRONMENTAL OBJECTIVES FOR THE 1990S

1.1 Overall Objectives

At the beginning of the 1980s, China formulated overall strategic objectives for economic development: to quadruple the 1980 gross national product (GNP) by the year 2000 (calculated in constant prices) so as to make her people generally well-off, and to raise her per capita GNP to the level of medium-developed countries by the middle of the next century.

Corresponding to national objectives for social and economic development, China has set the 2000 goals of environmental protection: the environmental pollution will be basically brought under control¹; the environmental quality of major cities will be improved and ecological degradation will be alleviated; and environmental protection will catch up with the national economic and social development.

This will lay a good foundation for the long-term goal of achieving a self-sustainable ecological system and creating a clean, beautiful and quiet environment in Chinese cities and the countryside.

1.2 Main Targets

The specific targets in this respect to be attained by the year 2000 are as follows.

1.2.1 Environmental Pollution Control

The total discharge volume of industrial waste water will be kept under 30 billion tons; the treatment rate of industrial waste water will be raised to 84 percent; and the centralized treatment rate of urban sewage will reach 20 percent.

The sulphur dioxide (SO₂) discharge will be kept under 21 million tons; the soot discharge, under 14 million tons; the industrial dust discharge, under 7 million tons; and the treatment rate of industrial gas will be raised to 90 percent. The use of gas as cooking fuel in urban areas will increase to 60 percent; central heating for residential housing will cover more than 470 million square meters.

The overall reuse rate of industrial solid wastes should reach 45-50 percent.

Comprehensive treatment of the urban environment will receive major attention in order to control, reduce or eliminate pollution from the "four harmful elements" of cities: smog, sewage, garbage and noise.

For example, the noise level along major traffic lines will be kept the same as that in 1990. The rate of urban areas meeting environmental noise standards will increase 15-20 percent over that of 1990.

¹ This means that whereas with any development, environmental pollution can be expected to increase, China has the goals of minimizing the amount, and offsetting it with improvements in current levels of pollution. The State-owned enterprises have controlled pollution emissions, the township enterprises have not; but the overall objective is to hold the line on pollution.

1.2.2 Ecological Protection of Nature

China proposes to afforest 35.9 million hectares, of which 8.98 million hectares of forests will be developed by sealing off hills. The total forest coverage will increase to 15-16% of the territory.

Between 1991 and 2000, 20 million hectares of land deteriorated by water loss and soil erosion will be treated.

By 2000, farm land used for construction will be kept under 3.3 million hectares; over 33 million hectares of low-and medium-yielding farm land will be improved, and ecological agriculture will be introduced to about 6.5 million hectares of land.

Nature reserves of various types will cover a total of 70 million hectares, accounting for 7 percent of the nation's total land area.

2 POLICIES AND MANAGEMENT

2.1 Direction of Environmental Policies

In the past decade, China formulated and carried out a series of policies, regulations, standards and systems on environmental protection. They played a very important role in controlling environmental pollution and ecological degradation, and improving environmental quality in some regions. The achievements proved Chinese environmental protection policies are suited to Chinese conditions. In the 1990s, the basic guidelines for formulating and implementing environmental policies are: to continue to carry out every environmental policy proved to be successful, and to make necessary adjustments and improvements according to specific situations and problems as they occur in practice. At the same time, some new environmental policies will be formulated and implemented, based on the specific conditions in China and lessons learned from international experience. The basic direction of these policies are described in the succeeding sections.

A period of rapid population growth occurred after the founding of the People's Republic of China. From 1949 to 1972, China's population jumped from 541.7 million to 871.8 million, registering an average annual growth rate of 2.09 percent. Since the 1970s, with the successful implementation of the family planning policy by the Government and people of China, the nation's annual population growth rate averaged at 1.56 percent between 1972 and 1990, lower than the average growth rate of all the other developing countries.

China's population distribution across regions is rather uneven, showing a decreasing distribution trend from east to west. Three-fourths of the population is concentrated in the northern, northeastern, eastern and central-southern parts of China, which are only 44 percent of the nation's land area; one-fourth are dispersed in the southwestern and northwestern parts of the country, which are 56 percent of the land area. This gradual westward decreasing trend of density reflects also the nation's uneven features in natural conditions, as well as in the social and economic development (National Report of the People's Republic of China on Environment and Development, 1991).

2.1.1 Strategies that Integrate Environmental Protection into the Development of the Economy and Society

Since 1980, tremendous changes have taken place in the economic and social development strategies of China: a shift in the major emphasis to industry; and a change from the unsteady economic development to the coordinated, steady and continuous development of every aspect of the economy and society. These changes include:

- first, in development principles, stressing sustainable and coordinated development, paying attention to the rational proportion of the national economy and to every aspect of society, and taking environmental protection and the balance of ecology as important contents of coordinated development;
- second, in development objectives, paying attention to an increase in the quantity and the quality of improvements; paying attention to improving people's living standards, as well as improving environmental conditions;

- third, in the relation between development speed and economic benefit, taking the increase of economic benefits as the center and seeking the integration of speed and benefits in economic development; and
- fourth, in expanded production, stressing potential realization and technological transformation of existing enterprises by adopting new technologies and new equipment; increasing production capability and economic efficiency at the same time; and preventing and controlling environmental pollution and degradation.

In the 1990s, China will take further effective measures in order to realize the change in development strategies as soon as possible and to make efforts to implement sustainable development strategies. Efforts in environmental protection will include:

- Continue to adhere to the guiding principle of coordinating the environmental planning, implementation and development with national economic development and with urban and rural development; and of making efforts to realize the integration of economic, social and environmental benefits. China will take environmental protection as a basic national policy in social and economic development, and adhere to it unremittingly.

Box 2.1**Environmental Protection Planning**

The Environmental Protection Law of the People's Republic of China stipulates that the environmental protection planning drawn up by the State should be integrated into the national economic and social development plan; the State adopts economic and technological policies and measures conducive to environmental protection so as to coordinate environmental protection with economic construction and social development." Since the 1980s, environmental protection has been incorporated into the Five-Year Plan for national economic and social development. In the Eighth Five-Year Plan period (beginning 1991), 24 concrete targets were planned for realization by 1995, including the level of comprehensive treatment of industrial "three wastes" (i.e., liquid, gas and solid wastes generated by industries), and the discharge and removal volume of SO₂ and dust. In order to implement the Eighth Five-Year Plan, the State Planning Commission has drawn up yearly plans, beginning from 1992. The planned targets contain two parts: (1) environmental quality targets for 37 cities in which the State conducts the quantitative examination on environmental quality control and waste discharge; and (2) treatment targets for each provinces, autonomous regions, and municipalities directly under the Central Government and cities with independent planning status. The planned targets of waste discharge treatment include the treatment rate of industrial liquid, gaseous and solid wastes; dust discharge volume per unit industrial output value; waste water discharge volume per unit industrial output value, and industrial solid waste volume per unit industrial output value. Urban environmental quality control targets include yearly and daily average volume of total suspended particulates (TSPs) and SO₂ in the atmosphere; and drinking water qualification ratio.

All environmental control targets are assigned to every region. Environmental protection plan, together with the plan for national economic and social development will be carried out after they are reviewed and adopted by the National People's Congress. The people's governments at different levels will then formulate their regional plans for environmental protection.

The departments of planning and environmental protection at different levels have the responsibility of supervising and inspecting the implementation of environmental protection goals. In August 1992, the Central Patriotic and Public Health Campaign Commission, NEPA, and the Construction Ministry organized the inspection of urban hygiene and the comprehensive harness of environment. Inspection of the implementation of environmental protection plan is an important part.

- Environmental protection will formally become an integrated part of national economic and social development plans. While formulating the development strategy and plan of regions and departments, local governments at various levels and authorities of various sectors must include environmental protection as an important part of their plans and incorporate environmental considerations into their overall planning. The objectives, plans, targets and important measures for environmental protection will be incorporated into the medium-or long-term programme and annual plan of the nation, regions and departments, and comprehensive planning of projects, funds and technology must include environmental considerations so that environmental protection becomes an organic part of the national economic and social development.
- Regional and urban planning must be based on geographic and socio-economic conditions and on the full consideration of all relevant requirements for environmental protection. While planning regional and urban development, China will adopt scientific methods to design zoning for the construction of residential areas, commercial areas, industrial zones, transportation facilities, farmland, forests and green areas. When a project is newly built, it is required to follow the principles of appraisal before construction and "three simultaneity" and environmental impact assessment (EIA), so as to control the emergence of new pollution

sources. In old enterprises, measures will be taken along with their technological renovation efforts to promote clean production and install facilities for the comprehensive utilization of "three wastes". While trying to increase the technical level and productivity of enterprises, pollution control and treatment capacities must also be enhanced to reduce the discharge and emission of pollutants.

2.1.2 Formulate and Implement Environment-Friendly Sectoral Policies and Reduce Environmental Pollution and Destruction Through Sectoral Restructuring

From now on, when formulating industrial policies, China will take the environmental impact of every kind of industry and product as an important factor, strictly controlling (or forbidding) the development of enterprises with high energy consumption, high raw material waste and serious pollution problems; and devoting major efforts to developing qualitatively efficient industries with advanced technology and high utilization efficiency of resources. A pollution control deadline will be set for enterprises, industries and regions where serious pollution problems have occurred. The development of the tertiary industries that use few resources and energy, and produce less pollution is encouraged. <The State Council Resolution on Priorities of Current Sectoral Policies> stipulates that inefficient township and village industrial enterprises competing with the state's important enterprises for materials and having serious pollution problems will be forced to switch production or stop operation all together.

2.1.3 Promote Science and Technology and Actively Develop Environmental Protection Industry

A positive solution to Chinese environmental problems lies in scientific and technological advancement. From now on, to counter the major environmental problems existing in their regions and industries, the governments at all levels, relevant departments, enterprises and institutions, should actively study, develop or introduce the new waste-free or low-waste, water-saving and energy-efficient technologies; and they should assess and promote the application of practical technologies for environmental protection. In order to transfer these scientific and technological achievements into the realistic pollution prevention and treatment capacities, China will guide and actively support the development of the environmental protection industry, giving it the same emphasis that was given previously to environmental protection. Authorities of planning, science and technology administration at various levels must support the establishment of pilot projects and zones of pollution control and nature protection, and they must give priority to granting approval and funding for such efforts. The State Science and Technology Commission will incorporate environmental protection industry into plans for major science and technology research tasks, research results promotion and the establishment of state engineering and technology centers.

The State Council Environmental Protection Committee has issued the following comments on actively developing environmental protection industries:

(1) Governments and departments at various levels must fully understand the significance of environmental pollution control and the protection of ecological environment. They must act according to the <State Council Resolution on Priorities of Current Sectoral Policies> and give priority to the development of environmental protection industries. They must provide strong leadership, create favorable conditions and support the development of environmental protection industries.

(2) The guiding principles of developing environmental protection industries are: increase the quality of environmental protection products and projects through reform and opening, and provide material and technology guarantees in the area of environmental protection and improvement, pollution control and the elimination of other hazardous factors.

(3) The most urgently needed environmental protection products are advanced, reliable, economical and efficient equipment for air pollution control, water pollution control, solid waste treatment, waste materials comprehensive usage, noise and vibration control, water saving, and energy saving, as well as environmental protection devices to be used in high technology industries such as electronics and bio-engineering industries, equipment to recover chlorine, fluorine and hydrocarbon or to produce their replacement products, equipment used for dealing with pollution accidents, special materials for environmental protection purposes, pollution control projects, agriculture ecology projects, afforestation and nature protection projects, and technologies to protect endangered species.

(4) The development of environmental protection industries must rely on science and technology. The research and promotion of new technologies, advanced equipment and materials must be incorporated into the national science development programs such as "the sparkling program" and "the torch program. Environmental protection technology research capability in research institutes, universities and enterprises must be strengthened, so must the cooperation between research institutes and production enterprises. Efforts must also be made to develop markets for environmental protection technologies so as to accelerate the transformation of research results into production capabilities.

(5) In developing environmental protection industries, specialization and scale production must be encouraged. Wholesale service contracting must be adopted and market mechanism must be used to support those enterprises that produce good products and operate efficiently, and those work units that provide good service in the designing and construction of environmental projects and the installation of environmental protection equipment.

(6) Serious efforts must be made to rectify the production and marketing order of environmental production industries. Authorities concerned must conduct overall inspection of existing environmental protection enterprises and institutions, and exercise management over their registration, supervision and categorization.

Quality standards for environmental protection industries must be established and product supervision must be strengthened. A number of environmental protection products inspection centers will be gradually established and spot inspection results will be regularly published. Product quality contests will be conducted so as to promote good products and eliminate poor ones. Standards and norms for environmental protection projects designing and construction must be established so as to strengthen quality control and supervision. Various consultation, appraisal, projection, training and inspection activities must all be brought into standardized management.

(7) Under the principle of opening to the outside world, efforts must be strengthened to conduct international technical cooperation and exchanges at various levels and in various forms so as to introduce and eventually master advanced foreign technologies and equipment of pollution control and energy saving. Meanwhile, efforts must be made to develop international markets and participate bidding for the construction of overseas environmental protection projects. Those work units with the right capabilities will be encouraged to undertake overseas consultation, designing and construction projects, and the export of environmental protection products and labor must also be promoted.

(8) Authorities concerned must actively attract university and professional school graduates majoring in environmental protection courses as well as other professionals to gradually enhance the professional level of the environmental protection technical force.

(9) Initiatives of various departments and sectors must be brought into full play. Departments and sectors must formulate their own plans for the development of environmental protection industries and their management methodologies and implementation details.

Box 2.2 The Promotion of Best Environmental Protection Technologies

Since 1992, NEPA has started a program to identify the best applicable environmental protection technologies. In 1993, NEPA organized a panel of specialists to appraise technologies recommended by provinces, municipalities and line ministries. Among 563 technologies, 21 were identified to belong to A class (the best applicable technologies) and 542 to B class (applicable technologies).

2.1.4 Strengthen Environmental Management, Improve Institutional and Policy Coordination of Environmental Protection

Many environmental problems in China have resulted from bad management, but if environmental management is reinforced, this situation can be improved to a great extent. For many years, China has attached importance to environmental management and has achieved results. In the 1990s, strengthening environmental management will remain a priority of China's environmental protection policies system in China.

- Enforce the law strictly. At present, China has formulated more than 10 laws of environmental protection and resources protection, such as the Environmental Protection Law, Water Pollution Prevention and Control Law, Air Pollution Prevention and Control Law, Marine Environmental Protection Law, Land Law, Forestry Law, Grass Land Law, and Wildlife Conservation Law; and has published many administrative decrees and environmental standards. Local environmental regulations and standards were established by in many provinces and autonomous regions and municipalities directly under the Central Government. It is fair to say that a basic legal framework for environmental protection has been established in China and it is playing an important role in environmental protection. In the 1990s, the legal system will be further improved. The regulations such as the Solid Waste Pollution Prevention and Control Law, Radioactive Pollution Prevention and Control Law, Regulations on Natural Reserve, and Regulations on Construction Projects Environmental Management, will be formulated and enacted one after another. The existing problem is the impotence of law enforcement and personal influence overwhelming the authority of law. These conditions hinder not only the full enforcement of environmental protection regulations, but also the authority of the law. As China continues its efforts toward democracy and rule by law, governments at various levels will take firm and effective measures to support law enforcement departments to deal resolutely with violations of the law.
- Law enforcement supervision. The Chinese Government has decided that in 1993 and the following two years, the Standing Committee of the National People's Congress and the Environmental Protection Commission of the State Council will organize an investigation

group to conduct inspections of the enforcement of the Environmental Protection, Prevention and Treatment Law and the National Ecology Protection Law; and to impose strict penalties for serious violations of the environmental protection regulations.

- Reinforce the establishment of institutions. China's environmental protection practice over the past years shows that without appropriate institutions and effective supervision, good guiding principles, policies, laws, and plans will be impotent and difficult to be implemented effectively. In the future efforts of economic system reform and institutional reform, China will further strengthen the government's role in environment protection and institutionalize environmental management at all levels. It will also strengthen coordination between the national environmental protection departments and environmental protection departments of different sectors; and enhance the quality of environmental management staffs. China will establish professional contingents² at all levels of governments to enforce environmental protection laws and give them the authorities such as supervision, inspection and levying administrative fines.
- Improve the environmental protection policies formulation system. China's environmental protection systems and measures were formulated in different periods and were aimed at every aspect of environmental protection, so coordination among them is needed in order to bring the overall effectiveness of the policies into full play. China's existing environmental protection policies need to be further improved to cover additional fields and deal with some deeper issues such as the penalty system for pollutants emission (at present, fines are levied only on the emission that exceeds the standards); exchange in discharge power; and centralized control of pollution. All of these need strengthened with concrete policies and stipulations. During the mid 1980s, China formulated a number of policies on the control of air pollution and water pollution. These policies need to be improved and amended.
- Strengthen environmental protection foundation-laying work. The implementation of all environmental protection policies and measures needs the strong support of such basic work and technological means as environmental standards, planning, information, monitoring, etc. In the next ten years, China will attach even greater importance to the basic work of environmental protection, and will make efforts to increase the ability of environmental management, strengthen the formulation of technical guidelines and standards for environmental planning, and improve the procedure for the collection and processing of monitoring and statistics.

2.2 Economic Policies

2.2.1 Price Policies

Reforming the irrational price system is an important part of China's overall economic system and also an important economic measure in environmental protection and improvement. At present,

² These professional contingents would be formed from local EPB professional staff who would have specific enforcement responsibilities. Many cities have already established these positions; others have plans to form them when funding is available. The Standing Committee of the People's Congress will help establish the professional contingents where they particularly needed, but currently there is no schedule for completing the project.

there are serious complications caused by the current price system, particularly the low price of materials and the free use of natural resources. These problems not only hinder efforts to increase efficiency, but also create severe waste of natural and energy resources as well as environmental pollution and ecological degradation. In the future decade, as the economic system reform deepens, China will gradually marketize the supply of every kind of resources and energy. Under the market principles of the law of value and the relation between supply and demand it will adjust the price of resources, so as to reduce both the waste of resources and environmental pollution.

The Building Materials Departments stipulate that enterprises can use up to 20 percent of technical renovation fund for pollution control purpose. Environmental protection departments provide the special low-interest or interest-free loans for pollution treatment projects of cement enterprises. Cement enterprises can also use the first five-year profit generated by dust collection devices, if the revenue can be separated from the enterprise total income. But the fund must be earmarked for pollution treatment. That part of income will also be entitled to tax reduction and exemption depending on the efficiency of the enterprise and approval by sector authority.

2.2.2 Tax Policies

Box 2.3 Stipulations on the Comprehensive Utilization of Natural Resources

- Enterprises are encouraged to comprehensively use "three wastes", applying the principle of "who invests money shall get the benefit," i.e., enterprises are entitled to keep profits generated from comprehensive utilization projects that funded with self-raised funds.
- Unless otherwise stipulated by the state, enterprises can determine prices of products that are produced through comprehensive utilization.
- Comprehensive utilization projects funded by enterprises and their products are entitled to tax exemption and reduction. Once such projects are put into operation, workshops and subsidiaries are entitled to five years of exemption of income tax and budget readjustment tax if their accounts can be separated from the parent factory.
- The funds for developing comprehensive utilization are mainly raised by enterprise itself. Export-oriented enterprises can use foreign capital for such projects. Those projects that produce good social benefits but little benefits for the enterprise should be incorporated into the state plan and be given support. As for comprehensive utilization projects that are marginally profitable but produce materials badly needed by the state, specialized banks must provide them with long-term loans.
- Comprehensive utilization projects that need to import technology, equipment and parts will be regarded as technical renovation projects and enjoy the same tax exemption and foreign exchange allocation treatment.

With these measures in place, the output value of "three wastes" comprehensive utilization has reached 6.42 billion yuan, the profit is 1.81 billion yuan and 100 million yuan is reinvested into pollution treatment and "three wastes" comprehensive utilization.

In the 1990s, the main tax policies that China will use to prompt environmental protection include the following:

- Levying compensation taxes (for the environment) on discharge of pollutants. Departments such as environmental protection agencies and taxation and fiscal authorities will study and

determine methodologies, measures and standards for levying compensation taxes on discharges of waste water, waste gas, and solid waste. If unified taxes cannot be levied all over the country in a short time, experiments will be carried out in selected regions. The State Council has approved the trial collection of SO₂ discharge levies in two provinces and nine cities, and the revenue will be used for treatment of acid rain and SO₂ pollution.

- Preferential tax treatment will be granted to environmental protection projects. Most environmental protection projects such as those of pollution treatment and natural ecological protection are of low economic return. Therefore, pilot projects will be selected to experiment with preferential tax levying. At present, the State has exempted environmental protection projects of the fixed assets investment orientation readjustment tax.
- Preferential tax treatment will also be granted to the production of environmental protection products and products for the comprehensive utilization of "three wastes". The comprehensive usage of "three wastes" is an effective means for solving environmental problems, while environmental protection products are an important part of pollution treatment and natural ecology protection. Therefore, it is important to partially or totally exempt taxes to support these sectors within a certain period. The relevant departments in China will make concrete stipulations.

2.2.3 Credit and Other Policies

Environmental protection is a new and developing sector with a strong feature of generating social benefits. Therefore, it needs support from every sector of the society. Besides the economic measures mentioned above, China will also take the following additional measures:

- When conditions are ready, the state will establish environmental protection fund to strengthen the macro management capability in pollution prevention and control, and natural ecological protection. This fund is currently being planned with both national and international financing.

In 1988, the State Council stipulated that the special pollution sources treatment funds be drawn from pollutant levies. The funds are used in repayable way and the banks are entrusted with responsibilities for the loan. It is proved by practice that the effect is remarkable. In order for Shengyang City (Liaoning Province) to manage the special funds effectively, the environmental protection investment corporation was set up in the city. Through strict management, evident effects were achieved: First, the capital turnover is being speeded up and the utilization efficiency of capital raised. During the two years after its setting up the corporation lent loans of 2.273 million yuan to 137 treatment projects, making up 36.9 percent of the total engineering investment. The recycling rate of the corporation's funds has reached 80%, increasing by 25 percent as compared with the past, and changing the practice of letting capital lie idle. Secondly, the capital is used concentratively and the investment benefit increased. After the corporation was set up the investment for each project was increased from 113,000 yuan to 246,900 yuan, and the scale economic benefit from the investment was obviously raised. The reduction volume of pollutant per investment of 10,000 yuan raised from 7.4 tons to 9.2 tons, and the rate of input-output increased by 19.6 percent.

- Departments concerned will give interest discount compensation for bank loans earmarked for environmental protection³.
- The state, localities and enterprises will actively attract foreign capital to help solve environmental protection problems.

2.2.4 Natural Resource Accounting

Worldwide quantification of natural resources is still in a stage of study and experimentation. Natural resources accounting plays a very important role in the following aspects: to assess the value of every kind of resource and its increase and decrease; to define the value of natural resources, so as to define the total national wealth on this basis; to evaluate the state of social and economic development and the future development potential from all sides and objectively; and to handle correctly the relation between long-term and short-term development, and the relation between economic development and natural and environmental protection. From now on, China will enforce the theory and method study in natural resource accounting, select proper regions and departments to use the theory and method of natural resource accounting to assess the national economy, expand the implementation of the policy of compensatory payment for the use of resources, reduce the waste of natural and energy resources as far as possible, and thereby, gradually establish the new national economic accounting system.

Natural Resource Accounting

The Chinese Government attaches great importance to the determination of natural resources and its significance in plans for future development. With financial support of the Ford Foundation, the State Environmental Protection Administration has begun initial research. This technical assistance project concentrates on research theories and methodologies:

— Natural resources survey conducted by the Ministry of Forestry in the Changbai Mountain region in Jilin Province;

— Underground water resources survey conducted by the Ministry of Geology and Mineral Resources in Beijing Area;

— Resources survey and research projects in Liaohe River reaches in the northeast.

Since methods of natural resources determination are not mature, much research work needs to be completed (see the Administration's yearly report and follow-up research reports).

³ There are two ways to get loans. First, financed from the discharge levy system, the local EPB provides financial support, as low-interest loans, for enterprises that carry out pollution control. Second, the SPC provides low-interest loans through the local SPC departments. Part of the money is spent on pollution control, for bench scale, pilot plant, and full scale demonstrations.

2.3 Environmental Protection Organizations

With efforts made in the past 20 years, the environmental protection organization has been strengthened. The staff of the national environmental protection system reached over 70,000 in 1991, 2.5 times as many as that in 1981. With the continuation of China's economic system reform, the market system will be further perfected and the administrative system will be completely reformed. According to stipulations of the Chinese constitution and laws, environmental protection is an important function of the government. This function will be strengthened instead of being transferred or diminished in the process of the government's drive to transfer its functions.

However, the present environmental protection organizational structure is still unsuitable to meeting current needs, and the shortcomings are most outstanding in the following three aspects: institutional inadequacy; weakness in functional bodies; and low professional quality of personnel. Therefore, to strengthen the construction of the environmental protection organization will be an important task of China's environmental protection work in the 1990s.

2.3.1 Improve Environmental Protection Organizations

Western experience and China's practice in the past 20 years prove that a well established organization is the key to environmental protection. This will be accomplished through the following means:

- Strengthen the central environmental protection organization. Since the central environmental protection organization of China was established 20 years ago, it has been constantly strengthened. But the present organization still cannot meet the work demand. Comprehensive coordination is especially needed if it is to exert its function of unified supervision and management. In the drive to transfer government functions and streamline government organizations, China will strengthen the functions of the central environmental protection organization.
- Improve the local environmental protection organization. The local environmental protection organizations of China include four levels: province, city, county, and township. At present, local organizations are rather weak and unable to carry out their environmental protection functions. As an important link of national environmental protection system, local organizations are in charge of supervision and enforcement of environmental protection laws. Therefore, in the next ten years, the Chinese government will give priority to the strengthening of local environmental protection organizations in the institutional reform of the local administrative organs.

2.3.2 Improve the Operation System of Environmental Management

To improve the administrative operation system is another important part of the administrative system reform. It includes rationalization of relationships, clarification of responsibilities and rights, and the establishment of scientific and democratic decision-making procedure through the following actions:

- After the State Council restructuring in 1988, the Central Organ Establishment Commission designated the State Bureau of Environmental Protection to formulate its own regulations on an experiment basis. The objective is to formulate the "Organizational Ordinances of the

National Environmental Protection Agency", obtain experience and resolve the problem of backwardness in administration.

- Study and establish a rational, coordinated and highly efficient environmental management system. The research will be conducted according to the characteristics of environmental management work and it will concentrate on features of China's environmental management system so as to form an operation system meeting the needs of environmental protection, from the central to local departments, and improve the general standard of environmental management.
- Carry out international comparative study, absorb advanced foreign experience to widen research scope and provide theoretical and practical data for the establishment of Chinese environmental management system.

2.3.3 Improve Professional Quality

The level of personnel professional quality directly affects the effectiveness and efficiency of environmental protection institutions. Therefore, China will concentrate efforts in the following two areas:

- Experiment on civil servant system within the environmental protection sector. The State Bureau of Environmental Protection, as one of the six units designated by the State Council to experiment civil servant system. After three years, the experiment is basically completed and good results have been achieved. In line with the requirement of the central government, some localities have included environmental protection departments into their civil servant system experiments and will complete the program in a few years. The State Bureau of Environmental Protection will conduct short-term training, exchange of information, and organize observation groups.
- Improve on-the-job personnel skills through further education in environmental protection. The Chinese government will conduct post training and examination of environmental protection staff in a planned way so as to improve the professional skill and ability of environmental protection management staff. The State Bureau of Environmental Protection is responsible for the training of directors above the municipal level. The local environmental protection bureau will train the environmental protection directors at the county level and the workers according to the local conditions.

2.3.4 Improve the Technical Supporting Ability of Environmental Protection Organizations

Environmental protection is a very professional work of high technical concentration, which needs better technical support. China's conditions in environmental protection are rather poor. For example, administration methods are not scientific and lack of automation, and supervision, information processing, appraisal and consultation methods are backward. Now, the State Bureau of Environmental Protection are improving their environmental management ability at the national, provincial and municipal levels with the technical support of the World Bank and the Asian Development Bank.

2.3.5 Strengthen Environmental Protection Commissions at All Levels and Improve Their Coordination Capability

The Environmental Protection Commission of the State Council is the highest decision-making and coordinating body of China's environmental management, which includes the heads of all relevant ministries and agencies and meets periodically to formulate relevant policies and discuss problems and actions in the environmental protection field. NEPA, as its administrative body, tackles the relevant concrete work. The State Environmental Protection Commission invites well-known experts in environmental fields to provide advisory opinions for relevant decision-making. For example, in 1982, in order to resolve the pollution problems in Baiyangdiang Lake in Hebei Province, Song Jian, State Councillor and Minister of the State Environmental Protection Commission called a meeting in Baoding, Hebei Province to discuss methods to improve the environment of the lake. The meeting was attended by officials from the State Planning Commission, the State Science and Technology Commission, the National Environmental Protection Agency, the Ministry of the Finance, the Ministry of Construction, the Ministry of Energy, the Ministry of Light Industry, the Ministry of Chemical Industry and Hebei Province.

The State Environmental Protection Commission relates to many departments, so it is difficult for a lot of leaders to be called together to have a meeting; therefore, it is necessary to establish some special committees that embody representatives from relevant departments to deal with major environmental problems. Similar to the setup of the State Council, most provinces, autonomous regions and municipalities have also established their own environmental protection commissions to be in charge of policy making and coordination in this field.

2.4 Environmental Science and Technology

Science and technology are the most important production force in economic development. They provide the basic solution to environmental problems. The Chinese Government has always considered the development of environmental science and technology as the mainstay of environmental protection strategy.

2.4.1 Current Status and Problems

In the past 20 years, rapid progress has been made in environmental science and technology research. Nowadays, the research does not simply cover "three wastes" treatment, but also includes natural ecological environment and natural resource protection, and the maintenance of eco-balance, etc. A research system has been established, consisting of environmental geology, environmental physics, environmental chemistry, environmental biology, environmental medicine, environmental engineering, environmental economics, environmental law, environmental management, etc. More than 300 kinds of environmental research institutes in different disciplines have been set up, such as the Chinese Institute of Environmental Studies and the Eco-environment Research Centre of the Chinese Academy of Sciences. They employ more than 20,000 part-time and full-time researchers and have made great achievements. In the Seventh Five-Year Plan period, 1,810 research items were awarded, among them 52 were national awards, 700 were provincial or ministerial awards, and 1,058 were regional or municipal awards. The achievements of environmental research provided technical basis for the formulation of the strategy of coordinating economic development with environmental protection, the development of pollution control technologies and measures, and the establishment of environmental protection laws, regulations, standards, and management measures.

The backwardness in science and technology is the main cause of China's low efficiency in energy and resource usage as well as low productivity and serious pollution, hence there is an urgent need to improve it. Meanwhile, the global environmental issues have set new requirements for environmental research. Therefore, the advancement of science and technology seems an arduous task.

Considering the current situation of China's economy, environmental researches must focus on the development of techniques that are economical and can be applied on a large scale to improve China's environmental science and technology.

2.4.2 Targets

In the 1990s, China will strengthen her environmental protection strategy, technical support system and research in environmental techniques; provide a set of scientific data for the implementation of China's Action Plan of Environment and Development in the 21st century; develop pollution prevention techniques which fit her situation; provide technical support for effective pollution control; conduct research in eco-environmental protection; provide scientific and technical back-up for the rational utilization of natural resource, protection of eco-environment; promote positive feedback in the eco-system; actively participate in the research of global environmental issues; fulfil her international obligation; make contributions to the global environmental protection.

2.4.3 Major Fields and Priority Programmes

1. Research of Global Environmental Issues

China is one of the few countries which use coal as the main energy source. Coal accounts for more than 70% of China's energy consumption. And this will not change much by the end of this century. Therefore acid precipitation remains to be one the very urgent global environmental issues at present. Meanwhile, China will cooperate with international community to conduct research in greenhouse effect and ozone layer protection.

2. Research in Natural Resource Protection

The damage to natural resource is mainly manifested by the damage to forest and grassland, land desertification, water loss and soil erosion, and deduction of species. And all these can be attributed to the forest and grassland damage. Thus in this field, the priority of research will be the protection and coverage of forest and grassland. Taking the regional characteristics and the current problems into consideration, China will actively conduct research in the prevention of land desertification, water loss and soil erosion, and increase in endangered species.

3. Research in Environmental Pollution Prevention and Control

The priority of research should be the study of cleaner production technology. Develop technology with no pollution or low pollution. Make a list for the cleaner production technologies, and promote their implementation. Try to eliminate pollution in the production process. Emphasis will be laid upon the development of more efficient technique for oxygen-consuming pollution treatment. At the same time, devote efforts to the research in the treatment of industrial waste water which is of high concentration and low dissolvability.

The focus of research of atmospheric pollution control techniques will be on the comprehensive treatment of air pollution caused by coal-combustion.

The priority of research of solid waste treatment is in the development of recovering, and non-hazardous techniques, and the safe disposal of hazardous wastes.

4. Research in Environmental Management

The priority of this field of research is in the strategy and measures of environmental planning and management.

2.4.4 Strategy and Measures

1. Strengthen the Management and better the organizational structure of environmental research.

Box 2.4**Chinese Research Academy of Environmental Sciences**

The Chinese Research Academy of Environmental Sciences is a comprehensive research institution directly under NEPA. Its main task is to study the country's comprehensive and basic environmental issues. It is a research centre to promote the development of China's environmental sciences according to the needs of environmental management and to provide the scientific base and technological support for national environmental management.

Under the Chinese Institute of Environmental Studies, there are eight institutes (stations): the Air Environmental Science Institute, the Environmental Ecology Institute, the Environmental Standard Institute, Environmental Management Institute, the Environmental Analysis and Institute, Environmental Information Institute, and the Computer Station. These institutes respectively undertake relevant studies on the key state scientific and technological projects and major science and research projects. In addition, there are some management departments such as Science and Technology Department, Personnel Department, Financial Department and Administrative Department that provide logistics support for environmental science research. The Chinese Institute of Environmental Studies now have a staff of 560.

In order to strengthen and improve environmental research, it is of vital importance to reform and perfect the research management system, set up long term plans for environmental management, and form a steady, rational organizational structure for environmental research. China's environmental research will take her specific condition into consideration; keep sustainable development as the starting point; emphasize the priority programmes; guarantee their investment through policy, administrative and institutional means; raise investment funds efficiency; fully tap the potential of existing input in research; and upgrade environmental research level.

2. Strengthen Multi-disciplinary Environmental Research. Raise the General Level of Research.

Environmental issues are multi-disciplinary and complicated in nature, whose solution needs the cooperation of different disciplines.

In order to improve China's environmental research, it is necessary to set up multi-disciplinary research institutes to meet the needs of sustainable development and environmental protection.

3. Increase Investment in Environmental Research and Improve Research Conditions

At present, China's environmental protection techniques not only lag behind those of advanced countries, but also trails the development her industrial techniques. Improvement of such condition lies in the bettering of environmental research. From now on, China will not only increase the total amount of investment in environmental protection, but also in environmental protection research.

Box 2.5 Modern Policy Research Center for Environment and Economy

The Modern Policy Research Center for Environment and Economy is a institution directly under NEPA, and also a leading unit in the research on coordinated development of environment and economy in China. This centre contains three tiers. The first tier is the centre itself, consisting of some senior research fellows, experts and departments leading cadres as academic leaders, who have great attainments and policies research ability in the studying of coordinated development of environment and economy as academic leaders. There are number of middle-aged and young leading researchers and adequate number of supporting staff. The second tier includes the specially invited research fellows. Some senior experts, who have great academic attainments, strong research ability and high policies level, and some world famous experts are invited as the center's special advisors or visiting research fellows. The third tier is research network, which is composed of the research capability of institutes and universities and colleges, undertaking the center's research tasks. Now under the center there are five research departments, including the Global Environmental Research Department, Asia and China's Environment Research Department, Analyzing and Research Planning Department, Expert System and Decision-making Research Department, and International Exchange and Cooperation Research Department.

The centre undertakes not only research tasks assigned by NEPA, but also those assigned by relevant sectors of the State Council, policy research tasks of international organizations such as the World Bank, the Asian Development Bank, United Nations Development Programme (UNDP) and United Nations Environment Programme (UNEP). The research achievements will serve the Chinese government and the international organizations.

China will set up funds for environmental protection; develop market for environmental technology; strengthen international academic and personnel exchanges; actively conduct cooperative research; try to obtain international support.

4. Train Professionals for Environmental Research; Strengthen Environmental Research

Professionals play the most important role in the development of environmental science and technology. Now, China has some personnel in environmental research, but this situation needs to be improved quantitatively and qualitatively to keep up with the scientific and technical development. China will spare no efforts to improve the professional quality of environmental research personnel, especially pay attention to the renewal of knowledge of the present environmental professionals, do her best to provide opportunities for their further learning.

2.5 Public Participation and Environmental Education**2.5.1 Public Participation**

China has learned through past experience that environmental protection requires mass participation in the implementation of protective measures and enforcement of environmental laws and regulations. In the next ten years, efforts will be made to disseminate various kinds of environmental information, so that the public will be aware of environmental situation. The EIA of construction projects will also collect opinions from the public and social organizations concerned. The environmental problems posed by the PCs and PPCCs should be settled timely. Mass media should be used to expose those organizations or individuals that violate environmental laws and regulations, or have caused serious pollution, in order to raise environmental consciousness of the whole nation, and engage the whole nation to conscientiously take part in preventing and controlling environmental

pollution and improving ecological environment.

1. Giving Full Play to the Scientific and Technological Circles

At present, a system to study environmental science and technology covering a wide range of disciplines has been established with a staff of tens of thousands of environmental science

personnel. They are an important force in China's environmental protection cause. China will pay more attention to the role of the scientific and technological circle, and depend on the advance of science and technology to protect and improve the environment. The following actions are planned:

In the past decade, some institutions of education have experimented popularizing environmental protection education in kindergartens, primary and secondary schools. These experiments have proved that such education at early stage can help children acquire environment awareness. In fact, quite a few pupils said after taking the classes that they will do their best to control environmental pollution when they grow up. Others took more immediate action closer to home: it was reported that in some rural areas, the inspired pupils tried to persuade their parents not to catch snakes or frogs.

- Devote major efforts to the study and development of environmental science and technology. China will organize scientists to develop high-efficiency and low-consumption production technology and equipment, develop technologies for pollution treatment and ecological restoration suitable to the conditions of the country, strengthen research and popularize technologies for the comprehensive utilization of resources, and conduct united research on major subjects. Environmental protection has been designated as a key area of scientific research during the Seventh and Eighth Five-Year Plan periods and the state has allocated certain amount of research funds each year to support research and strengthen environmental monitoring and the development of new technologies and equipment.
 - Scientific appraisal of environmental protection policies. In China, after the environmental protection policies are formulated, experts in every aspects will be organized to appraise their necessity, feasibility and scientific rationality. For this purpose, the Environmental Protection Commission of the State Council and the National Environmental Protection Agency have set up consultative committees composing of experts in different fields to solicit their opinions as well as that of foreign experts. The International Commission on Environment and Development of China established with the approval of the State Council has conducted some topical studies and formulated consultation plans. These activities are conducive to facilitating the formulation of policies that can ensure a coordinated development of environmental protection and the economy.
 - Promote environmental protection technical consultation and service. China now has a few environmental technology consulting companies. Their business scope is small and technical service range is narrow and only a small number of them can provide high level technical service. As the reform deepens, more environment technology consulting firms have been established. They have become a significant force to provide services to the society and transform environmental protection technologies into environmental benefits and economic benefits.
- 2. Give Full Play to Industrial and Commercial Circles**

Box 2.6**Environmental Consulting Organizations**

Various kinds of consulting firms are now operating in China. They undertake design and provide consultation service for construction projects. For example, one consulting firm established by Tsinghua University has won the contract to design, construct and operate a sewage water treatment plant, and it has completed the prototype project in Ningbo while other designing works continue.

Some consulting companies are attached to certain ministries; the consulting firm attached to the Ministry of Machinery and Electronics Industries provides information on environmental protection equipment and manufactures pollution control equipment. The consulting groups attached to the ministries charge for their services. NEPA has established a center for EIAs. The Chinese Institute of Environmental Studies offers consulting services in many environmental pollution control fields.

Since China is transforming its economy to a market system, many research institutes and colleges are setting up their own technical services organizations. These organizations charge fees for their services.

EPBs at the provincial, municipal and county levels have research institutes that can provide consultation to any enterprise seeking assistance. They charge for their services, though they are not specialized consulting firms.

Industrial and commercial entities are the main sources of environmental pollution in China, so their participation in protecting and improving environment have decisive influence on the state of environmental quality. China will take the following measures to make industrial and commercial entities take their own responsibilities and obligations in the environmental protection:

- Proper support will be given to enterprises that use low or no-waste, water-saving and energy-efficient production technologies and equipment. The government will also encourage the utilization of technologies that are harmless to environment, the development clean production technologies, and will prohibit projects that wastefully consume natural resources and energy or use inefficient technologies and cause serious environmental pollution.
- China will stress the environmental impact of products and develop "Environmental Label" projects when conditions are ready. It will promote the production of products harmless to environment, and encourage the public to buy products with "Environmental Labels." China has already launched the campaign of "Green Food," produced with technologies harmless, for example, grain, vegetables, fruits and livestock products.
- Encouragement will be given to enterprises for actions taken in environmental protection. At the same time economic measures and standards will be used to stimulate enterprises to increase investment in environmental protection so as to strengthen the pollution prevention and control capabilities. China has begun to formulate and implement new standards for pollutant emission that make a stricter requirement for the newly-built enterprises. By 1992, six sets of such standards had been issued. In the next few years, more sets will be announced, in order to force enterprises consider the requirements of environmental protection when expanding production capacity.
- China will gradually formulate the quality standards of environmental protection products, promote the standardization of environmental protection equipment, and increase the quality of environmental protection products. At present, China is setting up some quality checking

centers to monitor the quality and performance of environmental protection products, eliminate those products that are not up to the standard from the market.

In order to further coordinate industrial and commercial enterprises and stimulate them to play their role in environmental protection, the Chinese government has approved the establishment of an Environmental Protection Industry Association of China, which will exert its multi-aspect influence as a nongovernmental organization.

3. The People's Congress

The People's Congress at various levels are the supreme power organizations of the state and localities. Their roles in environmental protection are as follows:

- **Legislation on the environment.** The National People's Congress and the provincial people's congresses are responsible for legislation in China. The National People's Congress will strengthen the legislation on environment and enact new environmental protection laws; while the People's Congress at the provincial level will formulate local environmental protection laws according to local conditions.
- **Supervision of law enforcement.** People's Congresses at various levels also have the power of supervising law enforcement by administrative departments. From now on, People's Congresses at various levels will fully use their supervisory power to ensure that governments and environmental administrative departments at various levels enforce the law conscientiously according to the requirements of environmental protection law. In 1993, the Nation People's Congress, the Chinese People's Political Consultative Conference, and the Environmental Protection Commission of the State Council will make an inspection on the enforcement of environmental protection laws and severely crack down on violations of the laws. Such activities will continue in the future.
- **Review and appraise environmental programmes and plans.** The medium- and long-term plans and the annual plans for the national economic and social development of the state and localities will all be examined and approved in the People's Congress at the state and local levels. At present, environmental protection is contained in the medium- and long-term plans and yearly plans. When examining the national economic development plan, People's Congresses at various levels will examine the environmental protection plan in it, at the same time.

Box 2.7 NPC Environmental Protection Committee

The 8th National People's Congress (NPC) has set up a Committee on Environmental Protection to formulate new laws and regulations and study measures to guarantee enforcement. The Committee is responsible for supervising enforcement departments. The Committee will inspect the environmental protection work of governments at every level (municipal, provincial, and national) by, for example, examining executive records. The Committee not only supervises law enforcement at various levels of government, but also provides legal consultation to government authorities.

- Examination of the environmental impacts of major projects on national economy and people's livelihood. For example, in 1992, the National People's Congress examined the environmental impacts of the "Tree Gorges" water control project, and proposed many constructive amendments to the project plan, thereby playing very important role in the final decision-making.

4. The Chinese People's Political Consultative Conference

Under the leadership of the Chinese Communist Party, CPPCC is an united front composed of members from democratic parties, personages with no party affiliation, people's organizations, minority nationalities, and patriots from all walks of life. Environmental issues are the major components of political consultation and democratic supervision by CPPCC. In the Economic Committee of CPPCC, there is a working group for environmental protection. Members of CPPCC can supervise the implementation of environmental laws, regulations, policies, and plans. The main approaches to political consultation and democratic supervision are:

- CPPCC uses motions to give comments and suggestions to the government on environmental issues. The related sectors of government are obliged to answer these motions. Feasible proposals should be adopted to improve their work.
- It makes inspections on environmental conditions, and provides the government with proposals. For instance, CPPCC has made special inspections on the environmental impact of "three gorges", the pollution of Chao Lake in Anhui, the pollution of Guanting Reservoir in Beijing, the atmospheric and solid waste pollution in Beijing.
- It studies environmental issues at CPPCC meetings, and puts forward proposals to the government.
- The Central Committee of the Chinese Communist Party and the State Council hold symposiums to collect opinions from the CPPCC on major issues, many of which are concerned with the environment.

2.5.2 Environmental Education

A strategic task in the field of environmental protection in China is to promote environmental education, raise the national environmental awareness and encourage the public to conscientiously participate in environmental protection activities. This necessary component of environmental protection has attracted much attention from the Party and the government.

1. Background

The First National Environmental Protection Conference was held in China in 1973. The 32-Chinese-character principle was adopted at the meeting: "Overall planning, rational allocation, comprehensive utilization, turning harm into benefits, rely on the people, mass participation, protecting the environment, benefit the people." It gives special emphasis to encouraging mass participation in environmental protection conscientiously.

After the meeting, the State Council approved and issued two documents drafted by the State Planning Commission — "Report on the National Status of Environmental Protection" and "Several Regulations on Protecting and Improving the Environment." The latter stipulated clearly that

institutions of higher learning must establish courses on environmental protection to train professional personnel.

China attached much importance to environmental education as she started her environmental protection cause. In the past 20 years, a fairly complete education system has been formed, including: management personnel training programs, professional education, on-job training, and education in primary and secondary schools.

- **Management personnel training program.** To learn environmental protection policy and procedures is an important way for decision-makers to raise their environmental consciousness. Consequently, in recent years, the CPC Central Party School and other local party schools have given lectures on this topic in their courses on science and technology. The Ministry of Construction, CPC Organization Department, and State Science and Technology Association jointly organized seminars for mayors, with courses on environmental protection strategies in China and urban comprehensive environmental control.
- **Professional education.** Professional environmental education in China consists of higher education, secondary technical education and vocational education; and trains students at all levels, including the doctoral, masters, bachelor's degree programs, secondary technical and secondary vocational training. These programmes started in the mid-1970s, but were offered in only a few colleges and universities until the 1980s, when rapid progress was made. Now, 15 undergraduate degrees in 86 environmental disciplines (in science, engineering, agriculture, forestry, medicine, and so forth) are offered in 71 colleges and universities. Preliminary statistics indicate that there are about 8,000 undergraduate students majoring in environmental science in the institutes of higher learning. By the end of 1989, five secondary technical schools of environmental protection had been established; and more than 10 courses on environment were offered in 80 secondary schools and 160 secondary vocational schools, with a total enrolment of more than 12,000 students. These schools have now trained more than 10,000 students at all levels, and the shortage of specialized personnel has been considerably alleviated.
- **On-job training.** The professional staff in environmental protection is a new contingent, and most are from other trades and professions. Since relatively few have taken courses on environmental protection, it is a pressing task at the moment to raise their vocational level and professional ability through on-job training. The first such training school, the China Environmental Management Cadres' College, was founded in 1981. From 1981 to 1989, the number of trainees totalled 5,200 including more than 800 senior cadres. NEPA has also established a training base in Tongji University in Shanghai for directors of Environmental Monitoring Stations, and about 1,000 have received training there in recent years. The local departments of environmental protection have also organized a variety of training courses and symposia. From 1986 to 1989, NEPA organized four on-job training courses on environmental management, in which 12 topics (480-590 hours each) were taught. A total of 437 trainees were issued Certificates of Environmental Law and Environmental Management Training after passing the examination. At present, the certificates are required for the cadres to qualify management posts. According to statistics, the departments of environmental protection at all levels have conducted about 10,000 training courses in the past 10 years and more than 400,000 personnel have been trained.

- Education in primary and secondary schools. Since the first meeting of the Environmental Education Committee was held by China Environmental Science Society in November 1979, environmental education of children has been vigorously encouraged and promoted.
- Environmental education through mass media. Since the late 1980s, the media have played an important role in guiding public opinion about the environment, spreading knowledge of environmental science, law and policy, and raising the consciousness toward the environment and participation. Apart from these positive reports, the media have also criticized various regions and departments. For example, several news organization jointly reported on the serious atmospheric pollution in Benxi of Liaoning Province. These reports evoked strong reaction from society and drew the attention of state leaders. As a result, actions were taken and the air quality of the city was improved significantly within a few years. Television and film and even popular songs now feature environmental protection more frequently. Their themes and forms (including newsreel, feature film, popular science film, special program, art film and education film) are more diversified; but they have all served to focus attention on raising awareness about the environment.

2. Targets

The basic task of environmental education will be (1) to improve the national environmental consciousness of the whole people; and (2) to improve the professional knowledge and technical abilities of environmental personnel. During the Eighth Five-Year Plan period, the general goal is to develop environmental education through detailed planning, to adjust and improve professional education, to expand the basic and social education, and raise the national environmental awareness rapidly, particularly among leading cadres.

3. Strategies and Measures

- Establish the system of post-training and follow-up education. During the Eighth Five-Year Plan period, the post-training pass ratio of young and middle aged staff in management and technology will be increased to 50 percent, and the pass ratio of key personnel will be increased to 80 percent. The pass ratio of newly recruited personnel will reach to 90 percent.
- Improve the national environmental awareness. Environmental awareness must be raised particularly among leading cadres, managers of pollution-causing enterprises, and personnel in the field of resources development.
- Popularize environmental protection education in primary and secondary schools. Environmental education courses should be offered in secondary schools and institutions of higher learning, and particularly in rural primary and secondary schools.
- Develop professional environmental protection education steadily, reorganize the structure of courses and formal schooling, encourage education system reform and improve the quality of teaching.

2.6 Ten Policies on Environment and Development

After the UNCED meeting, the Government of China has devoted much attention to its international obligations and responsibilities, and is ready to do a good job in its environmental protection. The 10 proposals on environment and development officially issued by the Central

Committee of the Communist Party of China and the State Council, will be an important policy guidance document on environment and development for a long time in the future in China.

The 10 proposals on environment and development are:

1. To implement the strategy of sustainable development.

At present, China's economic development follows, by and large, the traditional development model, which is characterized by large consumption of resources and inefficient management. This model has not only caused serious damage to the environment, but made development hard to sustain. Therefore, in order to speed up economic development and solve environmental problems, the correct choice is to change the development strategy and take the road of sustainable development.

Thus, the guiding principles of synchronized planning, implementation and development in economic planning, urban and rural construction, and environmental construction must be reiterated. Governments at various levels and authorities of departments concerned, while formulating and implementing the development strategy, should work out environmental protection programmes, formulate environmental protection targets and measures as part of the medium-term, long-term and annual plans of national economic and social development, and channel funds for pollution treatment and control into government budgets and ensure the programmes' implementation.

When readjusting their industrial structures, governments at various levels should strictly carry out industrial policies, discard techniques, facilities and products that consume too much energy, waste resources in large quantities and cause serious pollution. Project construction should be approved strictly follow legal procedures, which means environmental assessment must be done before construction begins. The evaluation of local economic achievement and officials' merits should take into consideration development speed and economic efficiency, as well as social and environmental efficiencies.

2. To adopt effective measures to prevent and control industrial pollution.

At present, the major pollutants affecting environmental quality come from industrial production. The main causes are outdated industrial facilities and backward technologies. Therefore, when new projects are built and existing enterprises are expanded or renovated, the technology must be of a higher standard, using clean technologies with lower energy consumption and lower levels of pollution. The capacity of the environment to support development should be considered as the basis for the rational allocation of projects and arrangement of resources. The responsible departments at various levels, when examining and approving projects, should make strict checks. Permission should not be granted to industrial projects that use outdated technology, are irrationally located and pollute the environment.⁴ Overall regional treatment and centralized control should be advocated in the prevention and control of industrial pollution to raise wide-ranging efficiency.

The principles of guidance and restriction should be upheld to prevent and control pollution from TVEs and to strictly forbid indiscriminate mining of resources. Comprehensive utilization should be carried out as much as possible in order to turn liquid, gaseous, and solid wastes into resources.

⁴ The government and sector ministries will publish policies on which technologies will be favored and which should be avoided. These policies would be implemented by the industry specific ministries as well as the EPBs.

In the process of transforming enterprise management system, the responsibility of pollution prevention and control should be specified. The principle of "polluters pay" should be upheld. No enterprises are allowed to transfer pollution to society in order to gain high efficiency. Activities of creating factories with "clean and civilized production environment" and "advanced enterprises of environmental protection" should be conducted widely, aiming at building up a new civilization of modern industry.

3. To conduct comprehensive treatment of urban environment and eliminate the "four harmful elements" in cities.³

The fight against urban environmental pollution should accelerate since it is of great importance to improving the investment environment, promoting reform, opening to the outside world, and raising living standards. Overall treatment of the urban environment should continue to concentrate on prevention and control of industrial pollution and on infrastructure construction.

The most important tasks are to treat dust-and-smog pollution, extend the use of standardized coal for industrial and domestic purposes, limit scattered burning of raw coal, and expand coverage of central heating in urban buildings. Urban sewage should gradually be separated from rain water drainage, and raw sewage must be treated. Recycling efforts should be intensified; comprehensive utilization of solid wastes and domestic rubbish should be widened to ensure that cities are not enclosed by garbage; and industrial and traffic noise pollution should be strictly controlled. When new urban districts are built or older ones redeveloped, central heating, fuel gas-supply, garden greening, and rubbish and sewage treatment should be simultaneously planned and constructed.

4. To increase energy consumption efficiency and improve the energy consumption structure.

In order to implement the Climate Convention (Montreal), control the emission of carbon dioxide and reduce air pollution, the most effective measure is to save energy. At present, China has a high energy consumption rate, and energy saving potential is big. Therefore, we should help the public raise their consciousness about energy saving and implement energy-saving measures. The energy pricing system should be gradually reformed. Coal price will be determined according to the quality, and price differential between coal products of different qualities must be widened. Construction of electric power plants should accelerate and the proportion of coal transformed into electric power should be enlarged. Large generating units should be developed while smaller generators should be replaced or renovated to save energy and lower consumption. This will help attain the target of "using 60 grams fewer of coal per kilowatt hour in 2000 than in 1990," which is a goal set by the Energy Ministry.

The proportion of coal washing and processing should be raised. Cities are encouraged to expand coal gas and natural gas use, central heating, and coordinated production of heat and electricity; and to supply urban residents with fine-grade coal. We should change the energy mix, which now centers on coal, speed up the construction of hydropower and nuclear power stations, and develop and popularize such clean energies as solar, wind, geothermal, tidal and biogas power according to local conditions.

³ The "four harmful elements" are smog, sewage, garbage and noise.

5. To introduce eco-farming, persevere afforestation and effectively strengthen biodiversity protection.

Agricultural soil and forest vegetation are important components of ecology. It is an imperative and long-term task for China to promote afforestation, enhance protection of soil and timber resources, and reverse the present deterioration of farmland and the shrinking of forest coverage. The state and local authorities should gradually increase the input in eco-farming, afforestation and forest cultivation, mobilize the initiative from all walks of life, collect funds through various channels and at various levels, and speed up soil improvement and afforestation. They should also persevere land and forests according to the law, implement felling limitation quotas, and improve the management of farmland and forests to ensure soil improvement and a stable increase in forest resources.

China is exceptionally rich in biological resources, containing reserves of enormous economic and scientific value. We should find out as soon as possible the conditions of the existing biological resources and the endangered species and further enhance their protection and rational utilization. Scientific research, rational development, and utilization of biological resources must be stressed.

Nature reserves should be expanded step by step and their construction and management should be strengthened. Protection and breeding centers for rare species and poultry, livestock, crops and medicinal plants should be built up systematically, and the protection, development and utilization of species and genetic resources and their export management should be improved. Illegal fishing and hunting and indiscriminate collection of rare and endangered animals and plants should be severely punished according to law.

6. To vigorously promote scientific and technological progress, strengthen environmental research, and develop the environmental protection industry.

Solving environmental and developmental problems depends on scientific and technological progress. Governments at various levels, relevant departments and all enterprises and institutions should, depending on which major environmental problems they have, actively study, develop or import new technologies to reduce wastes and save water and energy, and they should select, assess and spread technologies for environmental protection. Therefore, more input should be made in this field.

The development of the environmental protection industry must be guided correctly and supported vigorously in order to quickly transfer scientific and technological achievements into real capability of pollution prevention and control. Priority should be given to the development of the environmental protection industry. Advanced and practical environmental protection facilities should be developed and popularized. Production of green or organic products should be actively encouraged. A system of product quality standards should be set up to raise the quality of environmental protection products. Planning and scientific and technological departments at all levels should give full support to the construction of model projects and model zones of pollution prevention and control and nature conservation, and give priority to project approval and funding.

7. To apply economic means to protect the environment.

With the deepening of economic restructuring, the market mechanism is playing a much greater part in readjusting China's economic life and as a result the management mechanisms of enterprises are changing gradually. Therefore, governments at various levels should use more

economic means to attain the goal of environmental protection. Based on the principle of adequate payment for use of resources, remedial fees for using resources should be collected and a study on environmental tax should be conducted. The governments should also consider natural resources and the environment in the national economic accounting system, and ensure that market prices correctly reflect the environmental cost of economic activities. They should set standards for pollutant discharges from different industries, gradually increase pollutant-discharge levies, and urge enterprises to meet the requirements set by the state and local authorities on pollution treatment. Preferential policies on taxes, loans and prices should be given to projects with obvious social benefits for environmental pollution treatment, overall utilization of wastes and nature conservation. Environmental protection projects should be taken into consideration in the course of absorbing and using foreign capital. The transfer of pollution to China should be prevented when projects are introduced from other countries.

8. To strengthen environmental education and consistently raise the environmental consciousness of the whole nation.

Environmental consciousness is an important symbol of social progress and national civilization. It is a long-term task to strengthen publicity and education and exert every effort to raise the environmental consciousness of the whole nation. Departments responsible for publicity and education should exert every effort to do so. Radio, television and print media should take publicity of environmental protection as an important duty and a regular task. They should also widely publicize the principles, policies and laws and regulations of environmental protection, as well as good and bad examples in this field.

Educational and related departments at all levels should attach importance to environmental education and the dissemination of environmental protection knowledge among kindergartens, primary and secondary schools, as well as encouraging environmental protection specialties in colleges and technical secondary schools. Schools for officials at various levels should also strengthen environmental education to raise their decision-making abilities on environment and development issues.

9. To perfect the environmental legal system and intensify environmental management.

China's experience shows that to perfect the management mechanism and enhance management in accordance with the law is an effective way to control environmental pollution and ecological destruction at a time when the level of economic development is relatively low and environmental input is limited. It is also a successful experience in environmental protection characteristic of China's conditions. We should draw on the experiences of developed countries where the economy depends on the market but environmental protection depends on the government. In the process of reforming governmental institutions and economic system, environmental protection, as a fundamental function of government, is very important. Therefore, the system of environmental management should be perfected until it is working efficiently and service quality should also be raised, while the requirements of examining and approving environmental protection projects should be met as usual.

Experiences and problems existing in implementing environmental protection laws and regulations should be carefully summarized, in order to further perfect the laws and regulations and standards of environmental protection. Government authorities at all levels should support departments responsible for environmental management in monitoring according to the law, strictly enforcing the

law and punishing illegal actions. China will continue to implement various effective systems of environmental management and strengthen overall environmental administration.

10. To formulate China's action plans in the spirit of the UNCED.

Agenda 21 is the action guideline to achieve sustainable development at national, regional and international levels. It is related to all areas of national economic and social development and will be of reference value in protecting China's environment and coordinating its development. The Environmental Protection Commission under the State Council has organized related departments in an effort to work out action plans for the environment and development, which, after comprehensive balancing, will be incorporated into the latter three-year plan of the Eighth Five-Year Plan (1991-95) and the Ninth Five-Year Plan (1996-2000).

3 ENVIRONMENTAL ACTION PLAN BY SECTORS

3.1 Urban Environmental Protection

3.1.1 Background

The focus of the first stage of China's urban environmental protection was on the treatment of the sources of industry pollution. At the first National Environmental Protection Conference in 1973, it was proposed that plans be made to tackle pollution of cities, rivers, ports, industries and mining enterprises. This was to be accomplished in stages, and the first target would be the prevention and treatment of pollution sources in industrial cities. Prevention and treatment of heavy metals in industrial waste water, the renovation of urban coal-burning boilers, and the elimination of soot and dust were carried out. From 1973 to 1976, over 700 pollution treatment projects were completed in the cities. The treatment of pollution sources at this stage had partially reduced pollution in some areas; however, due to the lack of overall, scientific planning and the inadequate use of the comprehensive facilities of the environment investment, the treatment was not effective enough.

The second stage focus on the comprehensive prevention and treatment of industrial pollution. In 1978, the Chinese government stipulated that those factories that were irrationally located and were harmful to the health of their staff and workers as well as local inhabitants were to be transformed, merged, transferred or their production changed within a time limit. It was emphasized that factories harmful to the environment were forbidden to be built windward of cities, at the upper reaches of rivers, or in densely-populated areas and scenery spots. In 1979, the promulgation and enactment of "The Environmental Protection Law of the People's Republic of China" ensured that these stipulations would be legally enforceable. Thus China's urban environmental work entered a new era of "putting prevention first, combining prevention with treatment and carrying out comprehensive treatment." During this stage, guided by the plan of controlling pollution sources, the increasingly serious industry pollution was controlled by adjusting sectoral structure and innovating industrial technology. However, the prevention and treatment were confined merely to industrial pollution, while comprehensive pollution renovation of urban areas as a whole did not appear.

The third and current stage is the comprehensive renovation of the urban environment (CRUE). After focusing on the treatment and control of industrial pollution sources and the comprehensive prevention, China turned its attention to the urban environment. With the expansion of China's economy and the development of urban construction, it has become clear that prevention and control of industrial pollution along will not be enough to meet the needs of development and environmental protection. The only correct way is CRUE 9 (NEPA and MOC 1992).

3.1.2 Current Situation and Problems

By the end of 1990, China had 467 cities with a total non-agricultural population of 150 million. It is estimated that the number of cities will increase to 600 in 2000 and the urban population will increase correspondingly. China's industries mainly concentrate in urban areas, where the discharge of pollutants accounts for 80 percent of the country total. At present, the major urban environmental problems are:

- Lack of safe drinking water and of sewerage treatment capability. Establishing a sanitary drinking water supply is a major problem. In the 1980s more than 300 cities were facing water shortages, with 100 of them suffering severe shortages. About 25.4 percent of the entire population's drinking water was unsanitary.

More than 40 percent of the newly-built urban areas have no rainwater and sewage separated drainage facilities. In many cities, rain water and wastewater flow through the same pipes into rivers, or penetrate into the groundwater system. The rivers and lakes around the cities and half of the urban groundwater sources are polluted to varying degrees. At the end of the 1980s, urban wastewater generation increased by 7 percent per year; but in 1991 the whole country had only 87 municipal wastewater treating plants with the treating capacity of 3.1 million tons per day, which fell far behind the needs.

- **Air pollution.** The city atmosphere is polluted by soot, motor exhaust gas and industrial waste gas. By the end of 1990, the coverage of gas for fuel was 42.2 percent and central heating was 5.34 percent. In 1990, the city atmosphere of China contained plenty of TSP and SO₂; the annual and daily average rate of TSP was 387 micrograms per cubic meter and the annual and daily average rate of SO₂ was 96 micrograms per cubic meter; the acid rain area in southern cities of China tended to expand. It is estimated that by the year 2000, the urban coal consumption will surpass 1 billion tons a year, and the number of motor vehicles will also multiply. Therefore, the atmospheric environment will undertake more pressures of pollution.
- **Urban solid waste disposal.** The generation of urban garbage increases by 10 percent per year. Due to the lack of collection and transportation facilities, 25% of garbage in Chinese cities cannot be disposed in a timely way. Ninety-seven percent of garbage and night soil are either piled up in residential areas, or improperly berried or simply discharged into rivers, lakes and seas, without treatment. Over the past 10 years, departments concerned paid much attention to the comprehensive use and disposal of industrial solid wastes and have industrial pollution controlled; however, urban domestic waste still pollutes the environment. It is estimated that, by 2000, the total discharge volume of urban domestic waste will reach 140 million tons per year.
- **Noise.** Urban noise pollution is still serious. In 1990, the noise in active urban areas surpassed the national noise emission standards, and more than half of the city residents were disturbed by noise.

3.1.3 Targets

There are two levels of environmental targets: (1) macro or regional environmental targets; and (2) urban environmental programs. Urban construction planning is done in conjunction with environmental planning to determine development plans.

The general goal of urban environmental protection is: by the end of this century, the environmental quality of municipalities, large cities, and tourist cities should reach national standards; the environmental quality of the coastal developing cities should reach national standards; and the environmental quality of the major industrial cities should be improved. A drive to control urban environmental pollution will also be launched to make environmental protection keep up to synchronize environmental protection with social and economic development and pave the way for the creation of a clean, beautiful and serene urban environment.

- **Water supply and sewerage.** By 2000, the quality of drinking water in all the cities should meet the national standards. The tap water coverage in Chinese cities should reach 95 percent with a daily water supply of 200 liters per capita, the reusing rate of industrial water should be 60-65 percent. The total

discharge volume of urban sewage should be controlled below 40 billion tons a year, of which industrial wastewater must account for less than 24 billion tons; the central treatment ratio of urban sewage should reach about 20 percent; the displacement of COD in the urban sewage should be less than 10 million tons, of which COD from discharged industrial wastewater must be less than 6 million tons.

In 1995, the urban sewage centralized treatment rate should reach 10-15 percent. And sewage networks in urban areas should be basically completed, covering no less than 65% of all urban areas.

- Atmospheric pollution control. In 2000, the national urban discharge volume of SO₂ should be less than 16.5 million tons, soot less than 10 million tons, industrial dust less than 5 million tons; the treatment rate of the industrial waste gas should reach 90 percent. Among all the key cities, 80% of them must reach the national third-grade standards for air purity. TSP and SO₂ in the atmosphere should be reduced.
- Urban solid wastes treatment. In 2000, the treatment rate for urban garbage and night soil should reach 20 percent; the comprehensive utilization ratio¹ of the industrial solid wastes should reach 38-40 percent.
- Noise control. The noise level on major traffic lines should be controlled to at least the same standard as that of 1990. In 1990, 50-60 percent of the urban environmental noise met the national standards of noise emission. In 2000, 60-70 percent of urban areas meet the national standards of noise emission and the average value of the environmental noise should be less than 60 decibels.
- Urban afforestation. In 2000, the urban per capita share of forested area should reach 7 square meters.

¹ The comprehensive utilization ratio is estimated according to statistics from annual reports from factories. Every factory makes an annual report on: production, waste generation, and recycling of wastes. The comprehensive utilization ratio is then calculated by dividing reused waste by total waste generated.

Box 3.1

Quality Assurance of Urban Environmental Data

The quality assurance/quality control of urban environmental data is accomplished by:

- the requirement that factories register waste discharges with local EPBs;
- the requirement that a factory must get a license for waste discharges; and
- the measurement of actual waste discharges by local monitoring stations. These monitoring stations focus on the larger enterprises that account for 65 percent of the total pollution in China. EPB professionals run these monitoring stations. Violations of discharge standards are reported to professional enforcement agencies.

Quality control or quality assurance of laboratory results is accomplished by:

- daily sampling and analysis by environmental protection personnel in the factories;
- regular inspections by EPB monitoring stations. They also take samples for comparative analysis during these inspections;
- investigations by a third party, usually an upper level EPB if there is a great discrepancy between factory data and EPB monitoring; and
- serious problems will be handled by the State's General Station of Environmental Monitoring.

3.1.4 Strategy

1. Urban construction needs overall planning.

Strategic policies of urban development call for the down scaling of big cities and the development of medium and small cities.

2. Make great efforts to strengthen the construction of the urban water supply facilities.

Through technical renovation and increasing the capacity of water supply, efficient water consumption and water saving measures will be strengthened. Accelerate the construction of the urban drainage and sewage treatment networks, and flood-control facilities. By 1995, 7,000 kilometers drainage pipes will be laid; a batch of wastewater treatment plants will be built; the daily treatment capacity will be increased by 2.5 million tons to bring the total urban wastewater treatment capacity to 5.5 million tons per day. Meanwhile, efforts will be strengthened to conduct research on techniques of wastewater recovering and treatment, such as discharge into rivers and seas; and develop a number of pilot projects.

3. Continue efforts to increase coverage of using gas for fuel and central heating in urban areas and promote the application of using briquette and other types of cleaner energy.

By the year 2000, the coverage of using gas for fuel in urban areas will increase from 42.2 percent in 1990 to 60 percent; central heating coverage will increase from 210 million square meters of construction space in 1990 to 470 million square meters.

4. Construction and maintenance of urban roads and public transportation facilities should be improved to reduce the pollution from noise and automobile exhaust.

Box 3.2**Guidelines for Chinese Urban Development**

In the long-term process of development, large numbers of cities emerged in China. By the end of 1990, there were 467 cities with almost 150 million non-agricultural population. Among these cities 20 are large metropolises with a population of over 1 million each. City groups have emerged such as Beijing-Tianjin-Tangshan, Shanghai-Ningbo-Hangzhou, Central and South Liaoning, and the Pear River Delta. Historically, China's large cities have had large populations with a high concentration of industries, serious pollution problems, and a severe shortage of infrastructure and housing. For example, in 1990, the population of Shanghai, China's largest city, was 13.3 million, among which 8.21 million were concentrated in the city core area, which accounted for only 5% of the greater Shanghai. The population density in the city core area was 10,000 per square kilometer and in six most crowded blocks, the population density had exceeded 160,000 per square kilometer. The per capita share of road in Shanghai was only 2 square meters, which was far lower than that of London and Paris. A large amount of wastewater was discharged into Huangpu River, which caused water pollution. The dust and noise pollution was very serious. The per capita share of housing was below the national average.

With the high-speed development of Chinese economy, more rural people will flow into cities. It is estimated that the number of cities will grow to 600 by the year 2000 and the urban population will increase sharply. If no control measures are taken, the problems in existing large cities will be more acute and newly built large cities will confront difficulties too. Therefore, in the early 1980s, the Chinese government formulated the policy of "strictly controlling the growth of large cities and rationally developing medium and small cities" so as to encourage the development of large numbers of medium and small cities and towns to avoid the "large city disease" and promote social and economic development in localities as well as protect the environment.

5. Efforts will be made to accelerate the construction of urban infrastructure and establish a pricing system for the use of public utilities.

At present, the tariffs of public utilities and services are completely out of proportion with their costs, and public utility sector is suffering losses and difficulties of poor maintenance and disrepair. To solve this dilemma, the principle of "using self-generated revenue to support their own development in water supply and road construction" will be applied.

6. The development of urban construction should synchronize with efforts of environmental protection and rationalization of urban land use.

In 1995, zoning according to urban activities in large and medium cities and corresponding environmental quality management plans will be completed. The pollution generating industries should be banned from the residential areas, scenic spots and water sources.

7. Efforts will be strengthened to comprehensively treat and control urban pollution and to establish monitoring and management systems. The system will be gradually extended to all large and medium cities.

8. Strengthen supervision and control over mobile polluting sources.

Emission standards for nitride and oxide will be formulated; emission monitoring methods will be unified and automobile exhaust emission standards will be rigorously applied.

9. Strengthen urban afforestation.

Voluntary participation by the people in tree and grass planting in urban areas will continue and be encouraged. Every city must establish a number of afforested districts and gradually enlarge urban green areas to reach the planned targets of 5 square meters per person in 1995 and 7 square meters per person in 2000.

Box 3.3**Comprehensive Renovation of Urban Environment**

Quantitative monitoring of comprehensive pollution treatment and control of urban environment is led by city governments. With a scientific and quantitative index system for the treatment and control of urban environmental problems, and with social and economic benefit as its goal, the programme will quantify comprehensive treatment and control.

The targets are divided into three aspects: environmental quality, pollution control and the building of public facilities. It includes five items: atmospheric protection, water protection, noise control, solid waste treatment and urban afforestation. There are 21 targets in all. After considering how much a target influences urban environmental qualities, how difficult it is to carry out, and how much it improves the environment, the proportion of different targets is decided. The marks of quantitative examination for comprehensive treatment of the urban environment are computed on the sum of all of the targets, respectively multiplied by their own proportion. At the beginning, only 37 important cities, like Beijing, Shanghai and Tianjing, are checked. Other cities are checked by provincial governments and autonomous region governments. Inspections are carried out annually. The cities are listed according to their marks and published to the whole country.

Implementation of the quantitative monitoring system of comprehensive treatment of urban environment can mobilize all sectors and urban residents to take part in the movement of the environmental enhancement, improve management on environment, and strengthen the prevention and control of industrial pollution and the construction of public facilities. All the above are important to realizing urban environmental targets.

3.1.5 Major Fields and Priority Programmes**1. Urban sewage disposal and reuse**

In the 1990s, the treatment capacity of polluted water in urban areas should increase by 6-8 million tons per day, underground sewage pipe should be extended by 240,000 kilometers so that the annual discharge of organic pollutants will reduce by 350,000 tons. The urban wastewater treatment plant with the daily capacity of 200,000 tons is suggested to be built in Shenyang, Tianjin, Nanjing, Shenzhen, Jinan, Qingdao, Dalian, Fuzhou, Zhenzhou, Hankou, Kunming, Chongqing and Beijing. Meanwhile, water reusing projects should be built.

2. Urban fuel gasification

In the 1990s, the daily capacity of natural gas supply should increase by 8 million cubic meters, the daily capacity of gas supply should reach 16 million cubic meters, the annual capacity of liquified gas supply should increase to 650,000 tons. After the completion of the urban fuel gasification programmes, stove soot will be reduced by 2.25 million tons per year, and SO₂ emission will be reduced by 1.75 million tons per year; the number of urban residents using gas will increase by 90 million. Major gasification programmes include: the Gas Project of Corporation Beijing, the Gas Project of Harbin, the Gas Project of Shanghai, the Natural Gas Project of Chengdu, the Natural Gas Project of Xi'an, the Gas Project of Tangshan.

3. Central heating

In the 1990s, it is planned that central heating coverage will increase to 275 million square meters of construction space in the whole country. As a result soot discharge volume will be reduced by 2.2 million tons and SO₂ 900,000 tons if the following large programmes are completed: the central heating projects of Beijing, Taiyuan, Changchun and Lanzhou, and Xi'an. In addition, if the capacity of briquette production increases 30 million tons, soot discharge will be reduced by 700,000 tons and SO₂ by 450,000 tons.

4. Urban garbage disposal

In the 1990s, a number of urban solid waste treatment plants will be built and the annual treatment capacity will increase by 55 million tons.

Two examples of urban solid waste disposal projects are: (1) Harbin and Shijiazhuang, landfills with leachate collection and treatment, but no gas collection since most of waste is coal ash, and would not generate a significant amount of methane; and (2) the Shenzhen municipal incinerator. The current annual urban waste generation in China is now 100 million tons. There are waste disposal facilities with some manner of environmental controls for about 20 percent of the total quantity generated. Most big cities have landfills, with leachate collection, and some have leachate treatment systems. The program for the future is for most cities to build landfills. It is planned that the increase in environmentally controlled disposal facilities will exceed the increase in waste generation. Recycling of Urban Waste: In the past urban waste was used as fertilizer; but now the components have changed, and the waste can no longer be used as fertilizer, so another disposal method must be used. The separation of wastes for recycling is not fully developed in China, there are no such facilities. There is a small plastic recycling industry beginning in China. Consumers sell the waste plastic to transporters, who sell to recycling plants. NEPA does not have statistics on the volume of this industry. China is just beginning to officially consider recycling programs.

3.1.6 Implementation and Monitoring

Urban environmental protection is based on "the Environmental Protection Law of the People's Republic of China". According to this law, a municipal government is responsible for the environmental quality of the city, in particular, the mayor is personally responsible.

The municipal government will organize relevant agencies at the municipal level to deal with environmental protection issues. For instance: (1) The urban construction bureau is responsible for water supply, sewerage, drainage, central heating; and (2) as for urban pollution sources, relevant industrial departments are responsible for organizing enterprises for treatment of pollution. The enterprises themselves are responsible for controlling pollution. Many municipal departments are involved in environmental protection management. The control of air pollution, for instance, involves authorities of urban construction, energy department and materials department. The control of water pollution involves the administrative organizations of industry, urban construction and water conservation. The control of noise pollution involves the administrative organizations of industry, transportation, and public security. The control of garbage pollution involves the administrative organizations of industry, urban construction and materials. To ensure that the various departments of the municipal government share responsibilities of improving the urban environmental quality, as well as pollution prevention and treatment, a powerful environmental administrative body should be created.

Every year environmental protection organs conduct inspection on environmental quality of each urban district. NEPA is responsible for 37 major cities, other cities are examined by the provincial EPBs. The results of the quantitative NEPA examinations are compared between cities. The top 10, and bottom 10, are published in the newspaper. The mayors of top-10 cities each receive an award. The mayors of the environmentally worst ten cities will be criticized in newspapers. Progress towards environmental goals is monitored by the EPBs. The local EPB is under the control of the mayor; but the mayor must report to the upper level (provincial) EPB. The environmental data are collected yearly by the NEPA environmental monitoring network.

3.2 Energy

3.2.1 General Features and Problems

China is one of the few countries in the world that use coal as a major source of energy. The coal takes up 70 percent of the non-renewable energy. From 1980 to 1990, China's raw coal consumption increased from 620 million tons to 1.08 billion tons. It is estimated that its consumption will reach 1.4 billion tons in 2000. This kind of energy structure is the main reason for the discharge of large amounts of CO₂, SO₂, soot and solid wastes.

Every year, over 100 million tons of coal gangue is produced, only 23 million tons of which is reused. After many years, the accumulated coal gangue has reached 1.2 billion tons. In China, there are 1,200 coal gangue mounds, among which, 110 mounds are spontaneously burned. The spontaneously-burned coal gangue mounds discharge a great deal of SO₂, CO₂, nitride, oxide, hydrogen sulphide and soot which pollute the local environment.

The waste displaced from coal mines and the coal-washing water have a high content of suspension solids and other pollutants, which are the important polluting source of water. In addition,

Box 3.4 Laboratory Quality Assurance/Quality Control (QA/QC)

1. NEPA has standard sample and analysis techniques, and the Manual of Lab Practices is distributed to NEPA labs, as well as to enterprise environmental labs. Both sampling and methodology for analysis have been standardized.
2. Labs have to pass a reference test; NEPA sends out spiked samples and blanks to test lab accuracy every year. Personnel must pass a test before being assigned to a lab post.
3. At the NEPA bio-ecological center and other NEPA designates, there is a department that deals exclusively with laboratory reference materials.
4. This QA/QC system is in place in the China National Environmental Monitoring Center that belong to NEPA.
5. The enterprises would have their own QA/QC references through guidelines of the China National Environmental Monitoring Center, according to the type of contaminant. These labs are standardized by analysis of the reference materials.
6. The tests the enterprises use are not sponsored by NEPA, but by the industrial ministries. The industrial ministries have their own environmental institutes. The QA/QC programs are run by the industrial ministries, not NEPA.
7. Since environmental monitoring is complex, NEPA does not yet have standard methods for some pollutants. (Especially for organic pollutants, international standards are used when available; but in a recent EIA analysis, international standards did not exist for the contaminant of interest.)
8. QA/QC is also guaranteed through management of China's environmental monitoring stations through professional analysis of reported data.
9. In 1990 there were 200 standard environmental monitoring sampling and analysis techniques. These standards are not only for QC; there are 13 standards for QA. There are 145 standards methods for analysis, and also standard methods for sampling technique and data processing.

the collapse of coal mines also causes great damages. Now the total area of collapsed mines is 870,000 hectares whose treatment is badly needed.

In China, 76 percent of the electric power is thermal power. Most power plants generate electricity by burning coal. Therefore, the power industry is the main source of atmospheric pollution. Especially in Southwest China, the coal for generating electricity has a high sulphur content. Some coal's sulphur content is as high as 3.7 percent.

At present, China's energy production and utilization technologies are still backward. The energy shortage and the energy waste exist simultaneously. The clean energy (hydroelectric power) and the high-quality energy (electric energy) account for only a small proportion of energy supply.

3.2.2 Targets

The Ministry of Energy is responsible for setting the environmental targets for the energy sector in the EAP. Targets are set by industrial category, and the discharge standards are met by a majority of the facilities. Some older facilities have trouble meeting standards.

In the 1990s, the national non-renewable energy should increase 3 percent per year and the electric power should increase 7 percent per year. In 1995, the national non-renewable energy output should reach 1.2 billion tons.

In the 1990s, efforts will concentrate on increasing the supply of clean energy such as hydroelectric power and nuclear power.

As to the coal industry, by 1995, the standard-reaching rate of the discharge of coal mine wastewater should reach 90 percent, the utilization rate 16.5 percent; 135 closed-route cycle coal washing plants will be built so that the standard-reaching rate of the discharge of coal-washing water will reach 85 percent; the utilization amount of coal gangue should reach 30.9 million tons, or 35 percent of the total discharged coal gangue.

The pollution control priority of oil enterprises is to treat polluting water and oil, and sulphur-containing gas in 1995. The reinfection rate of the polluted water should reach more than 95 percent; the treatment rate of the sulphur-containing exhaust gas should reach 100 percent and the standard-reaching rate of the discharged sulphur-containing exhaust gas should reach 90 percent.

In power plants under the direct leadership of power industry, the average dedusting rate should reach 95 percent, the discharge of soot should be reduced to less than 4.6 million tons. In the Ninth Five-Year Plan period, desulphurization demonstration projects will be built in two or three coal burning power plants. By 1995, discharge of ash into rivers will be eliminated. The comprehensive utilization of coal ash should reach 27 million tons per year. The discharged wastewater of the power industry should meet the standards. Forty percent of the power plants should build the close-route cycle systems of ash disposal.

3.2.3 Strategy And Measures

The Chinese government has implemented the guideline of laying equal stress on development and conservation of energy and formulated the following policies: with electric power as the center and coal as the basis, make great efforts to develop hydroelectric power, actively develop oil and

natural gas; make great efforts to save electricity, coal and petroleum; and increase the utilization ratio of energy to reduce environmental pollution.

1. Improve energy structure, increase the proportion of clean energy such as electric power, especially the proportion of hydroelectric power.

The electric power development adopts the guideline of laying equal emphasis on hydroelectric power and heat power, and rational development of nuclear power. The construction of hydroelectric power follows the principle of combining large, medium and small projects, and comprehensive utilization. The major areas of exploiting hydroelectric power are: the upper reaches of the Huanghe River, the mainstream and tributary of the Yangtze River, and the Honghe River reaches. Through the development of hydroelectric power and nuclear power, the proportion of thermal power will be reduced and energy supply structure will be improved.

2. Make great efforts to develop the techniques of clean coal energy.

First, raise coal refining ability and the efficiency of desulphurization and delimiting. The capacity of refining coal is now 240 million tons, accounting for 20 percent of the total raw coal. (Total coal production is 1.1 billion tons per year.) Steps to accomplish the switch to cleaner coal include: (1) limit the amount of directly burning raw coal, encourage residents and industries to use briquettes; (2) accelerate urban fuel gasification and the development of central heating (see section 3.1); and (3) abolish backward boilers, popularize new products with high combustion efficiency and low consumption of energy, like fluidized-bed and small cyclic fluidized-bed boilers.

3. Save energy.

The conservation of energy was a feasible and effective policy in the 1980s and will also be a long-term policy. In the 1990s, coal consumption for power generation will be reduced; low-efficient power plants will be renovated; existing industrial boilers and kilns will be improved; energy consumption by coal mines and oil fields will be reduced; reduce the energy consumption of electro-mechanical equipment like wine-mill generator and pump; reduce domestic consumption of electricity; reform the price policy in energy; and combine the energy-saving benefits with the investment of the conservation of energy. In order to extend the work of saving energy, the government has implemented or is implementing a series of policies: Regulations for Developing Small-Size Cogeneration and Limiting the Construction of Small Gas Condensing Heat Power Plants (1989), Regulations for Saving Civil Electricity, and Law of Saving Energy.

4. Exploit renewable energy.

China has already exploited the biomass energy, solar energy, hydroelectric, and wind energy. These renewable energy sources can solve the energy problem of rural areas, ranch areas and islands.

To control the pollution in the process of producing coal, petroleum and electric power, research on new technologies and development of equipment should be strengthened, advanced technologies should be applied and the efficiency of environmental protection fund use (furnishing with new environmental protection equipment and increasing the operating ratio of environmental protection equipment) should be improved. In addition, environmental protection administrative organs should be strengthened, the supervision and management system must be improved and environmental protection legal framework must be established and perfected.

3.2.4 Major Fields and Priority Programmes

1. Coal industry.

- Coal refining equipment and the purifying and reusing of coal-washing wastewater and mine wastewater. Although the capacity of coal washing has increased, the percentage of washed coal won't increase much since production has increased. The average ash content of coal produced in China is 25 percent, coals used for steel production are 10 percent ash.
- Desulphurization of coal of high sulphur content and the techniques of retrieving sulphur. The sulphur content in coals greater than 4 percent accounts for 3 percent of the coal in China. Desulphurization would be done on these reserves. These reserves are generally found in the southwest. Desulphurization is in the experimental stage now.
- Comprehensive use of coal gangue. Coal gangue from impurities in the coal seam could be used as construction material. Components of the gangue can be used for brick making and backfill of mines.
- Land reclamation in collapsed coal mine areas. Open pit mining is rare in China, the new mines are all of deep pits. Collapse of mines seems to be a serious problem in some areas.

2. Oil industry.

- Exploit oil in shallow sea, mudflats, desert and lake areas and the techniques of preventing and treating pollution.

3. Power industry.

- The desulphurization techniques and equipment of flue gas from heat power plants. There are no large scale programs in China for flue gas desulphurization (FGD) in power plants, because Chinese technology and equipment are not fully developed, and it is too costly to import the needed equipment. FGD technology from Japan is being developed in China, a demonstration project has been built in Chongqing City in Sichuan Province nearby the Yangtze River in southwest China. There is a serious problem of acid rain in southwest China. The loci of the problems are city centers. The damages are seen in fruit crops not bearing fruit; soil fertility reduction; and the death of many pine trees. Corrosion is accelerated in the metallic materials in buildings, and automobile (bus) lifespans are reduced by half. For newly constructed projects, NEPA requires space be allotted in the plant design for FGD.
- Comprehensive treatment of wastewater and make it resources again. Ash slurry water from ESP units in power plants will come under regulation; 40 percent of the power plants will be required to recycle ash slurry water by 1995. All power plants will be required to stop direct discharge of ash slurry water by 1995. Generally, the relevant industry ministry (in this case Energy) is requiring wastewater recycling over all the industrial sectors. Closed cycle condenser cooling water systems are used in the north where most of the power plants in China are located.
- The demonstration project of refilling coal dust into the coal pits and comprehensive utilization. A demonstration project for backfilling coal pits with coal ash from power plants is included in the Eighth Five-Year Plan.

4. Save energy.

- Renovate low-efficiency sets in old power plants.
- Introduce innovation in industrial boilers and cogeneration, and the energy-saving techniques of industrial kiln.
- Use energy-saving techniques and equipment in power generation, transmission and distribution
- Use energy-saving techniques in industries of high consumption of electricity, like electric steel, ferro-alloy, and electrolytic aluminum.
- Use petroleum-saving techniques in motors.
- Use social energy-saving techniques and consumer products.

5. Control pollution from coal burning.

- Equipment and techniques of desulphurization and denitration of flue gas from coal-burning boiler. The most serious air pollution in China is soot. In the southwest the sulphur oxides problem is serious. Work has just begun to address the problem. FGD and NO_x reduction refers to industrial boilers. Bench scale and industrial scale experiments are being carried out. The State Science and Technology Commission is conducting an experiment with desulphurization and denitrification in a 10-ton boiler. This technology will be spread throughout the south of China. Lack of funds slow progress of the program. China is cooperating with Japan in this research, and a program will be implemented by 2000, depending on availability of funding.
- Large-scale Fluidized Bed Combustion. Large fluidized bed combustion is for use in power plants, the subject is under study by Tsinghua University, but no industrial scale demonstration project has been undertaken yet. Technology and equipment is available abroad but it is too costly and does not fit the Chinese situation, so China will have to develop the technology indigenously.
- briquettes for industry and domestic use, and burning sets. Briquettes burn more efficiently and reduce air pollution. An additive is put into the briquettes to reduce sulphur emissions. The additive is black liquor recovery sludge from paper making, plus calcium oxide. Coal briquette burning sets for industries are being developed, and those for domestic use have already been developed. There are two kinds of briquettes in China, one is moulded before transport, the other is moulded on site just prior to burning.
- Techniques of wet dust removal. Technologies for wet dust removal from small and medium sized boilers (4-10 tons) have been introduced in the last ten years and are quite commonly used; but no statistics are available. Alkali scrubbers for desulphurization are also used. This technique has been applied in many different types of industrial boilers.
- Comprehensively use desulphurized slags. China has some demonstration projects in treatment and comprehensive use of desulphurized slags. Treatment of desulphurized slag is very important. This program is in the research phase now, to find additional ways to use the desulphurized slag.

6. Techniques of controlling pollution of automobile exhaust gas.

Auto exhaust gas is potentially a big problem in Chinese cities. China is implementing a project with the World Bank to address this issue, to be carried out by 1995. This is a research project.

3.2.5 Implementation and Monitoring

NEPA will ask the enterprises to make a pollution control plans. Key enterprises are required to have detailed inspections of waste generation and misuse of raw materials, including energy. The first step of the plan is to check the use of raw materials, energy, water, and waste discharges. The procedure is mandatory but the system of implementation is not perfected.

Inspection will be conducted every 5 years, and every year there will be a brief review and update. With the supervision of related industrial sectors, the enterprises themselves have adequate staff to carry out inspections. Specialized people are being trained by line ministries under NEPA guidance. This is an ongoing program.

3.3 Industry

3.3.1 General Features and Problems

In the 1980s, China's industry had rapidly developed. The gross industrial output value in 1990 was 3.3 times as high as that in 1980 with the annual average increasing rate of 12.6 percent.

Now, China's industry is still faced with the problems of backward technology, outdated equipment, enormous consumption of energy and big discharges of pollutants from unit products. The large numbers of widely scattered small factories and township enterprises created considerable difficulties in pollution control and management. The toxic wastes of the chemical industry and metallurgical industry are slowly accumulating and pose a latent menace. The industrial pollution load accounts for more than 70 percent of the country total. Therefore, to control industrial pollution is still one of the focal points of environmental protection in the 1990s.

Despite significant progress in the past decade, environmental protection in the chemical industry is still lagging behind the demand of development in chemical industries and the requirement of the State. The pollution of urban and rural environments remains serious. Currently, the amount of wastewater, waste gas and waste residue discharged by the chemical industries account for 20 percent, 5 percent and 8 percent respectively of that of the entire industrial sector. The amount of toxic substances such as mercury, phenol, chromium, cyanogen, ammonia-nitrogen discharged by the chemical industries ranks foremost among all industries. Though the reasons are multitudinous, the chief ones are: lack of environmental protection consciousness on the part of some leading cadres, impotence in law enforcement, as well as ineffective management; difficulty in controlling industrial chemical pollution for which heavy funding is required; inferior technologies with intrinsic environmental problems in many medium and small enterprises; and unavailability of cost-effective pollution control, because of the shortage of reliable and economic technologies for the control of certain pollutants. The environmental protection leading group of the Ministry of Chemical Industry has completed an outline for industrial chemical environmental protection in the Eighth Five-Year Plan period. The outline defines that in the future, industrial chemical production and construction must be developed in coordination with corresponding development in environmental protection, and that economic benefit, social benefit and environmental benefit must be unified. Also set in the outline are specific tasks and targets for the chemical industries.

In the metallurgical industry, specific problems have been identified as of priority importance: lower levels of partial technological equipment for metallurgy and the higher consumption of materials and energy; the emissions of partial waste gas and wastewater cannot meet the levels specified because of unmatched and incomplete environmental protection facilities; problems of treating low

concentrations of SO₂, dedusting of charging coke oven and pushing out coke, removal of coking wastewater, ammonia and nitrogen treatment; entrainment at the dry slope section of a tailings dam; treatment and utilization of special blast furnace slag; treatment of noise from steel rolling; and shortage of funds for environmental protection (Ministry of Metallurgical Ministry undated).

3.3.2 Targets²

The major tasks of preventing and controlling industrial pollution are: effectively reduce the discharge of toxic matter, try to reduce the discharge of pollutants of every 10,000 yuan-worth output; control the displacement of the chemical oxygen demand substances in waste water; enhance the ability of treating SO₂; increase the comprehensive utilization rate of the industrial solid wastes; gradually develop the central disposal of toxic matter; mainly prevent and control the key polluting sources of 9,000 enterprises whose industrial pollution load takes up 85 percent of the total industrial pollution load of China.

In 2000, the discharge of the total industrial wastewater should be less than 30 million tons; the discharge of wastewater of every 10,000 yuan-worth output should drop to 120 tons; the disposal of industrial wastewater should reach 24 billion tons with the treating rate of 84 percent; the discharge of SO₂ should not surpass 18 million tons; the discharge of soot should not surpass 14 million tons; the discharge of industrial dust should be less than 7 million tons; the treating rate of industrial waste gas should reach 90 percent; the treating rate of industrial solid wastes 95 percent; the comprehensive utilization rate 45-50 percent; the treating rate of toxic wastes 5-10 percent.

The industries that most need to control pollution are the chemical industry, the metallurgical industry, the building material industry and the light industry.

In the chemical industry, the water reusing rate of large and medium enterprises should increase 25 percent in 1995 than 1990 and the discharge of industrial wastewater should reduce 30 percent in 1995 than 1990; the pollutant discharge of one ton chemical products reduce 20 percent; both the treating rate and the standard-reaching rate of the chemical technological waste gas should increase 20 percent than in 1990; the discharge of chemical industrial dust should be less than 270,000 tons in 1995; all the exhaust gas of an enterprise with annual yield of 40,000 tons sulphur acid should be retrieved or treated.

The environmental protection leading group of the Ministry of Chemical Industry has completed drawing an outline for industrial chemical environmental protection in the Eighth Five-Year Plan period. The outline defines that in the future, industrial chemical production and construction must be developed in coordination with corresponding development in environmental protection, and

² The targets are set by the specific industry ministries. NEPA is the organizer of these ministries. For some industries, standards may not be met when targets are attained, especially in the case of certain individual facilities. The metallurgical industry facilities are larger, and discharge more pollutants, so this industry has concentrated on pollution reduction and compliance goals. There are also no compliance goals in the environmental pamphlet of the Building Material Industry. (See environmental documents for the Building Materials, Chemical and Metallurgical industries listed in the references.)

The targets are set based on statistics of a region or province. After 1985, a system for environmental statistics was set up by NEPA. The environmental data is provided by the industrial ministries.

China is not yet proficient in analyzing economic losses due to pollution and environmentally wasteful technologies, although national analyses have begun; the task is complicated, since the pollution in any one area is not due to only one type of industry.

that economic benefit, social benefit and environmental benefit must be unified. Also set in the outline are specific tasks and targets for the chemical industries.

Short-term targets are: (1) By 1995, large and medium-sized chemical enterprises should raise the utilization rate of circulating water by 25 percent as compared to 1990, and reduce the emission of wastewater by 30 percent as compared to 1990. Pollutants emitted per ton product for the major chemical products should be 20 percent less than that of 1990. The pollutant emitted should conform with emission standards set by the State. (2) By 1990, chemical enterprises emitting heavy metals, radioactive substances and difficultly degradable organic substances should realize the target of completing treatment within the enterprises themselves so that the sources of pollution could be effectively controlled. For chemical enterprises located in state key protection areas and scenic tourist cities, the "three wastes" emitted should completely meet with the standards. (3) By 1995, the treatment rate and the rate of conformity with the standards for industrial chemical wastewater should be 20 percent higher than that of 1990; and 15 percent higher in the case of waste gas treatment rate. (4) By 1995, one-fifth of chemical enterprises should become clean and civilized, and the total number should reach 1,200.

In the metallurgical industry, by 1995, the treating rate of ferrous metallurgical industrial wastewater should reach 94 percent and its discharge should be less than 3 billion tons; the disposal rate of waste gas should reach 93 percent; the discharge of dust should be less than 0.68 million tons; the comprehensive utilization ratio of metallurgical slags should reach 85 percent and, in 2000, 84 percent while the comprehensively used slags should reach 47 million tons and 90 million tons in 2000.

The wastewater treating rate of non-ferrous metals metallurgical industry should reach 55 percent; the discharge of SO₂, HF, dust and industrial wastewater should maintain at least the same standard as that in 1990; the retrieving rate of industrial dust should reach 97.5 percent; the retrieving rate of sulphur from smelting flue gas should reach 75 percent and the retrieving sulphur acid should increase from 1.8 million tons in 1990 to 2.3 million tons in 1995; in 2000, the retrieving rate of sulphur should reach 85 percent and the retrieving sulphur acid 3.1 million tons.

Table 3.1 Main Indexes of Environmental Protection for the Metallurgical Industry

	<i>Level at the end of the 7th 5-year plan</i>	<i>Level at the end of the 8th 5-year plan</i>
Rate of treated waste gas	86.9	93.0
Rate of meeting standards of waste gas discharged	70.0	80.0
Rate of treated industrial wastewater	93.0	94.0
Rate of meeting standards for wastewater discharged	77.8	85.0
Reuse rate of industrial water	76.0	80.0
Reuse rate of steel slag	61.0	82.0
Reuse rate of iron slag	80.0	86.0
Dust and mud containing iron	83.0	88.0

Reuse rate of waste acid	77.8	80.0
Afforesting rate	19.0	23.0

In construction materials industry, dust discharge rate of large and medium cement enterprises should be reduced from 1.31 percent of the output in 1981 to 1 percent, and the rate of local cement enterprises should drop from 3.55 percent to 2.5 percent.

The light industry should do its uttermost to "increase production and reduce pollution" in the Eighth Five-Year Plan period. The objective is to bring down the pollutant discharge of the whole sector by 5% by 1995 compared with the figure of 1990, and 10-20% by 2000 compared with 1990. In paper making industry, large and medium pulp enterprises are required to retrieve all the alkali to reduce the organic pollution load by 10 percent and, in 2000, 20 percent. In sugar refineries, a number of enterprises will be upgraded to meet the national standards on wastewater discharge in 1995. Factories in food processing and fermentation trade should increase the comprehensive utilization rate of highly concentrated organic wastewater, and the discharge of pollutants should be reduced by 20-30 percent in 1995 compared with 1990. Leather processing factories should take measures of comprehensive treatment of wastewater. By 1995, 50 percent of the enterprises should be treating wastewater and 10 percent of the enterprises should reach the national standards of emission.

3.3.3 Strategy

Continue to implement the system of environmental impact assessments, "three simultaneousness," and charged emission of wastes; strengthen environmental management; perfect environmental protection supervision and monitoring systems; implement existing laws and regulations and gradually improve them; set up the environmental protection inspection system and the system of pollutants-discharging permit, and pay great attention to the prevention and control of industrial pollution.

Strategies for industry include:

1. Promote cleaner production technology

The priority is to encourage technical renovation aimed at saving energy, water and raw materials and to adopt technologies that produce least pollutants, thus bringing pollution treatment to the whole process of production rather just at the end, therefore eliminating pollutants in the process of production.

The Ministry of Chemical Industry demands that enterprises tackle the problem of environmental protection by dealing with the sources of pollution and by linking technical renovation with eliminating pollution. Policies have been set up to guide the technical transformation, clearly pointing out what technology should be used by each industry, what technology should be used only in limited cases, and what technology should be prohibited entirely, so as to achieve unity of economic benefit with environmental benefit.

The Ministry of Chemical Industry formulated a series of regulations concerning technical renovation: replace the one-rotation-one-absorption water-washing flow process in sulphuric acid production with the double-rotation-double-absorption acid-washing flow process; replace the open calcium carbide furnace with the closed furnace; and replace the mercury method in caustic soda

Box 3.5

Environmental Audits

The basis of environmental audits is a NEPA rule, "Total Amount Control of Pollutants," that is based on experience gained from similar U.S. and Japanese systems. The capacity of the environment to absorb pollution is limited; therefore, the purpose of the permit system is to limit the total pollutant loading so as not to exceed the "carrying capacity" of the environment. Based on modelling of the environmental carrying capacity, the local EPB will issue pollutant discharge permits. The registration system is to determine the type and quantity of pollutant discharges of the enterprises. For regulation of environmental protection, NEPA will test the system on sample enterprises. A few enterprises have done audits to see how the process works. Some cities or provinces will be taken as samples and all enterprises will undergo an environmental check up.

The EPBs at every level will be responsible for registration of enterprises in their regions. The audit is to be conducted by a combination of enterprise EPBs, and EPB or university research institute personnel. In order to model the pollutant input in any specific area, data must be complete, so every enterprise will be required to register, and those that do not register will be strictly prohibited from discharging pollutants into the environment.

The registration system and permit is an environmental management system only, and has not been passed as legislation. One of the "Eight Systems of Environmental Protection in China" is the "Principle of Governments shall be responsible for environmental quality." Administrations at all levels (provincial, county and municipal) have the same responsibilities and liabilities as managers. There is a network of institutional structures that have authority to effect environmental protection actions. Enterprises are also included in this system and are under the control of several authorities: the relevant industrial ministry's local representative and local EPBs, as representative of the local government (see also Kunmin and Guilin 1992). In China there are no criminal penalties, since the enterprises are part of the government; but enforcement tools include fines on the enterprise, notification of order to cease operations, deadlines for compliance, and fines levied on the enterprise leader.

production with the ion membrane process.

The Ministry of Light Industry decided to mainly develop the economic and practical pollution-treating techniques of the industries such as paper making, fermentation, leather making and electroplating. The paper making industry should study the techniques of retrieving alkali and treating black liquor and the techniques of comprehensively using wastewater in bleaching process; the food fermentation industry should first study the comprehensive utilization of highly concentrated organic wastewater. For example, new electroplating techniques that do not produce wastewater should be studied.

The building material industry has decided to make technical innovations with saving energy as a focal point so that the energy consumption drops year by year and the atmospheric pollution is alleviated. The cement enterprises will study and choose the highly-efficient dedusting techniques and equipment as the important measures of controlling the dust pollution and increasing the economic benefits.

2. Develop and extend the techniques of comprehensively using industrial "three wastes."

The non-ferrous metals metallurgical industry mainly extends the techniques of recovery of SO₂ from smelting flue gas for producing sulphuric acid, retrieving and comprehensively using industrial dusts, and producing cement with red mud.

The metallurgical industry brings the techniques of recovering and purifying converter gas, of saving water, of using steel slag, of treating water and of stabilizing water quality into the state's important extension plan; and lists the water supply system of iron and steel enterprises and the reusing of water as new research programmes.

The building material industry must develop the residue heat for industrial and civil heating and the products' further processing, separate and retrieve the usable matter from the "three wastes," and comprehensively use the solid wastes such as coal ash and coal gangue from different trades. The chemical industry will extend and apply the existing techniques of multi-purpose comprehensive utilization. An example of comprehensive utilization in the Fertilizer Industry is: after the Weifang Fertilizer Plant of Shandong adopted the techniques of cooling water and closed-route cycle retrieving water, the water consumption in producing 1 ton of ammonia dropped to 32 tons. If its techniques are extended in the small fertilizer plants of China, 3 billion tons of water will be saved per year. The light industry has achieved environmental and economic benefits by applying the techniques of producing protein feeds from leather slags and producing monocell protein from MSG wastewater. The waste liquor from making wine and sugar can be fermented in an anaerobic digester to produce biogas and protein feeds; the leather industry should study the more economical techniques of retrieving chromium waste liquor. It is one of the major counter-moves of treating environmental pollution in the 1990s to widely extend the existing techniques of comprehensive utilization and further develop new technologies.

3. Strengthen the treatment of old polluting sources.

In the 1990s, treatment of old enterprises will accelerate since they are backward in technologies and equipment, have a low utilization rate of resources and energy, and produce a lot of pollutants.

The metallurgical industry has made a list of old polluting sources that need treatment; the Ministry of Chemical Industry has decided that to develop the chemical industry mainly relies on the improvement and exploitation of old enterprises and new enterprises should not be set up again. New projects cannot be built in the seriously polluting enterprises and their production should be limited. Medium and small enterprises that cause serious pollution and have no ability to treat it will be closed, forced to stop production, merged into other enterprises or switch to other products.

To set a deadline for the pollution treatment of the old enterprises is one of the China's environmental protection policies. In the 1980s, China announced two groups of projects that should be treated within a given time, and these measures had achieved good results. The local related departments also identified projects that should be treated within a given time, which quickened the pace of treating old polluting sources.

4. Concentrate efforts on pollution control and improve treatment effectiveness

The principle "He who pollutes treats" will be observed. While insisting that toxic and heavy metals pollution should be treated by the factories themselves, efforts will be encouraged enterprises to jointly treat wastewater instead of treating industrial wastewater independently, to reduce cost and increase the treating efficiency. For example, in the 1990s, centralized sites for treating toxic wastes (solid) should be built in Beijing, Shenyang, Shenzhen and other cities.

Most industries are concentrated in cities, so different enterprises can cooperate to treat wastewater. For instance, the Jizhuanzhi Wastewater Treating Plant of Tianjin has treated the

industrial wastewater of 650 factories and the sewage of 3 districts of Tianjin; it has also treated the wastewater of heavy metals of 37 factories and 70 percent of the wastewater pollution of heavy metals in Tianjin.

5. Rationalize Industrial Allocation

Box 3.6 Environmental Protection Measures for the Chemical Industry

In order to achieve the above goals, the Ministry of Chemical Industry intends to take the following measures:

1. Carefully summarize the experience in the enforcement of the environmental protection plan for the Chemical Industry, implement the environmental protection guidelines of the "Eighth Five-Year Plan" in the Chemical Industry, identify a number of projects to control the serious pollution sources, praise the advanced units, and bring the enthusiasms and the initiatives of the leaders at various levels and the mass workers into full play.

2. Popularize the education of environmental laws and other environmental knowledge, in accordance with the principles agreed at UNCED in Brazil; raise the consciousness of leaders and workers for environmental protection; and increase their sense of responsibility for pollution control.

3. Continue to control pollution by intensifying management, updating technologies, and comprehensively utilizing the resources. In the "Eighth Five-Year Plan" period, all the new, expansion and reconstruction projects should follow the guidelines of "using advanced technology to control the old polluting sources, and reducing the total pollutant amount". Promote the application of comprehensive utilization technologies which are beneficial to the environment.

Meanwhile, the Chemical Industry has set up a series of facilities for the comprehensive usage of industrial wastes. Their output reached 12 billion yuan in 1990, more than the total amount in the "Sixth Five-Year Plan" period. Comprehensive utilization has reduced the discharge of pollutants. At present, 1.3 billion m³ of waster water, 30 billion cubic meters of waste gas and 10 million tons of drag can be recycled through comprehensive utilization.

4. Solve the environmental problems in the Chemical Industry through technical upgrading and management improvement. Shift the focus of the management for environmental technology to the selection, appraisal and dissemination of new technology. Develop new environmental techniques in a down to earth manner, and disseminate the practical techniques efficiently.

5. Guarantee the fund for the treatment of serious pollution sources in the Chemical Industry with the government's permission. Improve the investment environment, and try to obtain loans from the World Bank, the Asian Development Bank for environmental protection. Introduce new technologies for environmental protection.

6. Further adjust the product structure and institutional structure in the Chemical Industry. Eliminate a series of products which cause serious pollution; encourage the enterprises to develop products causing little pollution. Implement the licence system in the production with pollution effects; centralize and maximize the production; close, combine, transform some of the small or medium sized enterprises without pollution control facilities.

At present, all the provincial capital cities have completed their urban master plans. In some large and medium cities like Changsha, Taiyuan, Nanjing, Beijing, Anshan and Changzhou, the zoning plans have also been formulated. All the plans contain a part on environmental protection. Industrial districts and districts of other functions are divided according to their environmental characteristics and requirements, resources and other production factors, to carry out the "Total Amount Control of Pollutants." The plans that are approved by the municipal People's Congress are

Box 3.7 Chemical Industry Environmental Protection Organization

Environmental protection organizations within the chemical industry sector were founded under the Ministry of Chemical Industry and the departments of chemical industry of provinces, autonomous regions, and municipalities directly under the central government as well as large and medium-sized plants and large workshops; and full-time or part-time personnel were appointed. Under the Ministry of Chemical Industry and more than a dozen departments of chemical industries of those provinces and municipalities where the task of pollution control was heavy, leading groups headed by a deputy minister or a deputy director were set up to make decisions on major environmental issues. Thus, a managerial system was established for the effective supervision and control of environmental protection in industrial chemical production. Research and design institutions were established in the eight major research institutes and the nine design institutes under the Ministry of Chemical Industry, as well as in a number of provincial chemical industrial research institutes. Among these, Beijing Research Institute of Chemical Industry set up an environmental protection institute of over 130 persons, which was designated as the national center for environmental protection for the chemical industry. Environmental protection scientific information centers for industrial chemical research and design were established to be responsible for directing the exchange and spread of information.

An environmental monitoring center was built to conduct technical assessment and to direct the work of 23 second-grade monitoring stations established by the chemical departments of provinces and cities, and more than 500 third-grade monitoring stations set up by large and medium-sized enterprises. An environmental impact assessment center was also formed.

The Technical Center for Waste Water Treatment and the Development Center for Water Treatment Agents were set up to provide advanced technology for water pollution control and water conservation.

The Ministry of the Chemical Industry has made and promulgated regulations and rules and technical economic policies for control of industrial chemical pollution. In order to create common rules to follow in controlling new and existing pollution sources, the Ministry of Chemical Industry worked out a dozen regulations and rules according to relevant environmental laws and regulations of the State. In order to strengthen the management of chemical industries and instruct in a macroscopic manner the local industrial chemical departments and enterprises to control effectively new pollution and existing pollution, the Ministry of Chemical Industry put forward 37 technical-economic policies. All of these were based on extensive investigations and demonstration by experts, as well as on specific pollution characteristics and conditions of chemical industries. At the same time, emission standards were set up for industrial chemical pollutants including chromium salts, sulphuric acid, yellow phosphorus, calcium superphosphate, and petrochemicals. All of these regulations and rules, technical-economic policies, and pollutant emission standards were taken from practical experience, and have played a positive role in preventing pollution in new projects and in promoting pollution control of older enterprises.

legally binding. China's related laws and plans also regulate the industrial allocation. For instance, polluting enterprises are not allowed to be built near water sources. The related departments can implement their own regulations and plans. Different projects have different procedures of environmental impact assessment. Therefore, industrial allocation must be adjusted according to relevant regulations, laws and assessment. In the 1990s, the management system will further strengthened and improved to ensure that urban construction and industrial development are carried out according to the plans.

3.3.4 Priority Fields and Projects

All of the industrial priority programs in the EAP are the responsibility of the industrial ministries. Supervision of these programs is by the environmental protection institutions of the industrial ministries and the local EPBs.

Funding for these programmes comes from two sources: the enterprise themselves and the industrial ministries (the enterprises submit some portion of profits to the industrial ministries). Some research and pilot projects are supported by the state or local governments.

In the 1990s, the major fields and priority programme are as follows:

1. Iron and Steel Industry.

Mainly construct the following projects: wastewater treating sites; sintering sewage treating facilities; slag-washing water treating facilities of blast furnaces; gas-washing treating devices of converters; and wastewater treating facilities of the new and expanding projects. (The iron and steel industry comes under the Metallurgical Ministry.)

2. Non-Ferrous Metals Metallurgical Industry.

The major industrial technological waste gas treating projects are: improve the copper smelting technology of Tonglin Company; the pyritic smelting technology innovation and the dedusting project of electric furnace in Jinchuan Company; improve the copper smelting technology and treat SO₂ in Shenyang Smelting Plant; rebuild the smelting plants of Zhongtiaoshan Non-Ferrous Metals Company and Daye Non-Ferrous Metals Company; rebuild the aluminum plants of Yuncheng and Guizhou; and improve the acid producing system of Yunnan Smelting Plant.

The major industrial wastewater treating projects are: the wastewater treating projects of Dexing Copper Mine of Jiangxi, Shenyang Smelting Plant, Tongling No.2 Smelting Plant; the alkali wastewater treating project of Guizhou Aluminum Plant; the wastewater treating project for producing acid of Huludao Zinc Plant; the Dongdagou Sewage Treating Project of Baiying Company.

3. Building Material Industry.

The building materials industry is under the State Administration of Building Materials Ministry of China. The focal points of waste gas treating are 14 cement factories and 1000 mechanical kilns. The key technological off-gas treating projects are: dedusting facilities of soot from oxygen blown open hearth; dedusting systems of flue gas from electric furnaces; the dedusting facilities of sintering machines; the dedusting facilities of flue gas from heat furnaces of some iron alloy plants; the flue gas treating projects of various industrial kilns; and the purifying and retrieving facilities of flue gas from converters in some iron and steel enterprises.

4. Chemical Industry.

During the period of the Eighth-Five Years Plan, the focal points of waste gas treating are: the fluorine waste gas treating of phosphate fertilizer production; treating projects of toxic gases such as hydrogen sulphide, hydrogen chloride (from pesticide production), Chlorine gas (Cl₂ from mercury chlor-alkali plants), CO (from farm pesticide production); retrieving and reusing SO₂ waste gas (in producing sulphuric acid); adopting double-conversion/double-absorbing techniques (in producing nitric acid); treating projects for the off-gas of nitrogen oxide; retrieving dust and changing open

electric furnace into closed electric furnace (in the production of calcium carbide); hydrogen fluoride (HF) waste gas treating project (in producing refrigerant chemicals).

During the period, the key wastewater pollution treating projects are: (1) in chemical mining industry, acid wastewater and mineral separation wastewater treating projects of sulphur deposit. (2) in the chemicals-producing industry, the cyanogen wastewater treating projects in synthetic ammonia plants, and water cooling, gas producing, wastewater treating and closed-route cycle project of small synthetic ammonia plants; phosphorus wastewater treating projects of phosphate fertilizer plants, the treating projects of organic phosphorus wastewater, highly concentrated salt wastewater, highly concentrated phenol wastewater, Rogor-synthesis wastewater in farm pesticide plants. (3) in basic inorganic chemical industry, replace mercury technology in producing soda with membrane technology; the toxic wastewater treating project. (4) in organic material and synthetic material industry, organic wastewater treating project, cyanogen, fluorine and phenol wastewater treating project, mercury wastewater treating and mercury recovery projects. (5) in the fine chemicals industry, treating projects for waste sulphuric acid-containing organic matter, wastewater treating projects of heavy metals, sulphur, nitro-compounds and chlorobenzene. (6) in chemical reagent industry, heavy metals wastewater treating projects, synthetic mercury organic wastewater treating projects. (7) in rubber industry, reclaimed rubber wastewater treating projects.

5. Light Industry.

The key wastewater treating projects are: in the paper making industry, alkali recovery and white water recovery project; and in the fermentation industry, comprehensive utilization projects of MSG, alcohol, and highly concentrated organic wastewater.

6. Commercial Industry

The focus of waste water treatment is on the treatment of waste water from meat manufactures, edible oil factories and laundry industry, and on the reuse of waste water from the service industry.

The emphasis of atmospheric pollution control is laid upon enclosed production of feed and tea, and the storage of grains, etc, and also on the treatment of dust from boilers.

7. Machinery Manufacture Industry of Environmental Protection

- **Atmospheric Pollution Control:** Fluidized-bed boilers, a set of desulphurizing equipment, computerized system for kilns' energy saving, small and medium sized industrial boilers with dust-eliminating equipment, coal washing and selection equipment.
- **Waste Water Treatment and Reuse:** Treatment equipment with daily capacity of 250,000 Ts of urban waste water, multi-function treatment equipment for industrial waste water, mobile drinking water cleaner for seriously polluted water, cleaning and reuse equipment for underground water of coal mines.
- **Treatment and Comprehensive Use of Solid Wastes:** Efficient and long service life technology and equipment for the separation and selection of coal dust, sets of equipment for the treatment of urban solid wastes, reuse equipment for rubber and plastic wastes, equipment for the reuse of CFCs, equipment for the reuse of non-ferrous metals.

- **Control of Noise:** Combined noise- eliminators for wind- engines, noise- reducers for big air-compressors, noise-eliminators for diesel engines in mines and tunnels.
- **Environmental Monitoring Equipment:** Monitoring equipment for pollution source, automatic monitoring equipment for air, water and noise pollution, automatic sampling system, quick, automatic and portable environmental monitoring equipment.

3.3.5 Implementation and Monitoring

The specific industry ministries will be responsible for implementation of the EAP targets. The local EPBs will monitor the progress of the industries in achieving EAP goals. The EPB annual reports to NEPA will summarize data on progress. Interim milestones will be used to track progress, and NEPA will have annual reports and a publication on the environmental situation every year. Although such cases for industries are rare, if adequate progress is not made in the interim, the local EPB will set a deadline for the enterprise to come into compliance. If the enterprise fails to come into compliance, the facility can be fined, closed, or forced to move to another place. The local governments have the authority to do this under the environmental protection laws of the People's Republic of China.

The organizer of cooperative wastewater treatment projects would be the local municipal government, both in new industrial parks and existing industrial zones. Waste treatment facilities would be included in the development program of new industrial areas, by the municipal government. These waste treatment facilities are required by the environmental protection laws (the general law of the People's Republic of China). If problems are too serious, the upper level government will force the local government to set up industrial waste treatment facilities. The required funds for municipal wastewater treatment projects would come from: municipal maintenance fees, the enterprises, the state government (for serious problems), or loans from multi-lateral development banks or other sources.

3.4 Forests and Grasslands

3.4.1 Forests

3.4.1.1 Current Status and Problems

China has few forest resources, and its forest coverage ratio to the total territory is rather low, only 13.4 percent in 1991. In addition, the forest resources are not evenly distributed. The forest's growing stock and the trees' growth rate are rather low. The national forest area accounts for a very small part of the acreage the forestry uses. The ecological benefit of forests diminishes daily.

Forests are falling behind the need for improving the national economy and the ecological environment. The forest needs to increase its area, promote its quality and adjust its composition so as to fully play its role in improving the environment, preventing water and soil erosion, and alleviating floods, droughts and storms.

3.4.1.2 Targets

Protect existing forests and increase forest coverage and resources. From 1991 to 2000 the afforestation acreage should increase by 35,930,000 hectares, and 8,980,000 hectares will be planted by closing hillsides. That is, in the Eighth Five-Year Plan period (1991-1995), the forested area should cover 21,070,000 hectares, 5,260,000 hectares should be added by closing hillsides, and

18,130,000 hectares by adding new forest area. In 1995, the forest coverage should increase to about 14 percent. In the Ninth Five-Year Plan period (1996-2000), the forested area should cover 14,870,000 hectares, 3,720,000 hectares should be added by closing hillsides, and 13,730,000 hectares by adding new forest area. According to the plan, by the end of this century, the total forest coverage should rise to 57,160,000 hectares; the annual national growing volume of trees should increase from 275 million cubic meters in the mid-1980s to 345 million cubic meters; and the annual national consumption should be limited below 300 million cubic meters. Forest coverage should reach 15-16 percent of land territory.

3.4.1.3 Strategy

1. Continuation of National Afforestation Efforts

Through propaganda, enhance the consciousness, enthusiasm and responsibility of the people and leaders at various levels to facilitate the move of afforestation at national, local and individual levels.

2. Protect the Existing Forest Resources and Control the Consumption of the Forest Resources.

- Strengthen efforts to prevent forest fire and pests, and ban illegal felling of trees.
- Limit the cutting of trees. Regulations should be enforced so that the cutting volume and the transportation of logs must be approved by responsible departments. Logging beyond plan should be strictly controlled.
- Increase the utilization ratio of forest resources and economize timber use to reduce the drain on the forest resources.

3. Enforce Forest Administration and Management.

- Strengthen the consciousness of protecting the forest land through propaganda and education. The governments at various levels should put the protection of forest on the agenda and arrange the responsible forest and land departments to manage and protect the forest by taking effective measures.
- Tightly control the forest land use. The Forestry Law of the People's Republic of China regulates, "The legal rights and interests of the owners and users of forests, timber and forest lands are protected by law. Any unit or person cannot violate their legal rights and interests." To build project facilities or explore mineral resources should occupy no or few forest lands. Those who take over the forest land should refer to the law concerned."
- Strictly abide by the compensation rules. All the compensations imposed on the utilization of forest land are used to recover the forest vegetation and reforest the land. According to the regulations, any unit taking over the forest land should pay the compensation for the loss of forest lands and trees, and the recovery of the forest vegetation; any unit or person that temporarily takes over the forest land should give the compensation for the loss of forest lands.

- Strengthen the supervision of forest resources. Establish and improve forest administration organizations in cities, regions and provinces to keep a regular watch over the changes of the forest resource consumption and growth. Every year the responsible forest departments should investigate the change of the forest area and amplify necessary statistics systems. Meanwhile, the regulations about supervising tree felling should be formulated.
4. Value the Government's Support and Develop Diversity in Economy.
 - Abide by the principle "He who consumes timber pays," stabilize and improve the contracted responsibility system, establish a forest base for raw materials, stimulate the development of forestry under the principle "He who benefits pays." Favorable tax policies for forestry should be implemented; for example, removing the forestry farms income tax for some time. Long-term special loans with no or low interest can be granted to afforest the land. At present, because the national government's financial power is limited, various fund-raising sources can be opened up and exploited by emphasizing self-reliance with the government's support as subsidiary.
 5. Develop Forestry by Science and Technology.
 - Improve forestry management by incorporating scientific achievements into everyday practices.

3.4.1.4 Priority Fields and Projects

1. "Three-North" Shelter Belt Development Programme (including the Beijing and Tianjin Afforestation Programme).

This shelter belt stretches from Binxian County of Heilongjiang Province in the east to Uzbek of Xinjiang Uygur Autonomous Region in the west, including 13 provinces (autonomous regions or municipalities) of Xinjiang, Qinghai, Gansu, Shaanxi, Inner Mongolia, Shanxi, Hebei, Beijing, Tianjin, Qinghai, Jilin and Heilongjiang with a total land area of 4 million square kilometers, or 42.4 percent of the total land area of China. This programme will gradually develop windbreaks, sand fixation forests, water and soil conservation forests, ranch shelter belts, water conservation forests, cash forests and timber forests on the basis of protecting the existing forests, grasslands and vegetation, by means of planting grass and trees, aerial seeding, and closing hillsides and sand dunes. It helps to harmoniously develop agriculture, forestry and husbandry. A green shelter belt will then be created through planting multi-species of forests and multi-types of trees in belts, lines and spots. The programme has been further divided into three stages: the first, from 1978 to 2000; the second, from 2001 to 2020; and the third, from 2021 to 2050. By 1989, the afforested area had reached 9,130,000 hectares and 3 billion trees had been planted. The total afforested area is planned to reach 10,750,000 hectares from 1989 to 2000.

The Beijing and Tianjin Afforestation Programme that started in 1986 is scheduled for completion in 2005. By the end of 2005, forest coverage under the program should increase by 3,746,000 hectares (2,307,000 hectares from 1986 to 2000) and the forest coverage rate of the area should increase from 17.2 percent to 34.5 percent.

2. Programme on Soil and Water Conservation Forest in the Upper and Middle Reaches of the Yangtze River.

The Yangtze River is the longest river in China with a total length of 6,300 kilometers; the area and population of its valley account for 18.8 percent and 33.3 percent, respectively, of the total in China. Over a long period of time, because of irrational farming, overcutting of forests for fuel wood as well as illegal logging, vegetation has been severely damaged and the ecological environment has increasingly deteriorated. The area affected by soil erosion in the whole valley is 0.56 million square kilometers; total eroded soil in this area is as high as 224 million tons per year. The soil and water erosion is more severe in the upper and middle reaches of the Yangtze River, with more than 90 percent of this area eroded so that the social and economic development has been greatly hindered. In order to reverse this trend as rapidly as possible, the Seventh Five-Year Plan stipulated that priority should be given to the establishment of soil and water conservation forests. The Master Plan of the First Phase of Soil and Water Conservation Forest in the Upper and Middle Reaches of the Yangtze River was approved in 1989. This plan (with a projected life of 30–40 years), is designed to increase 20 million hectares of forest through devoting major efforts to afforestation. This plan is divided into two phases. The first phase, to the year 2000, is targeted to increase 6.66 million hectares of forest. The second phase is planned to afforest 13.34 million hectares within a 20-30 year period. The first phase of the programme, started in 1989 and in full swing by 1990, included 145 counties or cities of 9 provinces of Jiangxi, Hubei, Hunan, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai. Over the past 3 years, there were 2.66 million hectares of plantations established thanks to the high attention of the various levels of the government and the common efforts of the people in the project area. By the end of this century, it is designed that the forested area will increase to 13.32 million hectares (doubling the pre-project forested area), with forest coverage increased 40 percent (20 percent higher than that before the project), the soil and water erosion controlled area increased to 74,000 square kilometers, and eroded soil reduced by 400 million tons per annum. Upon reaching these objectives, various natural disasters will to some extent be reduced and the national ecological environment improved.

3. Coastal Shelter belt Programme.

The coastal line of China, starting north of Yalujiang River in Liaoning Province and ending south at the mouth of Beilun River in Guangxi, is as long as 18,000 kilometers, stretching across 195 counties (cities or districts) of 11 provinces (autonomous regions or municipalities) of Liaoning, Hebei, Tianjin, Shandong, Jiangsu, Shanghai, Zhejiang, Fujian, Guangdong, Guangxi and Hainan (Taiwan Province is not listed presently). The weather in the coastal area is very changeable and alternating between marine and continental climates, the area is always subject to natural disasters such as typhoon, storms, tsunamis, droughts and winds and shifting sand dunes, with a very fragile ecological environment. In addition to the depletion of forests in some areas, the ecological environment is being deteriorated. New China has put a significant effort in facilitating the construction of coastal shelter belts. By the 1980s the eroded area in coastal area had decreased to 3.97 million hectares which is 15.8 percent of the total coastal area and the erosion modulus decreased to 3,000 tons per square kilometer per year. However, there is still 35 percent of the cultivated land endangered by winds and sands resulting in 1 billion kilograms of grain losses. In order to entirely improve the ecological environment of the area, based on the existing achievements, the Government of China worked out the Master Plan for the Coastal Shelter belt Construction in 1988, designating 195 counties (cities or districts) of the 11 coastal provinces (autonomous regions or municipalities) as the trunk of the coastal line aiming at constructing multi-forest types, multi-tree species and multi-function shelter belt system. The target is to establish 3.55 million hectares of plantations by the year 2010. After the targets are achieved, the forests in the coastal area will be increased from 5.44 million hectares in 1988 to 9 million hectares with forest coverage increased from 24.9 percent to 39.1 percent; and 7.7 million hectares of agricultural land will be protected; soil and water erosion will be preliminarily controlled with soil and water erosion reduced by 50 percent; and

the ecological environment will be obviously improved. Since the founding of the People's Republic of China, remarkable achievements have been gained in regard of coastal shelter belt construction. By the end 1990, over 10,000 kilometers of coastal backbone shelter belts were established; Some 2.47 million hectares of farm land were protected by shelter belts and forested area totalled 6.6 million hectares; and in some areas, shelter belt systems will be completed with rational structure of appropriate forest types, good combination of belts, networks and plots with highly improved ecological, social and economic benefits.

4. Plains Afforestation Programme

There are totally 915 plain, semi-plain counties in China's 10 large plains such as the Northeast Plain, and North Plain. The plain area, accounting for 15 percent of the territory and 45 percent of the arable land where 50% of the population live, is the important production base of grain, cotton and edible oil. Owing to the sparse vegetation on the plains in the past, there were frequent natural disasters such as sand storms, droughts and floods. Therefore, soil and water erosion was very serious resulting in low and unstable grain production, shortage of fuel wood and timber and low living standards of local farmers. The Government of China has placed a high priority on plains afforestation and launched massive tree-planting campaigns with full involvement of the people. Since the mid-1970s, plains afforestation has entered a new era based on taking counties or cities as units; shelter belt networks of farm land as principal parts; windbreaks, inter-cropping and four-sides plantations as main components and making combination of belts, networks and plots. Since 1986, China has issued the afforestation standards for counties on the plains of Northeast, South and North, and worked out the development blueprint of the national plains afforestation so as to make 5000 counties (banners, cities or districts) in the Seventh Five-Year Plan period (1986-1990) and 700 counties in the Eighth Five-Year Plan period (1991-1995) reach the standards issued by the Ministry of Forestry and make all of the 915 counties reach the standards in the Ninth Five-Year Plan period (1996-2000). With the concerted efforts of the masses and government officers on the plain areas, the plains afforestation has been greatly developed. By the end of 1991, in the whole nation, there were 508 counties (banners, cities or districts) and 36 prefectures which had reached the standards of plains afforestation so that the objectives of the first stage of the plains afforestation programme have been realized. Among which, Shanxi and Henan provinces and Beijing have fully realized the standards of the plains afforestation. On the vast territories of China, it is so easy to find across the entire country the integrated shelter belt systems like belts, networks, plots and sites which link several or dozens of counties. The "sea of man-made forest" is appearing on the plain and the ecological environment on China's plains has been improved.

5. Fast-Growing and High-Yielding Timber Bases.

In order to alleviate the critical shortage of timber supply and lighten the pressure of timber production on protection forests and other types of forests with an aim of conserving existing forests in favor of ecological environment development, the Chinese Government decided in 1988 that in 30 years or so 20 million hectares of fast-growing and high yielding timber forest bases will be built. The programme in its first phase (by 2000) is to establish the bases of 6.7 million hectares of fast-growing and high-yielding forests located in Daxinganling and Xiaoxinganling mountain regions, Yunnan and Guizhou provinces as well as the Southeast of China where site conditions and technical conditions are superior. Taking mountain ranges and water systems as boundary lines, these bases are divided into 20 segments, five groups of state-owned forests (905 in all). First phase area covers 297 counties and 82 forestry bureaus. Upon completion of the first phase, it is expected that 27 million cubic meters of timber may be produced per annum by the year 2000. Around the year 2010, it will be the time for final cutting, and 370,000 hectares can be harvested yearly on rotation

basis with an annual production of 43.8 million cubic meters of wood. Up to then, the long existing shortage of timber supply will be tackled and ecological environment improved effectively.

3.4.2 Grasslands

3.4.2.1 Current Status and Problems

China's grasslands cover an area of 400 million hectares, accounting for 40 percent of the total land area. The usable grasslands cover 310 million hectares (artificial pastures 105,000 hectares). The grasslands can be divided into five parts: the Inner Mongolia-Ningxia-Gansu Steppe Area, the Xinjiang Steppe Area, the Qinghai-Tibet Pastoral Area, and the South China Pastoral Range. But inattention to ecology and stress on grassland use, to the neglect of conservation, pose a serious threat to pastures.

Illegal reclamation also has severely degraded the grasslands, and poor non-unified management has slowed pasture development. The grassland desiccation, desertification and salinization worsened and the yield of grass dropped constantly. Throughout China, 866,700 square kilometers of pasture, accounting for one-third of the total usable pastoral area, has degraded at a rate of 13,300 square kilometers per year. The pasture soil has become much less nutritious, and animal and grass resources have been seriously degraded. If no measures are taken, it is estimated that by the end of the year 2000, forage grass yields will drop 30 percent and pasture ecological conditions will further deteriorate.

3.4.2.2 Targets

In 1995, artificial and improved pasture will increase 10 million hectares and enclosed pasture will increase 6.7 million hectares to keep the grassland from degrading. Then the total artificial and improved pasture will be 20 million hectares and the enclosed pasture 12 million hectares. From 1995 to 2000, artificial and improved pasture will increase 13.3 million hectares and enclosed pasture will increase 8 million hectares. Then the total artificial and improved pasture will be 33.3 hectares, accounting for 10 percent of the usable pastoral area; and enclosed pasture will be 20 million hectares so that 26 percent of the degenerate grasslands can be improved.

3.4.2.3 Strategy

1. Enhance the Grassland Construction and Improve Degraded Pastures.

Build artificial and semi-artificial pastures by combining the national, local and individual efforts, and improve the degraded pastures. Build "grassland enclosures." Irrigate pastures with water stored in the depression from rainfall and surface runoff. Wherever possible, plough up the earth and reseed to raise grass yield. Grow forage grasses artificially as much as possible in favorable habitats. Implement rotation of grasses and crops in suitable places. Control pests, rodents and insects by scientific measures. Prevent the pollution of the grassland by insecticides and industrial wastes. Protect the natural enemies of rodents, such as weasels, hawks and foxes.

2. Improve the Scientific Management of Animal Husbandry.

Improving animal husbandry includes rationally controlling the size of flocks, regulating the composition of the stock, determining animal numbers according to available pastoral area, and

prohibiting overgrazing. Establish two-season or three-season camps for livestock. Delimit and enclose grazing areas and rotate them.

3. Tap New Energy Sources.

Solve the problem of fuel for some of the residents in pastoral areas by developing new energy sources (such as solar, wind and methane), and reduce the destruction of natural vegetation.

4. Enforce Management according to the by Law.

The Grassland Law stipulates that indiscriminate reclamation and excessive grazing should be punished by criticism, warning, fines or compensation for the economic loss. Those committing crimes shall be charged.

5. Step up the Establishment and Management of Natural Reserves.

6. Improve Grasslands by Science and Technology.

Develop grassland science by studying the grassland ecology. Introduce excellent forage grasses and enhance the studies of how to prevent pesticide damage and improve the degraded pastures. Establish a permanent supervising network of the grassland's ecology to provide scientific data for the grassland construction and management.

7. Grant Policy Support and Increase Investment.

Various fund sources will be developed. Abide by the principle "He who invests benefits." Set up the national and local special funds for managing and developing the pasture resources and a price system for using the grassland.

3.4.2.4 Major Pastoral Areas

Mainly improve the degraded pastures in the following areas: north Xinjiang and part of south Xinjiang, the surroundings of Qinghai Lake, Gannan Prefecture of Gansu Province, the Yellow River Valley Corridor, Mount Taihang and Mount Luliang.

Different types of reserves should be set up in representative areas. For example, the Yellow Mountain Shrubs Steppes of Anhui Province, the Dajihu Meadow Steppes of Shennongjia of Hubei Province, the Meadow-Steppes of Hulun Buir in Inner Mongolia, the typical steppe of Xilingol and the mountain steppe on the Tianshan in Xinjiang.

3.4.2.5 Implementation and Monitoring

MOA will be responsible for implementing these strategies. MOA has a grasslands specialist in provinces where there are grasslands and have extension workers at the township level. The State Land Management Agency had the authority to settle disputes over reclaiming land for agriculture. If in a local area, local people are degrading grasslands because this is their livelihood, the local BOA, as part of the local government would have the authority to intervene.

NPC monitors MOA and MOA monitors the DOA. Within MOA, the Energy and Environmental Protection Department has responsibility for grasslands. NEPA would be involved only for grasslands in nature reserves.

3.5 Rural Area and Ecological Agriculture

3.5.1 Farmland

3.5.1.1 Current Status and Problems

In China, the disparity between land resources supply and demand is very outstanding. The decrease in farmland poses a severe threat to the protection of land. From the 1950s until current times, farmland has decreased by 500,000 hectares every year. From 1981 to 1985, farmland decreased 480,000 hectares every year. In the year 1985 alone, farmland occupied for non-farming purposes was 1.6 million hectares. The net decrease was 1 million hectares, with 600,000 hectares of cropland gained by reclamation. Meanwhile, the population increases by 12 million each year. The decrease of farmland and the increase in population constantly reduces the per capita share of farmland, and the land is pressured even further.

In China's drive to modernize, all kinds of construction is under way at an unprecedented speed and on an unprecedented scale. Due to the increasing population, farmland will be occupied and the farmland per capita share will decrease. Therefore, in China, protection of farmland is a very challenging problem.

3.5.1.2 Targets

In a bid to meet the demands of national economy and social development in the year 2000 and to ensure self-sufficiency in grains, farmland should be over 120 million hectares. So the occupied farmland for constructions should be controlled under 3.3 million hectares and farmland should increase at least 3.3 million hectares by reclaiming.

3.5.1.3 Policies and Measures

1. Plan land use according to local conditions while an overall plan for land use is made at the national level. In order to realize the goal of protecting cropland and vegetable farms and enlarging the farmland, a series of plans should be formulated about cropland reserves, vegetable farm reserves, reclamation of land, and land use for constructions.
2. Develop diversity in the economy. For example, the farmland cultivation tax, the farmland occupation tax, the wasteland development fund and the land reclamation fund should be collected to control the occupation of farmland for projects. The compensation for using the farmland should be increased in order to enhance the ability to reclaim the land.

These funds are provided to help with the reclamation efforts but the recipient also has to put up investment money.

3. Regulate the cropland reserves to ensure farmland acreage. The high-yield field, the commodity grain base and the vegetable farms near large and medium cities are major projections. Their application forms should be under strict control, especially the non-agricultural construction.

4. Converting farmland for construction should be bound by the principle of saving lands. The conversion of farmland should better be avoided, especially the fertile farmland.
5. Protect the ecological environment and improve the land to prevent or reduce the destruction of land by the natural disasters of water and soil erosion and desertification.
6. Reclaim land suitable for farming from farmland destroyed by construction and natural disasters (especially wastelands), provided the ecological environment will not be worsened.
7. Reclaim wastelands destroyed by human and natural factors such as mine pits and brick kilns, for fields or for other use.
8. Improve the laws and regulations suitable for lands, and enforce them strictly.

3.5.1.4 Major Fields and Priority Programmes

Comprehensively develop the Huanghe-Huaihe-Haihe Plain, Northeast Three-River Plain, the Songliao Plain, the east four leagues of Inner Mongolia, south Hunan, southeast Jiangxi, the Hetao Irrigation District, the Hexi Corridor, and the Liaohe River delta. The major areas for reclamation are the Shanxi chemical industry base; the Liaohe oil field; the iron and steel base and the coal base of Liaoning; the coal bases of Shandong, Anhui and Jiangsu; the coal, iron and steel, electric power, and building materials bases of Tangshan; and the coal and oil bases of Heilongjiang.

3.5.1.5 Implementation and Monitoring

MOA is the general authority. Lands that are seriously polluted will be assessed by the environmental division of the local EPB. For some small reclamation projects, the local bureau of MOA would make the assessment.³

The State Land Management Agency (SLMA) in conjunction with MOA will be mainly responsible for land use planning for agricultural lands. SLMA suggests the general strategies, then the specific actions concerning agriculture are MOA's, such as cropland reserves or vegetable farm reserves. As in other agencies, the local SLMA monitors local measures, the state agency monitors them, and finally the NPC has overall responsibility.

3.5.2 Desertification

3.5.2.1 Current Status and Problems

China is one of the countries with vast deserts in many parts of the country. It also faces a serious problem of desertification. From the 1950s to the 1970s, the desertified land increased 1,560

³ It is difficult to define wasteland, but anything that is not cultivated would be a wasteland, with the obvious exception of forests, wetlands, grasslands or national parks. It would be hard to protect these sorts of ecosystems outside of nature reserves. For instance, in the past, the policy of diking and damming of wetlands lakes was considered reclamation of wastelands, but China is beginning to understand the ecological value of these kinds of areas and to change the way they are treated. Wasteland now is more an environmental protection term to indicate areas that, for example, have caved in from mining. The coal towns are very badly polluted, so in order to increase agriculture production, these areas are being reclaimed. Similarly, areas around polluting industries will be cleaned up and reclaimed.

square kilometers per year and the pace had increased in the 1980s to 2,100 square kilometers per year. Now, the national deserts and desertified land is about 1.5 million square kilometers, accounting for 15.9 percent of total land area in China. The deserts and desertified land are scattered across 11 provinces and autonomous regions of the "Three North" (Northeast, North and Northwest China). One-third of the total land area of China has been impacted by winds and sands. Drifting sands threaten the safety of farmlands, ranches, towns, villages, communication projects and water conservation facilities. About 130 million hectares of farmland in the "Three North" are vulnerable to strong winds and sandstorms resulting in low and fluctuating grain production. The deterioration of 1 billion hectares of pasture accelerates the loss of forage grasses, farmland and livestock; deposits sand in large numbers of reservoirs and irrigation canals; and results in traffic disruption and shortages of fuel, fodder and fertilizer in many areas. Sixty percent of China's impoverished counties are concentrated in the sandstorm affected areas.

3.5.2.2 Targets

The fight against desertification in the "Three North" area is very important. Here, a combating-desertification programme should be set up. At present, the protection and extension of the grass vegetation is the focal point to improve the desertified land. Combating the desertification in a comprehensive way mainly focuses on windbreaks and on measure to fix the sand and protect the farmland. In the area of deserts and gobi, the emphasis should be put on the protection of the existing vegetation and prevention of encroachment from drifting sand.

By the year 2000, the concrete goals of the desertification programme are based on protecting the existing vegetation and of improving 6,670,000 hectares of desertified land: 1,330,000 hectares by establishing plantations; 2,670,000 hectares by closing sand dunes; 670,000 hectares by aerial seeding; 400,000 hectares by improving fields; 1,330,000 hectares by sowing artificial, or improving existing, pastures; and 180,000 hectares by growing various medicinal herbs and economic plants.

3.5.2.3 Strategy

1. Formulate an overall plan of combating desertification. In line with the national ten-year combating desertification programme, every area can make its own plan and put forward the feasible proposals about responsibility systems, construction funds and combating desertification by science and technology.
2. Adhere to the principle of laying equal emphasis on prevention and treatment, combining treatment with utilization and combating in a comprehensive way and seeking for benefits; adhere to the principle of combining biological methods with artificial methods; achieve the ecological, economical and social beneficial effects.
3. Collect funds at various levels and through all kinds of channels. Lay emphasis on the increase of labor with the government's support as subsidiary. The local government can increase its support through various ways. The national and local governments can set up the combating desertification programmes according to local needs when granting funds for aiding impoverished areas, developing agriculture comprehensively, and building grain bases, water conservancy projects and pastures.
4. Conduct EIAs for every project in sandy areas to ensure that measures of combating desertification and the principal part of the project are completed simultaneously, in the case of new construction.

square kilometers per year and the pace had increased in the 1980s to 2,100 square kilometers per year. Now, the national deserts and desertified land is about 1.5 million square kilometers, accounting for 15.9 percent of total land area in China. The deserts and desertified land are scattered across 11 provinces and autonomous regions of the "Three North" (Northeast, North and Northwest China). One-third of the total land area of China has been impacted by winds and sands. Drifting sands threaten the safety of farmlands, ranches, towns, villages, communication projects and water conservation facilities. About 130 million hectares of farmland in the "Three North" are vulnerable to strong winds and sandstorms resulting in low and fluctuating grain production. The deterioration of 1 billion hectares of pasture accelerates the loss of forage grasses, farmland and livestock; deposits sand in large numbers of reservoirs and irrigation canals; and results in traffic disruption and shortages of fuel, fodder and fertilizer in many areas. Sixty percent of China's impoverished counties are concentrated in the sandstorm affected areas.

3.5.2.2 Targets

The fight against desertification in the "Three North" area is very important. Here, a combating-desertification programme should be set up. At present, the protection and extension of the grass vegetation is the focal point to improve the desertified land. Combating the desertification in a comprehensive way mainly focuses on windbreaks and on measure to fix the sand and protect the farmland. In the area of deserts and gobi, the emphasis should be put on the protection of the existing vegetation and prevention of encroachment from drifting sand.

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4. Conduct EIAs for every project in sandy areas to ensure that measures of combating desertification and the principal part of the project are completed simultaneously, in the case of new construction.

5. Improve the system of combating desertification by science and technology, technical supervising and service. Through different ways, train qualified personnel and popularize the knowledge of combating desertification.

6. Strengthen the management of combating desertification. Abide by the principle of arranging the construction in a planned way, building the planned project, managing strictly and checking benefits to increase the utilization benefit of fund.

A United Nations training center for desertification is in China, in Lanzhou (Gansu province); and MOA and MOF people are trained at this center.

3.5.2.4 Priority Fields and Projects

Construct the demonstration test areas of exploiting and comprehensively treating high-altitude sandy land in Horqin, Mu Us, Ulan Buh, the Hexi Corridor, the middle and lower reaches of Yongding River, Alxa wasteland, the middle and lower reaches of the Ganjiang River, saline and alkali sandy land of Xinjiang and Qaidam Basin.

Mainly treat, by recovery and rational use, the following 20 areas: the natural forest vegetation in the area from Inner Mongolia to Xinjiang; the Hulun Buir sandy land; the Songnen sandy land; the sandy land in the reaches of the West Liaohe River; the north Horqin sandy land; the Hunshandake Steppe; the land of Yanbei, Datong, Shuozhou and Xinzhou of Shanxi; the sandy land of east of Ningxia River and southeast of Tengger Desert; the sandy land of the Hexi Corridor; south of Junggar Basin; the Green Corridor of Tarim Basin; south of Tarim Basin; the desertified land in the middle of the Huanghe-Huaihe-Haihe Plain; and the sandy land of the Taklimakan Oil Field.

3.5.2.5 Implementation and Monitoring

MOA, MOF and NEPA have developed these targets and strategies, and MOF and MOA will have the primary responsibility for implementing them. Monitoring will be accomplished similarly to other environmental matters: the local EPBs and MOF or MOA offices will monitor the progress of the actions and report to their upper level departments. These departments will make field inspections and report to the central MOF or MOA ministries, which in turn report to the special committee of the National People's Congress, when necessary.

3.5.3 Water Loss and Soil Erosion

3.5.3.1 Current Status and Problems

China is one of the countries in the world that suffer serious water loss and soil erosion problems. Both north and south China have vast afflicted areas. In the 40 years after the founding of New China, 500,000 square kilometers afflicted by erosion have been treated. However, the afflicted areas are still increasing at an alarming scale because of the irrational use of land. Water and soil erosion reduces the productivity of land and results in the destruction of the Northwest Steppe and the Loess Plateau. The sand deposits raise river beds, silt up the reservoirs and lakes, and increase flooding. The impoverished areas are subject to water and soil erosion that makes them even poorer.

Water erosion areas cover 1.53 million square kilometers. The distribution of the water losses and soil erosion affected lands in China can be divided into four regions:

1. Northwest Loess Plateau. Water erosion affects 430,000 square kilometers, mainly in Shaanxi, Shanxi, Gansu, Ningxia, Qinghai and other provinces and autonomous regions where the land surfaces are mostly covered by loess. These areas are drought-stricken with less precipitation. The land is bare or vegetation is scarce. The most seriously affected regions are the areas of the loess hilly gullies and loess plateau gullies, accounting for 260,000 square kilometers, out of which 156,000 square kilometers have annual mean soil erosion of over 5,000 tons per square kilometer. The highest can reach 20,000-30,000 tons per square kilometer. There are about 13 million hectares of slope cultivated lands, most of which have a slope of 15 degrees, with the result that the lands are infertile with very low and unstable grain output. The yield is only several hundred kilograms per hectare. The gully erosion is also extremely active. The top of the gully moves ahead while the sides are expanding and the bottom cutting down, leading to the loss of farmland and the destruction of rural roads. Water losses and soil erosion have contributed to local poverty and shortages of fuel, fodder and fertilizer. In some areas, people are still struggling to obtain basic food and clothing.

Large amounts of eroded sediment are deposited in rivers and reservoirs. The Linfen Reservoir had a storage of 700 million cubic meters, but 310 million cubic meters of its capacity have been silted up after 22 years, amounting to 42 percent of the total storage. The sediment load in the Yellow River is very large in quantity. The annual mean sediment volume is as high as 1.6 billion tons, 400 million tons of which deposits in the downstream channels, raising the river beds by 10 centimeters annually. The river channels are now 4-10 meters above the land level, constituting the "suspended river," which poses serious threat to industrial and agricultural production and the safety of life and property of people in the lower reach plains.

2. South Mountainous and Hilly Areas. Water erosion, occupying an area of 460,000 square kilometers, are mainly distributed in the Yangtze River Valley and the Pearl River Basin. The soils are mostly red soil, yellow soil, lateritic soil and purple-colored soil, the origin of which are weathering granite, purple-colored sandstone and shale, and limestone. Water losses and soil erosion are the most serious. Due to high temperature and high precipitation, organic substances dissolve rapidly after the destruction of the vegetation, and the soil fertility will thus be decreased. For example, in the seriously eroded areas in the south of Jiangxi Province and the central part of the Hunan Province, red and white sand hills have been brought about that are very difficult to restore. In some areas of Canton, Jiangxi, Hunan and Fujian provinces, there also exists the drastic erosion of collapse. In these regions, the slope cultivated land covers 10 millions hectares. Many slope cultivated lands in the upper Yangtze River have a slope of over 25 degrees. Added to the thin soil layer, a lot of slope lands have been eroded and become naked rock, causing the permanent loss of land use values. For instance, in the Shenzheng special Zone of Guizhou Province, the area of the naked rock in the rocky mountains has been expanding with an annual increase of 2,100 hectares.

3. North Earth and Rocky Mountainous Areas. Water erosion, occupying 540,000 square kilometers, is mainly distributed in the upstream mountainous areas of the Huaihe and Haihe rivers, including the Taihang, Yanshan, Yimeng, Funiu, Dabie mountains and the like. Due to various reasons destruction had been very severe. The vegetation is thin and dispersed; the thin soil layers are mostly coarse. The waste mountainous areas cover a wide range and the areas of the naked rock are very large. The rainfall in the flood season is quite concentrative with more rainstorm, therefore the torrential floods and mud-rock flow are likely to occur. In these regions, the slope cultivated land covers 3.30 million hectares. The cultivated land per capita is very little and the survival rate of the plants are very low. Both the structural and biological approaches will meet great difficulties in the treatment.

4. **Northeast Black Soil Areas.** Water erosion, occupying an area of 100,000 square kilometers, are mainly distributed in the Songhua River Basin and the Daxing'anling and Xiaoxing'anling mountains. The slope cultivated land covers 6.50 million hectares. The slope is gentle, but the slope surface is very long and cultivation has been done along the direction of the slope for a long time. With the scouring of the rainfall, the layer of black soil is getting thinner year by year and the grain yield per unit is going down as well. In many areas, the surface erosion has deteriorated into the gully erosion, and the slope surface has been cut into the pieces, not only reducing the area of the cultivated land, but also aggravating the drought disaster. The upstream mountainous areas were densely sheltered by forests in the past, however, due to denudation and population increase, the wastelands have been over-reclaimed, leading to the expansion of water losses and soil erosion. The flood control capability of the rivers has dropped while the reservoir benefits are declining. According to the statistics, there are more than 40 rivers whose annual mean sediment transport exceeds 10 million tons. Sediment problems bring about many difficulties to the river harnessing, flood control, irrigation, drainage, power generation, navigation, fishery and aquaculture.

Sedimentation in reservoir is also serious. In the Shanxi Province, the annual mean storage loss is 100 million cubic meters; in the Ningxia Autonomous Region, there are 11 medium-sized reservoirs, which have 218 million cubic meters storage silted up, amounting to 45.5 percent of the total. The Gongzui Reservoir in Sichuan had a total storage capacity of 360 million cubic meters; but in 1987 it was changed to runoff power generation because of the fill-up of sediment from the impounding power generation after completion in 1976. The waterways have been silted and blocked, affecting the development of navigation.

In general, water loss and soil erosion have already become serious social problems, as well as the fundamental factor of people's poverty in the mountainous areas. It is not only harmful to the present generation, but also threatening its descendants.

3.5.3.2 Targets

Between now and 2000, do the work of protection and prevention according to local conditions in order to reduce annually the erosion-stricken areas and to control the new extension of water and soil erosion. With the increasing financial power of the state, launch the movement of treating the water loss and soil erosion and 20 million hectares of land deteriorated will be treated. Reduce deposits by 50 percent in the 14 badly-affected areas where the treatment has already begun, and by 30 percent in the 19 badly-affected areas where the treatment is going to start.

3.5.3.3 Strategy

1. Formulate and carry out the national water and soil conservation plan. According to the national plan, local areas should make their own water and soil conservation plan that should be listed in their local economy and social development plan. The departments at various levels closely connected with water and soil conservation, should be well-coordinated in treating erosion, in line with the overall plan.

2. Stick to the guiding idea of "putting prevention first." Set up key water and soil conservation reserves at the levels of state, province and county. While strengthening the treatment of erosion, enhance the protection of the existing forests and grasslands and the recovery of water and soil conservation and strengthen the strict management of the production and construction to avoid new erosion.

3. Combine erosion treatment with the exploitation of water and soil resources; revitalize agriculture and make the peasants rich; promote the enthusiasm of the local governments and peasants for water and soil conservation. Combine erosion treatment with poverty alleviation so that the farmers can obtain the economic profits as soon as possible. A micro-watershed is a treatment unit as well as an economic unit. Not only should erosion be treated, the ecological environments also should be improved. What is more important is to develop and utilize rationally, so as to upgrade the erosion areas to the economically developed areas and to turn the micro-watershed to the production bases enriching the farmers. The simple protective-type treatment should be changed to the development-oriented, thus combining ecological and economic benefits closely and stimulating the farmers' initiatives for treatment to the maximum.

The micro-watershed treatment relies on the policies for stimulating the initiatives of the farmers to contract, control and invest, ensuring that the farmers have the right to control, responsibilities for management and maintenance, and profits from the development. The treatment, management, maintenance and utilization are made into a whole, both preventing the short-term activities and alleviating the fear of disturbance. The government worked out the incentive policies to encourage farmers to set up the idea of long-term running, so as to ensure the sustaining, stable and favorable development of the micro-watershed treatment (MOWR undated).

4. In unit area, implement the overall plan and treat erosion comprehensively, concentratedly and continuously, and integrate the engineering measures, and biological measures with the measures of farming by maintaining water and soil.

5. Open up various fund-raising sources and increase investments in water and soil conservation. In addition to the national and local special funds for water and soil erosion, get the support from compulsory work days, agriculture development fund and foreign countries.

Box 3.8 Micro-watershed Treatment for Water and Soil Erosion

The focus of the strategy used by the Ministry of Water Resources is "micro-watershed treatment".

At present, the micro-watershed treatment has been carried out in 27 provinces, autonomous regions and municipalities throughout China. In accordance with the characteristics of water and soil erosion in China and the current rural productivity and operation conditions, it is clearly stated that the micro-watershed refers to the natural catchment of an area of less than 30 square kilometers, which is the linking tie to the large basins of rivers and vast areas. On this account, the implementation of the micro-watershed treatment is an infrastructure means for the river harnessing, land amelioration, ecological environment improvement and national economic development, especially for the promotion of the agricultural potential, as well as a crucial part of poverty alleviation in the vast mountainous and hilly areas.

Since the 1980s, more than 9,800 micro-watersheds have been put under treatment, a total area of 380,000 square kilometers, out of which water losses and soil erosion cover 220,000 square kilometers. There are about 3,000 micro-watersheds already completed. At present, more than 6,000 micro-watershed are being treated, with an annual treated area as large as 20,000 square kilometers.

Publicity and education efforts have begun primarily through radio, slide shows, pictures, films, videos and field trips, to show actual erosion disasters and conservation benefits. These will vary according to the audience but in general are geared toward raising the awareness of decision-makers at various levels and the masses, reinforcing the views on water and soil conservation.

6. Increase personnel and equipment in the water and soil departments at various levels in order to strengthen the ability to manage water and soil conservation projects and provide technical instruction.

7. Establish and improve the science and technology system of water and soil conservation. Popularize the scientific achievements and train qualified personnel to solve the big problems of combating water and soil erosion.

3.5.3.4 Priority Fields and Projects

1. The key treatment areas: in the reaches of the Huanghe River, the part from the River mouth to Longmen and the upper reaches of the Jinghe, Weihe and Luohe rivers; in the reaches of the Yangtze River, the upper and middle reaches of the Xiangjiang, Zishui and Ganjiang rivers, the upper and middle reaches of the Yuanshui, Lishui and Qingjiang rivers, the middle reaches of the Hanjiang River and its six tributaries such as Huayang River; in the reaches of Huaihe River, the upper reaches of the stem of the Huaihe River, the upper reaches of the Yishui, Shushi and Sishui rivers, and the upper reaches of the Honghe and Yinhe rivers; in the reaches of the Pearl River, the upper reaches of south and north Panjian River, the stem of Xijiang River; in the reaches of the Songhua and Liaohe rivers, the Daling River of Liaoning, the Huifa River of Jilin, the Wuyur River of Heilongjiang and the area along the Songhua River of Changchun; the middle and lower reaches of the Saijiang, Tingjiang, Jinjiang and Jiulong rivers.

2. Special projects: the gully-treating project in the reaches of Huanghe River, terrace-building project in poor hilly lands, the treatment of breaking granite in the granite area of south China, the warning systems of landslide and mud-rock flow in the upper reaches of the Yangtze River.

3.5.3.5 Implementation and Monitoring

1. Working system for water and soil conservation. The Ministry of Water Resources is responsible for water and soil conservation. The functioning entities for water and soil conservation have also been widely set up in the provinces, prefectures and counties under the leadership of the governments at all levels. Below the county level, the management and service station for water conservancy and water and soil conservation have been established in the townships.

2. Scientific research and extension system. There are more than 100 scientific research and extension stations and institutes for water and soil conservation above the county level in China, distributed in the eroded areas of various kinds; among them are the Northwest Water and Soil Conservation Research Institute and the Chengdu Research Institute of the Mountainous Disasters are under the conjunctive leadership of the Chinese Science Academy and the Ministry of Water Resources; three conservation experimental stations attached to the Yellow River Conservancy Commission of the Ministry of Water Resources; six Provincial conservation institutes; others are all the experimental and extension stations at the prefecture and county levels.

3. Education and training systems. There are now 12 schools of higher learning affiliated with water and soil conservation departments of specialties. Water and soil conservation courses can also be found in six middle profession schools for water conservancy. Quite a number of senior and medium technical personnel have been trained, meeting the demands of the management, scientific research and teaching. With regard to the water and soil conservation, the training falls into three categories: the normal education of the universities and colleges; the on-job technical training; and the specific operational training for farmers in the treatment areas.

4. Status of the scientific and technological information and publications. In order to exchange the experience of the conservation works throughout China, the Ministry of Water Resources publishes a monthly magazine, "Water and Soil Conservation in China;" The Northwest Research Institute of Water and Soil Conservation, "Water and Soil Conservation Bulletin;" and the Chinese Society of Water and Soil Conservation, "Water and Soil Conservation Journal." Similar publications have also been published by some provinces to exchange experience (MOWR undated).

3.5.4 Land Degeneration and Pollution

3.5.4.1 Current Status and Problems

Apart from water and soil erosion and land desertification, land degeneration and pollution of various forms are rather serious in China. Due to the intensified use of farmland and the lack of organic manure, the farmland's quality deteriorates. According to investigations, the national average value of farmland's organic content is less than 1.5 percent. The national medium and low yield fields are 86 million hectares, including the terracing land on slopes, infertile land, water-logged land, saline-alkali land, sandy land and water-short land. The salinization and irrigation related salinization are very serious. Now, the saline-alkali land reaches 27 million hectares, of which 6 million hectares is farmland. The farmland polluted by the industrial "three wastes" reaches 7 million hectares so that the agricultural production suffers a tremendous loss. Every year, China uses almost 10 billion tons of fertilizer; 50,000 to 60,000 tons of pesticides and 43,000 tons of plastic sheets. The spread of fertilizer and pesticide and the remains of the plastic are part of the reasons the land is degraded and polluted.

3.5.4.2 Targets

On the eve of 2000, improve 3 million hectares red and yellow soil into fertile soil, treat 1.33 million hectares of saline-alkali land and 2.67 million hectares of water-logged land so that the improved farmland's productivity increases 20 percent to 30 percent; treat industrial pollution, especially the pollution of township enterprises to avoid new destruction of farmland; popularize the techniques of comprehensive prevention and treatment of insect pests and crop disease and control the chemical pollution of farmland. By 1995, the national biologically-treated land should reach 33 million hectares, accounting for 20 percent of the total treated area (for disease and pests). By 2000, the national comprehensively-treated area should reach 100 million hectares, accounting for 63 percent of the total treated area.

The SLMA and MOA developed these targets; though NEPA was involved in some of the pollution control issues.

3.5.4.3 Strategy

1. Improve the organizational structure of the environmental protection in agriculture. Enhance the capacity of management organs in agricultural environmental protection; through various ways strengthen the environmental consciousness of rural leaders and peasants; train the environmental protection leaders and technicians so as to meet the demands of the environmental protection in rural areas.

2. Furnish the existing agricultural environmental monitoring station with equipment and increase the monitoring means and ability; meanwhile, set up new monitoring stations so as to form a network of monitoring the national agricultural environment with advanced equipment, various functions and

levels. Strengthen the irrigation management of the environmental protection in rural areas. Establish and improve the statistics management system of agricultural environmental protection; train qualified statisticians; furnish the necessary equipment; and build up a highly efficient information network on the agricultural environment.

These monitoring stations would inspect the quality of the soil, pest control measures and would measure insect damage and levels of pesticide residues in the soil.

3. Make technical policies in favor of the soil protection. For example, the policy of developing the township enterprises and rural enterprises with no or low pollution, the policy of rational use of the agricultural remains and the policy of preventing and treating the pollution by agricultural chemicals.

4. Develop and popularize the comprehensively-treating techniques of preventing the plant disease, extensively apply the biological measures, develop chemical and biological farming pesticides of less poison and small remains so that the farming pesticide quality reaches international standards.

5. Advocate the use of organic fertilizer, popularize the scientific techniques of applying fertilizer, rationally use the fertilizer and increase the utilization ratio of fertilizer. Recycle the worn-out plastic sheets while popularizing the techniques of plastic sheets covering. (Plastic sheets are used to raise the temperature of the soil and to hold moisture.) Develop dissolvable earth covering sheets.

6. Develop the techniques of treating the soil salinization. Improve drainage and irrigation works in the fields through water-saving irrigation and all kinds of other agricultural measures, such as the comprehensive measure of planting trees, levelling land, recovering fertile land, and rational farming. Form an excellent ecological system and develop anti-salinization crops.

7. Strengthen the management of pollutant discharges at the ranches and feeding farms. Set emission standards. Study and develop the techniques and equipment of comprehensively using the wastes from ranches.

3.5.4.4 Major Fields and Priority Programmes

The representative areas where the salinization needs to be comprehensively treated are: the Huanghe-Huaihe-haihe Plain, the Hexi Corridor, and the Hetao area between Ningxia and Inner Mongolia.

3.5.4.5 Implementation and Monitoring

MOA will have the primary responsibility for implementing these strategies and train the agro-environmental protection personnel. NEPA has the responsibility for training the environmental protection leaders and the local EPBs.

3.5.5 Rural Energy

3.5.5.1 Current Status and Problems

Eighty percent of China's population lives in rural areas where biomass resources such as crop straw and stem, firewood and cogongrass have been used in daily life for many years. The

disparity between energy supply and demand is an outstanding environmental problem that China's rural areas face. The commodity energy utilization of coal, oil and electricity in rural China was only a very small part of the total energy consumption, far below the national average. The energy shortage in rural areas has seriously damaged the ecology. On the one hand, a large number of farmers and herdsman had to collect all kinds of combustible materials, such as firewood, cogon grass, crop straw and stem (even cattle manure) as fuel for cooking and heating, which led to the over-consumption of biomass energy. On the other hand, backward and inefficient traditional stoves were used that only increased the shortage.

Due to this over-consumption of biomass energy, the forests were destroyed. Furthermore, crop straw and stem could not be returned to the fields, decreasing gradually the organic content of the soil and increasing the frequency of natural disasters year by year. Moreover, it has led to a vicious cycle of damage of vegetation, causing water loss and soil erosion, causing land desertification, causing a sharp increase of grassland desertification and degradation, causing a further decrease in vegetation, causing an increasing shortage of rural energy.

The national economic development and improvement of people's living standard will not only consume more energy, but also demand better quality energy. If effective measures are not adopted to improve the situation of insufficient supply of rural energy and low-quality energy fuels, the agricultural environment cannot be effectively protected; and agricultural production could become more insufficient, which would surely become an important limiting factor to rural economic development and to a sustained and stable increase in agricultural production. In order to provide enough energy for the agricultural modernization and to protect the ecological environment, great efforts must be made to strengthen the rural energy structure.

According to the analyses of concerned departments and experts, even if the national development rate in China is controlled at 6 to 7 percent annually, the supply gap of commodity energy will remain unsolved. It is difficult to expect the State to increase the energy supply by a big margin in rural areas, so the situation of energy scarcity will not be alleviated effectively for a rather long time. To a large rural area with a population of 900 million, it is unrealistic and might aggravate environment pollution to continue to use the traditional backward energy methods or simply to rely on increasing fossil fuels to meet energy demands. By evaluating the economic results, rural energy construction gains the output value of 150 billion yuan if one ton of coal equivalent (TCE) brings 2,500 yuan of output value. So, it is obvious to see that capacity increase of rural energy development and saving is significant in the development of rural China's economy.⁴

3.5.5.2 Targets

In the 1990s, coal and firewood saving stoves will be extended to 80 million households nationwide and will be extended to 200 million households by the year 2000; coal and firewood saving *kangs* have been extended to 5 million households in cold areas; and the grand total is 46 million households. Since energy construction in agriculture, animal husbandry, fishery and township enterprises began in the past ten years, a capacity of 10 million TCE has been generated every year

⁴ Over-consumption of biomass resources is a very important factor causing damage to the natural vegetation in China: 1,500,000 square kilometers of water loss and soil erosion, 1,090,000 square kilometers of wind erosion, and a sharp increase in grassland desertification and degradation. Agriculture is a material- and energy-intensive operation. Increasing the output of agricultural products will surely carry with it an increase in energy use as well. China is challenged considerably, therefore, to control energy use while trying to feed 22 percent of the world's population with only 7 percent of the world's arable land.

and a capacity of 20 million TCE should be generated annually by 2000. Due to the extension and application of practical energy-constructing techniques like biogas, solar energy and wind energy, family-sized biogas pits have been built with an annual increase rate of 2 percent, and 5.6 million to 6 million pits are sure to be owned by 2000. There has been an increase of 3 million square meters in solar heaters, 200,000 in solar energy stoves, 3,000,000 square meters in solar houses, 200,000 small hydro-power stations (the capacity of small hydro-electricity generators installed reached 25,000 kilowatts), and 90,000 micro hydro-power stations (the capacity of micro electricity generators installed reached 270,000 kilowatts).

3.5.5.3 Strategy

1. In the Eighth Five Years, choose 100 counties of different types and certain potential to be important counties for rural energy construction. In an all-round way, carry out the guiding idea of developing the rural energy construction. Adopt and extend in suitable places the advanced techniques of biogas, coal and firewood conservation, and solar, wind and geothermal energy. Two hundred preliminary electrification counties will be constructed on the basis of 109 completed preliminary electrification counties.
2. Reform the existing rural energy enterprises; rebuild and extend a group of enterprises to produce the facilities for generating rural energy; turn out standardized, striated and universalized products; establish and improve the construction of the rural energy industry and its service system; and strengthen the monitoring and supervision of the quality of the equipment and products that rural energy construction needs.
3. Try to save energy in daily life and production. As for the energy for living use, extend the techniques of saving coal and firewood; as for the energy in production, extend the supervision of the energy consumption quota.
4. Strengthen the studies of developing and saving rural energy. First, study the techniques of comprehensively using the biomass energy, produce better quality energy, rationally use the organic wastes, design complete sets of equipment for large and medium biogas supply stations, and comprehensively use the remains of fermented biogas. Then, study the practical standard techniques of using rural energy, regulate the criteria of solar heating according to the local conditions, develop small wind power stations, solar battery devices and controlling systems, study solar dryers suitable for agricultural by-products and medicinal herbs, promote the standardization of design, production, supervision and energy consumption of rural energy products, and study the techniques of saving energy in farming and township enterprises.
5. Strengthen the management of rural energy, train qualified personnel, extend the techniques of using rural energy, and supervise its use.
6. Raise funds through various sources for the rural energy construction. The State should continue to support the construction of small hydro-power stations and the extension of techniques of using and saving rural energy. The local governments should also give their support and encourage the collectives and individuals to invest.

3.5.5.4 Major Fields and Priority Programmes

1. Build 100 counties of comprehensively using rural energy.

2. Build 200 rural preliminary electrification counties.
3. In ten provinces or autonomous regions such as Henan, extend 1,000 brick and tile kilns for saving coal and firewood; extend energy-saving techniques in 1,500 tea-processing factories, and 10,000 tea-making stoves in 10 provinces and autonomous regions such as Zhejiang; and extend the energy-saving techniques of curing tobacco in 10 provinces or regions such as Yunnan.

3.5.5 Implementation and Monitoring

Since 1980, the State has included coal and firewood saving, biogas, firewood forests, and 11 hydro-power programmes in the national economic development plan. With the State Planning Commission as the coordinator, the Ministry of Agriculture, Ministry of Forestry, Ministry of Water Resources and Ministry of Energy are responsible mainly for the implementation of rural energy construction management. According to work divisions by rural energy type, the MOA is in charge of national exploitation and utilization of biogas, coal and firewood saving in rural areas, and renewable energy resources of solar energy, wind energy and geothermal energy in agricultural and pasture areas; the MOWR is in charge of rural small hydro-power construction; the MOF is responsible for firewood forest construction; the MOE is responsible for rural electricity networking. Because of the close cooperation among ministries, remarkable progress has been achieved in energy conservation and exploitation and utilization of renewable energy resources.

3.5.6 Township Enterprises

3.5.6.1 Current Status and Problems

In 1991, there were 19 million enterprises with 96 million staff workers and with a gross output value of 1,100 billion yuan, accounting for one-third of the social industrial output value. While the township enterprises, with the industrial output value of 850 billion yuan, have become an important part of the Chinese economy, they have turned out to be a major polluting source. In 1989, the waste gas discharged by the township's main polluting industries was 1,200 billion cubic meters (3.01 million tons of soot, 2.22 million tons of SO₂, and 140,000 tons of fluoride); the wastewater displacement was 1.83 billion tons (1.55 million tons of COD, 1.12 million tons of suspension solid matter); and the solid waste discharge was 40 million tons. The main waste gas polluting industries are earthenware making, ceramic industry, cement making, and chemical industry; the main wastewater polluting industries are paper making, the chemical industry, printing and dyeing, and electroplating.

3.5.6.2 Targets

The following targets were developed mainly by MOA and NEPA; the State Land Management Agency developed those related to land use issues.

1. In the Eighth Five Years, mainly protect the water sources of cities and countryside, and try to control the environmental pollution of the township enterprises along the coast and in the drought areas; try to control the atmospheric pollution in urban residential areas, smelting industry areas and the agricultural product bases; and mainly control the pollution of the major polluting industries (paper making, printing and dyeing, electroplating, leather making, chemical, mineral smelting, sulphur producing, coking, brick and tile, and cement).

2. From now until 2000, try to keep the environment in most urban residential areas the same as that in the late Seventh Five Years or better. The goals of different industries are: in the paper making industry, the wastewater disposal rate should reach 80 percent by 2000 and the standard-reaching rate 40 percent; in the electroplating industry, all the electroplating plants should have wastewater disposal equipment before 1995 and the township electroplating plants on a certain scale should reuse minerals and wastewater by 2000; in the printing and dyeing industry, all the printing and dyeing plants should have first-grade disposal equipment of waste by 1995 and the standard-reaching rate should be more than 50 percent; the coking industry should try its best to abandon the old coking

stoves before 1995 and all the old coking stoves should be replaced by 2000, while at least one-third of coke should be produced by medium- and small-size mechanical coke stoves; in the sulphur industry, all the open-style sulphur stoves should be replaced by innovative stoves by 2000 and the sulphur-reusing rate should be more than 60 percent; and the building material industry should devote its efforts to solving the dust pollution problems in producing bricks and tiles, ceramics and cement. The cement industry should not be allowed to build old-style kilns and mechanical kilns with the yield of less than 20,000 tons; and it will gradually apply computer-control techniques. Eighty percent of its enterprises should control the dust pollution by 2000.

3.5.6.3 Strategy

1. Adjust the structure according to the industry policy, control the development of polluting industries, and mainly solve the problems of major polluting industries and factories. The relevant ministry and the local EPB will inspect for compliance with environmental standards.
2. Promote the technical progress of township enterprises and extend the new techniques so as to change the backward production of township industries.

Box 3.9 Examples of Environmental Work by Township Enterprises

In 1990, the Hebei government practised pollution control and improvement in such small industries as paper making, metal smelting, electroplating, coking, and oil refining; and closed and terminated 6,623 polluting factories. In the same year, Panjing of Liaoning Province trimmed 107 small oil refining factories to 56; and closed, terminated or converted 410 small electroplating and chemical factories. Anshan and Yingkou improved the exploiting and production of magnesia that wasted resources and energy and that produced pollution. A of these actions played an important role in alleviating pollution.

In 1990, the Shanxi government terminated more than 30,000 pits of coking with local methods. After using the new innovative coke-making furnaces, the discharges of polluting matter was reduced by 50-60 percent, coal consumption fell 25 percent, and efficiency doubled. In Yunnan Province, after using new sulphur-making furnaces instead of the old furnaces, the discharged SO₂ was reduced 95 percent, retrieved sulphur increased 20-25 percent, and the production cycle was cut by half. Dandong City of Liaoning Province extended the experience of treating wastewater of paper making with methods of filtration through riddling nets. The displacement of suspended solid matter and COD was reduced by 40 percent. The retrieved COD and suspended solid matter could be reused in paper making, which made every factory gain 20,000-40,000 yuan. It not only protected the environment but also increased the economic benefit.

3. Develop techniques and equipment suitable for treating the township enterprises' pollution. The relevant ministry and local EPBs will be involved in this work.
4. Establish laws to extensively tighten up the township enterprise's environmental management. Gradually apply to the township enterprises the successful methods of controlling pollution of large and medium enterprises; for example, the environmental impact assessments system, the regulations of "three-measures-must-be-taken-simultaneously," and treatment by a certain deadline.
5. Formulate plans for the township environment and reasonably distribute the industry. In the township enterprises concentrated areas, practice the concentrated control of pollution.

3.5.6.4 Major Fields and Priority Programmes

1. In the 1990s, adopt new coke technology and new coke techniques, instead of the local methods.
2. Study the techniques of producing minimum wastes in such small industries as paper making, dyeing and leather making; extend the central control of pollution; and construct a group of demonstration projects.

3.5.6.5 Implementation and Monitoring

One part of the local EPBs manages the TVEs. The targets and strategies would be developed from comprehensive sources, such as MOA, NEPA etc.

3.5.7 Ecological Agriculture

3.5.7.1 Current Status and Problems

In the 1980s, China started to set up test spots of ecological agriculture. It is the deepening of China's traditional organic farming and the guideline of agricultural development "Farming, forestry, animal husbandry, side-line production and fishery develop in an all-round way;" it is a trial of applying the fundamentals of ecology to the establishment of an efficient artificial ecological system.

By the end of 1990, China had set up 1,100 demonstration farms of ecological agriculture of various types. A batch of successful farms (villages) appeared, like Liumingying of Daxing County in Beijing, Shanyi Village of Xiaoshu County of Zhejiang Province, Heheng Village of Taixian County in Jiangsu and Xiaozhangzhuang of Yinshang County of Anhui Province; Shanglija Village of Jin County of Zhejiang Province; and the Xian Ecological Breeding Field of Dawa County of Liaoning Province. The test spots of ecological agriculture develop from villages and farms to townships and counties. There are 3.3 million hectares of test spots.

At present, because the construction of ecological agriculture needs more input of science and technology, the ecological agriculture is not extended and still lingers in the trial stage. However, the

experiences of the test spots of ecological agriculture show that this is a feasible way of developing agriculture.³

3.5.7.2 Targets

In the Eighth Five Years, China will continue to reinforce, improve and promote the existing test spots of ecological agriculture to make them play their demonstration roles. Based on this, choose 50 representative counties with better foundations to be test spots and to establish a group of demonstration areas of ecological agriculture that have advanced techniques in the Three-River Plain, Huanghe-Huaihe-Haihe Plain, Loess Plateau, Hetao area, Sichuan Basin, Yangtze River middle and lower reaches, Jiangnan Plain, the hilly area in south China, Yungui Plateau, and the suburbs of Beijing and Tianjin. The targets of construction are: compared with other existing test spots, the utilization rate of resources should increase 5-10 percent, the systematic productivity 10 percent, the rate increase of grain 7-15 percent, and the annual income per capita 10 percent. The area of total test spots of ecological agriculture in China and its extension should reach 7 million hectares and the ecology of test spots should be obviously improved. In the Ninth Five Years, set up two or three representative test spots with advanced techniques in every agricultural county of China so that different ecological areas will have their own pattern of ecological agriculture.

3.5.7.3 Strategy

1. Strengthen scientific research. Mainly study the ecological agricultural pattern of various types and the methods of monitoring ecology; formulate the county's plan of ecological agriculture and develop appraisal norms for ecological agriculture.
2. Develop the techniques of ecological agriculture, including the comprehensive utilization techniques for agricultural wastes; the processing techniques for agricultural products; the biological techniques for spatial planting and non-hazardous agricultural products; the breeding techniques development of low-toxicity, high-efficiency, low-residual pesticides; and the techniques for management of fuel wood forests, bio-energy engineering and rural energy conservation.
3. Combine ecological agriculture construction with the development of "green label food," introduce market mechanisms and heighten the vitality of ecological agriculture construction. MOA will deliver the green labels to the producers and Chinese consumers will have the choice of an eco-ag product and a reg one, at the same cost. "Green label foods" are an intensive-agriculture product, a product of more efficient agricultural practices.
4. Conduct research in eco-farming policies and accelerate the spread out of eco-farming techniques.

3.5.7.4 Implementation and Monitoring

MOA will implement these strategies.

³Can China follow the "petro-farming" road of high input and high output like Western developed countries? The answer is no. China is a developing country with a population of 1.1 billion. Per capita agricultural resources are much lower than the world average and the nation's economic foundation is weak. China can only develop its eco-farming based on its own condition and run a new ground suited to its national conditions. Developing eco-farming is an inevitable choice for building a modern agriculture with Chinese characteristics.

3.6 Rivers and Seas

3.6.1 Rivers

3.6.1.1 Current Status and Problems

1. **Pollution.** Water quality of the mainstream of large rivers is fairly good. But the sections that run through cities and tributaries of large rivers are seriously polluted. According to the monitor in 1991, of the 43,562 kilometers of seven major river systems evaluated, 45 percent met Grade I and Grade II water quality standards as prescribed in the Environmental Quality Standards for Surface Water, 11 percent met Grade III and 44 percent met Grade IV and Grade V. The main pollutants were organic matters.

2. **Flood Control.** The flood-control level tends to be low. The major rivers can only prevent the usual floods. Serious flood disasters cause big losses in human life and property. The threat of especially large floods is a very serious problem. Among 400-odd cities with the task of flood control, 80 percent of cities cannot control the 50-year frequency flood, and 65 percent of the cities cannot control the 20-year frequency flood. The Yangtze, Huanghe, Huaihe and Haihe rivers have the heaviest task of flood control and have 85 detention areas, with 2 million hectares of farmland and a population of 16 million. In these areas, there are no safety facilities or no perfect safety facilities, so that peoples' safety cannot be guaranteed.

3. **Irrigation.** By the end of 1990, China had built 86,000 reservoirs with a storage capacity of 460 billion cubic meters, 470,000 irrigation and drainage pumping stations, and 2.7 million motor-pumped wells, and 5,360 irrigation districts, each with more than 10,000 mu. The irrigated area increased from 15.93 million hectares in the early founding stage of New China to 48.4 million hectares, accounting for one-third of the total farming area of China. The irrigation areas produce grains, and economic plants and vegetables, accounting for 65 percent and 60-80 respectively of the national gross yield; and have become major bases of grain, cotton and oil in China.

At present, one-fourth of the national water-conservancy facilities are at stake; the safety problem is serious; the irrigation and drainage facilities are not enough and the level tends to be low.

4. **Water Supply.** As China's water resources are in great demand, 300 cities (of the 480 cities in China) are short of water, 10 million tons per day. Millions of people's water for living use is in short supply and the annual output value reduces 120 billion yuan due to lack of water. The shortfall between water supply and demand is most outstanding in part of the seven provinces and municipalities of northern China (Beijing, Tianjin, Hebei, Shanxi, north Henan, central and south Liaoning and north Shandong). For many years in these areas, the average water resources have been 94.6 billion cubic meters and per capita share of 510 cubic meters. The local water resources that can be exploited are not plenty. The lack of water has not only limited the development of industry and agriculture, but also has aggravated the ecological problems. Water pollution increases the problem in water supply and demand, with serious impacts on the water supply of industry, agriculture and town residents. According to analyses, 60 to 70 percent of water shortage results from pollution. This condition is quite serious in the Yangtze River and Pearl River deltas, with large networks of waterways.

3.6.1.2 Targets

1. **Water pollution prevention and control.** By 2000, the source water of every water system will maintain Grade I, the waters for drinking, fishery and amusement reach Grade II or Grade III, and waters for industry, irrigation and shipping meet Grade IV to Grade V. The waters areas of Grade V in every river and province will reduce by 30-50 percent, so as to eliminate the areas lower than Grade V. For the eight major river-basins (Songhua River, Liaohe River, Haihe River, Yellow River, Hualhe River, Yangtze River, Tai Lake, Zhujiang River), the treatment rate of waste water reached 84 percent.

2. **Flood Control.** The general target by the end of this century is: when the big floods that have occurred since the founding of New China come, manage to prevent the key dikes from being breached so as to reduce the losses; when the biggest flood in this century occurs, try to divert and deter it in a planned way, decrease the flooding area as much as possible. The cities with flood control tasks must complete the flood-control projects in order of importance and urgency. The major detention areas are the important component of comprehensive flood-control measures, where the safety level must be increased.

3. **Irrigation.** In 2000, the irrigated area should increase from 726 million mu in 1990 to 800 million mu. The improved irrigation districts should reach 400 million mu.

4. **Water Supply.** In order to balance the water supply and demand, the national capacity of water supply should increase from 500 billion cubic meters at present to 650 billion cubic meters in 2000.

3.6.1.3 Strategy

1. **Water pollution prevention and control.** We should strengthen the planning and management for water quality of river basins, designate the water sources conservative section for the urban drinking along rivers, strengthen the central treatment for urban waste water, expand the treating capacity for waste water, rationally distribute the pollutants discharge load, thus realize the volume control of pollutants along the whole basin. We should also actively promote the registration for pollutant discharge and pollutant discharge permit system, and enforce the management of industrial pollution sources.

2. **Flood Control.** Different strategies must be adopted according to the local conditions of exploiting and using water resources.

The Yangtze valley, the river's middle and lower reaches in particular, is vulnerable to serious flood disasters, so the Three-Gorges Project should be constructed at a proper time in addition to raising and reinforcing the dikes.

The overall flood-control arrangement of the Huanghe River reaches is: shift the focal point of dikes construction from increasing height to reinforcing; increase the degrees of safety and capability of preventing leaks and collapses of big dikes; treat the river course and build reservoirs to reduce the silt of lower reaches; continue to enhance the water conservation of the upper reaches; the key flood-control cities (Zhengzhou, Jinan and Kaifeng) should be able to control the 100-frequency flood.

The Huaihe River reaches mainly solve the problems of serious water concentration in the middle reaches, low ability to divert floods, and irregular flow of the low reaches. The overall flood-control plan is: increase the diversion and detention ability of the upper reaches, especially the

Linhuaigang Project, Chihuai River and Hualong River; in the middle reaches, reinforce the dikes, treat and construct detention areas, enlarge the flood-diverting passage; and in the lower reaches, open the passage of Hongze Lake entering into the sea. The flood-control ability of the cities in Pearl River reaches must be increased; Guangzhou City should be able to control the 200-year frequency flood, Nanning and Wuzhou must be able to control the 50-year frequency flood. The Pearl River delta should be able to control the 100-year frequency flood. The dikes on the coast can prevent the force-10 typhoon (on the Beaufort scale).

The key flood-control areas of the Liaohe River are Shenyang City and Panjing Oil Base. Mainly solve the problems of low flood-control level, serious silt in the river bed, and obstacles to the river course.

The key flood-control areas of Songhua River are the important cities along the river, mining areas (Harbin, Changchun, Jilin, Jiamusi, Qiqiha'er and Daqing) and grain bases.

3. Irrigation. Reinforce and improve the old irrigation districts first. Constantly carry out the cropland's basic construction such as treating the mountain and the water resources, levelling the land, improving the terraced farmland. Then, develop and enlarge new irrigation districts. Of course, the conditions are very hard. For example, most areas of northern China that need urgently to develop irrigation are arid land with high mountains and the water far below or are like the Binhai Plain and very short of water resources. The hilly areas in southern China are in most urgent need of irrigation, but because of their varied topography or short supply of water resources, will require an enormous sum of money to construct irrigation projects.

4. Water supply. The Yangtze River and the area to the south of it are rich in water resources, where detention projects should be built to increase the water supply. Northern China boasts few water resources, but the utilization ratio is very high. Therefore, an overall plan should be made: save water, especially water for agricultural irrigation, as much as possible, and on the basis of pooling local water resources, build project for transferring water.

3.6.1.4 Major Fields and Priority Programmes

By 2000, we will pay more attention to conserve the centralized drinking water sources, build water-conservancy projects such as reservoirs, dikes, water supply, irrigation, water pumping, river harness and pollution prevention.

3.6.2 Seas

3.6.2.1 Current Status and Problems

Now, the water quality of most of China's seas is good, except in some offshore waters, river mouths and bays. Part of the South China Sea is seriously polluted by petroleum (average content is 0.05 milligrams per liter); the East China Sea is seriously polluted by petroleum (average content is 0.05 milligrams per liter); the East China Sea is seriously polluted by inorganic nitrogen, mostly from farm runoff (content is 300 milligrams per liter); the Yangtze River mouth and the Hangzhou Bay have a high nutrient content, where the "red tide" often occurs (the discharge of domestic sewage into coastal seawater has caused the massive proliferation of plankton, forming the "red tide" that affects fish production). Most coastal water COD content is 0.8-0.1 milligrams per liter but some coastal waters such as sewage-draining mouths contain even more than 5 milligrams per liter.

Box 3.10**Water-Saving Irrigation in China**

China's water resources are concentrated in the southeast, with relatively less water in the northeast. The development of China's economy is largely limited where there is short supply of water, especially in the northern area. Meanwhile, the practice of wasting water is quite common in the rural areas. Therefore, to save water used in agricultural irrigation is an important measure. In Beijing, the seepage and evaporation of water in irrigation ditches is rather serious, so the utilization ratio of water is low, only 50-60 percent. Recently, in Beijing, a water-saving irrigation project of 130,000 hectares has been developed, mainly using the spraying irrigation. The benefits have been striking. Daxing County of Beijing, after changing from irrigation ditches to pipes, saved 1.04 million cubic meters of water per year. In addition, electricity is saved and farmland and grain yields have increased. In the future, the Chinese government will continue to extend water-saving irrigation techniques in suitable places.

Box 3.11**Resettlement in China's Water Conservancy Construction**

Since the founding of New China, the country has built 86,000 water conservancy and hydroelectric power projects, with more than 1.3 million hectares of farmland inundated and 10 million people dislocated. Due to the efforts by the government at various levels and the related departments, most of them have been resettled; but because the complexity of resettlement was neither fully realized nor paid enough attention to in the past, a small group of people are still confronted with difficulties in living and production, which are being tackled.

Through summing up the past 40 years' experience, the Chinese government realized that a law of resettlement should be formulated. On 15 February 1991, the state council issued the "Regulation of Compensation and Resettlement in the Large and Medium Water Conservancy and Hydroelectric Power Projects." According to the regulations, the State should advocate and support development resettlement, adopt measures for paying compensation at the early stages, and support production in later stages. The people should be relocated according to local conditions, by exploiting wastelands, moving to another area or rationally using the resources in the pilot area so that the settlers' lives reach or surpass the original standards.

The construction of the Three-Gorges Project has now been listed in the national 10-year programme (1991-2000) for economic and social development. The normal pool level of the construction scheme is 175 meters. The backwater of the 20-year frequency flood can reach Mudong Township of Baxian County in Sichuan Province, 565.7 kilometers from the dam with 632 square kilometers of land inundated and 725,500 people affected by the end of 1995 (town residents 392,900; rural people 332,600). Pilot areas of all the counties have now finished their own resettlement regulations.

The resettlement is arranged in the following ways: exploit the land resources to build fruit and grain bases; make use of the water and grass resources to develop breeding industries and animal husbandry; adopt project protection measures to protect land resources; and make use of superior resources to cooperate with other areas and to develop township enterprises and second and third industries; and the cities.

The discharge of domestic sewage is the main pollutant in China's seawater. In 1988, the 11 provinces and municipalities along the coast displaced 16.7 billion tons of wastewater that directly or indirectly affected the marine environment, among which 8 billion tons of wastewater was directly drained from the sewage mouth. Every year, the land wastewater emptied into the seas contains 3.8 million tons of COD, 34,000 tons of petroleum, and 3,000 tons of phenol. In addition, the oil production at sea, the discharge of wastes at sea and the overflow of ship oil make the seawater seriously polluted.

The exploitation of resources and the pollution have aggravated the environmental problems of China's offshore waters. Only 17,000 hectares of mangrove forest exists in Guangdong, Guangxi, Fujian and Hainan; the species of marine life have been reduced and the "red tide" occurs more frequently (34 times in 1990), which is a big threat to the breeding of marine life. The exploitation of the coast and the engineering projects also damage marine life. China's seas generally are seriously polluted and the ecological environment is under threat, so protection of the marine environment has a long way to go.

3.6.2.2 Targets

The general goal of China's marine environmental protection is to control the pollution and protect the marine ecology.

- Control the discharge of land pollutants into sea. In 1995, the petroleum into the seawater should be less than 95,200 tons and in 2000, 95,600 tons; COD, 4.99 million tons in 1995 and 4.61 million tons in 2000.
- In the Bohai Sea areas, prevent the increase of petroleum and nutrients; the focal point in some areas is to control the pollution of organic matters and heavy metals.
- In the East China Sea areas, mainly control the nutrient content to reduce the occurrence of "red tide;" control oil pollution in the navigation areas of the harbors; mainly treat the pollution in the Yangtze River mouth and Hangzhou Bay.
- In the South China Sea areas, mainly control the petroleum content and prevent the increase of nutrient content in the Pearl River.
- Protect and improve the marine ecological environment of the Zhoushan Islands, Hangzhou Bay, Jiaozhou Bay, Jingzhou Bay, Taiwan's outer sea, Daya Bay and the islands on the South China Sea.
- In five years, set up 15-25 national and 50-70 local sea and coastal nature reserves. The general area is no less than 30,000 square kilometers, including 100 islands and a 400- to 500-kilometer coastline.

3.6.2.3 Strategy

1. Strengthen the supervision and monitoring of the marine environment; set up and improve the seas environmental supervising system to coordinate day-to-day supervision with emergency, and central with local; strengthen the management of marine pollution control and illegal behavior.
2. Classify the offshore waters according to quality, mainly control the pollution of organic matter and petroleum, and strengthen the emergency monitoring and reporting of accidental pollution (including "red tide") to reduce the loss. Make plans to establish emergency control systems for accident pollution in some important harbours.
3. On the basis of studies and experiments on the coastal environment, complete the work of the national coastal environmental divisions in order to provide data for the national construction of the coast and to ensure the harmony between the exploitation and utilization of marine resources and environmental protection.
4. Strengthen the management of exploiting and utilizing the deep-sea and outer-sea resources and gradually put into effect the permission system of sea development, the policy of charged utilization.

5. Continuously establish and improve the laws and regulations for controlling marine environmental pollution, for ecological protection, and for managing the exploiting of resources, to enforce the law and manage the seas according to the law.

6. Strengthen the management of the marine environment; for example, management of the discharge of wastes, of engineering projects, of land pollutants, of oil production at sea, and of the prevention and treatment of "red tide." Especially strengthen the environmental management of the key coastal areas such as bays, harbors and fishing areas. Gradually take control over the total amount of pollutants in these coastal areas. Strengthen the comprehensive treatment of the environment of the cities along the coast and the polluted coastal areas.

7. Strengthen the construction of the sea resources.

8. Carry out the study of the marine environment and ecology, make international cooperation in the study of the marine environment, and participate in the joint study of big programmes about the sea.

3.6.2.4 Major Fields and Priority Programmes

1. Observe and study the dynamic state of the sea level in China's sea areas.

2. Prevent and treat "red tide."

3. Set up emergency systems and equipment for oil pollution of the seas.

4. Develop procedures for breeding facilities for marine creatures and the environmental monitoring and improvement of the breeding area of aquatic products. (MOA would be responsible for sea farming, and EIAs would be required.)

5. Set up the sea natural reserves and equip ecology-monitoring stations.

6. Develop a zoning plan for China's sea areas.

7. Develop the techniques and projects for preventing and treating marine salt water penetration into groundwater in the coastal areas. (Local governments would be responsible for this action.)

8. Develop demonstration projects on rationally exploiting and using mudflats. (MOA would be responsible for developing these projects, and EIAs would be required.)

9. Study the comprehensive management (policy, systems and benefits) for the seas and establish an information system about the marine environment. (Both NEPA and SOA would be involved in these studies.)

10. Study for controlling the total amount of pollutants in China's coastal areas, half-closed bays and river mouths. Protection regulations and demonstration projects of major areas in the sea and along the coast including river mouths, bays, cities and famous scenic spots. (NEPA and SOA would have responsibility for these studies and programmes.)

3.6.2.5 Implementation and Monitoring

The environmental protection department under the State Council shall be in charge of the marine environmental protection of the whole country. The state administrative department of marine affairs shall be responsible for organizing investigations, monitoring and exercising surveillance over the marine environment and conducting scientific research therein; it shall also be in charge of environmental protection against marine pollution damage caused by offshore oil exploration and exploitation and by the dumping of wastes into the sea. The Harbour Superintendency Administration of the People's Republic of China shall be responsible for supervising, investigating and dealing with the discharge of pollutants from vessels and for exercising surveillance over the waters of the port areas; it shall also be in charge of environmental protection against pollution damage caused by vessels. The state fisheries administration and fishing harbour superintendency agencies shall be responsible for supervising the discharge of pollutants by vessels in the fishing harbours and for exercising surveillance over the waters thereof. The environmental protection department of the armed forces shall be responsible for supervising the discharge of pollutants by military vessels and exercising surveillance over the waters of the naval ports. The environmental protection departments of the coastal provinces, autonomous regions, and municipalities directly under the central government shall be responsible for organizing, coordinating, supervising and inspecting the marine environmental protection work in their respective administrative areas and shall be in charge of environmental protection against pollution damage caused by coastal construction projects and land-source pollutants (Marine Environmental Protection Law 1989).

NEPA and SOA will be in charge of setting up the marine nature reserves. The local EPBs have information on total wastewater discharges for the coastal cities in China. Establishment of wastewater treatment facilities is in the planning of the local municipalities, and the money comes from the urban maintenance tax.

3.7 The Conservation of Nature

Box 3.12

Background to the Biodiversity

With regard for its rich natural resource base and wealth of biodiversity (described in section 3.7.1.1 below) and the threats posed by population and economic growth, China has devoted a great deal of concentrated effort over the past two years to develop a national Biodiversity Action Plan. Funded by the GEF and coordinated by NEPA, four workshops were held (in April and November of 1992 and in February and April of 1993) to assemble the necessary information and to draft the plan. For each of these drafting workshops, NEPA assembled a very impressive and representative array of experts from all relevant ministries, academia and the legal profession; and invited various international experts to participate in the effort.

The conservation of biological diversity (described in this EAP in subgroup discussion on species and nature reserves) was further defined by the biodiversity experts in the BAP. They have considered carefully China's natural resources, both the species and the natural areas that support them, and have formulated recommendations on:

3.7.1 The Conservation of Species

Box 3.13 (continued)

- an update of the species requiring priority protection, nationally and internationally. These lists were developed by the experts using generally accepted criteria to set priorities for protection, by determining the biodiversity value of a species (for example, is it rare or the "keystone" of an ecosystem or a source of medicine) and the degree of threat it is under (for instance, is a species rare, vulnerable, or under such immediate danger that it will be lost unless action is taken). These lists will be further refined in ongoing research and continually updated to keep current with inherently dynamic systems.
- the specific actions needed to ensure conservation of these species. This determination requires a thorough analysis of: (1) the natural areas that support the critical species, leading to an identification of critical sites for biodiversity conservation. These usually will be protected areas representative of major ecosystems (for example, forests, wetlands, grasslands or steppes, farmland, coastal areas and the seas) already set aside as nature reserves or national parks, which in turn require thorough analysis of their ability to protect the priority species (for instance, is their size adequate, are they well-managed, how much human activity (hunting, fishing or other resource use) do they allow). This determination likely will lead to proposals for strengthening and enlarging these reserves and to needed regulations or policies. (2) the status of natural areas outside of protected areas. Protected areas alone—particularly if they are islands in an otherwise hostile environment—cannot conserve species (most obviously because protected species do not stay within protected boundaries: animals roam and seeds blow at random). Recommendations on policies concerning, for example, pesticide use or wildlife trade can be expected in this regard. (3) the actions needed to provide conservation in ex-situ facilities (including zoos, arboreta, aquaria, and breeding farms). Existing facilities of these sorts will require careful analysis and, probably, assistance to increase their effectiveness. (4) all of the actions needed to support the other recommendations; for example, policies that integrate biodiversity conservation into national economic planning; institutional coordination in the goals of conservation; scientific research on a wide range of topics (from the cataloguing of new species to the development of techniques for sustainable use of biological resources in fragile or sensitive areas); technical extension such as development of model or demonstration sites; publicity and education needs regarding biodiversity conservation; development of funding sources; and coordination with international organizations.

Biodiversity conservation is a dynamic endeavor and the action plan, therefore, will be expected to change with the changing conditions. As a sound foundation, however, this first national BAP has attempted to identify not only the long-term goals and the long-term actions needed to support them, but also the most cost-effective first steps to take now. The plan is a considerable achievement not only for the specific guidance on biodiversity conservation, but also as a very impressive example of collaboration among Chinese ministries, scientists and other professionals, and the international community; and it could very well become a model for other countries engaged in similar efforts.

3.7.1.1 Current Status and Problems

China's vast territory and complicated natural condition gave rise to a rich diversity of flora and fauna. China has some of the most diverse varieties of animals and plants in the world; there are 4,400 species of vertebrates, accounting for over 10 percent of the total vertebrate species in the world. It is estimated that there are 32,800 species of higher plants in China, or over 12 percent of the world total, making China rank third in the world, second only to Malaysia and Brazil. Among the plants, are 236 species of gymnosperm (800 species in the world), and 25,000 species of

angiosperm (200,000 species in the world). Because China was not subject to the fourth glaciation, many species that became extinct elsewhere in the northern hemisphere survive only in China. China has 200 unique genera and over 10,000 species, including *Cathaya argyrophylla*, *Metasequois glyptostroboides*, *Glyptodrobuspensilis*, *Pseudolarix amabis*, *Ginkgo biloba*, *Davidia involucrata*, *Gagus qongipetiolata*, Chinese *Bretschneidera*, and *Emmenopteryshenryi*.

China is also very rich in wild animals. There are more than 4,000 species of vertebrates alone, over 10 percent of the total species in the world. Among them 1,186 species are birds, 450 species beasts, 320 species of reptiles, 210 species of amphibious animals, and over 2,200 species of fish. In China, there are not only many economic species of wild animals, but also quite a few world-famous specialties of rare animals.

The Chinese Government has done a great deal of work for the conservation of species. She announced the first 354 species of key endangered rare plants for state protection in July 1984, and the first 257 species of key wild animals for state protection in December 1988; and successively set up a number of ex-situ conservation bases for plants and animals. By the end of 1991, China had established over 400 ex-situ conservation bases of various sizes and forms for endangered rare plants. The conservation of species has made some achievements. However, because conservation started a short time ago, the foundation was poor, and the experience inadequate, there are a lot of difficulties and problems: the loss of wild animal and plant resources, the increase in endangered species, the fragile management, and the lack of funds.

3.7.1.2 Targets

During the period of the Eighth Five Years, establish and perfect 22 ex-situ reproduction centers for country-class endangered rare animals and plants. Among them, there are 9 ex-situ conservation centers for plants, 12 reproduction centers for rare animal and 1 comprehensive reproduction center. A number of province-class reproduction centers will be set up. In addition, try to protect the genetic resources of endangered rare plants. Furthermore, plan to launch the movement nationwide to let species return to nature. As for plants, establish a country-class ex-situ conservation center for endangered rare plants, let reproduced plants of at least three species return to nature; and encourage and support the nature reserves to do this job. Plan also to release animals (except for *Elaphurus davidianus*) into nature, for example, release paddlefish, the Chinese alligator, *Crossoptilon mantchuricum*, and *Ailuropoda melanoleucus*.

By the year 2000, increase the list of key animals and plants for state protection. Meanwhile, the provinces, municipalities and autonomous regions should make their own lists of animals and plants for protection. On the basis of the Eighth Five Years, increase 30 more species of animals into nature.

3.7.1.3 Strategy

1. Make great efforts to do extension work in the field of wild animals and plants conservation. The governments at various levels should pay great attention to the importance and necessity of propaganda of conserving species and the regulations about it, and list it into the construction of spiritual civilization. The mass media should regard propaganda on conserving species as their responsibility. The provinces, autonomous regions and municipalities should sponsor such activities as Love-the-Birds-Week or Conservation-of-Species-Month, to turn the protection of species into a special custom. In addition, strengthen the consciousness of protecting species through education and training.

2. Strengthen the construction of legal systems for protecting species. Formulate a series of related laws, regulations and administrative procedures such as Regulations about Practising the Laws for Protecting Wild Animals and Plants, Regulations for the Management of the Import and Export of Animals and Plants, Regulations for the Protection of Wild Animals and Plants, Regulations for Trading and Utilizing Wild Animals and Plants, and Regulations concerning the Supervision of Wild Animals and Plants.

3. Strengthen the management of the conservation of species. Governments at various levels regard it their own important obligation to strictly apply laws. The law-enforcement department must resolutely investigate and handle criminal activities of illegal felling, illegal hunting, and smuggling state-protected wild animals and rare plants.

Strictly implement the system of "special hunting permits," definitely determine the non-hunting areas and seasons. Tighten the management of hunting rifles. Implement the system of trading permits. The marketing, purchasing, processing, transporting, domesticating and reproducing of wild animals and plants must be ratified by the related department. The key protected species the State announced cannot be smuggled, or sold or bought without permission.

4. Enhance the study of species. A thorough investigation should be made of the distribution, habitat, and population size; how they have been changed and why they are being endangered; how they have been utilized; and what measures have been or are to be adopted for their protection. Species should be carefully classified, and a list of endangered species and a "red data book" compiled.

5. Rationally exploit and utilize species resources. Under the guideline of "protect, train and reproduce the species, and rationally exploit and utilize the species," the provinces, autonomous regions and municipalities should comprehensively consider the economic and ecological benefits, and the present and long-term benefits; and implement the regulations of protection and development to ensure the continuous use of natural resources.

6. Take an active part in international cooperation for the protection of species. To protect effectively the wildlife resources, China has a great deal of work to do and is willing to establish close ties of cooperation with related countries and international organizations, and to strengthen exchanges, thus making greater contributions to the protection of the ecological environment upon which mankind relies for subsistence (MOF 1992b).

3.7.1.4 Major Fields and Priority Programmes

1. In the Eighth Five Years, establish and perfect the country-class ex-situ conservation centers for endangered rare plants in Xishuangbanna, Hainandao, South China, Southwest China, East China, North China, Northeast, Northwest and the Qinghai-Tibet Plateau.

2. Establish 13 reproduction bases for endangered rare animals: Xinjiang (wild horse), Wuwei of Gansu (animals with hoofs), Zhangye of Gansu (phasianidae), Xining (the endangered rare animals and plants in the Qinghai-Tibet Plateau), Hailin of Heilongjiang (cat-family animals), Honghu of Hubei (*Lipotes vexilliger*), Anhui (*Lipotes vexilliger*), Dafeng of Jiangsu (*Elaphurus davidianus*), Daxing of Beijing (*Elaphurus davidianus*), Chongming Island of Shanghai (paddlefish), Xuancheng of Anhui (Chinese alligator), Guangzhou (the primates), and Sichuan (*Ailuropoda melanoleucus*).

3.7.1.5 Implementation and Monitoring

NEPA developed the targets and strategies for nature conservation, and will have responsibility for implementing them. However, other agencies such as MOF and the Ministry of Public Security (which regulates hunting and prohibits the hunting of rare species) also will be involved. NEPA has a public relations arm, the Propaganda and Education Department that publishes an environmental newsletter with a large quantities of distribution annually to newspapers and so forth, even to the county level. NEPA's Department of Laws and Regulations and the Department of Natural Resource Conservation would be responsible for advising on needed policy and regulations. The National Legislature would have ultimate responsibility for enforcing the conservation laws through inspection of lower-level departments of relevant ministries (as described in other sections of this EAP).

3.7.2 The Conservation of Wetlands

3.7.2.1 Current Status and Problems

Wetlands of different types are found all over China, including the most important wetlands in the world. In China, there are about 25 million hectares of marshes, 12 million hectares of lakes (natural and artificial), 2.1 million hectares of mudflats. For many years, the Chinese government did not pay enough attention to the protection of wetlands. It was very common to reclaim the mudflats, build fish ponds, and dig ditches to drain water from wetlands; and wild animals were hunted and killed on a large scale and the ecological environment seriously degraded.

Recently, importance has been attached to the protection of wetlands. However, the practice of destroying wetlands still exists, as protection work has started only recently and has lacked a unified system of regulation and management.

3.7.2.2 Targets

Through nationwide propaganda, strengthen the consciousness of the protection of wetlands. Build a number of nature reserves including wetlands and some special reserves exclusively for wetlands.

3.7.2.3 Strategy

- 1. Strengthen the management of the existing wetland resources while ensuring the ecological balance. Economic benefits that may be derived from different methods of utilization must be taken into consideration and the best plan for utilization and management of different areas should be devised. Enclosure in harbors and gulfs important to navigation should be banned. Environmental control in coastal areas should be tightened and the sources of pollution stanchied. An appraisal of the impact on the environment should be made before any large-scale marsh and mudflat development is undertaken. Preventive measure should be taken against any possible damage that may result.**
- 2. Strengthen the construction of wetland reserves and establish the related laws and regulations to ensure the protection of wetlands is supported by law.**
- 3. Strengthen the scientific study of wetlands. A thorough going survey of the areas, types, and characteristics of marshes and mudflats must be made, as well as the quality, quantity and economic value of their resources. The structure and function of the marsh and mudflat ecosystem and the influence of human activities should be studied in selected representative areas so as to provide a scientific basis for exploitation.**

3.7.2.4 Implementation and Monitoring

China has a standard (developed by NEPA) for defining wetlands, that is based on the hydrologic history of the area. NEPA also has carried out investigations on wetlands, but there still needs more work particularly to help guide such decisions as occur in converting land for agriculture. In the past, diking and draining of wetland areas, both in lakes and in estuaries of rivers, but as better understanding was gained of the ecological value of the wetlands, this practice is dying out. NEPA and MOA will be jointly responsible for implementing the programmes for wetlands and for monitoring progress.

3.7.3 Nature Reserves

3.7.3.1 Current Status and Problems

The construction of China's nature reserves, which started in the 1950s, has rapidly developed since 1978. By the end of 1991, the number of nature reserves reached over 708, with an area of 56.8 million hectares, or 5.5 percent of the total land area of China; if forest parks, scenic spots and historical sites are included, the total area is 60 million hectares.

Although some achievements have been made in some aspects of nature reserves, many problems have also arisen at the same time: with a small number, the nature reserves cover a very small part of the total land; part of their topological structure and distribution is irrational, and their management is poor; the destruction of nature reserves has been eased but it still exists.

3.7.3.2 Targets

By the end of this century, China should complete the construction of nature reserves network with various types, rational distribution, different levels and proper area.

By 1995, the number of nature reserves should increase to 800, with an area of 60 million hectares, accounting for 6 percent of the total land area of China; if forest parks, scenic spots and historical sites are included, the area of nature reserves will account for 7 percent of the total land area of China. Among them, the country-class nature reserves should reach 100, or about one-fourth to one-third of the total area of nature reserves.

By 2000, the nature reserves of various types should reach 1,000, with an area of 70 million hectares, accounting for 7 percent of total land area of China; including forest parks, scenic spots and historical sites, the area of nature reserves will be 80 million hectares, or over 8 percent of the total land area of China, and will reach or surpass the world average. Among them, the country-class nature reserves are 120 to 140, with an area of 20-25 million hectares, or one-third of the total area of nature reserves. Thirty percent of the country-class reserves and 10-20 percent of the local-level reserves should support themselves completely, or at least partly.

By 2000, regulate the distribution of various nature reserves to make it more rational. The nature reserves of forests should account for 60-65 percent of all the nature reserves and the proportion of other types of nature reserves should also be increased: nature reserves of wetlands 12-13 percent, reserves of wilderness and grasslands 13-14 percent, marine reserves 5-6 percent, and natural historical sites 5-7 percent.

3.7.3.3 Strategy

1. Strengthen the legislation and law-enforcing work of nature reserves. In the Eighth Five Years, formulate the following regulations: Regulations for the Management of Nature Reserves, Regulations for Examination and Approval of National Nature Reserves, and Regulations for the Supervision of Nature Reserves. Based on these, formulate the Law of Nature Reserves of the People's Republic of China. The provinces, autonomous regions, and municipalities under direct government control can formulate their own regulations according to local conditions; and can determine the nature reserves's area, border, management organization, fund sources, targets of protection, and regulations for locally protected species.
2. Improve the management of nature reserves and strengthen their supervision. By 1995, the nature reserves should have the necessary administrative structure, enough personnel and funds. Nature reserves must coordinate local management with national management. The national, comprehensive departments must coordinate and monitor the management of nature reserves in their own system.
3. Train the management personnel. In the "Eighth Five-Years", the responsible departments of the central government must be in charge of training personnel of the provincial management level at least once every two years; the provinces, autonomous regions, and municipalities under direct government control should organize the training for country management sectors every two years. In 1995, 50 percent of management personnel should be trained and 80 percent in 2000. Meanwhile, send the qualified management personnel to study at college to increase their management capability.
4. Enhance the scientific study of nature reserves. Carry out a thorough survey in nature reserves; set up a resources data bank; conduct research to decide management targets and appraisal norms; supervise ecology in suitable reserves; improve supervision and management systems; and train a group of scientific researchers.
5. Rationally regulate and manage nature reserves. Absolutely protect the ecological system of nature reserve core areas and ensure they are not destroyed; reasonably use the buffer area to develop production and tourism, if these activities are compatible with conservation goals for the area; integrate protection, scientific research, education, production and tourism into a multi-functional pattern with ecological protection at the center.
6. Open up fund-raising sources to guarantee the construction of nature reserves. Governments at various levels and related departments should bring the plans and budgets for nature reserves into the planning of national economic and social development, and the development plans of their own departments. Open up fund-raising sources for the construction of nature reserves.

3.7.3.4 Major Fields and Projects

In the Eighth Five Years, the focal points of the construction of nature reserves are tropical zones, subtropical zones, coastal areas and populated areas. Give priority to the protection of areas with multi-type creatures and concentrations of state-protected plants. Increase the construction of nature reserves such as sea, wetland, grassland, wilderness and natural historic sites.

3.7.3.5 Implementation and Monitoring

NEPA developed these targets and with MOF, MOA and other relevant government organs, manages the nature reserves. There are three levels of nature reserves in China, the national, provincial and local. NEPA manages the national level; the other two are managed by MOF and the

EPBs. The director of a lower level nature reserve could be a member of NEPA or a lower level of MOF.

3.8 Geological Environment Protection

3.8.1 Current Status and Problems

China is a vast territory, whose geological characteristics are extremely complicated. Various kinds of environment problems resulting from geological movements have already been outstanding and severe, while human economic activities against geological law makes them worse. The geological disasters in China include earthquake, collapse, landslide, mud-rock flow, land subsidence, ground fissure, spontaneous burning of coal fields, gas explosion, rock avalanche, roof caving, soil expansion and contraction, freezing thawing, and frost heaving.

As China now expands its economic development, engineering construction will increase, which to some extent may quicken the frequency of geological disasters. According to incomplete statistics, geological disasters causes 7-12.5 billion yuan loss every year: among which, the immediate economic loss brought about by collapse, landslide and mud-rock flow is 2-3 billion yuan, indirect loss 15-22.5 billion yuan and the annual average casualties 337; the direct loss caused by land subsidence is 1-2 billion yuan and the indirect loss 4-6 billion yuan; the direct loss caused by karst land collapse is 1-1.5 billion yuan and the indirect loss is 3-4.5 billion yuan; the direct loss caused by ground fissure is 0.5-1 billion yuan and the indirect loss is 1-3 billion yuan. Every year in the Xinjiang Uygur Autonomous Region, coal fields spontaneously burn 0.1 billion tons, causing over 3 billion yuan loss, and the gas explosions cause over 1 billion yuan economic loss.

3.8.2 Targets

The following targets will be implemented by the year 2000. Strengthen the supervision and management of the geological environment in order to protect it. The goal of geological environmental protection is to guarantee that land development and engineering construction be accomplished according to the following principles: rationally use and transform the ecological environment; prevent the geological environment from worsening; ensure the safety of peoples' lives and property; and promote economic and social development.

The prevention and treatment of geological disasters should take into account land development and rational economic development, with the major traffic lines, large rivers, key cities, key projects, important economic zones and important areas of land comprehensive exploitation as focal points. Then, the overall planning and rational distribution should be guaranteed.

- Divide every province, autonomous region, and municipality into districts according to the environmental geology.
- Find out the distribution pattern and development features of China's geological disasters, then put forward counter moves for preventing and treating disasters in key areas.
- Supervise the geological environment of areas where geological disasters occur frequently. Gradually establish and improve the supervision station network and data system for geological disasters. If possible, set up a supervision and warning system.
- Reduce national economic loss from geological disasters to less than 30 percent of current loss.

3.8.3 Strategies

- In general, for preventing and treating geological disasters: combine the planning direction with supervision and management; lay equal emphasis on development and protection; prevent and forecast while comprehensively treating; promulgate laws to manage the geological environment; rely on scientific progress; strengthen propaganda; mobilize the broad masses to predict, prevent and treat; and combine professional forces with local forces to ensure the preventing and treating of geological disasters.
- In designing geological environmental protection efforts, follow the policies of: "overall planning, supervision at various levels, and comprehensive use of EIAs;" "he who uses, protects;" "with prevention first, combine prevention with comprehensive treatment;" and "he who causes to happen, treats."
- The State, regions and departments, in drawing up economic and social development plans, should be able to prove or forecast possible geological disasters and make plans for preventing and treating them according to the principles stated above.

3.8.4 Implementation and Monitoring

Economic loss data is used to estimate the benefits of priority programmes, and the targets have been set according to the situation in China. The United Nations resolution on the reduction of natural disasters (Resolution 169, 1987), however, was used as a reference. The target development work will be carried out by relevant sectors of agencies and ministries: for example, for earthquakes, the National Earthquake Agency; for mining-related problems, MOE; for landslides, the local governments and the Ministry of Geology; for land subsidence, the Ministry of Geology and Minerals; for gas explosions in coal mines, MOE.

4 INVESTMENT IN ENVIRONMENTAL PROTECTION

4.1 Investment in Pollution Control

During the Seventh Five-Year Plan period, the investment in pollution control was 47.7 billion yuan, accounting for 0.7 percent of GNP. In the 1990s, investments in pollution control will be increased: the percentage of GNP will be 0.85 percent in the Eighth Five-Year Plan period and 1 percent in the Ninth Five-Year Plan period, and the accumulative funds will be more than 100 billion yuan and 140 billion yuan respectively. It is estimated that 40 percent will be invested in air pollution control, 40 percent in water pollution control, and 20 percent in solid waste and noise control.

A representative example of how investments were allocated can be found in the chemical industry. According to incomplete statistics, during the Seventh Five-Year Plan period the investment for environmental protection in the chemical industry greatly increased as compared to that of the Sixth Five-Year Plan: investments totalled 3.25 billion yuan, with newly added waste water treatment capacity of 1.45 billion, newly added waste gas treatment capacity of 96 billion cubic meters, and newly added solid waste comprehensive utilization capacity of 4.25 million tons. The boilers and kilns of large and medium-size plants were equipped with smoke and dust eliminating devices, and most excessive noise or toxic dust were effectively controlled. The EIA report system and the system of "three simultaneousness" (designing, constructing and operating) were carried out without exception in chemical construction projects.

Thus, at a time when the total output value of chemical industries increased 56.8 percent, the amount of waste water discharged decreased 13.72 percent and the rate of treatment increased 11.03 percent; waste gas emissions increased only 6 percent and the rate of treatment increased 11.42 percent; and waste residue discharges increased only 5 percent and the rate of comprehensive utilization and disposal increased 10.2 percent. The growth in chemical industrial pollution was basically controlled (Ministry of Chemical Industry 1992).

4.1.1 Investment in Air Pollution Control

1. **Central heating.** During the Eighth Five-Year Plan period, there will be an increase in central heating area in cities of 125 million square meters of buildings, requiring investments of 6 billion yuan.
2. **City gas.** During the Eighth Five-Year Plan period, there will be an increase of 7 million cubic meters of coal gas supply per day, 2.75 million cubic meters of natural gas per day, and 0.25 million tons of liquified gas per year, requiring investments of 9.0 billion yuan.
3. **Civil and industrial coal briquettes.** During the Eighth Five-Year Plan period, there will be an increase of 50 million tons in coal washing capacity and an increase of 15 billion tons in briquette production capacity, requiring investments of 3 billion yuan.
4. **Treatment and recovery of waste gas, dust and soot from industrial boilers.** To treat waste gas and dust, comprehensive measures such as technical renovation, the application of non-polluting

and less-polluting technology, and waste gas purification, treatment and recovery technologies will be adopted, in order to control the whole process. Meanwhile, installation of smoke-elimination and dust-removal equipment for industrial boilers will be expanded. The total investment required is about 9 billion yuan during the Eighth Five-Year Plan period.

5. Demonstration projects of smoke-elimination, dust-removal and desulphurization for coal-burning power stations. During the Eighth Five-Year Plan period, 80 percent of the power industry installations, with a capacity of 56 million kilowatts, will have electronic dedusters. At the same time, some old low-efficiency power stations, especially smaller power sets, will be renovated by replacing small ones with large ones and old ones with new. The industrial boilers will be renovated by installing high-efficiency dedusters and adopting desulphurization techniques of recycling fluidized beds, to reduce emission of sulphur dioxide. Two or three demonstration projects for dust-removing and desulphurization in coal burning power stations are to be constructed, with investments of 7 billion yuan.

6. The Urban afforestation requires 25 billion yuan of investment.

The total amount to be invested in pollution control during the Eighth Five-Year Plan period will be 37 billion yuan.

4.1.2 Investment in Water Pollution Control

1. Construction of urban drainage and sewage treatment facilities. During the Eighth Five-Year Plan period, construction to separate rain and sewage drainage systems will be speeded up. More than 8-10 thousand kilometers of urban drainage pipes and a number of sewage treatment plants (with daily capacity of 2.5-4.0 million tons) and oxidation ponds (with daily capacity of 2.0 million tons) will be constructed. A total investment of 12 billion yuan is required.

2. Construction and renovation of industrial waste water treatment facilities. During the Eighth Five-Year Plan period, industrial waste water treatment facilities (with daily capacity of 21-22 million tons) will be constructed, and daily treatment capacity of 10 million tons renovated. A total investment of 27 billion yuan is required.

The total investment for water pollution control during the Eighth Five-Year Plan period will be 39 billion yuan.

4.1.3 Investment in Solid Waste and Noise Pollution Control

For comprehensive utilization, storage and disposal of industrial wastes, treatment of urban refuse and control of noise, 23 billion yuan will be invested.

4.1.4 Source of Pollution Control Investment

It is anticipated that during the Eighth Five-Year Plan period, the main channels of pollution control investment are as follows:

1. Investments for implementing the "three simultaneousness" system out of basic construction funds. An environmental fund of 38 billion yuan will be raised, 4.5 percent of the total basic construction investment.

2. If environmental protection investments account for 3.5 percent of old enterprise renovation funds, an environmental fund of 20 billion yuan will be raised.

Investment Channels for Environmental Protection in China

- Environmental protection investments for "three simultaneousness" in capital construction. Any newly constructed, expansion or rebuilding project must obey regulations of "three simultaneousness," and the funds for controlling pollution must be included in the investment plan of fixed assets. The various levels of planning, economic, construction and environmental protection departments should guarantee the strict implementation of these measures.
- Environmental protection investment in enterprise renovation. The Planning Commissions, Economic Commissions and industrial and communication departments at all levels, the local departments concerned, and the enterprises must invest 7 percent of annual renovation funds in pollution control. For those that are seriously polluting and difficult to control, the proportion can be increased. The enterprises must give priority to pollution control, facilitating investments in renovation. The enterprises production development funds can also be used for pollution control.
- Environmental protection funds in urban basic construction. The required urban maintenance investment in big and middle-size cities can be used for pollution control, combined with infrastructure construction, such as for sewage and hazardous solid waste treatment.
- The subsidy funds for pollution control from part of effluent charges. In China, effluent charge paid by enterprises are returned to enterprises or their responsible agencies, as subsidies for controlling pollution sources, so as to help channel pollution control funds to old enterprises.
- Comprehensive reuse profits retained for pollution control. The production profit, by comprehensively reusing waste gas, water and solids can be retained for further pollution control instead of being turned over to the state within five years.
- Loans for pollution control from banks and other financial institutions. These can be used mainly in construction of pollution control projects with higher economic benefits and the capacity to pay back the loans.
- Special funds for pollution control. These are funds allocated by the State Planning Commission and the provinces and municipalities for controlling key pollution sources and for key areas.
- Funds for strengthening environmental protection agencies to strengthen the whole environmental protection system. The state allocates funds for environmental monitoring, research, propaganda and education, nature reserves, construction of radioactive waste disposal facilities, and so forth. Over 20 percent of local effluent charges can be used for environmental protection agencies.

3. If urban construction and maintenance costs are used in environmental infrastructure construction, funds of 18 billion yuan will be raised.

4. The super-standard effluent charges are expected to collect 9 billion yuan.

5. Foreign funds totalling US\$2.5-5.0 billion yuan over five years (0.1-0.2 billion dollar per year) will be sought.

6. It is possible to collect 2.5 billion yuan in domestic loans in five years, through profits from comprehensive reuse and other channels.

If these funds can be generated as outlined above, pollution control requirements can be met.

4.2 Investment for Natural Resource Conservation

Investments for ecologic protection and control in China depends mainly on using the labor of the masses, supplemented by subsidies from state and local governments. There is no unified standard for computing the monetary value of volunteered labor, and state and local investments have various channels, so it is very difficult to accurately and wholly evaluate requirements and sources of investment on ecology protection. Therefore, the investment requirements will be evaluated roughly in this plan, according to targets and priorities of ecology protection and control and referring to previous average investment quotas. It is necessary to point out that the investment can vary greatly due to increases in the market value of labor (present rate is 1.5 yuan per day per labor).

4.2.1 Forests Conservation

According to afforestation plans, trees will be planted to cover 5 million hectares per year between 1990 and 2000. If 1000 yuan is invested per hectare, 5 billion will be needed per year and 50 billion yuan invested within 10 years, of which 85 percent will be a volunteer labor investment and the remaining 15 percent will be funded by state and local governments, with about 0.75 billion yuan per year and 7.5 billion yuan in 10 years. State and local subsidies include: special funds for afforestation planned by the state, special subsidies for afforestation from finance budgets, afforestation funds in agricultural comprehensive development, afforestation funds for providing work as a form of relief, and loans and grants from home and abroad. Fixed funds coming from the above-mentioned channels are far too little to meet the requirements for afforestation in the future and more fund sources must be found.

Forest protection mainly includes the prevention and control of disease and pests, prevention of fires, and the prohibition of forest destruction and clearing. Funds for forest protection mainly come from financial allocations from state and local governments, capital construction investments and funds raised by the departments concerned. The disparity between supply and demand for forest protection funds is outstanding and has restricted the development of forest protection. The problem must be solved as soon as possible.

4.2.2 Grasslands Conservation

According to the targets and key projects of grassland construction, it is estimated that about 45 billion yuan is to be invested in the next 10 years. The funds mainly come from self-provided money by herdsmen; loans from home and abroad; subsidies from state and local governments, mainly for controlling grassland degradation and sowing crops, and afforestation funds of providing work as a form of relief.

4.2.3 Soil Erosion Control

According to the plan to increase the annual soil erosion control area from about 20000 square kilometers to 27000-40000 square kilometers in the next 10 years, and considering the average control cost rates of about 100,000 yuan per square kilometer over the past 10 years, about 2.7-4 billion yuan will be needed annually or about 27-40 billion yuan in the next 10 years. About 70

percent of the funds for soil erosion control will come from the masses (including labor investment instead of money), the rest (including tools and materials) will be subsidized by state and local governments. State and local subsidies mainly come from capital construction investments in irrigation and water conservation, special funds for major soil erosion control, soil erosion control funds of providing work as a form of relief, soil erosion control funds of the agriculture comprehensive exploitation, funds for afforestation, and loans and grants from home and abroad. At present, subsidies of about 600 million yuan are provided by state and local governments annually.

4.2.4 Desertification Control

According to the plan that about 6.7 million hectares of desertified land will be controlled in China in the next 10 years and the present average cost, about 8 billion yuan will be invested in that time. About 70 percent of funds for desertification control is dependent on self-provided funds by the masses (including labor investment instead of money), the remaining 30 percent is subsidized by state and local governments. Subsidies from state and local governments mainly come from a part of the funds for afforestation and grass seeding, desertification control funds of providing work as a form of relief, and loans and grants from home and abroad.

4.2.5 Flood and Waterlogging Control and Irrigation

According to targets and demands for flood and waterlogging control and irrigation, it is estimated that about 70 billion yuan of state and local government investments for capital construction will be required in the next 10 years, with an annual average cost of 7 billion yuan. Funds for flood and waterlogging control and irrigation come from the masses labor forces and local government investments. Some key projects are funded by the State government. Flood control construction is generally funded by state and local governments, equally. Funds for water conservation fixed assets mainly come from capital construction investments by state and local governments, state investments for irrigation construction of providing work as a form of relief (about 2 billion yuan annually in the Eighth Five-Years period), loans and grants from home and abroad, or private investments.

4.2.6 Natural Reserves and Biodiversity Conservation

In order to achieve the planned targets for nature reserves and biodiversity conservation, roughly 1 billion yuan will be invested. Funds for natural reserves and biodiversity protection come from multiple channels, including special construction investment from state and local governments, investment from various levels of responsible agencies, self-raised funds for nature reserves development and management, and donations and grants from domestic and foreign governments, organizations, groups, and individuals.

Table 4.1 Requirements of Investment in Pollution Control (1991-1995)

<i>Medium</i>	<i>Item</i>	<i>Required unit investment (billion yuan)</i>	<i>Total investment (billion yuan)</i>
Air pollution control	Central heating	6.0	
	City gas	9.0	
	Civil and industrial briquettes	3.0	
	Treatment and recovery of process waste gas, dust and soot from industrial boilers	9.0	
	Demonstration projects of smoke elimination, dust removal and desulphurization for coal-burning power stations	7.0	
	Urban afforestation	2.5	36.5
Water pollution control	Construction of urban drainage and sewage treatment facilities	12.0	
	Construction and renovation of industrial waste water treatment facilities	27.0	39.0
Solid wastes pollution control and others	Comprehensive utilization, storage and disposal of industrial wastes, treatment of urban refuse, control of noise, and so forth	23.0	23.0
Total requirements (billion yuan)		98.5	

Table 4.2 Requirements of Investment in Ecology Protection (1991-2000)

<i>Medium</i>	<i>Item</i>	<i>Required unit investment (billion yuan)</i>
Ecology Protection	Forest ecology construction	50.0
	Grassland ecology construction	45.0
	Soil erosion control	27.0-40.0
	Desertification control	8.0
	Flood and water logging control and irrigation	70.0
	Natural reserves and biodiversity protection	1.0
Total requirements (billion yuan)		201.0-214.0

5 PRIORITIES OF ENVIRONMENTAL CONCERNS

China, with its vast territory where natural conditions vary and economic and social development between regions is imbalanced, is confronted with a whole range of environmental problems. Different regions may have different outstanding environmental problems. Therefore, the national priorities of environmental concerns are based on the following two principles: (1) to select those that have wider impacts on and can cause biggest damage to economic and social development and human health; and (2) to select those that show a trend of being more serious over the long term.

Some environmental problems, such as that of eutrophication of lakes, exist widely but are not outstanding yet. However, in long term, those problems are most threatening and difficult to control, and thus are selected as priorities. On the other hand, although transportation pollution shows an increasing trend, it is limited within local areas and does no obvious harm and thus is not considered a priority. Seven priorities of environmental concerns in China, including water, air and solid waste pollution and natural resources destruction, are discussed in the following section.

5.1 Environmental Priorities

5.1.1 Water Pollution (with key pollutants of organic)

Rivers and lakes within and near cities and the city sections of large rivers are seriously polluted. Of the seven water systems, the Liaohe, Haihe and Huaihe River systems are the most seriously polluted. All of the lakes and reservoirs near cities and the large lakes of the eastern plain regions (especially, the lakes of Daminghu, Donghu, Xuanwuhu, Xihu, Dianchi, Baiyangdian, Chaohu, Jingbohu and Taihu) are eutrophied to some degree. And river and lake pollution is becoming more serious. The major reasons are: discharge of a great quantity of untreated urban sewage (the treatment rate is now 4 percent) and discharge of industrial high-concentration organic waste water; run-off of nitrogen and phosphorus in chemical fertilizers. Groundwater pollution has directly affected the quality of drinking water and threatens the water table, intensifying the shortage of water supply in some areas.

5.1.2 Urban Air Pollution (with key pollutants of TSP and SO₂)

The concentrations of TSP in the cities generally exceed national air quality standards of Class II (equal to 300 μg per cubic meter), with northern cities more seriously affected than southern ones and winter more seriously than other seasons. The concentrations of SO₂ are mostly between national air quality standards of Class I and Class II, with 16 percent of the cities exceeding Class II standard. The pollution levels of SO₂ are becoming more and more serious. The main causes of pollution are the cities' irrational fuel consumption structures and burning patterns, leading to low-efficiency coal-burning. At present, most of China's dust collectors cannot reduce particles smaller than 10 μ , which have great impacts on human health. As shown by investigations in many cities, respiratory diseases caused by air pollution are increasing. Acid rain in southern China is caused by pollution of SO₂. The regions that have high concentrations and frequency of acid rain include: Chongqing, Guiyang and Nanchong in Southwest China; Liuzhou and Nanning in Guangxi Zhuang Autonomous Region; Changsha, Zhuzhou, Hengyang and Yichang in Hunan Province; Nanchang, Jiujiang and Tongling in Jiangxi and Anhui Provinces; and Qingdao in the north. Acid rain has resulted in losses of agriculture, forestry and fishery production, and has accelerated erosion of buildings and bridges.

5.1.3 Industrial Toxic and Hazardous Solid Wastes and Urban Pollution

Although no definite data on the total amounts of China's industrial toxic and hazardous solid wastes are available, it is certain that the disposal piles are increasing yearly. At present, few of the wastes are treated efficiently and most are not treated at all, thus have the potential of seriously polluting the land and groundwater. The yearly increase in the discharge of urban refuse and the shortage of transportation and treatment facilities have led to un-controlled piling in dumps that occupy much land, pollute the air, land and groundwater, and breed bacteria, mosquitos and flies.

5.1.4 Shortage of Surface-Water Resources in the North and Serious Shortage of Water in Many Cities

The main reason for these shortages is the unbalanced distribution of water resources. The cultivated area to the north of Huaihe River is 64 percent of the country's total cultivated area, but its water resources account for only 19 percent of the total. Storage is a serious issue because of great annual variation and seasonally intensive distribution of the limited amount, resulting in very serious conditions in dry seasons and years. Moreover, wide spread wasting water and water pollution further intensify this problem. The water resource shortages have restricted economic development and affected peoples' lives in some areas. The resulting abuse of groundwater resources has lowered groundwater levels, and made earth surfaces subside and water quality deteriorate. Also, there have been grassland degradation and soil desertification due to drought and salinization of cultivated land due to poor irrigation and drainage.

5.1.5 Serious and Widely-distributed Soil Erosion

Major soil erosion regions include the Loess Plateau, the hilly and mountainous lands south of the Yangtze River, the rocky mountain lands in the north, and the black earth area in the northeast. The main reasons for soil erosion are: low erosion-proof capacity of China's large area of mountains, blind cultivation of slope lands and cutting of forests for food and fuel under population pressure, and no water and soil conservation while extracting stones. Soil erosion has resulted in land degradation, decrease in land fertility, and lower and unstable agricultural output. In areas of serious soil erosion, poor living conditions and soil erosion are generally reciprocal causes. Moreover, the eroded soil has silted rivers, lakes and reservoirs, and has reduced the shipping and flood-preventing capacity of the rivers and the benefits of the reservoirs.

5.1.6 Low Forest Coverage Rate, Shrinking of Natural Forests and Serious Grassland Degradation

The main reasons for the reduction of natural vegetation are: long periods of serious destruction of forest resources and overgrazing and over cultivation of the grasslands. Because nearly one-third of China's land is not suitable for growing forests and trees, existing forests have become especially valuable. Also, grasslands, one-fourth of China's total territory area, have great impact on natural environments, especially in the northern dry and semi-dry regions where they provide the main vegetation. Due to destruction of forests and grasslands, lands lose the capacity to conserve water, water sources are depleted, and soil erosion, desertification, and loss of species results. This kind of deterioration of natural environment and life-preserving functions is the very crux of China's nature conservation problems. Efforts of afforestation have been made in past years and the coverage of artificial forests is increasing, but they are only of middle and young growth. It has not been widely understood that environmental benefits and the species-preserving capacities of natural forests are much higher than those of artificial ones.

5.1.7 Reduction of Ecosystems and Species

With population growth and economic development, extensive development and construction activities have affected the natural environment to an unprecedented scale, and natural habitats for many species are decreasing. The important reasons for species extinction are: the shortage of effective management of natural resources, and over-hunting or cutting of rare or endangered animals and plants. Birds in many areas are almost extinct because of the overuse of farming chemicals.

Sufficient attention has not been paid to the important role of various types of wetlands in maintaining natural ecological system, and in most cases they are regarded only as wastelands to be developed into farmlands. The extinction of species means, at least, the loss of resources of many kinds of agricultural products and a quantity of economic animals and plants, and thus over the long term, the loss of economic development in agriculture and medicine.

It should be noted that there are many other environmental problems in China, of which some are just as important. Those listed above should be considered as priorities. Efforts have been and are being made to solve them. They are set forth here to provoke more concern, suggest more definite working objectives, and promote understanding among the international community of China's environmental problems.

5.2 Main Points of Work in Environmental Protection

Being a great developing country with complicated and serious environmental problems, limited economic and technical power, and short of trained management personnel, China has difficulty in solving all its environmental problems within a short period. Therefore, it is necessary to stress the main aspects in environmental protection work, and to concentrate the limited financial, material and human resources on essential problems. Only in this way can great advancement and good benefits be made. Through many years' experience, a set of environmental protection policies suited to Chinese conditions have been gradually formulated in China, and the main points of environmental protection work at present and in the future have been determined.

5.2.1 Environmental Pollution Prevention and Control

Pollution problems exist in both urban and rural areas as well as various sectors, but they are most serious in cities. Statistics show that over 80 percent of pollutants are discharged by cities. Moreover, cities are densely populated and economically developed regions, and often are centers of politics and culture; and the harm from environmental pollution in them is especially obvious. Therefore, urban environmental pollution prevention and control is undoubtedly a main point of China's environmental protection work. At present, China has about 500 cities. Because of the constraints of national environmental management resources, it is difficult to put so many urban environmental problems on an equal footing, to be solved together. It is necessary to select the cities that have great impact on national economy and peoples' livelihood as the main points for environmental protection. The 52 selected cities are Beijing, Shanghai, Tianjin, Harbin, Changchun, Guangzhou, Wuhan, Chongqing, Shenyang, Nanjing, Chengdu, Hangzhou, Suzhou, Guilin, Kunming, Xi'an, Kaifeng, Shenzhen, Lasa, Zhuhai, Shantou, Xiamen, Fuzhou, Wenzhou, Ningbo, Nantong, Lianyungang, Dalian, Yantai, Qinhuangdao, Zhanjiang, Beihai, Haikou, Lanzhou, Taiyuan, Jilin, Tangshan, Shijiazhuang, Jinan, Zhengzhou, Qingdao, Changsha, Hefei, Nanchong, Luoyang, Datong, Guiyang, Nanning, Ulumuqi, Xining, Huhhot, Yinchuan. Among these 52 cities, there are 3 municipalities directly under the Central Government, 27 provincial capitals, 14 cities with independent planning status, 34 opening coastal cities, and 7 national level scenic, historic and culturally famous cities. In 1991, the urban population of these 52 cities account for 25.3 percent of the urban population of the whole country; their GNP was 36.1 percent of the whole country's total;

- Note:* a chemical industry.
b electric power-steam-hot water supply industry.
c ferrous metal smelt and mangle process industry.
d building materials nonmetal mineral products industry.
e papermaking and paper products industry.

5.2.2 Natural Resource Conservation

The protection of the natural ecology is essential to the sustained development of the country. It involves the protection of natural resources, the system that supports human life and development and biodiversity. This aspect is especially important to a country like China with a large population. The key point of natural ecological system protection is the rational utilization of natural resources and the preservation of natural habitats of species.

Natural resources include many aspects. At present, in China, the main aspects are soil, water, mineral and biotic resources. The main work of conservation is the protection and rational development of natural resources, including the protection and development of forests, grasslands and other biologic resources. Whether biologic resources can be utilized rationally or not directly affects the protection of soil and water resources. Once the forests' water-conserving ability reduces, water will not be conserved and rainstorms wash away soils that support crops. Water resources have dried up and eroded soil has been deposited in river courses and reservoirs, which bring about a series of problems. Once that happens, the life sustaining system supporting human beings is destroyed. It should be pointed out that the rational development and utilization of soil and water resources have great effect on the protection of the biologic resources, especially in arid regions. It is necessary to realize the goals of conservation by comprehensive planning of economic development and resources utilization, mainly in land planning. The main points of protection and rational development of biologic resources are the protection and development of forest management and operation. On the one hand, nature reserves and forest parks should be established to protect virgin forests. For forests that can be cut, the principles of rational cutting and reforestation over time should be followed. On the other hand, major efforts should be devoted to afforestation in order to increase forest coverage. Regarding grasslands, the priority is to enforce rational grazing, improve and build man-made pastures, increase per animal production yield, and prevent grassland degradation and desertification.

Another point of natural protection work is biodiversity conservation. China has now fully realized the importance of this issue and has established various kinds of natural reserves. In the meantime, zoos, botanical gardens and breed and protection centers have been established in different regions to protect rare and endangering species. It should be emphasized that wetlands are important to biodiversity protection. But in the past, China paid little attention to this aspect. Now, some important investigations have been conducted, and more wetland natural reserves have been set up.

6 SUGGESTIONS FOR INTERNATIONAL COOPERATION ON THE ENVIRONMENT

As a developing country confronted with pressures from both economic development and environmental protection, China should not try to depend on itself solely to solve environmental problems. However, because of the global significance of many environmental problems, China hopes to keep in close cooperation with and get support from the international community in solving its environmental problems, and in turn to contribute to mankind. There may be three types of international cooperation in environmental fields: technological cooperation, personnel exchanges and training, and aid for environmental control projects.

6.1 Technological Cooperation

6.1.1 Cooperative study on policies. Major studying fields are: policies on China's sustainable development; China's environmental strategies and planning objectives; environmental economic policies, for example, effluent charge system with Chinese characteristics and some other economic policies suggested before in the report; environmental management strategy and systems provincial and municipal levels; sectoral environmental policies (such as energy, industry, communication, agriculture, township industry, water resources, forestry and natural preservation).

6.1.2 Cooperation in strengthening environmental institutions. This may consist of: support for fundamental work, for example, environmental monitoring information (of environmental quality, ecological variations and global environment), environmental information collection and processing; formulation of environmental technological regulations, for example, environmental impact assessment, discharge reporting and registering and permit systems; drawing up environmental plans, for example, regional environmental plans, wetland investigation and preservation plans and natural reserve plans.

6.1.3 Technical assistance. This may include introduction and dissemination of cleaner production technologies in major polluting industries, such as metallurgical, chemical, petrochemical, nonferrous, building materials, food, paper, leather, textile, and pharmaceutical industries, etc.; applications of energy and water economization techniques; application of protection and utilization techniques for forest and grassland; and application of species protection and preservation techniques.

6.2 Personnel Exchanges and Training

To help universities educate students major in environmental sciences, including undergraduates, master and doctor degree postgraduates. Incomplete statistics show that 79 universities and colleges have set up courses on environmental sciences with 11000 students at school. It is suggested that development of these environmental departments and specialties be strengthened and personnel exchanges and training be conducted. Some of this kind of technical assistance programs are being conducted by the World Bank and other international organizations.

On-job training. There are 70,000 people working at various levels of environmental protection departments and 300,000 more environmental protection workers in the industrial sectors and enterprises, not including those engaged in resources management and ecological preservation in agricultural, forestry and water sectors. These people are the main force of environmental protection, and their professional quality directly affects the implementation of environmental objectives and policies. On-job training for these people is badly needed. Regular renewal of knowledge is required of the management staff, particularly knowledge on environmental law, economics and management

skills.

Some forms of personnel exchanges and training can be adopted such as co-compiling training materials, helping China train teachers, foreign experts visiting China, and/or Chinese students and cadres going on overseas study tours. These are the basic measures to improve China's ability to solve its own environmental problems.

6.3 Environmental Projects

Investments are required to set up a number of treatment and protection projects to solve environmental problems. Although funding for the investment will mainly come from domestic sources, external investments may function as catalysts to speed up environmental control. In view of China's outstanding environmental problems, priorities can be given to the following project fields.

1. Solving urban air pollution. Major measures include changing urban fuel structures and eliminating direct and low-efficiency coal-burning and realizing energy efficiency. Central heating may be developed and thermoelectric stations, of which electricity output is based on required heat, can be constructed in many cities and towns. Northern cities, such as Beijing, Taiyuan, Lanzhou, Changchun, Xi'an, Huhehot, Chengde, should be considered as priorities before the year 2000. The urban gas projects including natural-gas, coal-gas and oil-gas projects may be developed first in large cities and scenic cities such as Beijing, Shanghai, Xi'an, Harbin, Chengdu and Chengde. The conversion to burning coal briquettes should be developed, first for household then for industrial use, to replace scattered burning of raw coal, in SO₂ seriously-polluted cities such as Chongqing, Guiyang, Liuzhou, Changsha and Nanchang.

For those high energy consumption industries, energy-saving technical renovation is required to greatly reduce per-unit energy consumption, and with the non-ferrous, metallurgical, building materials, chemical, petrochemical and other industries as priorities. The burning equipment from larger industrial furnaces to small farming firewood stoves should be renovated to improve their burning efficiency. Priority can also be given to replacing a number of backward industrial furnaces and to popularizing fluidized bed boilers in cities seriously polluted by SO₂. The capacity of coal washing and dressing is to be improved also.

2. Controlling water pollution. Major measures include perfecting urban drainage networks, constructing centralized sewage treatment plants, effectively treating industrial high-concentration organic waste water. Priority could be given to constructing sewage treatment plants in environmental protection key cities, especially those suffering water shortages, such as Beijing, Shenyang, Tianjin, Anshan, Foshan, Dalian, Qingdao, Zhengzhou, Xi'an, Xuzhou, Shanghai, Nanjing, Wuhan, Fuzhou and Shenzhen. Sewage sea-discharge systems may be built in proper cities, such as Shanghai, Yantai, Shenzhen, Ningbo and Wenzhou. And stable ponds and land treatment systems can also be constructed in the light of local conditions. Candidate cities and regions include Shandong, Hebei, Heilongjiang, Inner-Mongolia, Beijing Guangdong, Xiangfan and provinces in the northwest.

Technologies to treat high-concentration organic waste water should be developed and a number of pilot projects should be established to treat waste water from paper mills, chemical factories and food processing factories.

3. Controlling refuse and hazardous solid waste pollution. Priority will be given to the treatment of urban garbage in Harbin, Shenyang, Shijiazhuang, Shanghai and Beijing. Several pilot plants of hazardous waste disposal can be constructed in Beijing, Shenyang, Changzhou and Shanghai, to

experiment systems for "solid waste exchanging" in some cities.

4. Conserving water. Priority will be given to developing water-saving techniques (of industrial, household and especially, agricultural use) and setting up a number of demonstration projects. For example, on the basis of existing urban sewage treatment plants in cities short of water, the treated sewage can be reused, and so demonstration cities can be appointed, with Qingdao among the first batch. It is also important to renovate rivers and to prevent drought and flooding disasters, with the focus on the Huaihe River basin and the Taihu Lake basin in near future.

5. Restoring vegetation. Five forestry engineering shelter belts of "Three North" (that is, north, northwest and northeast China), the upper and middle reaches of the Yangtze River and the seashore regions and afforestation of Taihang Mountains and the plain regions, are to be constructed. Priority can be given to the upper and middle reaches of the Yangtze River and the "Three North" shelter belts, especially to the construction of various water source forests. Additionally, artificial meadows are to be improved and constructed with the priority given to grassland seriously-degenerated areas and agricultural-and-herding mixed areas. Replacing firewood by coal is to be developed and solar energy, wind energy and bio-gas are to be used.

6. Conducting water and soil conservation. Major measures include: comprehensive control of forests, grasslands, farming fields and roads in the units of small river drainage; combination of treatment and development, with constructing projects of railways, highways, mines and water conservancy facilities having been conducted EIA and affiliated strict water and soil conservation measures.

Prior projects are in 14 key control areas having been identified by the government and 19 areas that are to be developed.

7. Preserving species and key natural habitats. Priorities can be given to: improving existing natural reserves to realize their preserving function; setting up a batch of new reserves, mainly for regions with rich species resources and habitats with rare and in-danger species; preserving and constructing a batch of wetland reserves, especially for lakes and marshlands in Yunnan-Guizhou Plateau and Qinghai-Tibet Plateau, freshwater lakes and the surrounding wetlands in the east, intertidal zones in northern Jiangsu and Liaoning, marshlands and lakes in Heilongjiang, Jilin and Inner Mongolia, and marshlands and inland lakes in Xinjiang.

It is necessary to construct a batch of breeding bases for rare and in-danger species, such as giant panda, white-flag dolphin, rare animals in Qinghai-Tibet Plateau, various pheasant ibis and other Chinese specialties, and tropical plants in Yunnan and Hainan. It is also important to investigate and preserve wild species sources of agricultural crops and economic animals and plants, and to set up a batch of gene bases and reserves for the species resources.

8. Coordination of international efforts. Another important aspect of environmental cooperation with the international community is to coordinate handling of all the environmental issues raised by the various development projects being funded by all of the various agencies or organizations. Because the task would likely be complex and could entail the harmonizing of the various environmental regulations with China's environmental regulations (and thus time consuming, as well), it could be undertaken in tandem with the ongoing requirement for EIAs for individual projects. The overall coordinating effort, as complex and costly as it might be, probably is a necessary step in China's ability to keep control of the environmental impacts inherent in a period of intense economic and social development.

REFERENCES

- Ministry of Water Resources, P.R.C. (MOWR). Water and Soil Conservation in China.
- . Three-Gorges Project: Key to Development of Yangtze River.
- Marine Environment Protection Law of the People's Republic of China. 1989.
- National Environmental Protection Agency (NEPA). 1992. Environmental Education in China. Beijing: China Environmental Science Press.
- . 1992. Introduction to the Environmental Protection Organizations in China.
- National Environmental Protection Agency (NEPA) and Ministry of Construction (MOC). 1992. China's Comprehensive Renovation of Urban Environment.
- Ministry of Forestry (MOF). 1992a. Forestry Development and Environmental Protection in China.
- . 1992b. The Protection of Wild Fauna and Flora in China.
- State Planning Commission (SPC). Comprehensive Utilization of Chinese Wastes.
- Ministry of Agriculture (MOA). 1992. Rural Energy Development in China.
- Ministry of Metallurgical Industry. Metallurgical Industry Environmental Protection.
- Ministry of Chemical Industry. 1992. Environmental Protection of the Chemical Industry of China.
- Zhang Kunmin and Jin Ruilin, eds. 1992. A Course in China's Environmental Protection Law. Beijing: Tsinghua University Press.
- Li Jinchang, Gao Zhengang, Zhong Zhaoxiu, He Xianjie, Kong Fanwen, and Fu Dedi eds. 1990. Natural Resource Accounting for Sustainable Development. Beijing: The China Environmental Science Press.
- State Administration of Building Materials Industry of the People's Republic of China. Environmental Protection of China's Building Materials Industry.
- National Report of the People's Republic of China on Environment and Development. 1991. Prepared for the 1992 United Nations Conference on Environment and Development (UNCED).
- The Conservation Atlas of China. 1990. Beijing: Science Press.
- Chen Yalin, ed. 1992. China's Eco-farming. Beijing: China Environmental Science Press.

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Ministry of Agriculture

Ministry of Forestry

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