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ENVIRONMENTAL MANAGEMENT AND PLANNING IN THE PEOPLE'S REPUBLIC OF CHINA

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UNITED NATIONS ENVIRONMENT PROGRAMME
REGIONAL OFFICE
FOR ASIA AND THE PACIFIC
BANGKOK

ISBN 92 807 1176 8

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Bangkok, Thailand, 1988.

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FOREWORD

Environmental management and planning is an evolving concept, and its application and implementation is also undergoing constant change and adaptation to respond to the prevailing conditions and needs. It is increasingly recognized that incorporating and integrating environmental consideration in economic social development planning and implementation enhances the quality of development and ensures its sustainability.

During the past decade, significant progress has been made in China in formulating environmental management and planning concepts and assessing, testing, and applying them at state, province and local levels. The experience gained so far and the percepting that is evolving are very interesting, particularly within the context of a large, diverse and most populus country such as China, that is undergoing very dynamic economic development and growth.

This monograph, the result of a scholarly research project, provides a very succinct review of the status of environmental management and planning in China; the institutional, administrative and organizational structures that exist to foster its application and a synthesis of the perceptions of possible trends in the evolution of concepts and application. It is an excellent source of information to those who wish to know more about the dynamic environment and planning evolution that is taking place in China.

Dr. Mostafa Tolba
Executive Director
United Nations Environment Programme

FOREWORD

The history of environmental management and planning in China is not so long. So we do not have much experience in these fields. Environmental planning is essential for environmental protection work. However, China has a vast territory with a great variety of natural conditions and imbalanced economic development within the whole country that makes environmental planning more difficult. At present, environmental management and planning in China is still at the stages of researching and exploring.

On the basis of her investigation and research, the author, Shuqin Xiu has made exploratory comments in an intensive and systematic way and presented some original views which are beneficial for further research in environmental management and planning in China.

I am very happy that the Regional Office for Asia and the pacific of the United Nations Environment Programme could publish this booklet. I hope that this publication would be of help to my colleagues working in environmental management in other countries of the world to understand the situation in China as well as serve as a reference for their research in environmental planning.

Prof. Qu Geping
Director,
National Environmental Protection Agency of China
Director,
Office of the Environmental Protection Commission
under the State Council

PREFACE

During the past decade the People's Republic of China has undertaken a significant and increasing number of measures to plan and manage the environment. In a huge an vast country such as China and with development proceeding very rapidly, the changes that are taking place are momentus.

There is keen interest by many people to know how environmental management and planning is carried out in China. What, for example, are the institutional system; organizational structures and the relationships at the various levels of government; coordinating mechanisms that are used and needed in the most populous country in the world; concepts and evolving procedures for planning; laws, legistion and environmental machinery; technical methods for pollution control; that are used in the country.

The research study carried out Shuqin Liu, with the advice and guidance of Dr. Walter E.J. Tips has resulted in a very useful compilation, analysis, and synthesis of environmental management and planning in China.

The four case studies dealing with industrial pollution control, nature conservation planning, desertification control and urban environmental planning have provided specific and pertinent examples that augment and amplify the environmental management and planning concepts and practices discussed in the text.

The research work is clearly and concisely presented in this monograph. The publication will provide a better understanding of the measures that are taken in China and could form a useful basis for further research and development of environmental management and planning.

Dr. Nay Htun

Director and Regional Representative
for Asia and the Pacific
United Nations Environment Programme

ACKNOWLEDGEMENTS

This monograph is based on a research study by Mrs. Shuqin Liu that was submitted to the Division of Human Settlements Development, Asian Institute of Technology, Bangkok, Thailand, to fulfil the requirements for a M.Sc. degree. The author received a great deal of help, guidance and continuous encouragement that made it possible to complete this work on schedule throughout this research study from Dr. Walter. In preparing this monograph Dr. Tips continued to provide valuable advice and assistance, and hence co-authored it.

Sincere thanks are extended to Dr. Nay Htun and Mr. Zhijia Wang for their valuable advice and numerous constructive comments. Mrs. Hilary Wongkaew is gratefully remembered for her editorial work on the earlier research study.

Shuqin Liu is deeply indebted to the scholarship donor, the Deutsche Akademische Austauschdienst, Federal Republic of Germany. She also wishes to express her indebtedness to the Canadian International Development Agency for granting funds for this study through the CIDA-Broad Based Development Programme.

The author is grateful to the National Environmental Protection Agency of the People's Republic of China for granting leave to complete this study at AIT. Sincere thanks are also extended to Prof. Qu Geping, the Director of the National Environmental Protection Agency, and related officials and professionals for their help, support and provision of valuable information.

CHAPTER I

INTRODUCTION

1.1. Environmental Planning in the People's Republic of China

The field of environmental policy stressed natural sciences and engineering during the period of the 1950s to 1960s. But now, the social sciences including sociology, economics and law are also in focus. For example, the history of environmental pollution control can be divided into three phases: elimination of polluting sources in the 1950s; reduction and prevention of regional pollution in the 1960s; and, regional planning and rational layout of production facilities and urban development, with emphasis on prevention in the 1970s.

Environmental planning became a part of the national socio-economic development plan in the late 1960s to the early 1970s. Traditional national socio-economic development plans did not or seldom consider environmental problems. From the industrial revolution (mid 1870s) to the 1960s in the 20th century, there was environmental planning and some measures were adopted to alleviate the contradiction between development and environment. But, these were limited to pollution elimination rather than prevention. Pollution was conceptualized in isolation and thought to be less connected to other fields. From the 1960s onwards, it has been realised that in order to control environmental pollution, comprehensive prevention measures must be taken on the basis of an integrated plan for the whole area first and pollution elimination should come second. Environmental planning has developed under these assumptions. Environmental planning is very important in the development of a country. It has been

proven in the context of many countries' industrial development that taking preventive measures is more effective and economical than attempting elimination measures so as to harmonize socio-economic development with natural resources and environmental protection and maintain a healthy environment for mankind. This history is also reflected in the administrative structure of the environmental bureaucracy.

Since 1974, two years after the United Nations Conference on Human Environment, China has had an official governmental organization especially dealing with environmental protection work in China, i.e. the Environmental Protection Leading Group (under the State Council, at first). The People's Republic of China has started substantial environmental planning in recent years. Along with the "four modernizations" in the People's Republic of China, industry, agriculture, tourism, etc. are being developed rapidly. Environmental planning has also become more and more important in national socio-economic development.

In the context of this planning the Chinese Encyclopedia of Environmental Science (1983), distinguishes three main types of environmental planning:

(1) Planning of environmental pollution control. This kind of planning includes: (a) industrial pollution control, (b) urban pollution control, (c) water pollution control and (d) agricultural pollution control.

(2) Environmental planning components of integrated national planning of the economy. This kind of planning is meant to include environmental planning in the national economic development plan.

(3) National land use planning. This includes: (a) regional planning, (b) watershed planning and (c) sectoral planning.

In this book, the focus is on environmental management and planning in the National Environmental Protection Agency of the People's Republic of China.

1.2. Environmental Issues Faced At Present

In the "Regulations on Environmental Protection and Improvement", which were adopted as a resolution by the participants of the First Meeting on Environmental Protection in China (held at Beijing, in 1973), environmental planning was the major concern. Among the ten main points of the Regulations, three were directly related to environmental planning. Although the Government has made great efforts in environmental protection work, P.R. China remains in the stage of elimination of pollution sources and in the stage of comprehensive elimination of regional pollution. It is at the threshold of the phase of regional planning and rational layout with emphasis on prevention. Due to a lack of practical experience and existing conditions, environmental planning can not be entirely carried out or can not be implemented in China. The problems can be identified as follows:

(1) Since environmental protection work in China has been started only in the 1970s, and environmental planning some years later, China lacks professional personnel, especially in the field of environmental planning.

(2) Environmental planning agencies are not effective since they are not soundly organized and provided with sufficient legal authority.

(3) To give a better legal status to environmental planning, regulations on environmental planning or environmental impact assessment are badly needed. Although China has an Environmental Protection Law (1979), this does not include standards for the regional environment. Thus, environmental

planning lacks sound legal provisions.

(4) Environmental planning needs cooperation among many disciplines, such as agencies in urban planning, national land management, national parks and reserves administration, since environmental protection needs to be undertaken in a multi-disciplinary, coordinated effort. But, evidence in China shows that there is a lack of coordination among the agencies from different ministries. As a result, environmental planning faces problems in implementation and duplication of assignments is inevitable.

(5) Environmental planning per se is of recent origin. Studies in this field have been conducted in many countries, but only a few research projects have been carried out by the National Environmental Protection Agency of China so far. Thus, quite naturally there is a need for more basic research.

(6) Environmental planning in China is just at its beginning and it is not implemented as a rule for every new project. Many people do not know much about environmental planning, or its aims. The lack of public awareness is obvious.

Within the context of these problems faced at present, the study below undertakes to discuss some issues of planning and implementing environmental planning in its broad sense in the National Environmental Protection Agency and its subsidiary agencies.

CHAPTER II

THE NATIONAL ENVIRONMENTAL PROTECTION AGENCY OF P.R. CHINA

2.1. Outline History of Environmental Concerns in the Constitution and Its Administration

By constitution, the People's Republic of China is a socialist republic in which the People's Congress is the supreme legislative body and the State Council the central executive organ. Administratively, the country is divided into 22 provinces, five autonomous regions and three municipalities directly under the State Council. Each province or autonomous region is further divided into districts, and districts into counties. Each county administers several people's communes as its basic administrative unit.

During the century preceding the foundation of the People's Republic of China in 1949, little or almost no action was taken in the field of environmental protection. However, since October 1949, more emphasis has been placed on this aspect, but mainly on the utilization of waste water, waste solids, and waste gases produced by industries. Its administration was the task of administrative units which also had other functions.

Since 1974, two years after the United Nations Conference on Human Environment, China has had an official governmental organization especially dealing with environmental protection in China, i.e. the Environmental Protection Leading Group. It comes under the State Council. Since then, environmental protection work has been receiving more and more attention from the Central Government.

2.2. The Organization of the National Environmental Administration and Other Policy-making Bodies

Environmental organization means here the state administrative body in charge of environmental management with its main functions of planning, organizing, leading, coordinating and monitoring environmental protection work. The environmental protection organization in China includes the organizations under the State Council, the units within ministries, local organizations, the organizations in enterprises and institutions and the like.

In the 1950s and 1960s, economic construction in China was at a threshold and developing the economy was taken as the most important of the national undertakings. As a result, environmental problems and the protection of environment were not getting much attention at that time. Though there were no specific organizations in charge of environmental management, environmental protection was the concern of some relevant administrative agencies. For example, forest and wildlife protection was under the supervision of the Ministry of Forestry; the prevention and elimination of soil erosion was under the National Soil Conservation Committee; the protection of the occupational environment was under the Ministry of Health. The main characteristic of this system of administration was its dispersed management, operating without a unified organizational framework.

In the 1970s, environmental problems in some areas of China became markedly severe and the Chinese Government realized the strategic significance of environmental protection progressively, especially after the United Nations Conference on Human Environment held in 1972. In 1974, after the First Meeting on Environmental Protection in China, the Environmental Protection Leading Group under the State Council was set up and a Standing Office affiliated to it was also set up to be in charge of daily affairs. At the same time,

environmental protection units were established in ministries, provinces, autonomous regions and in the cities. These were directly under the central government, as were the agencies established in large and medium-sized enterprises. The environmental protection organizations were, during this period, of a temporary nature and they did not possess clear competencies among the authorities. Also, different names were given to the environmental protection organizations, reflecting the dispersed nature of the action. Some were named "Three Wastes Elimination Office" (waste water, waste solids and waste gases); another the "Office of Comprehensive Utilization".

In 1982, the Ministry of Urban and Rural Construction and Environmental Protection was set up under which there was an Environmental Protection Bureau in charge of the environmental protection work in the whole of China. In 1984, the Environmental Protection Commission of the State Council and the National Environmental Protection Agency (as the standing office of the Commission) were established as a result of more attention given to environmental protection work by the central Government. At present, the environmental protection organizations directly under the State Council are the Environmental Protection Commission of the State Council, the Ministry of Urban and Rural Construction and Environmental Protection and the National Environmental Protection Agency. The National Environmental Protection Agency is affiliated both with the Commission and the Ministry.

2.3. The Organizational Structure of the National Environmental Protection Agency

At the national level, the Environmental Protection Commission of the State Council is the main policy and decision-maker in matters concerning the environment. The Commission is headed by one vice-premier, and includes ministers or vice-ministers from over twenty ministries concerned. Its functional body,

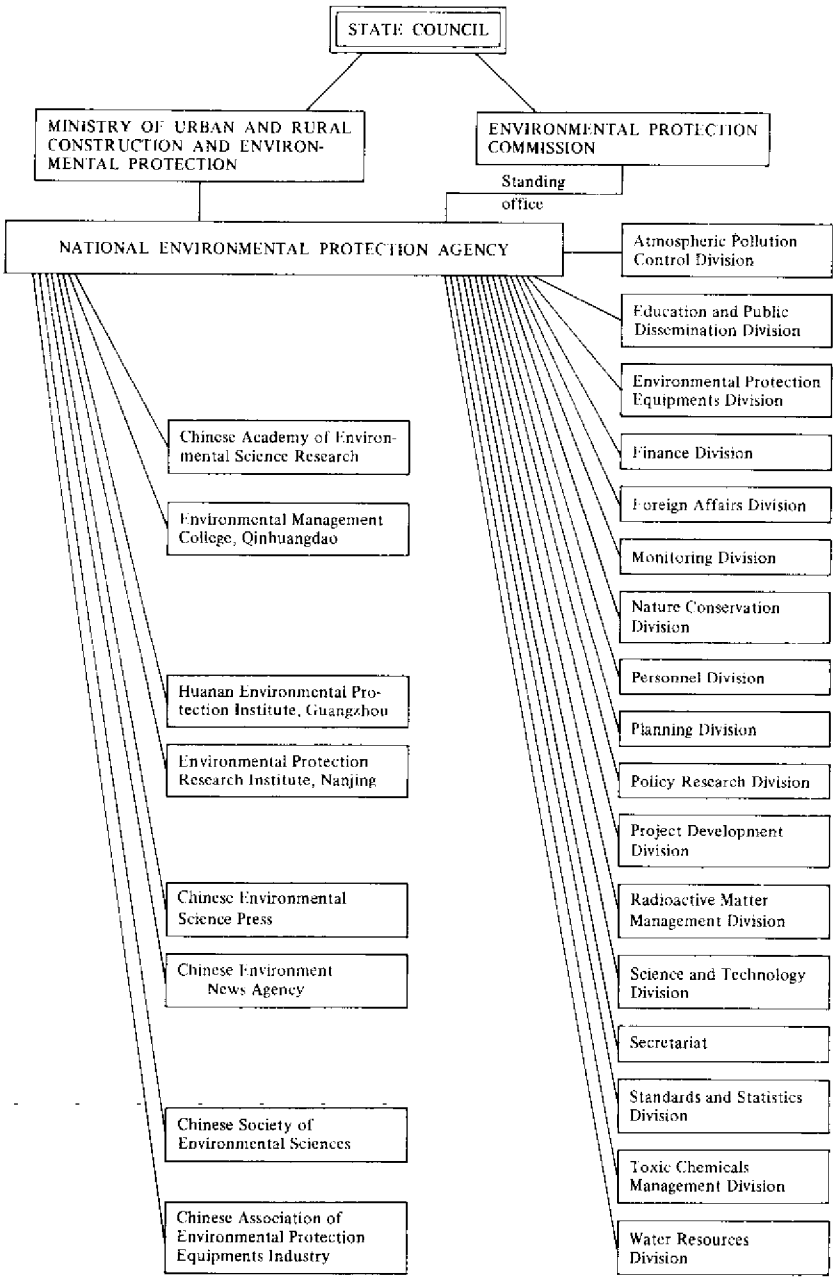


Figure 1. Organizational Structure of the National Environmental Protection Agency of the People's Republic of China

the Office of the Environment Protection Commission, that is the National Environmental Protection Agency, consists of one director, several deputy-directors and over 120 officials. Figure 1 shows the organizational structure of the Agency.

The functions of the main divisions can be briefly described as follows:

(1) The Atmospheric Pollution Division

Organizing and coordinating the projects regarding water pollution prevention and elimination; expanding the advanced techniques for atmospheric pollution control; establishing and enforcing the laws and regulations concerning atmospheric pollution prevention and elimination.

(2) The Education and Public Dissemination Division

Organizing the training courses for administrators and scientific and technical project managers in the environmental protection field; making suggestions on environmental education of the administrators in fields such as industries, agriculture, etc.; publishing books, magazines and information for environmental awareness; popularizing the environmental protection knowledge among the public in cooperation with news agencies, various academic societies and associations, etc.

(3) The Environmental Protection Equipment Division

Introducing and expanding the equipment with advanced techniques produced both at home and abroad.

(4) The Foreign Affairs Division

Organizing international academic exchanges in the environmental protection field including inviting foreign experts to visit China for academic exchange purposes and sending delegations and experts to attend international

conferences, academic meetings, workshops and the like in the environmental protection field; organizing the assignment and enforcement of bilateral and multilateral cooperation agreements in the environmental field.

(5) The Planning Division

Organizing the establishment of strategic goals of environmental protection and the process to implement them; making long-range and medium-range environmental protection plans at the national level; mapping out the development plan for the environmental protection field and incorporating it in the annual plan for the national economy, including the plans for capital construction, personnel training, etc.; organizing the formulation of regional, water and marine environment protection plans, such as, the environmental planning for certain regions and large and medium sized cities, marine environmental planning, agricultural environmental planning, etc.; promoting the environmental planning for various types of industrial pollution in each industrial sector.

(6) The Policy Research Division

Taking the responsibility for organizing the formulation of environmental protection guidelines and economic and technical policies; drafting laws, rules and regulations for environmental protection, decisions, methods and detail regulations for the implementation and dealing with the problems arising from the implementation of these laws and regulations; preparing the regular sessions of the Environmental Protection Commission of the State Council and making arrangements for carrying out the resolutions formulated by the Commission.

(7) The Development Project Management Division

Approving the reports on environmental impact assessment of large and medium scale construction projects, development

projects, newly-built industrial areas and newly-build townships; taking part in the approval and inspection of the implementation of the rule of "Three simultaneously", that is the installation for the prevention of pollution and other hazards to the public should be designed, built and put into operation at the same time as the main project.

(8) The Scientific and Technical Division

Organizing the establishment and implementation of a research plan for the environmental sciences; coordinating the research topics with other sectors; organizing the approval, incentives, dissemination of the important scientific research achievements and promoting scientific information exchange on environmental sciences.

(9) The Standards and Statistics Division

Organizing the establishment and modification of the standards for environmental quality, pollutants discharge, etc. and corresponding measures to implement them; organizing the work on environmental prediction and statistics, for supplying data and information to the decision makers.

(10) The Water Resources Division

Organizing, coordinating and inspecting the environmental management work on the investigation and monitoring of rivers and lakes and the oceanic environment; establishing and implementing the policies on water pollution control. The management of noise pollution elimination and control is also under this Division.

In Figure 1, the academy, the institutes, the society, etc. in the left hand frames are directly under the supervision of the National Environmental Protection Agency. The frames on the right hand are the divisions within the Agency. The Chinese Academy of Environmental Science Research is a

comprehensive research academy. It does include almost all kinds of research sections in the environmental protection field, including monitoring centres, information institutes, air pollution control modelling units, etc. This Academy and the other two institutes, are under the leadership of the National Environmental Protection Agency, both in administrative and academic matters. Some key-projects of each Five-Year Plan in the environmental protection field are carried out in this Academy or in the Institutes. The task of the Environmental Management College is to train qualified engineers, administrators and project managers for environmental protection work in P.R. China. Each year, many graduates are sent to institutes, environmental protection bureaux, etc., both at the local level and the national level. The Chinese Environmental Science Press and the Chinese Environmental News Agency undertake dissemination of environmental information for the Commission and the Agency. The policies, laws, rules and regulations as well as the experiences in the environmental protection field are disseminated and published in "Chinese Environmental News" which is issued three times a week. The Chinese Environmental Science Press is responsible for publishing books and papers, proceedings, etc., written by environmental scientists and administrators. It is also responsible for publishing the information provided by the United Nations Environment Programme. The Chinese Society of Environmental Sciences and the Chinese Association of Environmental Protection Equipments Industry are non-governmental organizations. Administratively, they are under the National Environmental Protection Agency. The Society is a purely academic organization and consists of the scientists and engineers in the environmental protection field.

2.4. The Functions of the National Environmental Protection Agency

The main functions of the National Environmental Protection Agency can be briefly described as follows:

(1) Management of the environmental pollution problems caused by production and domestic activities

This includes the pollution caused by discharge of industrial waste water, waste gases, waste solids, dust and radioactive matters; noise, vibration, bad odours, electromagnetic radiation and heat pollution; the hazardous gases, waste water, noise produced by the activities of communication; the poisonous and hazardous chemicals used and produced by peoples' daily lives and chemical fertilizer and pesticides industries; and, domestic smoke and waste water.

(2) Management of environmental damage caused by various construction and development activities

This includes environmental damage and impact of the development of coastal areas and mining areas; the environmental pollution and damage caused by unsound planning and construction of new industrial areas, townships and tourist zones; the environmental pollution and damage caused by the construction of nuclear power plants.

(3) Management of marine environmental problems

This includes management of the pollutants and pollution discharged and caused by marine transportation and ocean resource development; marine pollution caused by land-based sources.

(4) Management of natural environments with special values

This includes the protection of rare and valuable fauna and flora and their habitats; landscape, the ecological environment of agricultural activities, etc.

The environmental protection organizations that come directly under the State Council have wider functions and may alter their interests according to the circumstances. Some functions need the cooperation and coordination between environmental organizations and bodies with other functions. For instance, the management of the marine environment needs the cooperation of and coordination with the National Oceanographic Bureau; the management of the natural environments with special values with the Ministry of Forestry and the Ministry of Geology and Mineral Resources, etc. Since environmental problems are complex, comprehensive and broad, it is necessary that the environmental protection organizations directly under the State Council play the role of manager and coordinator.

2.5. Industrial Pollution Control and Prevention in a Publicly-Owned Economic System

The economy of the People's Republic of China is publicly owned and the planned economy model is used. All the enterprises and factories are under the control of the State. There are also some collectively-owned ones that are guided by the State and they must proceed in any undertakings according to the laws and regulations issued by the State.

The discharges from industrial production are the main cause of pollution at present and they constitute a major part of the total pollutants discharged. According to the statistics of 1980, the waste water discharged from industries amounted to 74 per cent of all discharged water, the sulphur dioxide 80 per cent, nitrogen oxides 87.4 per cent, suspended particles

88.4 per cent and carbon monoxide 72 per cent (Qu, 1984). There are two main aspects in industrial pollution control planning, one is the planning of the productive factories and enterprises existing now; another is the planning of the newly planned ones.

In the People's Republic of China, there are special agencies at the national level managing various kinds of enterprises and factories. They not only administer the enterprises directly affiliated to them, but also guide similar enterprises in the whole country in planning, objectives adoption and policy setting. There are corresponding institutes at the level of the province, the city, the autonomous region, etc. They are local institutions guided by the relevant agencies of the State. Thus, this forms a system from the central to the local government. If the industrial pollution control plan is based on this system, the pollution can be controlled effectively. The chemical industry is an example. At the national level, there is the Ministry of Chemical Industry which has a group of large and medium-sized enterprises under its administration. At the same time, the Ministry also provides guidance for the chemical industry nationwide in production, development planning, policy setting, etc. The chemical industry has a great number of products and is a major pollution source because of the pollutants discharged during the process of production. As a result, the Ministry has to organize production and submit a given quota of profits each year to the State as well as to be concerned about the pollution problems induced by production, carry out research on the techniques of pollution prevention and control, and ensure that the environmental standards and the requirements of the Environmental Protection Law issued by the State are met. There are, however, ambiguous situations that prevent efficient pollution control.

2.6. The Relationship between National, Regional and Local Levels of Environmental Administration

Provinces and municipalities that are directly under the Central Government, and also the autonomous regions have environmental protection bureaux. Municipalities, districts and counties also have their environmental protection departments. The environmental protection departments and units at various levels are under the direct authority of governmental and appropriate administrative departments at their respective levels. They receive operational guidance from higher level environmental protection bodies and are responsible for the work of environmental protection within their own departments. At the national level, as well as in key-departments of provinces, in municipalities directly under the Central Government, in autonomous regions, in districts and in municipalities, there are environmental protection institutions for scientific research and monitoring.

In brief, the environmental protection agencies at various levels maintain a 'leading and being led' relationship with local governments, but they are in a 'guiding and being guided' relation to the environmental protection departments at the higher levels. In China, the 'leading and being led' relation is expressed in certain rights to manage the administration of personnel and finance.

In order to continuously monitor the environmental situation in the country, the environmental protection bureaux at the provincial level and in the cities are required to submit monthly and annual forms with statistics on the environmental status to NEPA, the State Statistics Bureau and local governments. The forms are in a standard NEPA format. The annual summary report on environmental protection work and short, medium and long-term environmental protection plans are also required to be submitted to NEPA. NEPA, however, frequently carries out nation-wide investigations on subjects

of particular interest, e.g. the 1986 investigation on sources of pollution, to obtain first-hand information. In addition, annual meetings of Directors of provincial and city environmental protection bureaux provide more information to NEPA on the environmental status. Sometimes, guidelines can be transmitted through this channel and goals can be set by NEPA for local environmental protection bureaux.

NEPA also prepares national environmental protection plans and it sets goals, but, these are only guidelines and cannot be construed as directives. Based on the plan and the goals, various sectors will produce their own plan; so will the environmental protection bureaux at the provincial level and in the cities. Based on these lower level plans the industrial bureaux at various levels will, in their turn, prepare plans. In this manner, central guidelines will eventually reach the lowest levels as plans and goals.

At the national level, a coordinating body, i.e. the Environmental Protection Commission, was set up under the State Council. The Commission is authorized by the State and under the State Council's aegis its tasks are to set standards, guide policy formulation and coordinate the relationships concerning environmental protection work among various ministries and various levels. Coordination is one of the most complex problems to be dealt with in environmental management in China. It both is a daily as well as a long-term environmental management task for the National Environmental Protection Agency.

2.7. Strategies for Environmental Protection Work in P.R. China

It is emphasized by the Central Government that while developing the national economy, the planning of environmental protection should be strengthened. Industry and agriculture, cities and rural areas, production and

living conditions, economic development and environmental protection should be promoted at the same time and in a co-ordinated manner. The guiding principles governing environmental protection work are: overall planning, rational layout, comprehensive utilization, conversion of harm into good, and reliance upon the masses with everybody taking part in the protection of the environment for the benefit of the people.

In the Sixth Five-Year Plan of the People's Republic of China for Economic and Social Development, environmental protection was included in a separate chapter (Chapter XXXV). It also set a number of strategies to guide environmental protection work in China. The Plan states: "One major task of socialist modernization is to take care of our environments, exploit and utilize our natural resources in a rational way and preserve a fine ecological environment". The strategies adopted in the Sixth Five-Year Plan can be shortly described as follows.

(i) To give more sound guidance to the planning of environmental protection and to set up reasonable channels from which funds for this purpose can be drawn. All enterprises and undertakings as well as the departments in charge should set up specific environmental protection goals and targets in inspection work in this field as required by the state plan, and make such arrangements in their annual plans -- the work so arranged should be organized and carried out in a down-to-earth manner. Departments in charge of environmental protection shall intensify their supervision and check-up. Investments in installations for preventing pollution in capital construction projects as well as funds for anti-pollution measures in enterprises undergoing technical transformation should be included in the plans; profits from the comprehensive utilization of the waste water, waste gas and industrial residues should be reserved according to state regulations for these enterprises to further pollution

control; the fee for eliminating pollutants thus collected should be used specifically for tackling pollution and must not be appropriated for other purposes.

(ii) The various departments in charge shall draw up a general plan to combine the restructuring and reorganizing of enterprises and their technical transformation with pollution control. In selecting schemes for the restructuring of enterprises and their technical transformation, the best environmental results should be taken into consideration. Factories whose production technology is backward, which produce pollution with damaging effects that are hard to eliminate, should shift to the manufacture of other products, amalgamate with others or move to other places in a planned way. In doing this, shifting pollutants such as waste gas, waste water and industrial residues to the countryside is strictly prohibited. Simultaneously with notifying industrial and mining enterprises of their production targets, the departments concerned should also notify them of the requirements and targets for environmental protection and there shall be strict inspections to see if these targets and requirements are adequately fulfilled. Industrial enterprises and departments in charge of these enterprises must act in accordance with the principle of whoever is responsible for pollution during production undertakes to implement measures for its control and mitigation.

(iii) Undertake unified planning and tackle the problem in a comprehensive way. Engineering, biological, physical, other technical methods as well as administrative, legislative and economic measures will be taken inthe exploitation and utilization of resources with measures to protect, utilize and transform these resources, paying special attention to gradually bringing about permanent and continued utilization of renewable resources. At the same time, extensively promote the comprehensive utilization of resources and their utilization through recycling to

gradually make waste water, waste gas and industrial residues an industrial resource, thereby avoiding the waste of resources and destruction of the environment.

(iv) Intensify monitoring of the environment and research work on this subject. Work more attentively for the construction of environmental monitoring stations at different levels and strive to equip them as quickly as possible. Further strenghthen the leadership of research work in environmental protection and make the necessary readjustments to existing environmental research institutions at the provincial and municipal levels and work out a division of labour among them. Bring into full play the role of the Chinese Academy of Sciences, institutes of higher learning and the various departments doing research in environmental science. Knowledge of environmental sciences shall be popularized in primary and middle school; the various specialities of science, engineering, agriculture, medicine, economics and law in universities and technical secondary schools shall offer courses on environmental protection.

(v) Enact laws on environmental protection and enforce them. Departments of environmental protection at all levels shall, together with the various other departments concerned, constantly check on the implementation of the laws and regulations on environmental protection and conduct timely summaries of work. They also shall issue circulars discussing experiences in this field and the existing problems and circulars commending advanced units and criticizing the backward ones. They also shall penalize offenders. At the same time, supervision of the work to prevent atmospheric and water pollution, noise nuisance as well as the work in natural zones under protection is also needed.

2.8. Major Acts of General Environmental Legislation

The state has already issued many laws, regulations and standards concerning environmental protection, i.e. the "Environmental Protection Law", the "Marine Environmental Protection Law", the "Law on Water Pollution Prevention and Elimination", etc. In 1983, the State Council held the "Second Meeting on Environmental Protection in China" and promulgated that environmental protection is a basic national policy and one of the essential conditions and strategic tasks in the modernization of construction.

The Sixth Five-Year Plan (1986-1990) was the first to consider environmental protection work. The targets and measures to realize the protection were also provided. During the period of the Fifth Five-Year Plan, remarkable improvements had been achieved in the areas of industrial pollution control, urban environment deterioration control, natural environment conservation, environmental monitoring and research, environmental education and environmental management, etc.

The protection of the environment is provided for in the Constitution, article 11 of which states that "the State protects the environment and natural resources and prevents and eliminates pollution and other hazards to the public".

In 1973, the State Council convened the First Meeting on Environmental Protection and formulated a number of regulations governing the protection and improvement of the environment. Subsequently, some principles and methods of environmental protection and improvement were formulated. These regulations have played an important role in promoting environmental protection efforts. In order to define the basic guidelines and basic policies of environmental protection in the form of legislation, the Standing Committee of the Fifth National People's Congress ratified and formally proclaimed on 13

September 1979, for trial implementation, the Environmental Protection Law of the People's Republic of China (the text has been printed in Appendix 1). Its Article 2 stipulates that the function of this Law is "to ensure, during the construction of a modernized socialist state, the rational use of the natural environment, the prevention and elimination of environmental pollution and damage to ecosystems, in order to create a clean and favourable living and working environment, protect the health of the people and promote economic development".

The Environmental Protection Law covers a broad spectrum of environmental issues ranging from the rational use of land to the protection of wildlife and the prevention and elimination of pollution in its 33 articles. The "polluter pays" principle, is explicitly recognized (article 6). The Law contains the first legislation on environmental protection in China. It makes comprehensive and systematic provision for environmental protection guidelines, policies and principles, for the objects of protection, as well as its basic requirements and modalities, and for the mechanisms of environmental management, scientific research, propaganda and education, rewards and punishment. It also provides the basic guidelines and policies for environmental protection and water quality legislation to be developed subsequently, together with concrete regulations and rules for implementation. Since the Environmental Protection Law only attempts to set out the basic framework under which environmental policies and laws are to operate, article 33 specifically allows the State Council to promulgate specific and more detailed regulations in accordance with the Environmental Protection Law.

2.9. The Management of Environmental Protection and Development

In order to strengthen the management of the environmental protection of development projects, strictly control new pollution sources, accelerate the clean-up of existing pollution and protect and improve the environment, the Environmental Protection Commission under the State Council, the State Planning Commission and the State Economic Commission issued on 26 March 1986 the Management Guidelines on Environmental Protection of Construction Projects of the People's Republic of China on the basis of the Environmental Protection Law.

In the Guidelines, it is stipulated that for all the projects that will cause environmental impact, the Environmental Impact Assessment (EIA) examination and approval system should be followed. The purpose of the EIA process is to make an assessment during the feasibility study period on the long-term and short-term environmental impacts a project may cause. It is also required to propose control measures, review and select an optimal plan which is feasible technically and economically and which will have little harmful impact on the environment, so as to provide the appropriate authorities with a scientific basis for their decision-making.

An EIA report or Environmental Impact Form (EIF) should be completed during the period of the feasibility study. EIF is required for small projects or below-norm technical renovation projects, including projects in rural areas and those run by neighbourhoods or private producers. An EIA report should be prepared for those projects which will cause major environmental impacts as determined by the environmental protection authorities at county levels or above. EIA reports or EIF for the medium-sized and large projects or above-norm technical renovation projects should be submitted to the environmental protection department or the province where the project is located for examination and

approval. These are also submitted to the National Environmental Protection Agency for the record, after a preliminary check by the relevant authorities above the provincial levels, including the provincial level, responsible for the projects.

The following projects require an EIA report to be submitted to the National Environmental Protection Agency for examination or approval:

(1) projects that cross the boundaries of provinces, autonomous regions or municipalities,
(2) projects of a special nature, e.g. nuclear facilities, top-secret military or scientific projects, and
(3) very large scale projects (further examination by and approval of by the State Council is needed).

A system for the examination of the qualification of the units engaged in preparing Environmental Impact Assessment (EIA) will be established. The methods for the examination will be stipulated and promulgated by the NEPA. Units engaged in the preparation of EIA(s) shall obtain the necessary certificate (the Credentials) of their qualification from the NEPA and they shall carry out their work in accordance with the scope of work stipulated in the given Credentials. Before starting the assessment, the plan and outline for the assessment should be submitted to the environmental protection department for approval. The unit responsible for the preparation of EIA(s) shall be responsible for the conclusions of the assessment.

The environmental protection departments at various levels exercise unified administration and supervision on the environmental protection of construction projects; review the contents related to environmental protection in feasibility study reports and economic contracts; examine and approve the EIA report or EIF; review the chapter on environmental protection in the preliminary design and check on the construction of the projects; check and accept the

environmental protection facilities upon completion; check and supervise the operation and use of these facilities.

2.10. Implementation and Enforcement of Environmental Laws and Policies

While the National Environmental Protection Agency plays a catalytic, organizing, co-ordinating and supervisory role, the actual implementation of environmental policy is done in each province, autonomous region and municipality, and in each ministry in the State Council. The major ones are the Ministry of Public Health, the Ministry of Agriculture, Animal Husbandry and Fishery, the Ministry of Metallurgical Industry, the Ministry of Textile Industry, the Ministry of Water Resources and Electric Power, the Ministry of the Petroleum Industry, the Ministry of the Chemicals Industry, the Ministry of the Coal Industry, the State Planning Commission, the State Scientific and Technological Commission, the State Economic Commission, etc. In the actual implementation of environmental policies, more emphasis is given to the promotion of public awareness and mass participation than to enforcement of laws. Disputes are normally settled through arbitration rather than through decisions of a law court. Nevertheless, article 32 of the Environmental Protection Law specifically permits administrative and even criminal sanctions against "unit leaders, persons directly responsible or other citizens who have caused serious pollution and damage to the environment resulting in casualites or substantial damage to farming, forestry, animal husbandry, subsidiary production and fishery".

Mass participation is a main feature of the implementation of environmental measures. Every year numerous mass rallies of various sizes are held all over the country to inform and mobilize the people to participate actively in numerous projects which have a bearing on

environmental protection. Water conservation, be it the construction of numerous irrigation systems or the control of floods caused by the Yellow River, relies primarily on participation by the masses. The planting of millions of trees all over the country or the fixation of sanddunes in the Gobi desert are but a few of the very many successes that would not have been possible without the participation of millions of people.

Chinese environmental protection measures can best be summarized in the slogan of "triple simultaneity", which applies when a new factory or a research institute is constructed. It means in essence that during different phases - the design, the construction and the completion phase - environmental considerations have to be taken into account. Environmental protection should be a major concern in the design of the project, and has to be incorporated during the actual construction, as well as necessary measures that keep disruption of the environment to a minimum. Upon completion of the project, these protection measures have to be checked by environmental protection agencies before a licence can be obtained for the operation of the factory or institute. This elaborate approach is thought to increase costs, but societal benefits must also be considered.

CHAPTER III

ENVIRONMENTAL PLANNING PROCESS AND IMPLEMENTATION IN THE PEOPLE'S REPUBLIC OF CHINA

3.1. Introduction

There are four important aspects in environmental planning in China. These are: the understanding of the environmental planning concept; the process of environmental planning; factors that contribute to success and failure in coordination among the government agencies; factors that contribute to the problems of plan implementation, etc.

In order to obtain a better insight in these aspects, questionnaires were designed to interview planners, administrators and researchers in the environmental planning field. Fifty respondents were interviewed, among which a few who have not been involved in environmental planning projects previously. Nearly half of the respondents have been involved in environmental planning projects at more than three occasions.

The groups of respondents for this study are composed of:

(a) Officials from various divisions of the National Environmental Protection Agency.
(b) The Director of the National Environmental Protection Agency in charge of environmental planning (on the decision-making level).
(c) Corresponding officials and directors from provinces and cities concerned with environmental planning (on the local level).
(d) Environmental planners involved in the projects chosen as target cases.

(e) Planners and specialists from other disciplines, such as urban planners.
(f) Professors and professional persons from universities and colleges and research institutes involved in some environmental planning projects or studying the fields connected with environmental planning.

3.2. The Understanding of Environmental Planning Concepts

It is found that, in general, the respondents agree with the concepts of environmental planning described in the questionnaire as can be seen in Table 1. For example, environmental planning is a field made up of contributions from several academic disciplines, environmental planning is to maintain the ecological balance under conditions of development, environmental planning is to promote economic development and improve environmenatal quality at the same time, and environmental planning is a set of regulations made for a given period on the aims and measures of environmental protection. Only the concept that environmental planning is to alleviate the contradiction between economic development and the protection of environment is not accepted by about 15% of the respondents and about 36% of the respondents were indifferent to it. Thus, there are significant differences between the opinions on various concepts: some are more widely accepted than others.

3.3. Discussion on the Planning Process

In order to study the planning process, the process used by the planners at various levels needs to be investigated. In one question, a description of the planning processes as used before was requested. Although many different processes were described as related to the limitations of different types of planning practiced, a common process mentioned by about 90% of the respondents has been presented in Figure 2.

Table 1. Understanding of Environmental Planning Concepts (n = 50)

Environmental planning is*	Agree	Indifferent	Disagree
A field made up of contributions from several academic disciplines	36 (90%)	2 (5%)	2 (5%)
A set of regulations made for a given period on the aims and measures of environmental protection	24 (62%)	11 (28%)	4 (10%)
To maintain ecological balance under the conditions of development	31 (79%)	7 (18%)	1 (3%)
To alleviate the contradiction between economic development and the protection of environment	19 (49%)	14 (36%)	6 (15%)
To promote economic development and improve environmental quality at the same time	28 (72%)	8 (21%)	3 (7%)

* Multiple-choice question

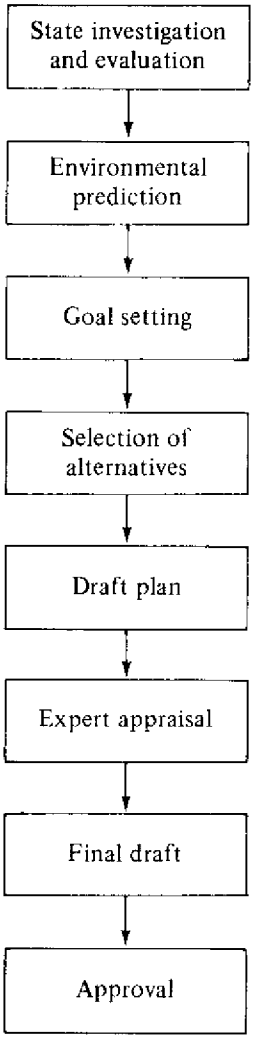


Figure 2. The Environmental Planning Process As Practiced by the Respondents

Unfortunately, almost no implementation or enforcement procedures are mentioned by the respondents. Only, a few respondents have considered plan implementation and thought that it should be a step to be included in the regular execution of a planning process. Different from others, they mentioned the following steps after "approval" of the plan:

(a) implementation;
(b) implementation evaluation of environmental social benefits;
(c) extension to the areas under similar conditions.

A few respondents mentioned a procedure of "adoption of guidelines and planning process that will be practiced" before anything else, that is as the first step of the whole process. The step of "discussion and coordination with other agencies" is also included by some respondents before the "final draft" is made.

Unsatisfactory results were obtained for some questions. For the question "what kind of ideal planning process should be followed according to your understanding?", there are about 20% of the respondents who do not provide any answers. For the question "what kind of planning process do you suggest be used in China?", more than 45% of the respondents do not provide answers. Some respondents like to use the same answer as for other earlier questions, such as on the present planning process.

The ideal planning process suggested by most respondents is shown in Figure 3. Some respondents also stressed that, before making a final draft plan, requesting recommendations from professionals in other disciplines is necessary. Some argued that the actual planning process is not very important, the most important thing is whether the plan can be realized or not. They suggested that environmental

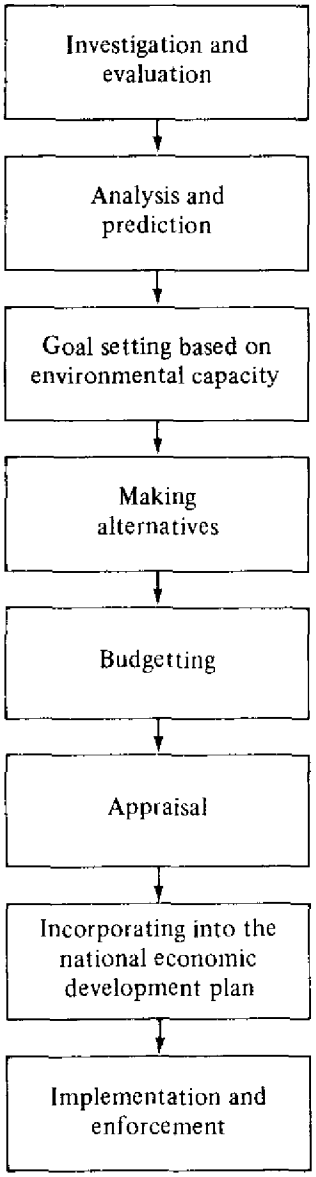


Figure 3. The Environmental Planning Process As Suggested by the Respondents for Use in the P.R. China

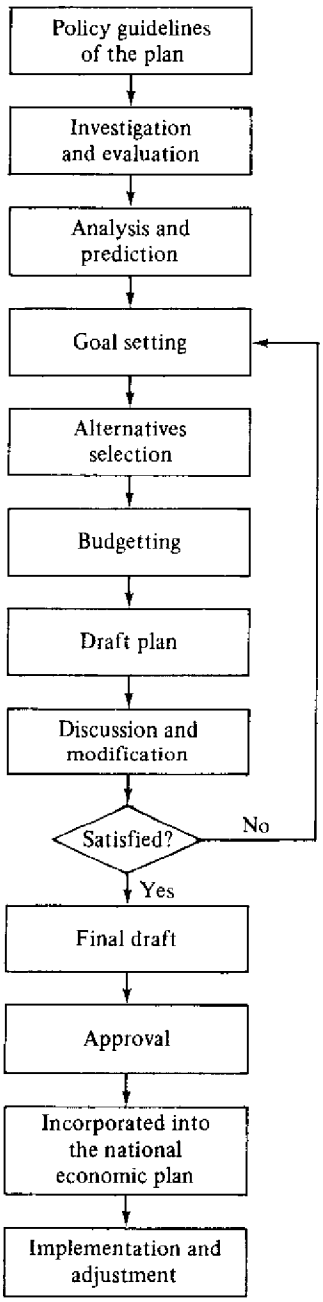


Figure 4. The Ideal Planning Process Suggested by the Respondents

planning be made in coordination and accordance with economic planning and urban construction planning. The ideal environmental planning process must provide strong directives for environmental management.

For a process for the People's Republic of China specifically, the answer is not very representative of the groups as a whole because again, nearly half of the respondents did not answer the question. Among them, some said the process previously mentioned in reply to the question on "what kind of ideal planning process should be followed according to your understanding?" is also suitable for China and some said the answer to the question on "what kind of planning process do you suggest to be used in China?" is applicable to China. Anyhow, on the basis of the answers, the environmental planning process suggested to be used in China can be expressed as in Figure 4.

Quite a number of the respondents stressed that in view of the conditions in China, i.e. a planned economy, the environmental plan at the national level should be integrated in the national economic development plan and the discussion on goal-setting in the Economic Commission of the State, the Planning Commission of the State and other ministries as well can not be ignored.

The environmental planning at various levels needs different time periods since the process also displays some smaller differences. According to the description of the respondents the time used for each step to achieve the goals adopted in the plan can be interpreted by using three categories: national level planning, local level planning and sectoral planning.

The environmental plan-making at the national level takes about one and a half to two years, the details are shown in Table 2. For the environmental plan-making at the local level, one to one and a half years are needed, details

are shown in Table 3. For the sectoral environmental plan-making, it takes about one year to accomplish a project. The details are shown in Table 4.

To the question about the need for a standard planning process, about 76% of the respondents see the need and about 65% of them like to incorporate the process in regulations, 25% in working procedures and 10% in laws.

The planning process summarized in this study has some limitations. The respondents have been involved in different kinds of planning, some are involved as planners and some as administrators or coordinators. So, they had experienced environmental plan-making in a different manner and interpreted the planning process from different angles. Also, two respondents who are involved in the same planning project may still give a different interpretation to its process. Furthermore, some respondents are not process-minded, they can not describe precisely the planning process they once practiced. For example, for the questions on the description of the planning process that had been used before, some of the respondents gave very detailed answers, but, a few respondents only gave an answer with a few words or remote to the point questioned. The planning process summarized above had to be based on a more quantitative denominator of all replies. As a matter of fact, some very interesting processes provided by the respondents could not be displayed in Figure 2, 3 and 4.

On the question of what the ideal environmental planning process should be there are some very professional answers. Figure 5 shows the process expressed by an administrator respondent from the National Environmental Protection Agency. Among the planner respondents, one from the Environmental Protection Bureau of Tianjin described the ideal planning process in his mind as is shown in Figure 6. At least such detailed proposals prove that there is ample potential for an in-depth discussion of the process used at present with a view

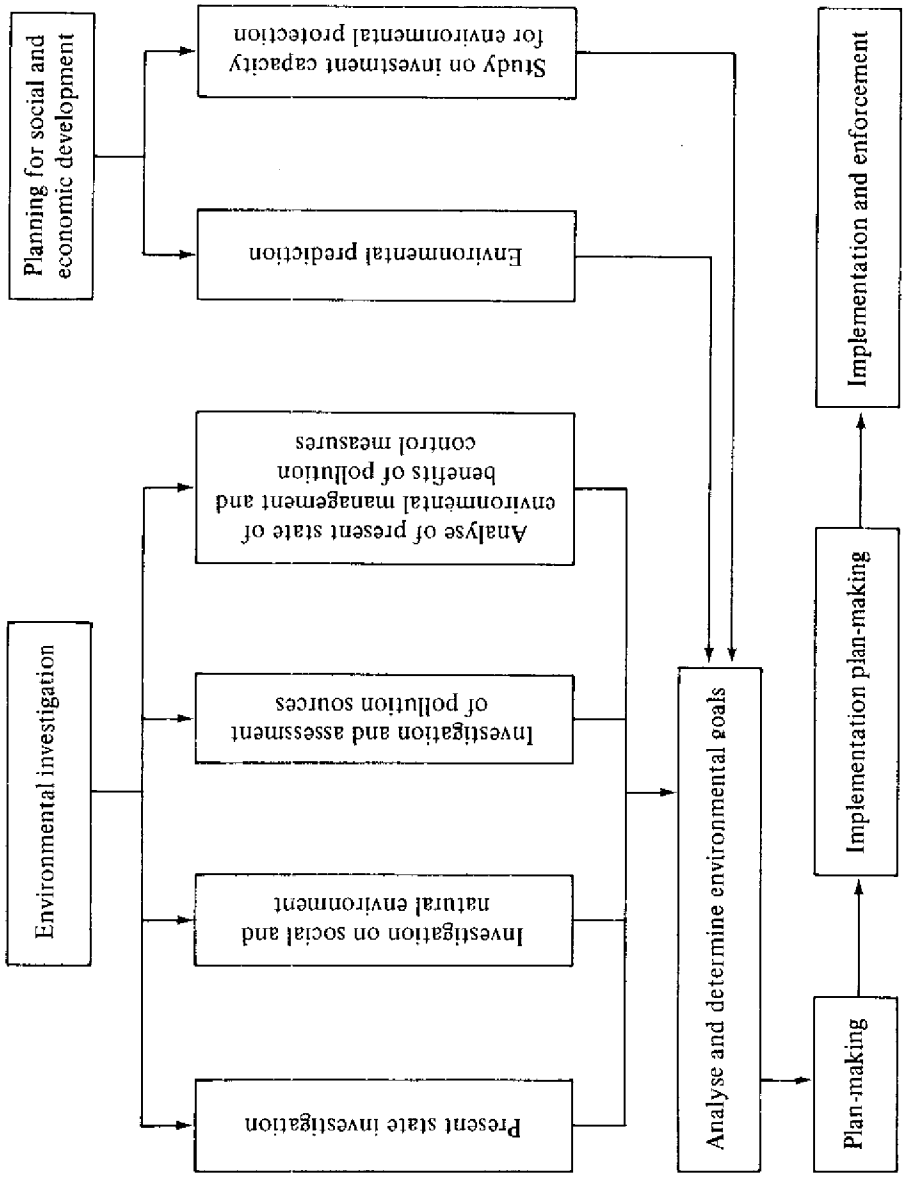


Figure 5. The Ideal Planning Process Expressed by An Administrator Respondent From the National Environmental Protection Agency

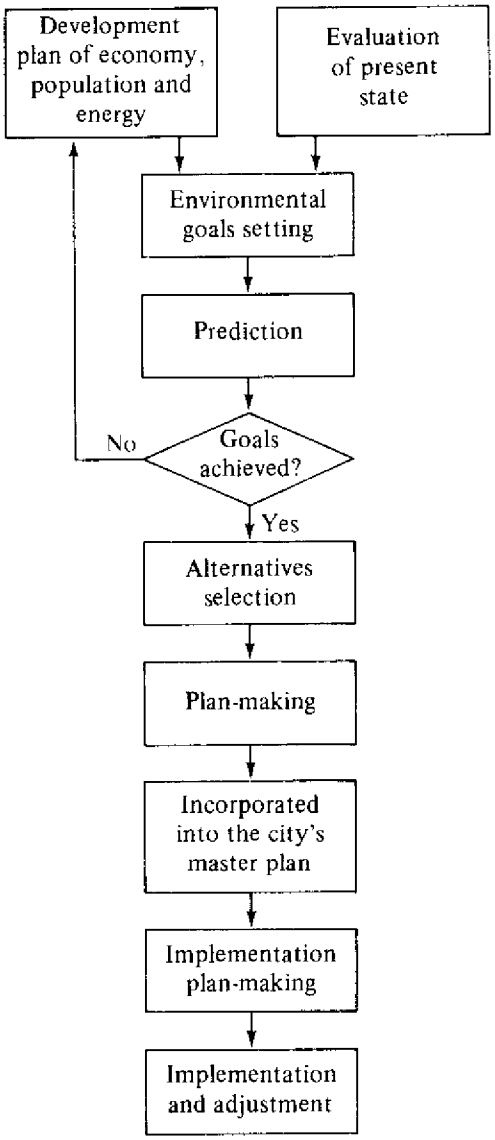


Figure 6. The Ideal Planning Process Expressed by a Planner Respondent from the Local Level

Table 2. The Time Needed for the Environmental Planning at the National Level

Description of the Work	Time Needed (months)
Guidelines and policy setting	3
Investigation of the present state and environmental prediction	6 - 12
Coordination with other ministries	3 - 6
Plan-making	1 - 2
Experts' appraisal	1
Modification	0.5
Approval	1
Issuing the plan	0.5
Total	18 - 24

Table 3. The Time Needed for an Environmental Planning Project at the Local Level

Description of the Work	Time Needed (months)
Investigation of the present state	2 - 3
Investigation of the development plans of the fields concerned	1 - 2
Prediction of environmental quality	2
Goal setting	1
Coordination	2 - 3
Plan-making	1
Discussion, appraisal and modification	2 - 3
Submit to the higher authority for approval	1 - 2
Approval and readying for implementation	1 - 2
Total	12 - 18

Table 4. The Time Needed for a Sectorial Environmental Planning Project

Description of the Work	Time Needed (months)
Present state investigation and evaluation	2 - 3
Environmental prediction	2 - 3
Goal setting	1
Selection of alternatives	2 - 3
Draft plan-making	1
Appraisal	0.5
Modification and final draft	1
Submit for approval	1
Total	12

of improving planning work in future undertakings.

3.4. The Coordination Among Governmental Agencies

Coordination needs to be of a continuous nature in environmental management (Geping, 1984). Lack of coordination and cooperation among governmental agencies is one of recurring problems throughout many plans in the People's Republic of China of any kind. For environmental planning, the coordination and cooperation among the agencies involved in urban planning, national physical planning and management, nature conservation administration, etc. is indispensable since environmental protection needs a multi-disciplinary approach.

This section will present the findings of the questions related to coordination and cooperation in the questionnaire. Some necessary other information is also added for the purpose of better understanding.

About 90% of the respondents said they requested or received support from other organizations in implementing an environmental plan. Reasons for support can be ranked as follows:

(a) The organization understands the importance of environmental planning;
(b) There is good coordination between organizations;
(c) There is a good personal relationship; and
(d) The organization understands the environmental planning project very well.

For the question "in case you get support, how does it usually come about? is there a procedure to be followed?", almost all the respondents said that there was no fixed procedure when they received support. Some of the respondents get support because the planning projects had been approved by the authority concerned and supported by

an official document. So, when they coordinate with people from other agencies involved in the project, they can get support without problems. Some respondents mentioned that they got support because there is a specific person in charge of environmental protection work in the agencies concerned. Quite a number of the respondents stressed the role of good personal relationships in cases where they get support.

Although only 10% of the respondents did not get any support at all from the officers in other agencies, they pointed out very important reasons for this to which we should give consideration. They said that lack of good coordination results in no support or no real support. Public awareness of environmental planning is also very important for environmental plan-making and implementation. Since they lack an understanding of environmental planning, some administrators are not interested in environmental planning work, let alone in supporting it. This is one of the most serious coordination problems. Furthermore the respondents also stressed some specific reasons in the cases where no support was provided. They said that environmental protection by its very nature is difficult to coordinate since different fields have different priorities and different interpretations as well. In urban planning and economic planning, only macro-strategy targets were set without detailed specifications. As a result, environmental targets can not be closely connected with economic development targets and the support needed from relevant agencies can not be obtained. Lack of good laws and regulations is also a reason for no support. For example, in the work of prevention and control of vehicle pollution, the environmental protection agencies need support from public security and communication agencies, but, the control can not be coordinated well because the law on atmospheric pollution prevention and control has not been officially issued yet.

In the respondents' opinion, coordination between environmental and other agencies is seen to be necessary for

Table 5. The Frequency of Meetings with the Officials from Other Agencies During Plan-Making (n = 50)

Degree of Frequency	Frequency	Percentage
Very often	36	72.0
Seldom	11	22.0
Only once	0	0.0
Never	3	6.0
Total	50	100.0

plan-making and implementation. Table 5 shows the frequency with which the respondents have meetings with the officials from other agencies during planning and implementation. Based on their practice, most of the respondents thought they entertained intensive coordination with the officials in other agencies when making and implementing a plan in matters of budgetting, data collection, project identification, plan-making, project implementation and project evaluation.

The coordination between environmental protection agencies and the agencies in other fields is one of the key-links in environmental management. Environmental protection needs to be multi-disciplinary, coordination seems to be more important in plan-making and implementation, and duplications can not be totally avoided, but, they can be reduced to a minimum if more effective measures are taken.

According to the results from the questionnaire, there are some other agencies in China involved in environmental planning work besides the National Environmental Protection Agency and its affiliates. They are: water resources management agencies, national physical planning agencies, urban planning agencies, urban and rural construction agencies, etc. It is a fact that there is a coordinating body at the national level, i.e. the Environmental Commission of the State Council, but, its rights to order other sectors to change their operating practices are rather limited. It can make suggestions and coordinate. The role of the Commission is to prepare the national environmental protection plan and, thus, it is a de facto coordinator among the various ministries and sectors. Since there is no single agency dealing with all environmental planning, coordination is one of the key issues that must be given attention. Existing duplications in environmental planning are the best way to show the problems in coordination. The duplications mentioned by the respondents can be summarized as follows:

(1) the planning of natural conservation with the Ministry of Forests;
(2) the planning of oceanic environmental protection with the State Bureau of Oceanography;
(3) the planning of the urban environment with municipal planning bureaux, such as the planning of infrastructure construction, industrial zone layout, etc.;
(4) the planning of solid wastes treatment with municipal sanitary bureaux;
(5) the planning of atmospheric environmental protection with some energy agencies;
(6) the planning of municipal waste water treatment with municipal engineering agencies;
(7) the study of certain questions by scientific research institutes affiliated to environmental protection agencies or by the scientific research institutes within colleges and universities;
(8) the monitoring work at the national level with local monitoring stations;
(9) regional environmental planning with territorial management agencies;
(10) the duplication in the stages of investigation (the first step in environmental planning) and the analysis of basic background information.

As long as there is duplication, there will be coordination problems. In other words, the existence of duplication shows that there are coordination problems. The respondents discussed also the methods to resolve these ineffective duplications. Some of these cause very serious coordination problems and a few even become potential sources of conflicts during the coordination efforts. The reason is that the integrative and coordination role of the environmental protection agencies is not well recognized by the other agencies and thus the environmental protection agencies are not invited to join the planning group when they start making plans. In this way, duplication appears as the by-product of coordination problems. But planning needs

Table 6. The Important Factors for the Coordination Between Government Organizations (n=50)

Factors*	Strongly agree	Agree	Indif-ferent	Disagree	Strongly disagree
Smooth information flow	24 (56%)	17 (40%)	2 (4%)	0 (0%)	0 (0%)
Good inter-personal relationships	12 (28%)	20 (47%)	9 (21%)	2 (4%)	0 (0%)
Adequate guidance from higher-level staff	18 (42%)	21 (49%)	4 (9%)	0 (0%)	0 (0%)
Sufficient staff experiences	17 (40%)	23 (53%)	3 (7%)	0 (0%)	0 (0%)
Clear organizational structure	21 (49%)	21 (49%)	1 (2%)	0 (0%)	0 (0%)
A workable administrative system	22 (51%)	18 (42%)	3 (7%)	0 (0%)	0 (0%)
Good understanding among staff within/ among organizations	14 (33%)	23 (53%)	6 (14%)	0 (0%)	0 (0%)
Clear agreement of roles and responsibilities among organizations concerned	20 (47%)	19 (44%)	4 (9%)	0 (0%)	0 (0%)
Frequent meetings between organizations	3 (7%)	18 (42%)	17 (40%)	5 (11%)	0 (0%)
Regular reporting on implemention of environmental planning projects	9 (21%)	20 (47%)	14 (33%)	0 (0%)	0 (0%)

* Multiple-choice question.

close cooperation of the agencies concerned with economy, capital construction, national planning and the environment; without this, the plan will be unrealistic and can not be realized.

Table 6 lists ten factors that are judged important for the coordination between governmental organizations, as they are accepted by the respondents.

A ranking of these factors was requested, but the results are not satisfactory because half of the respondents did not rank or only pointed out the first few factors. Therefore, the results are indicative only. In the questionnaires with a ranking, the most important factor for the coordination between governmental organizations is a smooth information flow; the second on the list is a good inter-personal relationship and the third is clear agreement on roles and responsibilities among the organizations concerned.

Table 7 concerns the factors contributing to the problems of coordination between governmental organizations. Ranking of these factors also was done by half of the respondents only and some only pointed out the first, the second or the third most important factors. The first three factors contributing to the problems of coordination between governmental organizations are a lack of budget (almost no budgets are available for environmental planning at the local level), the complicated administrative system and the ambiguity of roles and responsibilities between organizations in environmental planning projects.

How can these duplication and coordination problems be solved? Some respondents pointed out that the present organizational structure can not cope with actual needs, and two measures need to be taken:
(1) More authorized agencies in charge of environmental protection work at the state level need to be established.
(2) The responsibility of each ministry and agency needs to

be further clarified, especially in the environmental protection field.

Another alternative is that a planning group be established in the decision making department at the central government level, such as the Planning Commission of the State, being in charge of the formulation of the long-term national economic development plan and the five year plans. This group should be constituted from officials from various agencies and strictly carry out the policy guidelines approved by the State. The final plan must be legalized to protect it from any changes at anyone's whim. The main work of environmental protection agencies should be integration, coordination, supervision and inspection. The plans for each specific field will be made by the corresponding agencies and be incorporated in their own development plan. For example, the planning of forest conservation and some reserves can be done by the Ministry of Forests, the oceanic environmental protection can be done by the State Bureau of Oceanography, etc. In this way, most of the coordination problems may be solved.

In order to clarify which factors contribute to the coordination problems in plan-making and plan implementation, the responsibility for various kinds of planning tasks in the organizations at different levels are investigated and the results are shown in Table 8. It may be observed from the table that there are differences in opinion.

3.5. The Implementation of Environmental Protection Plans

Implementation is commonly understood to be the actual transformation of what has been put on paper during the planning process into physical structures or social welfare improvements. The state of implementation of environmental protection plans in China was investigated in part of the questionnaire.

Table 7. The Factors Contributing to the Problems of Coordination Between Government Organizations (n=50)

Factors*	Strongly agree	Agree	Indif-ferent	Disagree	Strongly disagree
Ambiguous policies at different levels	8 (24%)	22 (65%)	4 (11%)	0 (0%)	0 (0%)
Complicated administrative system	10 (28%)	23 (64%)	3 (8%)	0 (0%)	0 (0%)
Ambiguity of roles and responsibilities between organizations in environmental planning projects	15 (38%)	19 (49%)	5 (13%)	0 (0%)	0 (0%)
Unclear or lack of communication between organizations	5 (14%)	18 (51%)	10 (29%)	2 (6%)	0 (0%)
Complex structure of the organization	4 (12%)	12 (25%)	17 (50%)	0 (0%)	1 (3%)
Conflicts among the organizations concerned	10 (28%)	15 (42%)	9 (25%)	2 (5%)	0 (0%)
Frequent changes of staff	8 (24%)	12 (35%)	11 (32%)	3 (9%)	0 (0%)
Ambiguous authority	13 (37%)	14 (40%)	6 (17%)	2 (6%)	0 (0%)
Lack of a budget	17 (49%)	12 (35%)	6 (17%)	0 (0%)	0 (0%)
Different goals of implementation in various organizations	5 (16%)	13 (42%)	8 (26%)	5 (16%)	0 (0%)

* Multiple-choice question.

Table 8. Responsibility of the Organizations at Various Levels for Environmental Plans (n = 50)*

Organization	Policy	Planning	Implementation	Enforcement	Education
National Environmental Protection Agency	41	29	7	9	25
Urban planning agency	7	17	17	17	10
Municipal governments	8	13	20	29	10
Local authorities	12	17	18	24	20
Local environmental protection bureaux	13	28	21	24	25

* Multiple-choice

According to the results from the question on "how successful are environmental planning projects which are implemented by your organization?", the state of plan implementation is not considered to be very satisfactory by the respondents. There is no one giving a positive answer to the extent of "very successful" and, on the other side, "not successful at all". About 22% of the respondents have ticked "successful", about 76% of the respondents have ticked "normal degree of success" and 2% "not successful".

A considerable number of respondents replied to questions on the reasons for successful and unsuccessful plan implementation. For the reasons of successful plan implementation, some respondents explained the case of industrial pollution control in Tianjin: firstly, the plan was based on a full investigation of the present environmental state and a great deal of scientific research went into that. Then, the environmental goals set in the plan were responding to actual practice. Thirdly, the final plan was discussed within every sector and coordination for its implementation was practised at the same time; lastly, the plan was incorporated in the Master Plan of Tianjin and approved by the People's Congress of Tianjin. Many respondents stressed the importance of recognition of a plan by the authorities at various levels and of allocation of funds for its implementation. Furthermore, the most important reasons for unsuccessful implementation are that no one continues the work in plan monitoring and adaptation and there are also no organizational measures to manage the routine work of plan implementation. One respondent described the state of plan-making and plan implementation as two layers of skin (it means that it seems one layer covers another, but there is no real connection) and a plan is just "a drawing on a piece of paper and a picture on the wall". Some respondents pointed out that a few planners doing plan-making only respond to the orders from the officers at higher levels.

In answering the question: "in practice, have you ever adjusted the plan during the period of implementation?", there are about 98% of the respondents giving positive answers and there is only one official who denied he did ever adjust a plan. The adjustment is due to the unrealistic plans as well as other reasons or because of the order from a higher authority or at one's own request. The reasons for adjustment stressed by most of the respondents are: (a) the proposed budget was cut back; (b) the plan is not responsive to the needs of the locality; (c) the plan is incompatible with the existing conditions of the target areas; and (d) in order to shape the plan to suit the outcome of the work. According to the respondents, the adjusted plans are workable.

Table 9 lists ten factors that are believed to contribute to the problems of implementing the environmental planning projects. In the questionnaire, a ranking of these factors was requested, but the results are not satisfactory, because half of the respondents did not rank or only pointed out the first few factors. Therefore the results are indicative only. Based on the questionnaires which include a ranking, the most emphasised factors which contribute to the problems of implementing the environmental planning projects are: (a) the late release of funds; (b) the lack of a good plan; and (c) the complex administrative system. Table 10 presents the problems and constraints specified by the respondents in plan implementation.

One respondent said that all the reasons discussed above are not the main reasons contributing to the problems of plan implementation. The most important reason is that environmental planning has not been incorporated into the national economic development plan, so there are no authorized procedures for funds, equipment, land, resources, etc. Although environmental protection was included in the Sixth Five-Year Plan of the P.R. China for Economic and Social Development (Chapter XXXV), no part of the

Table 9. The Factors Contributing to the Problems of Implementing Environmental Planning (n=50)

Factors*	Strongly agree	Agree	Indif-ferent	Disagree	Strongly disagree
Late release of funds	16 (44%)	17 (47%)	2 (6%)	1 (3%)	0 (0%)
Lack of a good plan	8 (22%)	26 (70%)	3 (8%)	0 (0%)	0 (0%)
Lack of knowledge on implementing pro-jects among staff	2 (6%)	14 (45%)	11 (36%)	4 (13%)	0 (0%)
Conflicts among organizations	7 (21%)	15 (44%)	11 (32%)	1 (3%)	0 (0%)
Complex administra-tive system	9 (26%)	28 (53%)	7 (21%)	0 (0%)	0 (0%)
Inequitable distri-bution of funds	8 (25%)	8 (25%)	14 (42%)	3 (8%)	0 (0%)
Lack of understan-ding of the role and responsibility of the staff	1 (3%)	14 (49%)	13 (45%)	1 (3%)	1 (0%)
Lack of staff	1 (3%)	13 (39%)	16 (49%)	2 (6%)	1 (3%)
Lack of authority of staff	7 (23%)	11 (35%)	10 (32%)	3 (10%)	0 (0%)
Inadequate information	4 (12%)	17 (52%)	10 (32%)	2 (6%)	0 (0%)

* Multiple-choice question.

Table 10. The Problems and Constraints in Plan Implementation (n = 50)

Problems*	Very strongly agree	Agree	Indif-ferent	Disagree	Very strongly disagree
Internal coordination	13 (33%)	19 (48%)	7 (17%)	1 (2%)	0 (0%)
External or interorganizational coordination	18 (44%)	20 (49%)	3 (7%)	0 (0%)	0 (0%)
Structure of the implementing organization	8 (23%)	20 (57%)	7 (20%)	0 (0%)	0 (0%)
Capacity of the implementing organization	8 (23%)	19 (54%)	7 (20%)	1 (3%)	0 (0%)
Recruitment of manpower	2 (7%)	14 (42%)	14 (42%)	3 (9%)	0 (0%)
Administrative management	8 (24%)	16 (47%)	9 (26%)	1 (7%)	0 (0%)
Budget provisions	22 (63%)	9 (26%)	4 (11%)	0 (0%)	0 (0%)
Policy making constraints	11 (40%)	11 (40%)	7 (20%)	0 (0%)	0 (0%)

* Multiple-choice question.

Table 11. The Respondents' Experience with Some Important Factors During the Plan-Making Process (n=50)

Project factors	Clearly stated	Vague	n. a.
1) Policy guidelines	41 (82%)	3 (6%)	6 (12%)
2) Objectives	45 (90%)	3 (6%)	2 (4%)
	Easy	Difficult	n. a.
3) Target setting	13 (26%)	34 (68%)	3 (6%)
4) Target area(s) setting	34 (68%)	14 (28%)	2 (4%)
5) Project administration			
5.1 Plan making			
5.1.1 identification of problems	30 (60%)	17 (24%)	3 (4%)
5.1.2 generation of alternatives	20 (40%)	21 (42%)	9 (18%)
5.1.3 selection of alternatives	21 (42%)	22 (44%)	7 (14%)
5.2 Plan implementation	1 (2%)	48 (96%)	1 (2%)
5.3 Project evaluation	21 (42%)	19 (34%)	12 (24%)

(Table 11. continued)

	In time	Not in time	n. a.
5.4 Budget allocation from relevant offices	9 (18%)	34 (68%)	7 (14%)
	Sufficient	Insufficient	n. a.
5.5 Number of personnel available	8 (16%)	40 (80%)	2 (4%)
	Satisfied	Unsatisfied	n. a.
5.6 Efficiency of information	7 (14%)	35 (70%)	8 (16%)
5.7 Support from other divisions or agencies			
5.7.1 technical	23 (46%)	22 (44%)	5 (10%)
5.7.2 decision-making	17 (34%)	25 (50%)	8 (16%)
5.7.3 administration	14 (28%)	28 (56%)	8 (16%)
6) Coordination	Coordinate	No Coordination	n. a.
6.1 with other agencies			
6.1.1 technical	34 (68%)	8 (16%)	8 (16%)
6.1.2 decision-making	24 (48%)	19 (38%)	7 (14%)
6.1.3 administration	18 (36%)	22 (44%)	10 (20%)
6.2 among the divisions in NEPA	26 (52%)	16 (32%)	8 (16%)

investment budgets was provided for its implementation. Hence, the national environmental protection planning is done by NEPA and the State Commission of Science and Technology. Any kind of project will fail if there are no funds to support it. One respondent gave the example that once they made a plan for heavy metal pollution control but later they had to give up because no funds were allocated. A good plan is also very important for ensuring plan implementation on the condition that funds are available. Without a good plan the environmental goals adopted can not be achieved. The complex administrative system is an obstacle for plan implementation because it is diffused and disorganized in realizing the environmental goals adopted in the plan.

A comprehensive table was made to investigate how the respondents experience some important factors during the periods of plan-making and plan implementation, including the statement of policy guidelines and objectives, targets and target area setting, plan-making, plan implementation, internal and external coordination, etc. Details are shown in Table 11. In the table, one can see clearly that almost all of the respondents experience difficulties in plan implementation, which implies a serious plan implementation problem. It can also be seen that most of the respondents are satisfied with the statement of policy guidelines and objectives when they received a planning project. For plan-making, almost half of the respondents gave the answers in the categories "easy" and "difficult". This shows that there are some problems in plan-making. The same result has been obtained for "project evaluation". But according to the interviews, most of the respondents said that there was no evaluation for environmental plans. The table also implies there are some problems in coordination both internally and externally.

Generally speaking, in China not enough attention has been paid to plan implementation. In some areas, almost no one will take care of the actual achievement of the environmental

goals adopted in the plan. Planning remains planning only. What could be better ways to implement the environmental planning projects? According to the answers of the respondents, the ways and methods suggested can be summarized as follows. Given the conditions of China, it is necessary to disseminate information on the importance of environmental planning so as to get support from both the masses and the leaders at various levels. When making a plan, a scientific investigation must first be made in order to adopt a realistic plan. Environmental planning can not be done by the environmental protection agencies alone, coordination is needed, both in plan-making and plan implementation. In this way, the agencies from other fields will accept the goals adopted in the plan and implement them by joint efforts with the environmental protection agencies. Environmental plans can not be implemented under the supervision of environmental agencies only, it is the municipal governments that should be in charge of organizing plan implementation. Each item in the plan should be negotiated in advance with existing agencies signing contracts. A stage-by-stage implementation strategy should be made and incorporated in the annual plan of the agencies concerned.

Some respondents argued that the environmental agencies only can be involved in integration, coordination, supervision and inspection, but environmental plan implementation also needs legal back-up which is not within the mandate of the environmental protection agencies. The documents and orders for plan implementation need to be issued by the authorized government departments, with appropriate sanctions for offenders. The authorized government departments should better lay out the rules and regulations for assuring plan implementation. Incorporating the environmental plans into the national economic development plans is also an indispensable measure for environmental plan implementation.

In practice, the details of the formulation of the

environmental protection plan are considered by a specific group established by the National Environmental Protection Agency called the "Environmental Planning Drafting Group". The Group comprises some key persons from the Agency and universities or research institutes and officers from the Environmental Planning Division of the Agency. After consideration by the Drafting Group, the "policy guidelines" at the national level will become the policy guidelines for the bureaux at the local level. The local environmental protection bureaux will take the policy guidelines into consideration and incorporate them with their own felt needs. All the plans made at the various levels will be submitted to and approved by the National Environmental Protection Agenc. They will also be considered when national environmental protection plans are made. The plans can be implemented after approval and if and when part of the budget by the National Environmental Agency has been allocated. So, as a matter of fact, there is no finance for plan-making, but for plan implementation, budgets can be obtained from both the National Environmental Protection Agency and the governments at the province and municipal levels. But, sometimes this causes a late release of funds. Procedures for funding requests need to be clarified, otherwise, this will be the most serious factor obstructing plan implementation.

When a plan has been made, this does not mean that the goals adopted in it have already been achieved. The environmental protection agencies should supervise, examine and monitor the process of plan implementation and modify it at all times necessary. Some respondents stressed that environmental planning needs a better legal status. Under the present conditions in China, environmental plans at various levels can be legalized after getting approval from the Peoples' Congress. The process of planning and the procedures for plan approval need to be legally institutionalized.

In China, there are some laws and regulations concerning

the enforcement of environmental planning but no specific comprehensive one. For example, the respondents mentioned the "Environmental Protection Law", "Atmospheric Environment Protection Law", "Marine Environment Protection Law", "The Law on Water Pollution Prevention and Elimination", etc. But, in answering the question "do you know whether there are any laws and regulations concerning the enforcement of environmental planning?", only half of the respondents were giving a positive answer. This shows that the execution of these laws and regulations is not very effective. It is a pity, however, that, even though 94% of the respondents being interviewed in this study were at least once involved in environmental planning projects, only 50% of them know clearly what laws and regulations related to environmental planning there are. However, all respondents reported they believe that these laws and regulations are practical for the situation of China.

3.6. Conclusions

3.6.1. Conclusions Drawn from the Questionnaires

The Understanding of the Environmental Planning Process. Qu Geping (1983) expressed the opinion that environmental planning should be a component of the national economic and social development plan. This planning comprises a set of regulations made for a given period on the aims and measures of environmental protection with the purpose of protecting the environment under development and maintaining the ecological balance. He also said in another book, "Environmental Problems and Strategy of China", that environmental protection plans can adjust the relationship between population, environment and development and solve the contradiction between development and environment. Geping's opinion is generally accepted in the People's Republic of China and was used to assess the respondents' understanding of the concept of environmental

planning.

It seems the concept of environmental planning is not very well understood among the administrators and planners in the environmental protection field. In particular, only 62 per cent of the respondents agreed with the idea that environmental planning is a set of regulations made for a given period on the aims and measures of environmental protection and only 49 per cent agreed that environmental planning can alleviate the contradiction between economic development and the protection of the environment.

The first thing to be clarified in the conclusion is that environmental planning and environmental protection planning are two distinct types of planning, but the term "environmental planning" is used more often. Environmental planning comprises the planning in many fields, such as regional planning, land use planning, physical planning at various levels, energy planning, water resources planning, ecological planning, etc. and it draws on joint efforts from many academic fields. Environmental protection planning mainly deals with a control plan for various kinds of pollution which come under the management of environmental protection agencies. However, given the conditions in the People's Republic of China, with its centrally-planned economy, environmental planning can not be much different from urban planning. It is not realistic to except that environmental planning can be executed by environment protection agencies only.

Environmental planning needs coordination and cooperation with all other sectors. The various planning exercises have to be executed by the corresponding agencies, environmental protection agencies are limited to pollution control planning, and then, mainly in cities. For other kinds of planning, coordination needs to be undertaken by environmental protection agencies.

The contents of environmental protection planning in China, based on the interviews with Prof. Qu Geping, the Director of the National Environmental Protection Agency and other administrators and planners, can be summarized as follows. According to the present priorities of environmental protection work in China, environmental protection planning should consist of six component plans: (a) the industrial pollution control plan; (b) the urban pollution control plan; (c) the water pollution control plan; (d) the natural environmental protection plan; (e) a plan on the development of environmental scientific technology; and (f) a plan on environmental information dissemination and education.

The Planning Process. Comparatively satisfactory answers to the questions dealing with the environmental planning process respondents had used earlier were received. But unsatisfactory results were obtained to the questions on an ideal environmental planning process and the process considered suitable for China, because nearly half of the respondents did not provide answers. Ironically, 94 per cent of the respondents were involved in environmental planning projects before and 48 per cent of them were involved more than three times, thus more process-minded answers should have been received. For the three processes, the procedures are almost the same.

The process consists of three stages: investigation, plan-making and plan implementation, which are mentioned by all the respondents except the stage of plan implementation which was mentioned by some of the respondents only. Plan implementation would be an obvious step after plan formulation, which is mentioned by all the respondents, but, only 12 per cent of the respondents incorporated plan implementation, following the "approval" procedure in the process. This shows at least that plan implementation is not in the mind of the administrators and even of the planners. This shows a pre-occupation with plan-making

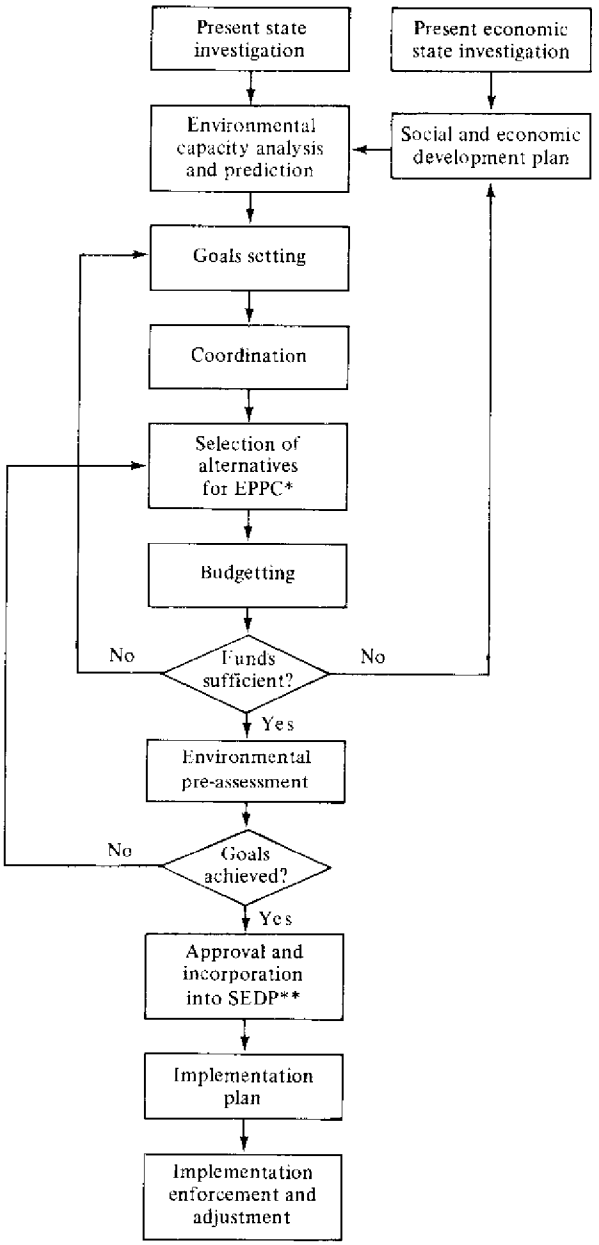


Figure 7. Flowchart of the Environmental Planning Process

* EPPC: environmental pollution prevention and control.

** SEDP: social and economic development plan.

and little care being taken of plan implementation. The environmental planning process discussed by the respondents in the questionnaire analysis as summarized by the authors is presented in Figure 7.

The Coordination Among Government Agencies. The results show that all the respondents thought that coordination between environmental protection agencies and other agencies is necessary and important throughout the entire environmental planning process. Problems in coordination can obstruct plan-making and implementation.

Most of the respondents thought they entertained intensive coordination with the officials in other agencies. There are some duplications in environmental planning between environmental protection agencies and the agencies dealing with water resources management, national physical planning, urban planning, etc. In addition, the coordination among the divisions in the National Environmental Protection Agency is also limited. Because, when asking about the sufficiency of coordination among the divisions in the National Environmental Protection Agency, only 52 per cent of the respondents gave a positive answer. The important factors for the coordination between governmental organizations are a smooth information flow, adequate guidance from higher-level staff, sufficient staff experience, a clear organizational structure, a workable administrative system, a clear agreement on the roles and responsibilities among the organizations concerned and good inter-personal relationships.

The respondents believe factors such as the complicated administrative system, ambiguous policies at different levels, ambiguity of roles and responsibilities between the organizations involved in environmental planning projects, a complex structure of the organizations, lack of budgets, ambiguous authority, unclear or a lack of communication between organizations and conflicts among the organizations

concerned contribute to the problems of coordination.

Policy-setting. The National Environmental Protection Agency and local environmental protection bureaus are responsible for policy setting for environmental planning projects and plan-making as well. For implementation, the municipal government and local environmental protection bureaux take the responsibility. For enforcement, the municipal government, local authorities and local environmental protection bureaux are responsible. For environmental education the National Environmental Protection Agency, local authorities and local environmental protection bureaux are responsible.

The Implementation of Environmental Protection Plans. The implementation of the environmental plan in the People's Republic of China is not very successful: only 22 per cent of the respondents thought it to be successful. On the other hand, 96 per cent of the respondents thought plan implementation was difficult. The reasons for successful plan implementation are: the plan was based on a full investigation of the present environmental state; the environmental goals adopted were responding to actual practice; the final plan was discussed within every sector and coordination for its implementation was practised at the same time and, the plan was incorporated into the social and economic development plan.

The factors causing environmental plan implementation problems seem to be a lack of a good plan, the complex administrative system, late release of funds, conflicts among organizations, a lack of authority of the staff and inadequate information.

The problems and constraints mentioned by the respondents in implementing environmental plans are external or inter-organizational coordination, budget provisions, the structure of the implementing organization, policy-making constraints,

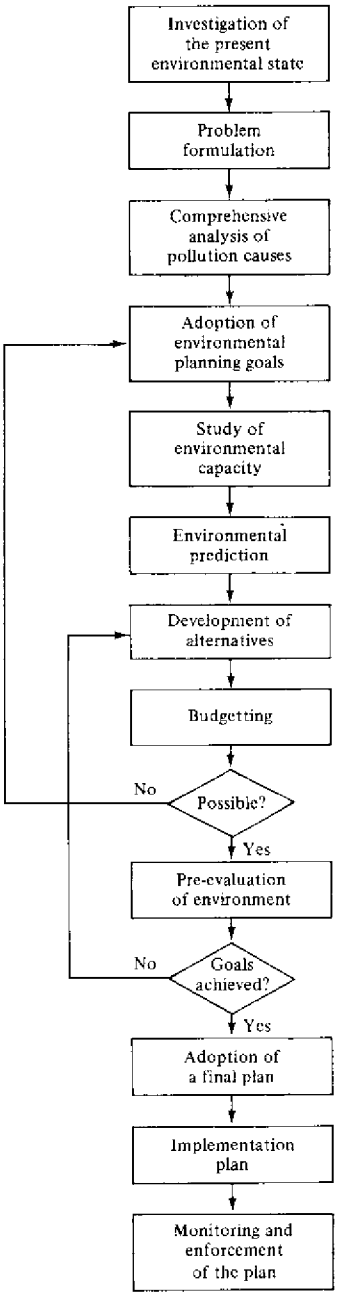


Figure 8. The Planning Process for the Industrial Pollution Control Plan of Tianjin

internal coordination, the capacity of the implementing organization and administrative management. Moreover, the fact that environmental planning is not incorporated into the social and economic development plan is perhaps the single most important constraint in plan implementation.

3.6.2. Conclusions Drawn from the Case Studies

Some case studies present supplementary information to the questionnaire analysis, especially on the aspects of the actual planning process. The details of these four cases have been included in the appendices 2 to 5.

The case study of industrial pollution control planning in Tianjin illustrates the development dilemma P.R. China is often facing. It is to go ahead with more rapid industrialization and thus economic development resulting in social advancement and, at the same time, preserving the basis for well-being. This is not an unfamiliar environmental management problem, but, in P.R. China the magnitude of the task necessitates special planning and management. This case also shows the interaction between Central Government and local authorities in all respects, i.e. research, monitoring, legislation, control and enforcement. The planning process practiced by the Environmental protection bureau of Tianjin for industrial pollution control is shown in Figure 8.

The preparation of the China Conservation Strategy, as an off-shoot of the IUCN/WWF/UNEP World Conservation Strategy amply illustrates the requirements for detailed environmental planning in P.R. China. If action is to be based on in-depth understanding of the problems and consensus on procedures, then careful analysis and drafting of implementation strategies is needed. The China Conservation Strategy aiming at conservation of nature and natural resources is certainly the most suitable major effort since the start of environmental planning in P.R. China to

demonstrate this. The planning process for nature conservation planning practiced by NEPA is shown in Figure 9. The nature conservation planning done by NEPA at the national level demonstrates how experts from NEPA have acted as coordinators for some 220 experts, scientists and professionals from 16 disciplines in drafting the plan.

Another major challenge facing P.R. China is the conservation of its agricultural production factors. In particular soils are becoming the object of much needed conservation measures. Now, in P.R. China desertification ranks among the top priority environmental problems: vast tracks of land already being the prey of former destructive land uses. In this field, P.R. China can claim innovative results: the Lanzhou Desert Research Institute's efforts are described as well as the various desertification control planning approaches in the third case study. Some 30 years of experience in this field are reviewed.

The fourth case study illustrates the newest development trend in P.R. China's as well as the new environmental problems and issues it creates and their mitigation. The Shenzhen Special Economic Zone is known to the entire world for the economic renewal it seemingly announced. Lesser known are the environmental management issues that came with the rapid development of the zone. The case study shows how urban environmental planning is needed and undertaken in the new towns of P.R. China. The planning process for urban environmental planning practiced by the Environmental protection Bureau of Shenzhen is shown in Figure 10.

It is hoped to present a more complete picture by using this two-pronged approach, i.e. to demonstrate, on the one hand, the magnitude of the problems in the physical environment through cases and, on the other hand, the environmental planning approaches that administrators are designing to cope with these problems while at the same time allowing sound development.

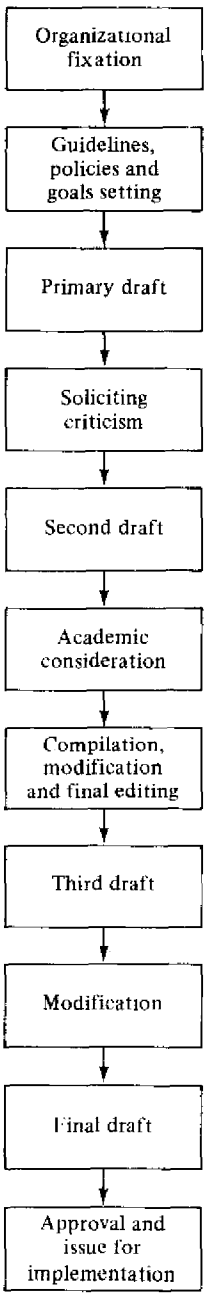


Figure 9. The Planning Process for Nature Conservation Planning

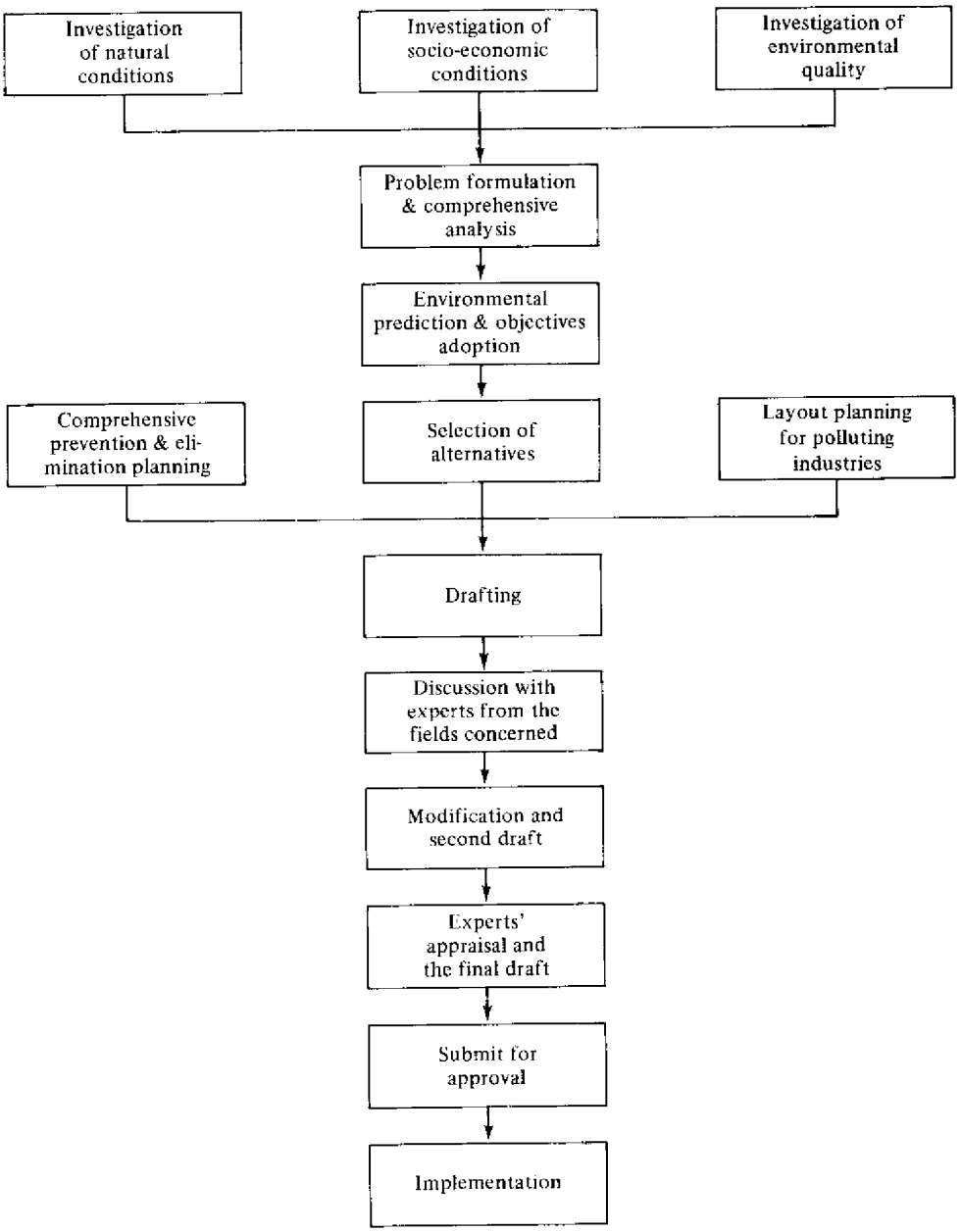


Figure 10. The Planning Process for Urban Environmental Planning Practiced by the Environmental Protection Bureau of Shenzhen

Based on the planning process used in these cases, it can be concluded that the environmental planning process consists of three stages, i.e. the investigation of the present state, plan-making, both technically and socially, and plan implementation and enforcement. Similar conclusions had already been drawn from the questionaire interviews. Thus, there is sound evidence to accept the views presented earlier.

APPENDIX 1

THE ENVIRONMENTAL PROTECTION LAW OF THE PEOPLE'S REPUBLIC OF CHINA

Chapter 1

General Provisions

Article 1

This law is established in accordance with Article 11 of the Constitution of the People's Republic of China which provides that 'The State protects the environment and natural resources and prevents and eliminates pollution and other hazards to the public.'

Article 2

The function of the Environmental Protection Law of the People's Republic of China is to ensure, during the construction of a modernised socialist state, rational use of natural environment, prevention and elimination of environmental pollution and damage to ecosystems, in order to create a clean and favourable living and working environment, protect the health of the people and promote economic development.

Article 3

For the purposes of this law, 'environment' means: the atmosphere, water, land, mineral resources, forests, grassland, wildlife, wild plants, aquatic plants and animals, famous spots and historic sites, scenic spots for sightseeing, hot springs, health resorts, nature conservation areas, residential districts, etc.

Article 4

The guidelines governing environmental protection work are: overall planning, rational layout, comprehensive utilization, conversion of harm into good, reliance upon the masses with everybody taking part in the protection of the environment for the benefit of the people.

Article 5

The State Council and its subordinate bodies, and the local people's governments at all levels shall endeavour to carry out environmental protection work in earnest and do a good job of it. They shall make overall plans for the protection and improvement of the environment in planning for national economic development and take practical measures for its implementation. Where pollution of the environment and other hazards to the public have already been caused, plans should be worked out to eliminate such in a systematic and orderly manner.

Article 6

All enterprises and institutions shall pay adequate attention to the prevention of pollution and damage to the environment when selecting their sites, designing, constructing and planning production. In planning new construction, reconstruction and extension projects, a report on the potential environmental effects shall be submitted to the environmental protection department and other relevant departments for examination and approval before designing can be started. The installations for the prevention of pollution and other hazards to the

public should be designed, built and put into operation at the same time as the main project. Discharge of all kinds of harmful substances shall be in compliance with the criteria set down by the State.

The units which have caused pollution and other hazards to the environment shall, according to the principle of 'whoever causes pollution shall be responsible for its elimination', make plans to actively eliminate such, or alternatively submit an application to the competent authorities for approval to transfer the property or move to some other place.

Article 7

In rebuilding old cities or building new ones, assessments shall be made of the potential environmental effects in industrial and residential areas, public utility facilities, and green belts by reference to the meteorological, geographical, hydrological and ecological conditions, and overall planning and rational layout be made to prevent pollution and other hazards to the public so as to build a clean modern city in a planned way.

Article 8

The citizen has the right to supervise, accuse and bring a complaint before the court against the unit or the individual who has caused pollution and damage to the environment. The unit or the individual thus accused and charged shall not take any retaliatory action.

Article 9

Foreigners or foreign aircraft, ships, vehicles, goods, plants and animals, etc. entering or passing

Chinese territory, territorial waters, or territorial air shall be subject to the present law and other regulations and rules relating to the protection of environment.

Chapter 2

Protection of Natural Environment

Article 10

Use the land rationally according to local conditions, improve the soil and increase the vegetation to prevent soil erosion, hardening, alkalinization, desertification, and water losses.

Comprehensive scientific surveys shall be carried out before going ahead with plans to reclaim wasteland, put up dykes along the seacoast or lakes, and construct large- or medium-sized new water conservancy facilities. Practical measures for protection and improvement of the environment shall be taken to prevent damage to the ecosystems.

Article 11

Keep the waters such as rivers, lakes, seas, reservoirs, etc. from being polluted so as to preserve the quality of water in a good state.

Protect, develop and utilize aquatic flora and fauna in a rational way. Fishing to the extent of threatening extinction of, and damage to, the living resources is prohibited.

Exercise tight control over, and economize, use of water in industry, agriculture, and in daily life.

Exploit rationally the subsoil waters to prevent exhaustion of water resources and surface subsidence.

Article 12

In exploiting mineral resources comprehensive surveying, evaluation and utilization should be carried out. Excavating and mining at random is strictly forbidden, and tailings and slags should be appropriately disposed of, to prevent damage to resources and fouling the natural environment.

Article 13

Strictly adhere to the National Forestry Law; protect and develop forest resources; fell trees in a rational way; tend trees and reforest at the appropriate time. Destroying forest to reclaim land and arbitrary cutting and felling are strictly forbidden. Preventive measures should be taken against forest fires.

Efforts should be made to plant trees everywhere and make barren hills, wasteland, desert areas and semi-desert areas green; tree planting should be vigorously carried out in villages, towns, and industrial and mining districts. Make good use of all available scattered open spaces inside and outside factory compounds, mining districts, school campuses, office compounds, along roadsides, river banks, and around villages and houses by planting trees and grass so as to turn the whole land into a big park.

Article 14

Protect and develop forage resources. Actively plan and carry out the development program of grass-

lands; herd the sheep and cattle rationally; maintain and improve the regenerating capacity of the grasslands, and prevent the grasslands from deteriorating. Abusive exploitation of grassland is strictly forbidden. Efforts should be made to prevent grassland fires.

Article 15

Protect, develop, and utilize rationally wildlife and wild plant resources. National regulations forbid hunting of rare animals and felling of precious trees.

Chapter 3

Prevention and Elimination of Pollution and Other Hazards to the Public

Article 16

Actively prevent and control noxious substances from factories, mines, enterprises and urban life such as, waste gas, waste water, waste residues, dust, garbage, radioactive material, etc. as well as noise, vibration, and bad odours from polluting and damaging the environment.

Article 17

Enterprises or institutions that will cause pollution of the environment shall not be set up in the residential areas of the cities and towns, water resource protection zones, places of historic interest and scenic beauty, scenic spots for sightseeing, hot springs, health resorts and nature conservation areas. Where such

units have been established, a target date shall be set for elimination and control of the pollution, or making necessary adjustments, or removal.

Article 18

Actively make experiments and adopt new technology, techniques and devices which are pollution-free or will cause less pollution.

Strengthen business management and carry out civilized production; make comprehensive use of such environment-polluting substances as waste gas, waste water and waste residues, and transform them into useful things. Discharge of such substances where necessary shall be in compliance with the criteria laid down by the State. Where such national criteria cannot be met for the time being, a later date will be set for its compliance, after which date a limit shall be set to production if the national standards still cannot be complied with.

In cases where release of pollutants goes beyond the limits of the specified national standards, a fee shall be charged towards dealing with the release of such pollutants according to the quantities and concentrations of the pollutants released as specified in the relevant regulations.

Article 19

All smoke discharge devices, industrial furnaces, motor vehicles, ships, etc. shall take effective measures to eliminate smoke and dust, and discharge of noxious gas shall be in compliance with the standards laid down by the State.

Develop and use on a big scale coal gas, liquefied petroleum gas (LPG), natural gas, marsh gas, solar energy, terrestrial heat and other non-polluting or less polluting energy sources. In the cities, district central heating should be promoted.

Article 20

Dumping garbage and waste residues into the waters is prohibited. Discharge of sewage shall be in compliance with the standards set down by the State.

Ships are prohibited from discharging substances containing oil or poison, and other harmful wastes into the waters protected by the law of this country.

It is strictly prohibited to discharge poisonous and harmful waste water by way of seepage pits, crevices, lava holes, or dilution methods. Prevent seeping of industrial filthy water to ensure that subsoil water is not contaminated.

Take strong measures to protect the sources of drinking water from contamination and gradually perfect the sewage discharge piping system and sewage purification facilities.

Article 21

Actively develop high effect, low toxic and low residue agricultural pesticides. Promote comprehensive and biological methods of prevention and control; use rationally sewage for irrigation so as to prevent pollution of the soil and crops.

Article 22

Step up control of noise and vibration in urban and industrial districts. All kinds of noisy machines,

motor vehicles, aircraft, etc. with heavy vibrations are required to install noise suppressors and anti-vibration devices.

Article 23

The units which emanate harmful gases or dust should actively adopt sealed production equipment and technology, and install ventilating, dust collecting and purifying, and recovery facilities. The amount of permissible harmful gases and dust in the working environment must conform with the standards for industrial hygiene specified by the law of this country.

Article 24

Registration and control of toxic chemicals must be strictly carried out. Highly toxic substances should be tightly sealed to prevent leakage during storing and transportation.

Radioactive materials, electro-magnetic radiation, etc. should be strictly monitored and controlled according to the applicable law of this country.

Article 25

Strict precautions shall be taken to prevent pollution of food in the course of production, processing, packing, transportation, storing, and marketing. Food inspection shall be strengthened, and sale, export and import of foods not meeting the requirements of the national hygienic standards shall be prohibited.

Chapter 4

Environmental Protection Office and its Functions

Article 26

The State Council has established an Environmental Protection Office whose main functions are:

1. To implement, and supervise the carrying out of, the national guidelines, policies, laws and acts relating to environmental protection;

2. To draft regulations, rules, standards, economic and technical policies relating to environmental protection in conjunction with relevant departments;

3. To make long-term programs and yearly plans for the protection of environment in conjunction with relevant departments; urge and supervise its implementation;

4. To make unified plans for organizing the monitoring of the environment; carry out investigations and keep under review the environmental situation and trends of development of the whole country, and recommend improvement measures;

5. To organise and coordinate in conjunction with relevant departments research and educational program in environmental science, and actively promote foreign as well as domestic advanced experiences and techniques in the field of environmental protection;

6. To direct the environmental protection work of all the departments under the State Council, and

of the provinces, autonomous regions, and municipalities directly under the central government;

7. To organize and coordinate international cooperation and communication in the field of environmental protection.

Article 27

The People's governments of the provinces, autonomous regions, and municipalities directly under the central government shall establish environmental protection bureaus in their respective areas. The people's governments of the municipalities, autonomous prefectures, counties, and autonomous counties may establish environmental protection organisations as required.

The main functions of the local environmental protection organisations at every level are: To supervise and urge the implementation of the national guidelines, policies, laws and acts relating to the protection of environment in the various departments and units within their jurisdictions; to draft applicable local standards and specifications concerning the environmental protection; to organise monitoring of the environment and keep under review the local environmental situation and trends of development; to make long-term programs and yearly plans applicable locally for the protection of the environment in conjunction with the relevant departments, and supervise its implementation; to organise local research and educational programs in environmental science in conjunction with relevant departments; to actively promote foreign as well as domestic

advanced experiences and techniques in the field of environmental protection.

Article 28

The relevant departments under the State Council and the local people's governments at all levels, large and medium enterprises, and relevant institutions shall establish as required environmental protection offices separately responsible for the protection of environment within their own system of affiliated organisations, departments, and units.

Chapter 5

Scientific Research, Propaganda and Education

Article 29

China Environmental Science Research Institute, relevant scientific institutes, universities and colleges should devote major efforts to research in the following areas: fundamental principles of environmental science, environmental management, environmental economics, comprehensive control techniques, environmental quality evaluation, environmental pollution and human health, rational use and protection of natural environment, etc.

Article 30

Cultural and publicity departments should actively carry out publicity and educational programs to disseminate the knowledge of environmental science so as to enhance the understanding of the

general public about the significance of environmental protection work and to raise the scientific and technical standards in the environmental field.

Environmental protection specialists should be trained in a planned way. The educational departments should establish a required course or speciality in environmental protection in the relevant departments of the universities and colleges. Middle and primary school textbooks should include appropriate texts relating to environmental protection.

Chapter 6

Rewards and Punishments

Article 31

The State will give commendations and rewards to units and individuals who have made outstanding achievements and contributions to the work of environmental protection.

The State will grant tax reductions or exemptions on, and apply a preferential pricing policy to, products manufactured by utilizing waste gas, waste water, and waste residues as main material, and the profits originating therefrom need not be turned over to the higher authorities but will be used by the manufacturers concerned to control pollution and improve the environment.

Article 32

Units which have violated this law and other environmental protection regulations and rules by

polluting and damaging the environment and causing hazards to the people's health shall, according to the merit of each case, be criticized, warned, fined, or ordered to pay damages and stop production and control and eliminate such pollution, by the environmental protection organisations at various levels subject to the approval of the people's government of the corresponding level.

Unit leaders, persons directly responsible or other citizens who have caused serious pollution and damage to the environment resulting in casualties or substantial damage to farming, forestry, animal husbandry, side-line production and fishery shall be held responsible administratively, economically, and even criminally, as the case may be, according to law.

Chapter 7

Supplementary Articles

Article 33

The State Council may establish regulations and rules relating to environmental protection according to the present law.

APPENDICES 2 TO 5

CASE STUDIES OF ENVIRONMENTAL PROBLEMS CONTROL IN THE PEOPLE'S REPUBLIC OF CHINA

In the appendices that follow we present a number of cases that have been chosen for investigation and analysis with regard to the planning process practised by the Chinese planners. There are four cases described each having different characteristics. They are: a detailed case study of industrial pollution control planning of Tianjin, which is an example of an industrial city with a long history on industrialization; a case study of nature conservation planning, which was done by the National Environmental Protection Agency of the People's Republic of China at the national level; a case study of plan-making and implementation of desertification control, which is sectoral planning mainly implemented by the experts from one specific field; and, a case study of urban environmental planning in the Shenzhen Special Economic Zone, which is presented as an example of urban environmental planning in the new and/or coastal cities.

APPENDIX 2

INDUSTRIAL POLLUTION CONTROL PLANNING IN TIANJIN

1. Background Information

Tianjin is one of the three cities that are directly under the administration of the Central Government. It is located at the coast of the Bohai Sea and along the banks of the Haihe River. Its area is about 11,300 sq. km. Tianjin is one of the large industrial and commercial metropolises and it also has export harbours. Within the city, there are about 4,000 industrial enterprises including those in the fields of metallurgy, machine building, textile, paper making, pharmaceutics, and the food industry, and oil exploitation and petroleum chemistry as well. The economy of Tianjin has developed rapidly with a gross output value of industry and agriculture rapidly increasing to a rate of 9.3% annually.

As the development of society and economic construction takes off, it is unavoidable that more pollutants are produced, especially under conditions of rapid economic development. In Tianjin, two kinds of environmental problems are present at the same time: environmental pollution and ecological degradation. In respect to environmental pollution, the most disastrous types of pollution are pollution of water, air, solid wastes and noise. For ecological degradation, the main problem is faulty industrial layout and structure. Along with the expansion of industrial production and the increase of the population, the urban environment tends to further deteriorate.

On the basis of interviews and information obtained during the field study, we can summarize and describe the

environmental planning work done by the Environmental Protection Bureau of Tianjin. All the data are from the following documents of the Environmental Protection Bureau of Tianjin: the "Environmental Protection Plan of Tianjin" (1985), the "Environmental Protection Plan for the Seventh Five-Year Plan" (1986) and the "Report on the Study of the Urban Ecosystem and Comprehensive Prevention and Control of Pollution of Tianjin" (1985).

2. The Main Environmental Problems at Present

2.1. Water Environment

In a recent study, i.e. "Study on Rational Use of Water Resources and Comprehensive Prevention and Control of Its Pollution", basic data on water utilization and economic activities (1983-1984) of 4,269 factories in Tianjin were presented. More than 800 factories were selected for investigation of the water-balance and 263 factories were studied for economic benefits by saving water. Moreover, 1,000 families were selected to investigate the situation of water utilization among households.

At present, 394 million tons of various kinds of municipal wastewater are discharged annually, including 280 million tons industrial wastewater and 114 million tons of sewerage with the main pollutants being organic matter and heavy metals. Industrial wastewaters are mainly from chemical industry, papermaking industry, textile industry, machine building industry, etc. The overall treatment rate of various wastewaters is 35%. The amount of pollutants discharged is high and the treatment rate is low: this is the main cause of the pollution of the waterbodies in Tianjin.

Since there has been a drought in the last few years in the Northern part of China, the Haihe River has almost dried up. This became a serious environmental problem faced by Tianjin

people. It not only had an effect on economic development and people's lives, but also made environmental pollution worse. Most of the rivers were polluted albeit to different extents and considerable areas of shallow underground water as well. Transborder waste water from Beijing and Hebei province contributed to the pollution of the surface and underground water environment and a more serious pollution of the oceanic environment. Owing to the discharge of land-based pollutants, the coastal water quality has decreased by pollution of petroleum products, organic matter and in some places even heavy metals.

2.2. Atmospheric Environment

The atmospheric quality of some urban areas had deteriorated seriously: coal-smoke type pollution with the main pollutants of sulpher dioxide, suspended particles and fall-out prevail. The situation is more serious during the winter seasons (heating period), because coal is the main energy source for domestic use. Most of the industrial boilers are small and scattered with short chimneys and a low efficiency. In 1985, the average concentration of sulphur dioxide in the atmosphere was 0.17 mg/cubic meter/day which was 1.8 times higher than the state standards of 0.06 mg/cubic meter; the total suspended particles measured 0.65 mg/cubic meter which is more than two times higher than the state standards of 0.30 mg/cubic meter; the average fall-out was 31.5 ton/month/sq.km, and during the heating period 36.87 ton/month/sq.km. Potential damage by acid rain was anticipated.

2.3. Solid Wastes

In 1984, 5.46 million tons solid wastes were produced in Tianjin, of which 3.76 million tons were industrial wastes. Only 38.6% of the industrial wastes could be reused and

others were disposed of on land. Since the production of solid wastes was so great and the reuse rate so low, vast tracks of land were occupied by the disposal sites. There have been about 10.71 million tons industrial wastes disposed of in about 435 ha of land since 1974. The soil, the water bodies and the atmosphere were polluted because of the great amount of discharge, the low reuse rate and the large area of land occupied.

2.4. Analysis of the Causes of Environmental Pollution

(1) Lack of coordination between economic development and environmental protection

For a long period, economic development was the priority in the development of the city. As a result, environmental considerations and economic development were not in tune. The funds for environmental protection were less than 0.2% of GDP of Tianjin. Due to this, the pollutants from industries or domestic use could not be treated in time. A trend of control after pollution, or even no control, has evolved.

(2) No rational readjustment and reform of industrial layout

Tianjin is an old industrial city. It has developed step by step. Unfortunately, it had no plan at the beginning of its rapid growth, so the city layout has haphazardly developed. Although some measures of readjustment, reform and relocation were taken and played an active role in the improvement of the urban environment, the urban population and industries were still over- concentrated in the center of the city.

(3) No effective control of industrial pollution sources

The industry of Tianjin has developed very fast during the last 30 years. The total output value of the industry in

1984 was about 25.2 billion RMB, which was 35.5 times that in 1950. Along with the development, the discharge of waste water, waste gas, and solid wastes also increased dramatically. The discharged amount of industrial waste water was very great but the treatment rate was very low. Industrial waste water was the main source of water pollution. Sulphur dioxide and smoke and dust discharged with industrial waste gas were the main sources of air pollution. Industrial solid wastes were discharged at a rate of 3.1 million ton/year. All these discharges are increasing year after year.

(4) Shortage of water resources

From the 1960's, the water quality down-stream of the Haihe River had decreased and the river could not provide enough water for domestic and industrial use. Except during years with a high rainfall, the water from other rivers had to be sent to Tianjin to meet the demand. Moreover, the water quality standards for municipal use were set higher while the economy was developing and people's life was improving. Storage of water was one of the important environmental problems. It caused not only pollution and salination of the water in river channels and reservoirs but also some other environmental problems. For example, over-exploitation of underground water brought about land subsidence and usage of waste water for agricultural irrigation brought about the pollution of soil and agricultural products.

(5) Unreasonable fuel and heating traditions which intensify the air pollution problem

The main fuel in China is coal, which is the main source of low altitude air pollution in Tianjin, especially during the winter seasons. On the one hand, the domestic use of natural gas or liquified petroleum is very limited, 95% of the natural gas which causes less pollution was used by industries. On the other hand, of the coal fuel, only 5% is

for domestic use but it is not of a good quality. As a result, air quality was deteriorating due to smoke from small stoves of thousands of households.

3. Environmental Planning Work in Tianjin

Tianjin, as mentioned before, is an industrial city. Environmental pollution problems were beginning to be solved when the Master Plan of the city was made. According to the Environmental Protection Law and relevant regulations and rules and standards issued by the State, based on the Master Plan of Tianjin and the results of scientific environmental research collected during many years and considering the social, economic and technical development trends of Tianjin, the goals for environmental protection were set. Up to 1990, environmental pollution would be controlled to some extent, the environmental quality of the urban areas would be improved and the environmental quality would remain at the level of the 1980's or even better. Up to the year 2000, national regulations and rules and corresponding environmental quality standards would be met based on environmental districts. Theoretically, the ecological balance should be sound within the whole city.

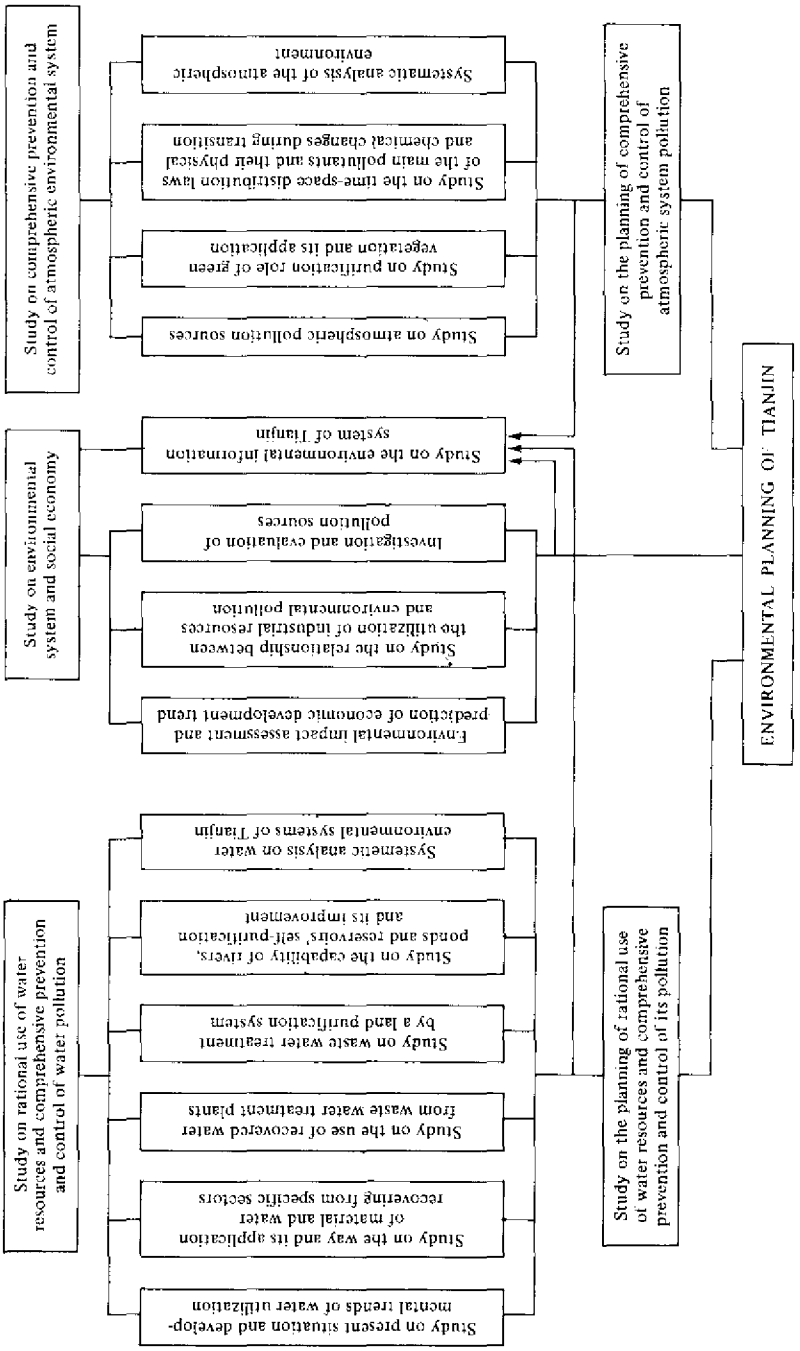
In the years before 1985, the environment had been substantially improved. Great changes took place in many fields such as potable water quality, air quality, noise pollution control, industrial pollution control, etc. After the implementation of various environmental protection measures, the functions of the city administration were enhanced, pollution elimination and control were promoted and the ecological balance of the city was further improved. On the whole, the environmental pollution of Tianjin was under control to some extent in spite of the rapid development of the national economy. But, since the economy has accelerated, the development of environmental protection work still could not catch up. The

environmental quality is deteriorating further.

From 1976 onwards, scientific research on environmental protection had been carried out, including such reports as "Comprehensive Analysis and Study on the Protection of Water Resources and Ways of Pollution Prevention and Control of the Jiyunhe River Valley", "Study on the Environmental Quality Evaluation and the Capacity of Self-Purification of Bohai Bay", etc. Starting from 1979, a study on environmental quality evaluation of the whole city has been carried out. From 1981 to 1982, a systematic assessment has been made in the fields of water and air quality, soil and agricultural products and the social environment which includes population, land use, settlements, transportation, etc. The results provide complete environmental data for Tianjin Municipality in order to make an environmental plan.

To prepare the Master Plan of Tianjin in 1985, the Tianjin Municipality assembled experts, professionals and planners from various fields. Environmental planning was given great attention by the Municipality. Some planners and engineers from the Environmental Protection Bureau of Tianjin Municipality were invited to join the Planning Group for the Master Plan of Tianjin. The Environmental Protection Bureau of Tianjin was authorized to be in charge of environmental planning which was then included as one of the main parts of the Master Plan of Tianjin.

After receiving the assignment from the Municipality, the Environmental Protection Bureau of Tianjin established a Task Force especially dealing with plan-making. The Task Force was constituted by the Chief and Deputy Chief engineers, engineers, planners and the people concerned of the Bureau, also the engineers and planners from the Environmental Protection Research Institute, the Monitoring Centre of Tianjin and various industrial sectors. After discussion and analysis, they carried out three specific research projects with several subtopics, some of which



Source: E.P.B. Tianjin (1985) (Revised).

Figure 11. Studies on the Urban Ecosystem and Pollution Prevention and Control in Tianjin

were on-going, in order to provide a solid theoretical foundation for the environmental planning of Tianjin. The research topics are shown in Figure 11.

These research projects were tendered by more than 50 research institutes of Tianjin, universities and colleges and research institutes affiliated to the Chinese Academia Sinica. All of the projects were completed within 3 years (before the end of 1985). There were 27 research institutes involved in the projects. The results provided valuable background information for the environmental protection planning of Tianjin.

At the same time, the Task Force organized the engineers and planners from 14 industrial sectors, i.e. 14 industrial bureaux of Tianjin, to prepare their own environmental protection planning (1986- 2000). These also contributed a lot to the environmental plan of Tianjin prepared by the Environmental Protection Bureau.

4. The Planning Process Used by the Environmental Protection Bureau of Tianjin for Industrial Pollution Control

4.1. Introduction

Based on information from the Environmental Protection Bureau of Tianjin, the Scientific Research Institute on Environmental Sciences, Tianjin, and the Tianjin Monitoring Centre, the industrial pollution control planning of Tianjin can be assessed as a comparatively successful one.

4.2. The Guidelines for and Goals of Planning

Based on planning guidelines of the Central Government, i.e. "one of the important components of improving people's life and its quality is living environment improvement",

"strengthen the work of monitoring and prevention and control of various public hazards, such as the pollution of air, water and soil", "pay attention to the work of environmental protection, especially the improvement of the environment of important cities and tourist areas", planning of industrial pollution control should be done using the principle of simultaneous development of economic construction, urban and rural construction and environmental construction and the principle of a developing economy, protecting environment and promoting a sound ecological balance at the same time in order to achieve the aim of integration of economic, environmental and social benefits. The goals of the plan are that the main development trend of environmental pollution will be basically under control by 1990, environmental quality of urban areas will be improved compared with that in 1985, and solid foundations will be provided for realizing the goals by the year 2000, i.e. meeting the national standards of environmental quality and having a sound ecological balance.

Aquatic Environment. The water quality of the reservoirs and channels with functions of storage and transportation of urban water should meet the second class standards of surface water environmental quality. The water quality of flood-relief channels and drainage should meet the third class standards of groundwater environmental quality. The concentration of heavy metals and other hazardous matter in sewerage should meet the standards of irrigation water quality, etc.

Atmospheric Environment. In natural reserves and water resource reserves, the second class standards of atmospheric environmental quality should be met and agricultural districts should be close to the third class standards of atmospheric environmental quality. In other districts, the third class standards of atmospheric environmental quality will be upheld.

4.3. The Planning of Industrial Pollution Prevention and Control

Aquatic Environment. It is predicted that in 1990, the discharged amount of industrial waste water will be 480 million cubic meters and 270 million cubic meters domestic sewerage. It is necessary to protect the water resources well so as to prevent water pollution. The basic conditions to create a sound balance in the aquatic environment are the rational use of water resources, increasing the waste water treatment rate and developing and utilizing waste water resources.

The following measures were taken:

(a) Identify water resources and water body reserves and map out the corresponding regulations for water resources protection.
(b) Carry out a management with different standards in different environmental districts.
(c) Use water resources rationally by the reuse of processed water and cooling water and by adopting watersaving processes for new projects, etc.
(d) Increase the capacity of waste water treatment and establish several waste water treatment plants.
(e) Strictly control the content of heavy metals in wastewater.
(f) Fully use water resources by rational use of treated water.

Atmospheric Environment. During the period 1986-1990, the main aim in air pollution control is to prevent and control the atmospheric pollution of the coal-smoke type. For this aim, the following measures will be taken:

(a) Realize central heating systems in urban areas by

utilizing geo-thermal resources and industrial waste energy and by building up central heating districts in industrial areas and residential areas, etc.
(b) Continue to improve the level of dust collection of boilers.
(c) Promote briquet usage in the industrial sectors on the basis of the processing capability of domestic briquets.
(d) In combination with technical innovation, decrease the energy consumption of products by transforming the factories with a high energy consumption, high materials consumption and serious pollution to suitable places so as to decrease the burden on the urban atmospheric environment.
(e) Plant trees and green vegetation by linking up with urban construction. Green belts will be built between industrial areas and urban areas.
(f) Decrease the content of total suspended particles in the atmosphere by gardening and planting grass in urban areas.
(g) Strictly control the pollution caused by automobile tail gases by popularizing catalytic burning techniques and banning the use of automobiles with a high energy consumption and heavy pollution.
(h) Strengthening the prevention and control of the sources discharging industrial dust.

Solid Wastes. Technical innovation, comprehensive utilization, proper treatment and taking solid wastes as resources are the ways to decrease the land used for disposal of solid wastes. Power plants, thermal power plants, soda plants, etc. should ally with building material manufacturing enterprises and adopt advanced processes and decrease the discharge of solid wastes. The study on using solid wastes to produce new building materials must be sped up and put into production as soon as possible. The comprehensive utilization rate of industrial wastes in 1990 should be increased to 47% from 38.5% in 1985. The municipal solid wastes can be used in stacked hills and then green vegetation can be planted or organic fertilizer can be made using non-harmful treatment.

4.4. Environmental Management

All the industrial bureaux and enterprises should strictly execute the Envionmental Protection Law, regulations and rules and policies concerned, issued by the State or local government and respect the special office or persons who are in charge of environmental protection. Pollution source monitoring stations are encouraged to be established under each industrial bureau and enterprise.

All the projects, new, expanded or reconstructed, must submit a report on environmental impact assessment and put it into operation at the same time with the installation of pollution control equipment. For foreign projects, the main equipment and environmental protection facilities must be imported at the same time or the relevant locally made facilities should be installed, and the national or local environmental standards must be met. The amount of pollutants discharged from new or reconstructed projects must be smaller than those from the old or previous enterprises. A pollution source registering system must be established within the environmental protection organs at various levels on the basis of the pollution source investigation of Tianjin done in 1983. The results should be submitted to the Environmental Protection Bureau of Tianjin and then to the Data Bank of pollution sources of the city.

4.5. Enforcement of the Plan

In order to realize these environmental goals, some suitable and effective measures must be taken to enforce the regulations.

(1) To strengthen the leadership in environmental management

Environmental protection is one of the major issues in

government administration, so, it must be listed on the agenda of the governmental agencies at various levels and one leading officer must be placed in charge of environmental protection work within his own district or county.

(2) To adhere to the principle of comprehensive prevention and control

Comprehensive prevention and control of the regional environment is the most important goal during the period 1986-1990 for environmental protection work in Tianjin. Industrial adjustment, urban construction and reconstruction, urban management and work of various kinds of sectors should be combined with each other. Site selection for new projects must meet the requirements of urban planning and industrial layout. It is forbidden to build any kind of new factories within the residential areas and the centre of the city. The principle of "Who causes pollution, must be responsible for its elimination" should be insisted on. A permit system for waste discharge is in the process of implementation.

(3) To strengthen environmental management with economic methods

The rule that the polluter pays must be excercised in a broader field with more items. Such as by fines for discharge of noise, automobile tail gas, solid and radioactive wastes, etc. Reasonable fines must be determined and this kind of income must be used for pollution control. A policy of tax freedom will be used for the products produced by using industrial residuals in order to encourage the enterprises to turn wastes into resources.

(4) To strengthen the legal system

Environmental Protection Law and regulations and rules

issued by the State and local government must be carried out strictly. At the same time, combining the functions with economic development strategies of the city and considering environmental features of Tianjin, the environmental protection laws and regulations and detailed rules and regulations for implementation should be mapped out for pollution control of the atmosphere, water, noise, vibrations, radioactive materials, solid wastes and automobile tail gas and the protection of economic development zones, natural reserves and important environmental protection regions. The study of the formulation of environmental standards should be accelerated in order to establish gradually an environmental standard system for Tianjin.

(5) To develop actively the manufacturing of environmental protection equipment

The funds for environmental protection in Tianjin have been very limited for many years. This is one of the reasons for the lack of control of the environmental quality degradation. During the period 1986-1990, the funds allocated to environmental protection in Tianjin should be 1% of its GDP. Otherwise, the environmental goals for this period can not be realized. The funds allocated for environmental protection by the State should not be used for other purposes.

4.6. The Planning Process Practiced in Industrial Pollution Control

After being assigned the task by the Municipality, the Bureau first investigated the existing environmental state of the city. About 300 engineers, researchers, social scientists, economists and planners participated in and about 7,000 people were involved in the state investigation. It dealt with a wide range of disciplines and technologies.

The main environmental problems were determined following the state investigation. Final papers on the investigation were presented at the Expert Appraisal Meeting and evaluated by the experts and professors invited to the meeting. Once the main problems were formulated, a comprehensive analysis was made on the causes of the pollution. The main environmental problems and their causes were included in the final report adopted at the end of the meeting.

In accordance with the Final Report of the Expert Appraisal Meeting, environmental goals for the planning period were set by the leadership of the Bureau and the Tianjin Municipality based on recommendations of planners, suggestions of social scientists and economists and actual conditions of the city as well. These might be changed according to the feedback from the financial evaluation. To achieve these goals, a study on the environmental capacity and environmental prediction would be carried out. On the basis of this, the measures needed for environmental pollution prevention and control could be mapped out. Furthermore, the budget for implementing these measures in order to achieve the environmental goals was very important. If measures were impossible economically, feedback would go to the environmental goals and some changes were expected to be made. If it was possible, an environmental pre-evaluation would be made to see whether the goals could be achieved or not. There was a feedback to the step of alter- natives setting for environmental pollution prevention and control, if standards could not be met. The final plan was then drafted by the Task Force and it was submitted to the Environmental Protection Bureau and the Tianjin Municipality. After approval, the draft became an official plan in the form of an administrative decree. Last but not least, an implementation plan was needed to ensure the achievement of the goals during the period of the plan.

Based on interviews and results of the questionnaires, the planning process that has been used by the Environmental

Protection Bureau of Tianjin can be summarized as has been done in Figure 8 (see above).

APPENDIX 3

NATURE CONSERVATION PLANNING FOR THE P.R. CHINA CONSERVATION STRATEGY

1. Introduction

The conservation of nature and natural resources is one of the important components in social and economic development that has the aim to respond to the growing need for commodities and culture of the people. The condition of the ecological environment and attitudes towards nature and natural resources are symbols of the progress of a country. In order to improve public awareness for natural conservation, to guide the work of nature conservation in the future and to use the natural resources in a planned way, the National Environmental Protection Agency decided to compile a China Conservation Strategy in a joint effort of several disciplines.

After more than three years of work and several rounds of modifications, the China Conservation Strategy was completed at the end of 1986 and issued to the public for implementation. It is a plan for nature conservation work in the People's Republic of China.

During the time of compiling, about 220 experts, scientists and professionals from 16 disciplines were invited to participate in its preparation. The Central Government and the State Council have shown great concern about its completion. The Nature Conservation Division of the National Environmental Protection Agency was in charge of the work from the beginning to the end. Roughly, the compilation of the Strategy can be divided into three stages: the first stage on drafting lapsed from June 1983 to October 1983; the second stage comprised modifications, from December

1983 to May 1984; and the third stage was compilation and final editing during the period from June 1984 to February 1986.

2. Background Information

After ten years of turmoil, environmental protection work is receiving more and more attention from the Central Government. On the basis of the experience in economic construction in the past 30 years, one can say that the most important issue is that everything seems to happen according to economic and 'natural' laws. Facing the damage caused by the radical ideas of that particular period, numerous experts and knowledgeable people appealed to strengthen the conservation of the natural ecological system and natural resources and suggested some good policies. At the same time, the United Nations Environment Programme (UNEP), the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF) proposed establishing a World Conservation Strategy in 1975. The IUCN was entrusted with preparing the draft of the World Conservation Strategy. After discussions, the first version of the Strategy was submitted to the United Nations Food and Agriculture Organisation (FAO), the United Nations Education, Science and Culture Organisation (UNESCO), UNEP and WWF for approval. After modification, it was promulgated at the same time to the people in the capitals of many countries all over the world on March 5, 1980. Beijing was one of them. Upon this, the idea of preparing a China Conservation Strategy was proposed by the National Environmental Protection Agency and it was placed in charge of the compilation work of the China Conservation Strategy later.

3. The Planning Process Used in Preparing the P.R. China Conservation Strategy

The process used for compiling the China Conservation Strategy by the National Environmental Protection Agency can be conceived as presented above (see Figure 9). The following describes some major steps in detail.

3.1. Organizational Fixation

In 1982, the National Environmental Protection Agency (it was still the Environmental Protection Bureau under the Ministry of Urban and Rural Construction and Environmental Protection at that time) proposed compiling the China Conservation Strategy after the World Conservation Strategy was announced. This idea was supported by the Ministry of Urban and Rural Construction and Environmental Protection and the Central Government as well. As a result, an Editorial Committee for the China Conservation Strategy was established and it was composed of people from 11 ministries and commissions and 18 bureaus. One well-known economist was invited as the editor of the China Conservation Strategy. All of this was to make the China Conservation Strategy more authoritative. For academic reasons, the experts and professionals from 13 societies and associations at the national level were invited to form the Academic Advisors Committee.

At the first meeting of the Editorial Committee and the Academic Advisors Committee, the guidelines and policies were discussed and then approved. The Office of the Editorial Committee, which was in charge of organizing the write-up of the China Conservation Strategy, was also established at that time.

3.2. Guidelines, Policies and Goals Setting

To make a country strong, it is essential to protect its nature and to combine, closely, the development and utilization of natural resources with protection for a reasonal and sustainable use of its resources, because:

(1) Although the People's Republic of China has vast land areas and is rich in resources, the per capita stock of some basic natural resources is comparatively small, e.g. for land, forests, water, etc. the per capita stocks are only 36 per cent, 13 per cent and 25 per cent of the world per capita stocks respectively. This is much lower than more than half of any other country in the world (Editorial Committee for the China Conservation Strategy, 1986). Depending on these resources in social construction needs careful planning and reasonable development and utilization. Any kind of damage and waste must be avoided.

(2) China now has a population of more than one billion, which will be increasing continuously. For the survival of such a large population and the increase of their living quality, more and more natural resources are needed and more and more measures for this aim are inflicted on the environment. There is a direct or indirect relation between environmental pollution, ecological degradation, resources damage and species extinction and dramatic growth of the population. This implies the need for protection of natural resources at the same time as developing and using them, because once natural resources or the natural environment are destroyed, it is very difficult to resume and restore or in some cases, no restoration is possible. This is bound to affect economic development in the end.

(3) In the People's Republic of China, since quite a number of people lack knowledge in the fields of ecology, environmental sciences and economics of resources and professionals in these fields are not available, short-term economic benefit

was stressed instead of long-term benefit during the process of national development and usage of natural resources. As a result of non-scientific management, damage was done to resources and the environment to different extents.

(4) The development of agriculture depends on a sound agricultural and ecological environment. Since for long not enough attention was given to nature conservation, the environment for agriculture has been damaged to some extent by deforestation, overgrazing, land reclamation, over-fishing, improper use of pesticides and chemical fertilizers and the pollution caused by industrial wastes. All these restrict sound agricultural production development. Therefore, it is of great urgency to protect an ecologically balanced environment for agriculture in order to promote further development of agricultural production.

(5) The natural environment of the People's Republic of China is complex and varied; this offers opportunities as well as constraints. For example, uneven time-space distribution of water, great areas of arid, semi-arid and barren lands, serious desertification and salinization of soils, some areas with fragile ecological systems and a low capability of self-adjustment, etc. All of these disadvantageous factors demand that we pay special attention to the protection of the natural ecological system during development in order to prevent irrevocable damage.

The goals of compiling the China Conservation Strategy are to expound systematically the position and role of nature conservation in the process of development and modernization; to provide a scientific basis for the setting of guidelines, policies, laws and regulations and planning for nature conservation both at the national level and local levels; to point out the responsibilities and obligations of every sector when developing and using natural resources; to explain the basic principles that should be obeyed when developing and protecting natural resources and various

kinds of regions; and to increase the public awareness of the importance of nature conservation and the protection of homelands by all citizens for the benefit of future generations.

3.3. The Compilation Process of the Strategy

THE FIRST STAGE (from June 1983 to October 1983)

A. Primary Draft

After the first meeting of the Editorial Committee, the Office of the Committee had started the routine work of organizing the compilation of the China Conservation Strategy. Two working meetings were held to discuss and arrange the writing of the background information of the Strategy and the primary draft of each chapter.

The China Conservation Strategy is composed of three parts with a total of 19 chapters. In the first part, there are three chapters, mainly dealing with the aims and significance of the Strategy, the position and role of nature conservation in modernizing national development, the relationship between nature conservation and economic development and some basic concepts and fundamental theory concerning nature conservation. In the second part, there are ten chapters stating separately the conditions, characteristics, the main problems existing during the time of development and the utilization and the counter-measures for various major aspects of nature conservation, including the conservation of land, forests, grassland and desert, various species, on-land water resources, waters, lakes and reservoirs, marshlands and shallows, seas and the ocean, mineral resources and the atmosphere. In the third part, there are two chapters, one states the environmental and resource characteristics of various natural regions of China, the problems and their counter-measures during

development and utilization; another chapter is especially dealing with the establishment and management of nature reserves for their particular characteristics of the natural environment and resources. In the fourth part, there are four chapters expounding the general measures and policies for technological aspects, legal institutions, dissemination, scientific research and international cooperation.

B. Soliciting Criticism and the Secondary Draft

The primary draft was printed and distributed to each editor, academic advisor and compiler for comments. Considering about 223 written comments and on the basis of the primary draft, the secondary draft was taking shape after modification and compilation. At the same time, 33 papers were compiled to provide the background information of the China Conservation Strategy to each editor, advisor and compiler, including the conservation strategies of Australia, New Zealand and the United Kingdom, the Human Environment Declaration and the Nairobi Declaration of UNEP, guidelines and policies on nature conservation in Japan, etc.

THE SECOND STAGE (From December 1983 to May 1984)

During this period, a large scale academic consultation on the Strategy was carried out, chapter by chapter by the Editorial Committee together with the advisors from 13 academic societies and associations at the national level, in order to ensure its scientific and policy validity and to enhance the quality of its presentation. These societies and associations embrace many fields, including agriculture, forests, water conservation, land management, geology, aquatic products, zoology, botany, oceanography, grasslands, geography, ecology and environmental sciences. The National Commission of Man and the Biosphere was also

asked to join the academic considerations.

Under the leadership of the academic advisors, ten meetings of different scales were organized from December 1983 to May 1984. About 220 experts, scientists and professionals from 16 disciplines participated in the meetings. During these meetings, full discussions and in-depth deliberations were made on the basic ideas, problems reflected and information introduced in the secondary draft of the China Conservation Strategy. This provided an important basis for further modifications, increased the scientific and policy level of the Strategy and laid solid foundations for the final version.

THE THIRD STAGE (From June 1984 to February 1986)

A. Compilation, Modification and Final Editing

In July 1984, an Editing Group was established to compile the China Conservation Strategy. The Group consisted of people who are familar with the Strategy and possess professional knowledge to write on each subject. The mission of this group was overall editing of the second draft, because the drafting, criticism and academic considerations had been carried out by independent chapters. It is necessary to do so in order to integrate the Strategy both stylistically and content-wise. In December, 1984, the third draft, edited by the Group, was submitted to the Editor and Deputy-Editors for final checks and approvals. In September 1985, it was edited again by the language experts and the result became the third draft.

B. Final Draft

From June 2 to 4, 1986, a Meeting of the Editorial Committee and the Academic Advisory Committee on Examination and

Appproval of the China Conservation Strategy was held by the Environmental Protection Commission of the State Council. A discussion on the publication of a series of books on nature conservation in the People's Republic of China was also one of the items on the agenda of the Meeting.

During the Meeting, the participants appealed that the effect of the degradation of the ecological environment was so serious that measures and actions needed to be taken urgently. Thus, it became necessary to speed up the compilation of the China Conservation Strategy and to guide and promote the work of nature conservation. The third draft was approved as the final draft in principle, but further modifications were needed based on the comments of the participants related to the concepts, consistency of the laws and regulations, systematization of each chapter, promptness of data, etc. At the end of September, the final draft was completed and submitted to the Environmental Protection Commission of the State Council for approval.

C. Approval and Issue for Implementation

On December 23, 1986, the China Conservation Strategy was approved by the Environmental Protection Commission of the State Council and then issued to the whole country for implementation. It is the first strategic document on the macro level with a leading role in the conservation of the natural environment and natural resources. From the organizational fixation to the approval and issue of the Strategy, more than three years had passed and seven times corrections, modifications and compilations had taken place. Now, follow-up actions and enforcement measures are being carried out using the China Conservation Strategy.

APPENDIX 4

DESERTIFICATION CONTROL PLAN-MAKING AND IMPLEMENTATION BY THE LANZHOU DESERT RESEARCH INSTITUTE OF THE ACADEMIA SINICA

1. Introduction

There are vast areas of desert, gobi and desertified lands in the People's Republic of China, totalling 1.49 million square kilometers, among which sandy deserts cover 593,000 square kilometers, gobi areas 569,000 square kilometers and desertified lands 328,000 square kilometers. Together these occupy approximately 15.5 per cent of the total land area of China. They are mainly located in the Northwest, the North and the Northeast of China. Thirteen provinces and autonomous regions with 50 million people, their living environment, and economic development in these provinces and regions are seriously affected. For the past fifty years, the desertified lands have been increasingly enlarged at the rate of 1,000 square kilometers annually. The study of desertification and the prediction of its occurrence and factors influencing desertification as well as the comprehensive regulation and rectification are scientifically and practically very important for China.

Studies on deserts were non-existent in China until the early 1950's, the Headquarters of the Chinese Academia Sinica organized a number of comprehensive surveys in Northern China in line with the requirements for development of the national economy. The significance of studies on deserts was thus realized. In 1956, the State Council held a National Conference on Desert Control, involving six provinces and autonomous regions in Northwest China and Inner Mongolia. In 1959, the Headquarters of the Chinese Academia Sinica

organized a large scale Desert Field Survey Team to conduct comprehensive investigations in desert and gobi areas in Northern China and established 6 permanent experiment and research stations in Northwest China and Inner Mongolia. A primary research and experimental network was created to research on the utilization of sand areas, dune stabilization and to conduct regular observations and experiments.

In 1961, these pilot experiments and research stations were regulated and placed under the local administration at the provincial level. In 1965, the organization of desert studies was shifted from Beijing to Lanzhou and merged with the Institute of Glaciology and Desert Research of the Academia Sinica. In 1978, the Division of Desert Research was separated from this joint Institute and established as the Institute of Desert Research in its present form.

The Institute of Desert Research of the Chinese Academia Sinica has seven divisions and three field stations. At present it employs 182 professional, scientific and technical staff members, among which, 28 research professors, 104 research associate professors and engineers, 85 administrators and staff, 50 technicians and graduate students. The Shapotou Desert Research and Experiment Station under the Institute was selected for a field study on the desertification control plan-making and implementation.

2. Natural Conditions in the Study Area

In Shapotou Region, the shifting sands spreads towards the north bank of the Yellow River, the highest sand hills are 300 meters above the surface of the Yellow River, which is 1,200 meters above sea-level. Owing to its northwestern inland location, the climate in the Shapotou Region is cold, arid and windy. According to the meteorological data (1954-1962), the annual mean temperature is 8.8 degrees centigrade, the absolute maximum temperature is 38.1 degrees

centigrade and the minimum -23.2 degrees centigrade; the temperature difference being as large as 61.3 degrees centigrade. The maximum temperature on the sand surface reaches 74 degrees centigrade. Most common species of plants can not survive under such a high temperature. The annual mean rainfall is 202.1 mm. However, the actual rainfall differs greatly from year to year. The highest rainfall was 304.3 mm in 1958, while the lowest was 88.3 mm in 1957. The distribution of rainfall is quite unequal. In spring and winter (from October of any year to March of the next) the area is very arid, and often there is no rain for 3 months. The dry sand layer thus being thickened creates very unfavourable conditions for spring afforestation. The annual evaporation is great, on average 3,000 mm, 15 times the rainfall. The relative humidity is low, on average 40%. The minimum humidity is not more than 10%, and the weather is very dry.

Wind is the main factor of damage to vegetation in this region. According to the observations, sand particles will be removed when the wind velocity reaches 5 m/s; this is called the threshold sand-moving wind velocity. The region often suffers from that kind of wind, on average 200 days or 310-330 times every year. The annual average wind velocity is 2.9 m/s, the strongest even reaches grade 11 on the wind scale. It blows mainly from the northwest; the secondary wind direction is from northeast to southwest, so, on the whole, sand dunes move south eastwards.

3. Desertification Control Planning

The Baolan (Baotou to Lanzhou) Railway line, for which primary surveys were conducted in 1953, was completed in 1957 and opened in 1958. It is an artery of traffic between North China and Northwest China. The Lanzhou-Yinchuan section runs six times through the Tengger Desert. The most undulating dunes along the railway are in the desert from Yingshuiqiao

to Mengjiawan in the Ningxia Hui Nationality Autonomous Region, this stretch is as long as 16 kilometers. In particular, huge barchan dunes can be seen in the Shapotou region. How to bring the dunes on both sides of the railway under control and how to protect the railway bed from wind erosion and burying by sand so as to guarantee the safety of the railway were the problems to be solved urgently at the time the line was being built. It was for these purposes that the Shapotou Desert Research and Experiment Station was set up in 1956: to control sand moving towards the railway was the main task of this Station assigned by the State.

The Shapotou Desert Research and Experiment Station, was established in 1956 and became one of the field stations of the comprehensive study on deserts of the Institute of Desert Research in 1978. The Station is situated at the Southeast edge of the Tengger Sand Desert.

The Shapotou railway station is a small station on the Baolan Railway Line and its region is situated on the southeastern fringe of the Tengger Desert. Its nothern part is elevated. A boundless stretch of active dunes constantly moves towards the railway. The research work has been engaged in creating a protective system for the railway.

The Research Station started the planning for the stabilization of shifting sands to prevent the railway line from being damaged as soon as it was established. With the cooperation and coordination of the relevant railway departments and local government, a full-scale survey was conducted on the natural conditions of the Shapotou Region, including its meteorology, rainfall pattern, the dominent winds, and the geographical environment as well. In 1958, the Station took part in the planning of sand stabilization by using plants which was organized by the Ministry of Forests. After investigation of the natural conditions, discussion among the experts from many fields, and the selection of technical alternatives, a plan for

sand stabilization by reforestation was worked out based on the results of two years field investigation and study. It was implemented soon after its approval.

However, since the ecological conditions were so severe, the efficiency of establishing artificial vegetation on barchan dunes using the study results and techniques and methods of the plan of 1958 was rather limited.

4. The Modification of the Desertification Control Plan (1958)

Although the 1958 plan was based on the results of two years of study and field investigations, some problems had been discussed after some years of implementation. This is because of the short period of experience with building shelter belts in regions with high and intensively shifting dunes, including the problems of the structure of shelter belts, sand barrier specifications and the selection of plant species and their arrangement. Thus, in 1963, a field study and on-site meeting was organized by the Academia Sinica to discuss the possibility of sand stabilization by plants. The decision was made to modify the plan on the basis of the experience over the years. At the end of the meeting, the scientists and experts all agreed that it is feasible to stabilize shifting sands by using plants. They recognized that the first years' practice of sand stabilization by plants was a good beginning with great hopes of lasting success. The only problem was that more time was needed to see the results.

In 1964, a modified plan based on the 1958 plan, research results and practical experience obtained was mapped out with the cooperation of the First Academy of Design of the Ministry of Railways. The principle of the 1964 plan was to take "fixing" as the main measure and a combination of "fixing" with "checking" as an auxiliary measure with the help of "transferring" in order to establish a

comparatively sound preventive system. Fixing means to plant a large area with a certain width along both sides of the railway with trees. Checking means to set up high vertical barriers to prevent shifting sands from moving forward. "Transferring" is to construct gravel platforms of a certain width along both sides of the railway.

5. Implementation of the Desertification Control Plan

The 1964 plan was based on stabilizing sand by plants. To conduct a long-term fixed position study on the establishment of artificial vegetation in the Tengger Desert, 100 ha of land at Shapotou region were designated as experimental fields. The results show that the modified plan (1964) was better than the 1958 plan.

From 1956, more than 50 species of plants have been tested for planting in the experimental fields and in the Shapotou Region in order to select the best sand-stabilizing flora and the ideal planting pattern. Although the artificial vegetation can only last for about ten years and then declines, a new ecosystem is established at the same time. The effect of the artificial vegetation also is to continuously settle the sand dust in the air. This provides a substance of fine particles which is suitable for the processes of turning shifting sands into soils and crusts, which are important to stabilize sand surfaces. Later, the settled fine particles will form a humus layer due to the activity of organisms and create a favorable habitat for the colonization by natural fauna and flora.

Although the research on sand stabilization by plants had to be stopped during the ten years of turmoil of the Cultural Revolution and nearly fifty per cent of the experimental fields were damaged by invasion of shifting sands and wind erosion, the experiments and fixed position research on sand stabilization resumed in 1978 and has been carried out

actively and effectively. Significant achievements have been obtained during the last years. All of these can not be separated from the cooperation and coordination of, and support from other agencies, the local government and the people. Until now, the implementation of the modified plan (1964) has been continued with unchanged aims but some technical revisions.

The artificial vegetation established on barchan dunes at Shapotou region is forming an ecosystem with particular features. Its trend is that the artificial vegetation will be replaced gradually by natural vegetation with more and more fauna and flora species and bee-hole sand dunes instead of shifting barchan dunes.

The change of environment lies mainly in bringing surface wind velocity down and settling fine particles in the air currents. Physical and chemical properties of the top layer of sandy land are changed by plants and their litter. After 20 years of sand-fixation with plants some environmental factors have changed in the south-eastern edge of the Tengger Desert (see Table 12).

Shapotou Desert Research and Experiment Station plays an essential role in the protection of railway tracks crossing shifting sands in China and by providing scientific evidence to stabilize moving sands in theory and practice. At the same time, the experiments on establishing a stable production system composed of agriculture, forestry and orchards with the help of the shelter belt have been carried out by the Station and satisfactory results have been obtained in the last few years. The pilot experiments on agricultural development and utilization on the shifting sands provide acceptable experiences for those areas with similar problems of sand encroachment. Research achievements of the station have been rewarded by the Chinese Government and praised by scholars both at home and abroad.

Table 12. Changes in Environmental Factors after 20 Years of Sand-fixation with Plants in the Southeastern Edge of the Tengger Desert

Site	Wind velocity (m. sec. -1)	Sand flux (g. cm-1. min-1)	Fine particle content (<0.01mm) (%)	Organic matter content (%)	N (%)	P (%)
Shifting sand area	6.0	1.888	0.23	0.0719	0.0012	0.0231
Sand-fixation area	3.3	0.410	0.68	0.7850	0.0291	0.0339

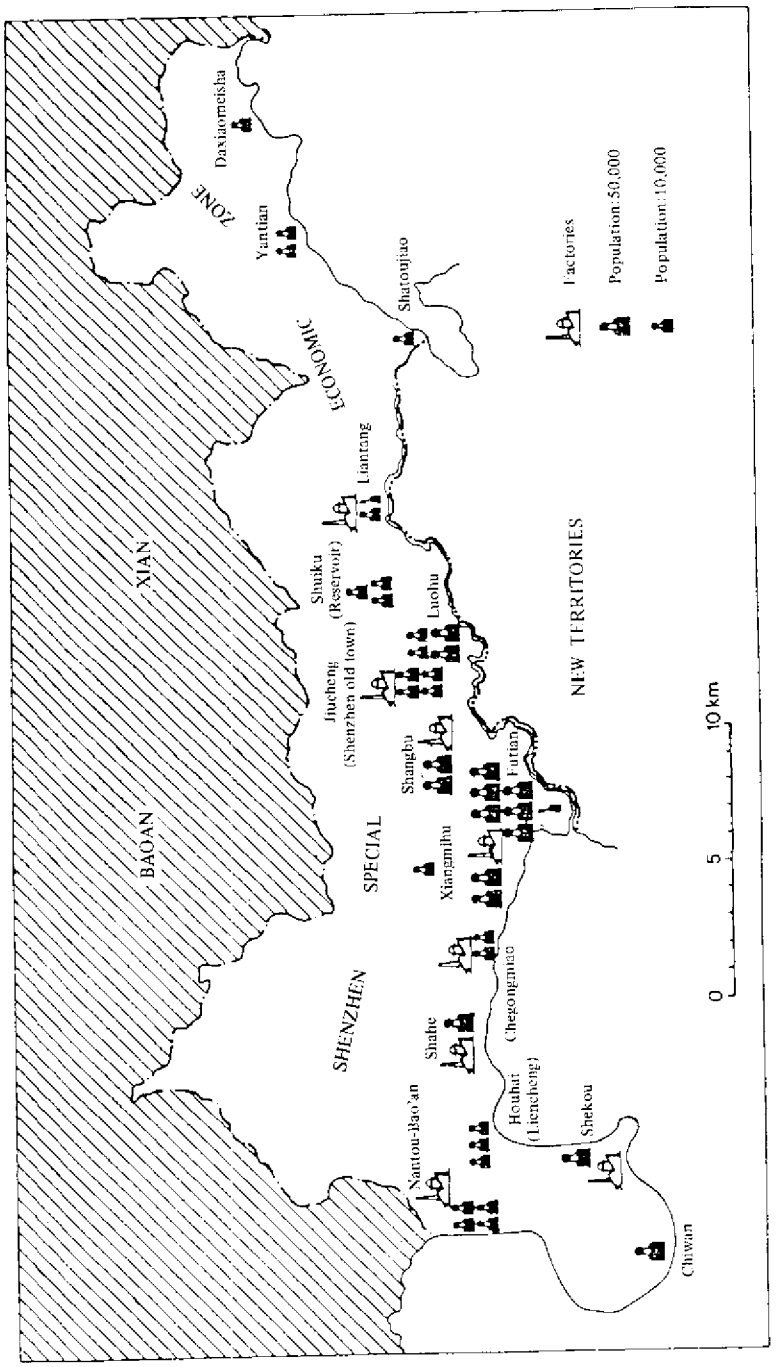
Source: Zhu Zhenda and Liu Shu (1983).

APPENDIX 5

URBAN ENVIRONMENTAL PLANNING IN THE SHENZHEN SPECIAL ECONOMIC ZONE

1. Background Information

In 1980, the Fifth Standing Committee of the National People's Congress of the People's Republic of China designated a total area of 328 sq.km just north of the New Territories of Hong Kong to be the Shenzhen Special Economic Zone or SSEZ, soon after the State Council authorized China Merchants Steam Navigation Co. Ltd. of Hong Kong to manage the industrial development of Shekou Industrial District on the 30th of January, 1979. Before this decision was made, the area of Shenzhen was less than three square kilometers, the population was less than 30,000, the total length of roads in the urban area was only eight kilometers, the number of motor vehicles was about 360 and housing floor space about 290,000 square meters. The total output value of industries was 30 billion RMB (approx 810 million US$ at the 1987 rate). But, great changes have taken place after the designation as SSEZ. Now, SSEZ has become a modern city to some extent. Up to 1985, the area of developed and utilized land was 47.6 square kilometers; three industrial estates had been built and four were under construction. There were 750 factories being put into operation in electronics, light industry, food processing industry, textile industry, building material industry, hardware machinery industry, chemical industry, etc. Housing construction being completed was 9.11 million square meters and road construction 161.3 kilometers. The population has increased to 470,000 people and motor vehicles number about 44,000. Figure 12 shows the population distribution and



Source: Hsu (1982)

Figure 12. Population Distribution and Industrial Allocation in the Shenzhen Special Economic Zone

industrial allocation in SSEZ (Hsu, 1982). At the beginning of urban construction, environmental protection was being given attention under the leadership of the Municipal Government. Urban environmental planning had been prepared by the urban planning department, environmental protection department, environmental scientific research institutes, etc. Although the economy has been developing rapidly in the last few years, the environmental quality in SSEZ is comparatively good. The principle of development has been to promote development of the economy and urban and environmental planning at the same time.

2. Environmental Problems and Analysis

2.1. Natural Conditions

The Shenzhen River, a natural physical boundary between the mainland and Hong Kong, runs from northeast to southwest into Deep Bay through the Shenzhen Basin, which is surrounded by hills of less than 500 metres on its north, south, and east banks. Major towns such as Shenzhen, Luohu, Shangbu, and Futian are located in the Basin to the north of the river and near the intersection of the Kowloon-Canton Railroad and the Shenzhen-Nantou Highway. A subtropical climate dominates the region throughout the year. In winter, under the influence of continental high pressure systems, northeastern winds prevail. During the summer, a continental low pressure cell draws warm moist air from the ocean resulting in prevailing winds being southwestern. These seasonal circulations are commonly known as the winter and summer monsoons respectively.

2.2. Environmental Problems and Analysis Related to Water

There are several rivers in SSEZ with an annual runoff capacity of 360 million cubic meters, including the Shenzhen

River, the Buji River, the Dasha River, etc. Most of these rivers converge into the Shenzhen River and flow to the Shenzhen Bay and then Zhujiangkou. From the late 1960s, the Shenzhen River has been polluted by organic matters from various pollution sources along both banks. At present, the water quality is seriously deteriorated. Odours from the River emanate more than 120 days a year. The Shenzhen Bay is in the same condition and, there is evidence of eutrophication. The Shenzhen River and the Shenzhen Bay receive waste waters from the Hong Kong New Territories and the middle and western parts of SSEZ. Based on the 1984 statistics, there were 37.27 million tons waste water produced directly by human activities in the river valley of the Shenzhen River, among which 15.76 million tons were from the Hong Kong New Territories (E.P.B. Shenzhen, 1986). The pollutants entering into the Shenzhen Bay from the Shenzhen River every year amount to 2,280 tons BOD5, 1,280 tons NH4-N and 460 tons phosphorus (total). The waste water from the Shenzhen side entering into the Shenzhen Bay is 3,521 tons per year with a BOD5 load of 4648.8 tons; from Hong Kong, the BOD5 load is 22,805 tons per year. In addition, the BOD5 and COD load brought by the pollution of urban surface runoff amounts to 22.4 per cent and 56.37 per cent of the total pollution load of the Shenzhen River and the Shenzhen Bay respectively (EPB Shenzhen, 1986). Except for the man-made effects, there are also some effects of hydraulic conditions on the environmental quality of the Shenzhen River and the Shenzhen Bay. For example, the net discharge capacity of shenzhen River is small and controlled by tide water all year around. As a result, the capability to dilute runoff pollutants is low, especially in the dry seasons. The pollutants at middle stream take seven days to reverse to the sea and during the rainy seasons, it takes one to seven days depending on the discharge capacity. Under these conditions, most of the pollutants remain in the inner parts of the Shenzhen Bay and then cause heavy pollution. Furthermore, the sludge at the bottom of the Shenzhen River is on the edge of eutrophication, causing secondary

pollution. Since the water is low in oxygen, organic matters are broken down very slowly, the heavier the pollution is, the slower the degradation is. Thus, a vicious cycle has come into effect.

2.3. The Development Problems Due to Administrative Changes

After SSEZ had been designated by the Central Government, the surrounding areas and SSEZ itself have been developed so rapidly that some areas have been out of control, e.g. Buji Village. Buji District, in Baoan County, is situated outside the northern boundary of SSEZ with an area of 100 square kilometers in the up and middle stream of the Buji River Basin. Buji Village is the centre of Buji District and situated in the upper-middle stream of the Buji River. It had a population of 3,900 in 1983. Recently, Buji Village has developed very fast. At the end of 1984, there were 125 processing factories using imported raw materials and 105 joint enterprises, including electronics, electrical equipments, toys, textile, tailoring, etc. The population was 35,000 in 1986 and its construction also had been developed on a large scale. It is predicted that the Buji Village will become a town with a population of 100,000 in 1990. The development of Buji Village has severe effects on the water quality of the Buji River. There was no systematic planning in the village and no consideration was given to municipal drainage and pollution prevention, as a result, the water of the Buji River was polluted. The Buji River is 15.5 kilometers long with 47.5 square kilometers river valley and its runoff capacity changes greatly depending on the seasons. The water quality was sound at the upper-middle stream in the early 1980s. In recent years, along with the development of industries and the increase of the population, there have been about 6,000 tons of domestic and industrial waste water discharged into the River every day without treatment. At the same time, about 30 tons domestic refuse a day has been disposed of

along both sides of the River and some of this was even dumped directly into the River (E.P.B Shenzhen, 1986). As a result, the pollution load is increased, the River is polluted and water quality decreases year by year.

Another example is the development of Shawan area, which is located along the banks of the entrance of the Shenzhen Reservoir. Originally, this area had relied on agriculture and had a population of 2,000. Along with the development of SSEZ, remarkable changes have taken place in its economic structure. Now, there are four industrial villages, 43 factories, 15 hotels and restaurants and the population has increased to 9,000. In recent years, the amount of waste water and solid wastes have increased greatly. In 1986, the waste water was more than 1,000 cubic meters a day and solid wastes stood at about eight tons a day, most of which were disposed of along the banks of the Shawan River. The water quality of the River has decreased because of the effects of the waste water and solid wastes.

The development trends of Buji Village and Shawan area and their results can be predicted as follows. According to the tentative plan for the development of Buji Village, the amount of waste water will increase to 20,000 cubic meters a day in 1990, which is close to half of the flow capacity of the Buji River in dry seasons. It is possible that the Buji River will become a river with odours and black water with the additional waste water discharged from the Shanwan area. The Shanwan area is also an area of water resources reserves. Continued uncontrolled development will affect the water quality of the Shenzhen Reservoir continuously, if no control measures are taken.

2.4. The Environmental Impacts of the Quarries in SSEZ

There are 38 quarries in SSEZ with an annual output of 4.39 million cubic meters, among which about 1.3 million cubic

meters are sold to Hong Kong. These quarries are mainly concentrated on the northwestern part of the urban areas and the eastern hilly lands. Since there was no unified planning and a lack of measures for water and soil conservation and tree planting, the quarries have caused comparatively large impacts on the environment of SSEZ. These impacts include: (1) the impacts on the natural landscape of SSEZ, since the mining fields are exposed to sight along the public roads and in the suburban areas. (2) the impacts on the urban environment, since the noise and vibration disturb the quiet environment of the city and the dust makes air pollution more severe. (3) the impact of deforestation, since any quarries will damage the vegetation and forests to a different extent. (4) the impact of soil erosion. There are few measures for water and soil conservation in the mining areas. The surface soil and small stones left by mining are washed away to the rivers and bays and form deposits in the basins. At present, the problems brought about by quarries are one of the major public hazards related to the natural landscape and they contribute to the soil erosion in SSEZ.

2.5. Noise Pollution

At present, the noise level of some areas with different functions in SSEZ exceeds the national standards: the extent of the excess for environmental noise is 41.4 per cent, for traffic noise, 25 per cent. Generally speaking, the noise levels of the industrial areas can meet the national standards, but the mixed commercial and residential areas and the residential, cultural and educational areas can not. The noise pollution sources can be listed as follows (E.P.B. shenzhen, 1986): (1) the vibrations and noise produced by construction, mainly construction machinery. (2) the traffic noise of trains passing through the city, vehicles friction with the road surface, horning of motorcycles driving in residential areas, etc. and (3) noise from the central

cooling towers and blowers of restaurants and hotels, loud speakers in some middle and primary schools, accoustics advertisements used by some commercial departments to solicit customers, etc.

It is predicted that the main development of environmental noise in SSEZ will be in the communication and transportation sectors, which is now also the main source of environment noise pollution. The type of communications and transportations producing noise include (a) overhead railways passing through 1.5 kilometers of the urban area; (b) highways; (c) the development of various air transportation routes and the international airport; (d) the increase in the number of motor vehicles in the city, and (e) the increase of vehicles with service purposes working in the residential areas, such as garbage collectors, milk vendors, etc.

3. Urban Environmental Protection Planning

3.1. Environmental Protection Planning Related to Water

The guidelines for environmental protection planning related to water are to set up macro-policies for SSEZ on water resources conservation, to ensure that potable water is not polluted; to implement water pollution control zoning within river valleys according to their different environmental capacities; to adopt the method of discharging waste water into the sea as the basic measure solving the problem of inland water pollution; to decrease the pollution load of each river valley; and, to discharge the waste water of some areas into the Dapeng Bay after secondary treatment. In SSEZ, fresh water is not abundantly available because of the area's landforms topography and geology. Therefore, it is necessary to evaluate the continued availability of water resources combined with the requirements for socio-economic development of SSEZ. At the same time, the rational

policies preventing water resources from being polluted need to be established and carried out in SSEZ. The policies laid down by the planners of SSEZ have been:

(1) Water usage with price differences, this means that in the socio-economic plan, the quota for water usage are set for all walks and more charges are made if the quota is exceeded.

(2) Water circulation. The rate of water reutilization in SSEZ is almost zero, relevant policies and measures are needed to be set to meet the planned target of a 40 per cent water reutilization rate in 1990.

(3) The polluter-pays-principle has been adopted.

(4) Chosing the trades that consume less water resources when developing the city.

For the protection of potable water resources, targets and measures are set by the planners of SSEZ. The planned target for the water quality of water reservoirs is to obtain and maintain the second class standards of surface water issued by the State. The Shawan area has been designated as an important area for environmental protection. The guidelines for its economic construction and development are, constrained by the conditions of ensuring the water quality of the Shenzhen reservoir, of developing mainly the trades of orchards, vegetables, aquatic products, etc.; of developing properly the non-polluting processing industries and of building the area into a garden-like commercial area with a sound environment. The development scale of the capital construction of Shawan area is strictly controlled and the built up industrial villages can not be expanded any more. The population will be controlled to about 10,000, among which half are permanent and half are temporary.

To solve the problem of water source pollution in the Shawan

area, discharging waste water outside of the river valley should be promoted. To achieve this end, some engineering measures are planned to be taken. The whole project is divided into three stages. The first stage is to stop and drain away the waste water discharged from the Shawan area from the reservoir valley to other areas. The second stage is to reduce by 30 per cent the BOD5 and by 60 per cent the suspended solids in the waste water discharged, by primary treatment and by some technical measures, like oxidation ponds in order to decrease the pollution load of the Buji River. The third stage is, depending on the effects of the second stage, to decide on the secondary biochemical engineering and to maintain the usage of oxidation ponds. In addition, all the domestic waste water from the communities, enterprises, etc. in the village should be discharged into the main waste water pipe after tertiary treatment in septic tanks. The refuse in the Shawan area, of eight tons a day, should be cleaned and transported to places outside the river valley. A 50 meter green belt is planned to for establishment along the banks of the Shawan River for water and soil conservation purposes. Overall planning of the functions of each river has been carried out (E.P.B. Shenzhen, 1986). For example, the functions of the Shenzhen River are shipping, flood-relief and waste water discharge; the functions of the Shenzhen Bay are shipping, tourism and cultivation; the functions of the Buji River are flood-relief, waste water discharge and viewing, etc. The objective value of the water quality in each river is also determined. A control plan for the Buji River will also be made.

The following aspects are planned to start the pollution control and prevention:

(1) Preparing and implementing a systematic plan for urban construction and municipal construction for the upper-middle stream areas of the Buji River. It was suggested that the population of the Buji Village be limited to 35,000 to

40,000 in the period of 1986-1990, including the temporary population.

(2) Strictly controlling the establishment of the enterprises or the factories causing air pollution because of the windward position of the Buji District in the city.

3.2. The Planning for Controlling the Environmental Problems Caused by Quarries

The development of mineral resources within the area of SSEZ is under the supervision of, and planned for by the municipal planning departments, with the aim of maintaining the natural landscape in harmony with modern cities and of retaining the magnificent mountains and the mountain peak with exuberant vegetation. To achieve this, soil erosion should be prohibited and damage to great areas of vegetation should be avoided. A balance between supply and demand should be upheld. When opening a new quarry, both economic benefits and environmental benefits have to be considered. As to the existing quarries, some would be closed without any condition because of the need for urban planning, the others must be managed according to the relevant laws and regulations by legal, economic and administrative means and measures preventing soil erosion and vegetation damage should be taken. After being closed, some reclamation measures should be taken to facilitate tree planting and vegetation recovery. It is also encouraged to use the various characteristics of each quarry to create a variety of man-made landscapes.

3.3. The Planning and Counter-Measures for Decreasing Noise in the City

The objective value of environmental noise in the urban areas of SSEZ will meet the Standards of Environmental Noise in

Table 13. Standards of Environmental Noise in Urban Areas

Area	Day Time	Night
Specific areas	45	35
Residential, cultural and educational areas	50	40
First class mixed areas	55	45
Commercial centres and second class mixed areas	60	50
Industrial areas	65	55
Sides of main roads	70	55

Urban Areas laid down by the State (see Table 13). To achieve this aim, it is important to provide a rational layout and proper arrangements of the land uses for residential areas, industrial areas and communication and transportation. The factories disturbing residential areas are requested to move or transform to other production processes. A feasibility study is needed when selecting the site of the international airport with consideration of its impacts on urban and residential areas and routes should avoid crossing over urban areas. In addition to this, appropriate shields are needed when constructing highways. In order to decrease the noise level in the urban areas, designated roads and times will be provided for loaded trucks and various kind of vehicles to pass through the city. Speed limits are also needed. At present, there are about 13,000 motorcycles in the city, which is one of the major causes of environmental noise. Thus, it is necessary to control their numbers and adopt speed limits when driving in residential areas, cultural and educational areas.

Furthermore, some other measures are also taken to reduce the environmental noise as much as possible, such as the halting of construction in or near residential areas at night to prevent the residents from being disturbed. Tree planting is encouraged in any place where it is possible, since it is beneficial both for scenic reasons and for the reduction of noise. Rules and regulations for SSEZ will be made to prevent and control noise in order to be able to implement various measures for noise control.

4. Planning for Polluting Industries

In coastal areas, both at home and abroad, heavy environmental pollution is caused by the irrational layout of polluting industries. The important role of industrial

layout planning in environmental pollution control is recognized based on long time practices. SSEZ is a new city, so, using prevention as a main measure is the basic guideline of environmental protection for SSEZ. Pollution prevention and elimination in SSEZ by using the means of planning, e.g. a rational layout of polluting industries would be advantageous. Based on the results of scientific research and the comprehensive analysis of social and environmental factors, load-bearing capacity of waters and the atmosphere, etc. a rational layout has been designed by the planners of SSEZ.

4.1. The Guidelines for the Rational Layout of Polluting Industries

The guidelines for the rational layout of polluting industries can be described in essence as follows (E.P.B. Shenzhen, 1986):

(1) The social conditions, such as industrial layout, land, communication systems, water supply, etc. are preconditions and the natural conditions, such as water, the atmosphere, etc. are relative conditions;

(2) Attention should be given to choosing areas with sound conditions for water discharge and the waters with higher environmental capacity should be used for locating certain kinds of polluting industries;

(3) Attention should be given to select geographical locations with sound conditions for air dispersion; they should not only have sufficient load-bearing capacities within the industrial districts planned, but also they should not cause pollution to the centre area of the city.

4.2. Present State and Development Trends of Polluting Industries in SSEZ

The industries of SSEZ have begun to take shape after several years of development. The polluting industries at present include printing and dyeing mills, paper mills, food and drinks production, electroplating, cattlehide processing, etc. They are a comparatively small number since industrial waste water only amounts to 10.5 per cent of all urban waste water discharged. The pollution caused by industries is smaller than that by households and communication and transportation. In principle, industrial pollution has not posed a threat to the environmental quality of SSEZ.

According to the Seventh Five-Year Plan (1986-1990) of industrial development, the investment for industries is in the first place of the whole capital constructive fund allocated to constructive investment. Therefore, it is planned to develop the "light, small, new and refined" industries, most of which are modern trades with no or less pollution. However, in order to ensure a stable development of SSEZ, the construction of fundamental industries enters gradually the agenda of industrial development, certainly this will include some polluting industries. At present, some polluting industries have been accepted, such as a floating glass plant, a titanium white factory, etc. and some other polluting industries have been considered or are planned to be developed, such as refineries, an iron and steel mill, a color kinescope factory, etc. Thus, polluting industries will constitute a considerable proportion and concentrate on the fundamental industries.

4.3. Social and Natural Environment Investigations and the Planning for the Rational Layout of Polluting Industries

In order to plan for the rational layout of polluting industries as predicted, the social environment has been investigated first, including land, water supply, or the availibility of water resources, and communication and municipal infrastructure. Given the principle not to establish any polluting industry within residential areas, scenic spots, water resources reserves and cultural resorts and the consideration of the social conditions mentioned above, some areas have been selected as priority areas for the development of polluting industries. However, their corresponding natural environment conditions also need to be investigated. These still further restrict the layout of polluting industries. To this effect an investigation and analysis of alternatives have been carried out for water and the atmospheric environment. As a result, a layout plan has been proposed (E.P.B. Shenzhen, 1986). In the areas that have suitable land, water resources and convenient communications, as well as a geographical position with a large water resources capacity and sound atmospheric conditions, certain large and medium-sized industries can be established, e.g. petrochemical industry, metallurgical industry, and building materials industry and their auxiliary medium and small industries. In the areas of transit to the urban environment, if they have sound social conditions, the industrial waste water can be treated and meet the standards within the factories and then be discharged into the waters through waste water pipelines. Thus, certain medium-sized and small water-polluting industries can still be established, e.g. foodstuff industries, leather processing, textile printing and dyeing, etc. In the areas with good conditions for air dispersion, some air polluting industries can be established. For example, Dapeng Peninsula has large areas of land with better conditions for air dispersion, but the basic social and economic conditions are not satisfactory and

communications are not convenient. As a result, the main restriction to industrial development is a lack of fresh water resources. Therefore, in this kind of area, air-polluting industries with small water consumption can be established. The planning process for the urban environmental plan as practiced by the Enviromental Protection Bureau, Shenzhen had been summarized in Figure 10 (see above).

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