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**ECONOMIC DEVELOPMENT IN AN ERA OF GLOBAL ENVIRONMENTALISM:
SUSTAINABLE DEVELOPMENT AND ENVIRONMENTAL POLICY
IMPLEMENTATION IN CHINA**

**A Dissertation
Presented for the
Doctor of Philosophy
Degree
The University of Tennessee, Knoxville**

**Qingguo Gao
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DEDICATION

To my parents

From whom I have learned the real meaning of tenacity and perseverance

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ABSTRACT

The primary purpose of this dissertation is to explore the opportunities and constraints of implementing environmental policy and sustainable development in China. As the most populous country on earth, China's development and survival has come to a turning point. Many scholars as well as the Chinese government have realized that there is only one way out of the impending environmental disaster. That is by adopting a policy of sustainable development to protect the already damaged environment.

The study is centered by a case study of Yunnan Biomass-to-Electricity (BTE) Program, which is a joint research effort between American and Chinese institutions to implement biomass energy projects in rural areas of Yunnan province, China. By integrating energy production and environmental protection, the BTE Program could serve both the environmental and economic needs of the local regions. Therefore, the Yunnan BTE program can serve as a model of sustainable development. Furthermore, because the Yunnan BTE program was a cooperative research effort involving Chinese and American institutions, it also provides an opportunity to study and assess international joint policy implementation efforts.

In this case study, we developed an analytical model that contains key factors, both constraints and opportunities, which may have affected the implementation of the BTE program. We explore the role of environmental policy and relationships among various relevant Chinese and American institutions involved in the BTE program. Through careful examination of these factors, and their roles in the process, we establish which facilitate and inhibit program implementation.

The study of Mengpeng BTE project showed that all the factors in the analytical model influenced the outcome of the project implementation. Some played more vital roles while others were just minor players. The study demonstrated that preferential environmental policy and sound institutional setting are essential for the success of environmental program implementation in China.

From this study, we have learned that it takes more than advanced technology and funding to implement sustainable development. We need not only good environmental policy, but also effective environmental policy. It was not that China lacked environmental policies to support sustainable development. It was rather that these policies were not thoroughly implemented. This case showed that the Chinese institutional setting posed problems for environmental policy implementation in China.

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LIST OF ABBREVIATIONS

ADB	Asian Development Bank
BTE	Biomass-to-Electricity
CA21MC	China's Agenda 21 Management Center
CPPCC	Chinese People's Political Consultative Conference
CPE	Central Planned Economy
EPLG	Environmental Protection Leadership Group
EPB	Environmental Protection Bureau
EPC	Environmental Protection Commission
EPO	Environmental Protection Office
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GFG	Greenhouse Gas
JI	Joint Implementation
JIEE	Joint Institute for Energy and the Environment
NEPA	National Environmental Protection Agency
NEPB	National Environmental Protection Bureau
ORNL	Oak Ridge National Laboratory
SEPA	State Environmental Protection Administration
UNCED	United Nations Conference on Environment and Development
YIES	Yunnan Institute of Environmental Science
YEPB	Yunnan Environmental Protection Bureau

CHAPTER ONE

INTRODUCTION TO THE STUDY

INTRODUCTION

Economic development has long been the key national goal of most developing countries. Although the implementation of growth and development plans differ for nearly every country of the world, developed and less developed alike, the concept of development almost always conjures up a positive perception as to what implementation will mean for the population of a given country. Most countries find a certain amount of comfort with the notion that economic growth and development are positive goals to be achieved (Billet, 1993).

Since the birth of development theories in the 1950s, economic growth has always been seen as a mighty tool that could modernize developing countries. Scholars of classical modernization theories advocated that developing countries should follow the Western model of development. Rostow stated that developing countries must go through five major stages of economic development before they become modernized. The five stages begin with traditional society and end with high mass-consumption society (Rostow, 1964). Although the new modernization theories are more tolerant about the alternative paths to modernization, they still embrace the idea that rapid economic growth and industrialization are beneficial to the Third World countries (So, 1990). In short, modernization theories as a whole have overlooked the issue of environmental protection that developing countries must face in the course of economic development.

Until the 1980s, most countries regarded global environmental problems as a minor issue marginal to their national interests and to international politics. In the past few decades, however, the economic development of developing countries as well as developed countries has seriously damaged the global environment. Since the mid-1980s, environmental problems such as global warming and acid rain have been becoming important issues of international politics. The new status of global environmental issues was reflected in the fact that the first global summit in world history was the 1992 United Nations Conference on Environment and Development (UNCED), held in Rio de Janeiro, Brazil. The conference also further heightened popular and official interest in global environmental problems and their relationship to economic policies. By the early 1990s, the global environment has emerged as the third major issue area in world politics, along with international security and global economics (Porter and Brown, 1996).

International environmentalism has been challenging the traditional tradeoff model of development ever since it was given birth. According to the traditional development model, rapid economic growth and industrialization was the only way to modernization. Environmental pollutants such as smoke from industrial smokestacks and burning chemicals on the rivers were once seen as signs of prosperity.

Today, in an era of global environmentalism, however, the tradeoff model of development designed by western scholars for developing countries is no longer viable. The new model of development that was officially raised at 1992 UNCED is sustainable development. Sustainable development is the ability of humanity to ensure that it meets the needs of the present without compromising the ability of future generations to meet

their own needs. Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are made consistent with future as well as present needs (World Commission on Environment and Development 1987: 8).

The argument that environmental degradation will reduce future benefits from economic activities is now well accepted. Many countries currently consider improvement in environmental quality an integral part of their overall national objectives. The concept of sustainable development, however, is not free of controversy. Many people argue that sustainable development is nothing but a beautiful delusion (Lewis, 1992). For many developing countries, strong economic growth and a more equal income distribution are still the immediate goals. These countries view with disfavor those policies that sacrifice economic objectives simply to improve environmental quality.

Given the ever-worsening global environment, it is essential to search for an alternative model of development for developing countries. This dissertation intends to examine the relationship between environment and development and explore the opportunities for and obstacles to implementing sustainable development in developing countries. The relationship between environmental policy as a means of promoting sustainable development and models of development in developing countries will be emphasized.

This dissertation focuses on a case study of biomass-to-electricity (BTE) program in Yunnan Province, China. The Yunnan BTE program is a pioneering renewable energy

effort. It exemplifies Chinese efforts to implement sustainable development by using renewable biomass to generate electricity. This research examines the process of environmental policy formation and implementation in China, exploring the constraints and opportunities for sustainable development. In so doing, it will also reveal the complex relationship between the central and local Chinese governments within the *new market-oriented* political and economic environment. Finally, this case study seeks to shed light on the principles of *Joint Implementation* (JI) as an approach to handling important global environmental problems.

TWO MODELS OF DEVELOPMENT

People's understanding of the relationships between environment and development has undergone a profound change in the past several decades. The two major schools of thought have been *tradeoff theory*, represented in Figure 1.1, and *sustainable development theory*, represented in Figure 1.2.¹

The tradeoff theory advocates that it is possible to have either development or environment, but not both simultaneously. If we want development, the price to pay would be a loss in terms of environmental quality. The tradeoff theory may lead to two different conclusions concerning development and environment. The first is a pessimistic view that believes that development will eventually bring environmental disaster to the world. Therefore, any kind of development will eventually doom the future of humankind as well as the earth. The second view of tradeoff theory acknowledges the facts that development will cause environmental degradation and optimistically believes that the

¹ All figures are in Appendix B.

environmental problems will be solved when development has reached a certain level. The once very popular slogan of "pollution first, treatment later" was derived from the latter.

On the other hand, under the assumption of the sustainable development theory, environment and development are interdependent, and in fact are mutually supportive. It becomes more and more clear that without environmental protection, it is not possible to have sustained development. And without development, it is very difficult to sustain a high quality of our environment and an improved quality of life for all the people living on the earth. Therefore, sustainable development is development that can be sustainable over the long term by explicitly considering the various environmental factors on which the very process of development is based.

The heightened political prominence of environmental problems in the late 1980s underscores the singularly important role of government and politics in devising solutions to the nation's and the world's mounting environmental ills. Effective response to problems such as global climate change, population growth, the spread of toxic and hazardous chemicals threaten the endangered species, and air and water pollution requires diverse actions by individuals and institutions at all levels of society. One major contribution will be scientific research and inquiry that draws from a wide range of disciplines, among them environmental and other natural sciences, economics, political science, sociology, history, and philosophy. There is also a wide range of response strategies. Some scholars and activists emphasize political initiatives and public policy responses more than others do. Most scholars believe that government clearly has an indispensable role to play in environmental protection and improvement. When

government is faced with changing public expectations, or when policy preference is inconsistent with professional canons, political controversy is likely to result. Faced with conflicting expectations and demands derived from incompatible assumptions, administrators with responsibilities for environmental policy making must cope with problems that seldom have technical solutions (Caldwell and Bartlett, 1997: 13).

The major reason for the preeminent role of government is that most environmental ills are public problems; that is, they cannot be solved through purely private action. This does not mean that individuals and non-governmental organizations cannot do much to prevent environmental deterioration, especially in local communities; it means only that individual efforts alone are insufficient. Moreover, self-interested individuals and a free economic marketplace guided mainly by a concern for short-term profits may predictably create byproducts such as pollution while pursuing their own interests. Thus, the very character, scope, and urgency of environmental problems and the inefficiencies in human institutions necessitate large-scale collective action, particularly by government.

Public policy is a course of governmental action or inaction in response to social problems, and it is expressed in goals articulated by political leaders, formal statutes, rules and regulations, and the practices of administrative agencies charged with implementing programs. Policy states the intention to achieve certain goals and objectives through a conscious choice of means--often within a specified time period. In a constitutional democracy like the United States, policy making is distinctive in several respects: it must

take place through constitutional processes, it requires the sanction of law, and it is binding on all members of society.

Implementation of these policies, however, has been far more difficult and controversial than their supporters imagined they would be. Partly for these reasons, the policies have been only partially successful, particularly when measured by substantive improvements in environmental quality. Further progress in the face of what are lively but persistent and severe budgetary constraints requires that the nation search for more efficient and effective ways to achieve these goals, including the use of alternatives to conventional "command-and-control" regulation. Nevertheless, the record of the past two decades demonstrates convincingly that the U.S. government is able to produce significant environmental gains through public policies. Unquestionably, the environment would be worse today if the policies of the 1970s and 1980s were not in place.

Government is an important player in the environmental arena, but it cannot pursue forceful initiatives unless the public supports them. Only significant changes in society's values can provide the impetus for an ambitious governmental response to a rapidly changing world environment that, in all probability, will involve severe economic and social dislocations (Vig, 1990).

The second problem, resulting from past use of fossil fuels by already rich nations, gives rise to the need to compensate those developing countries that are already using their own resources of cheap fossil fuels to foster modernization. If environmental initiatives such as the reduction of carbon dioxide emissions are to be effective, nations such as India and China must be persuaded to forego the benefit of using these resources.

Or, some form of compensating absorption of carbon dioxide must take place elsewhere in the globe. Inevitably, the second problem imposes a burden, mainly on the North, until such time as the countries have been equipped with an energy supply system that leaves them with no incentive to use their coal reserves in a manner that vitiates the overall scheme.

This path involves the transformation of the world's commercial fuel system onto a sustainable basis, relying on biomass for its main raw material. For the remainder of this century this involves *getting ready*, as opposed to *waiting and seeing*. In the decades thereafter, it can, unless nature holds in store some truly dreadful surprises, put the world economy in shape to get global warming under control by 2020--and get greenhouse gas levels where we may want them to be by around the middle of the next century.

That the sustainable energy path shows net benefits in the direct cost of delivered energy does not, of course, mean that fuel prices will be at or below their present level in 2020. Fuel prices will rise in real terms (i.e., exclusive of the effect of inflation) because it is getting harder and harder to find and extract new supplies of oil, and because the huge reserves of the Middle East will give preponderant market power to suppliers in that region. Furthermore, by competing with oil and limiting its market, the alternative technologies mentioned above could prevent oil prices rising as much as they otherwise would. So the eventual cost saving may appear less real than it is. With apparently endlessly rising oil prices in the later 1970s, the motivation for initiating the research into new energy technologies, which has now borne fruit was indeed cost saving. In terms of the original objective, however, the research has not, with the mid-1980s dropping oil

prices, been a great success. But as is so often the case with research, there has been an unexpected pay-off. Certainly, when it comes to cutting net carbon dioxide emissions, these technologies are winners.

By achieving a transition, over the next two to three decades, to sustainable fuel technologies based upon intensive biomass production-and its conversion for modern gas turbine-based power generation, together with chemical processing of ethanol for the portable fuels needed for mobility-we can achieve effective control over the rebate of carbon dioxide emissions and, over time, reach a desired level of carbon dioxide concentration in atmosphere. As far as exiting energy extractive industries are concerned, this means more or less doing away with burning coal and, to a lesser extent oil and natural gas, over the next few decades.

As has been said, the real problem is not the rate of emissions of carbon dioxide into the atmosphere, but the level of carbon dioxide concentration. This is rising because fossil fuels emit carbon dioxide without providing any mechanism for its recapture. However, biomass fuels absorb carbon dioxide during the plant's growth process so that, on a net basis, and over the duration of the growth and use cycle, first absorbing and then emitting, it leaves the carbon dioxide level unaffected.

To absorb carbon dioxide at a given rate, long rotation tree-growing, which is what would be best provide such a sink, takes three to five times as much land as short rotation intensive fuel-wood production techniques. However, tree-growing that is partly justified for other reasons, such as preventing soil erosion or providing wind breaks for instance, also carries additional amenity and conservation values. For example, long term

commercial reforestation may well provide the side benefit of reduced logging in virgin forest. This can certainly help boost the initial rate of recapture of carbon dioxide from the atmosphere (Read, 1994: 19). Now, let us look at the case of China.

THE CASE OF CHINA

In the past two decades, developing countries have experienced rapid economic development. On the other hand, however, these countries are also facing environmental degradation and even environmental disasters. This phenomenon has caught the attention of many scholars.

An ongoing debate over the future of resource-intensive growth has advanced well beyond the early skirmishes over the potential "limits to growth" in a finite world. More difficult questions about the potential for the continued diffusion of industrial prosperity to those on the other side of the industrial divide—the bulk of human race—are now being asked. The focus is shifting from assessing the limits to growth to an analysis of what types of modernization and development might be sustainable globally in the next century, giving increasing environmental uncertainties facing a rapidly growing and more affluent human population (Pirages, 1996: 3).

It is essential for developing countries as well as the industrialized countries to implement sustainable development. Sustainable development is the process of improving the living conditions of the poorer majority of mankind while avoiding the destruction of natural and living resources, so that increases of production and improvements in living conditions can be sustained in the longer term. Therefore, it is critical to find out the constraints and opportunities for developing countries to implement sustainable development.

China, as the most populous nation on earth, is one of the developing countries that have been experiencing rapid economic growth in the past twenty years. Over the last two decades of economic reform, China's socialist system has undergone a transformation of its economy, moving increasingly from previous planned economy toward a market-oriented economy. The result has been rapid rates of economic growth (averaging approximately 10% per year), a noticeable increase in the standard of living, and a tremendous expansion of consumption.

Economic success has not been gained without costs, however. During this period of reform, the quality of China's environment has steadily deteriorated. Rapid economic development in China has caused serious environmental problems. These problems will not only threaten sustainable development in China, but also threaten it on a global scale. The ever-worsening environmental degradation and an over-loaded population in China had caught a great attention of countries in the world as well as the Chinese government. Since the reform started in the late 1970s, the Chinese government has established an environmental protection legal, policy, and institutional structure to control these problems. Since the beginning of 1990s, especially after the United Nations Conference on Environment and Development in 1992, the government has made a great effort in making environmental policies that lead to sustainable development. But this effort has had only limited success.

China, which has one-fifth of the world's population, is the largest developing country in the world. It is also a country that faces serious environmental problems. For example, among the ten most polluted big cities in the world, five are in China. Almost

every major river is polluted. Some rivers are so polluted that no fish and water plants can survive in the water. There is only one way that can lead China to further development. That is sustainable development.

Since economic reform started in the late 1970s, the Chinese government has always viewed economic development as the ultimate goal of policy making. To a great extent, economic development is still placed ahead of the environment. For example, as summarized by a report issued by China's Agenda 21 Management Center (CA21MC):

Sustainable development is a strategic choice that must be made by both developing and developed countries. For a developing country like China, however, the precondition for sustainable development is development. The path of relatively rapid economic growth and gradual improvements in the quality of the environment must be taken in order to meet the Chinese people's current and future needs for basic necessities and their desires for higher living standards, and in order to consolidate the nation's strength. Only when the economic growth rate reaches and is sustained at a certain level, can poverty be eradicated, people's livelihoods improved and the necessary forces and conditions for supporting sustainable development be provided. While the economy is undergoing rapid development, it is necessary to ensure rational utilization of natural resources and protection of the environment. And while it is necessary for China to embark on a gradual path to sustainable development, it must do this at the same time as it is improving economic conditions, enhancing their effectiveness and maintaining an annual average GNP growth rate of between 8% and 9%" (CA21MC, 1994b: 5).

To a great extent, the Chinese government still places economic development ahead of environmental protection. The rationale for this is the perception that economic development is a cure to environmental ills. All of the environmental problems will be solved when economic development has reached a certain level. This is the so called "pollution first" model that had been used by most developed countries. Perhaps the "pollution first" model worked for the industrialized countries in the past. But the damage was done to a then rather healthy environment. On the contrary, the environment in

China today is already heavily polluted. Any further harmful damage to the environment may threaten the well being of future generations.

As it is defined in Our Common Future, sustainable development is a program designed to meet the needs of the present without compromising the ability of the future generations to meet their own. The economic development in China today is certainly not a sustainable one. Now, let's briefly review the current state of the environment in China.

THE STATE OF THE ENVIRONMENT IN CHINA

Air Pollution

China presently faces a host of environmental problems. The country's heavy reliance on coal, which accounts for 76% of energy consumption in China, has created serious air pollution problems, including acid rain, suspended particles and dust in urban areas. Acid rain is distributed mainly in the area south of Yangtze River and east of the Qinghai-Tibet Plateau and in the Sichuan Basin. The pollution of acid rain was most serious in Central China. The average annual PH value of acid rain in this area was below 4.0 and the frequency of acid rain was over 80% (NEPA, 1997).

According to the monitoring of 87 cities, the annual daily average of total suspended particles in the atmosphere was 55-732 micrograms per cubic meter. The annual monthly average of dust fall was 3.70-60.13 tons per square kilometer and the average value was 17.7 tons per square kilometer. The annual daily average of sulfur dioxide emitted was 2-424 micrograms per cubic meter-81 micrograms per cubic meter in northern cities and 80 in micrograms per cubic meter in the southern cities. The annual daily average of nitrogen oxides was 12-129 micrograms per cubic meter (NEPA, 1997).

All the monitoring results have exceeded the national standards. One can easily see and feel the air pollution in big cities. City dwellers have to live with smog all year around. Some cities are so polluted that people can hardly see blue skies. A Chinese student just started his study at a Canadian University and wrote a letter to his brother in Shen Yang, a heavily polluted industrial city in Northeast China. At the beginning of the letter he said: "Dear brother, you are right, the sky is actually blue!"

Climate Change

In 1995, the annual average air temperature across the country was universally higher than normal. The air temperature in winter and fall was obviously higher than normal. In winter, the air temperature in the areas south of the lower reaches of the Yangtze River, the Yangtze-Huaihe River valley and the eastern part of northwest China was generally 0.5-1.5 degrees centigrade higher than normal. The air temperature in most areas of northeast China and north China and northern Xinjiang was 2.0-4.0 degrees centigrade higher than normal, and in some areas it was 5 degrees centigrade higher than normal. (NEPA, 1997) The climate change has brought droughts and floods to many areas in China.

Water Pollution

Among the worst of China's environmental problems is its water pollution problem. According to the Report on the State of the Environment in China, all of the seven major river systems are polluted at various degrees: "Water pollution in the Yellow River basin was serious. Some sections of the mainstream suffered organic pollution, and

some sections of its tributaries such as the Fenhe River, Weihe River, Huangshui River and Yiluo River were most seriously polluted" (NEPA, 1997).

In *China's Environmental Crisis*, Smil observed China's environment closely and depicted it with rather vivid words.

Dominant colors of everyday China are the grays of trampled paths and sidewalks, of walls whitewashed or plastered generations ago, of dried-out ditches and low-slung factory halls, of unpainted wood worn by shuffle of millions of feet and by the repeated touches of millions of hand into hollowed, smooth shapes, of coal smoke dispersing above the nondescript concrete apartment blocks or above the slate village roofs. The palette of dull earth tones, tired browns and beige of thin soils, of windswept sand, of muddy waters, and of skimpy grass tufts dried out on arid slopes. Also dull reds of southern fields and mud, of quickly fired bricks that fall apart even before they are mortared crookedly into wavy walls, and of low chimneys puffing blackish, sulfurous smoke" (Smil, 1993: 16).

If one argues that Smil has only seen the dark side of China's environment, he might still find some places that are colorful and attractive, such as the subtropical forests in Yunnan. But the cruel reality is that we are letting the dark side expand not so much by revolting poverty but rather by a curious neglect, by the numbing sameness and dullness of worn-out, uncared-for surroundings.

Environmental Protection Efforts in China

It should not be assumed for the above discussion that the Chinese government has ignored its environmental problems. In fact, compared to other developing countries, China's efforts at industrial pollution control have been noteworthy. China has engaged in pollution clean-up effort since the 1970s. Over the last two decades, its attention to environmental protection has increased notably. During this time, the Chinese government has promulgated a host of laws, regulations, and standards; it has constructed an extensive

environmental protection administrative apparatus and monitoring network; and it has achieved some (albeit limited) success in solving specific environmental problems.

The Chinese Environmental Protection Law was passed in 1979. It was turning point for China's environmental protection efforts.

The Environmental Protection Law of the People's Republic of China is the cardinal law for environmental protection in China. The law has established the basic principle for coordinated development between economic construction, social progress and environmental protection, and defined the rights and duties of governments at all levels, all units and individuals as regards to environmental protection (Information Office of the State Council of the PRC, 1997: 7).

Up to the end of 1995, the central government had additionally compiled over one hundred national regulations to further define these laws and had issued over 300 pollution standards. Provinces have also supplemented national laws and regulations with their own statutes and regulations.

These environmental protection laws and regulations in the 1980s have greatly reduced the speed of environmental degradation in China. As a member of the international community, China, while making great effort to protect its own environment, has taken an active part in international affairs, striven to promote international cooperation in the field of environmental protection, and earnestly fulfilled its international obligations. All these have given full expression to the sincerity and determination of the Chinese government and people to protect the global environment (Information Office of State Council, 1997).

Concerning its environmental policy orientation, the Chinese environmental protection has experienced three different stages since the late 1970s. In the 1970s

efforts to prevent and control industrial pollution in China mainly concentrated on the control of point sources. In the 1980s, China carried out prevention and control of industrial pollution in a comprehensive way through the readjustment of irrational industrial distribution, the overall industrial structure and the product mix in combination with technical transformation, strengthened environmental management and other policies and measures. In the 1990s, China has changed its traditional development strategy, promoted clean production and embarked on the sustainable development road (Information Office of State Council, 1997).

In the past twenty years, however, China has experienced a dramatic change in almost every aspect of the society. Many established organizations and policies have been changed. New organizations and policies have been formed and replaced. If the early environmental policies are not totally effective, they, to a great extent, were implemented. How effective are the environmental policies in the 1990s? Many people who studied China's environmental policy argue that the implementation of environmental policies still remain in the first two stages. The transition to the third stage of environmental policy-sustainable development has been delayed due to the lack of institutional mechanism and effective policies. This study employs an in-depth case study to reveal the constraints and opportunities of environmental policy implementation and sustainable development in China.

STUDY OVERVIEW

This dissertation is organized into six chapters. This chapter introduced the study and provided an overview of the state of the environment in China. Chapter Two specifies

the scope of research and the research design. It also provides definitions of key concepts and a literature review. Chapter Three explains the environmental policy process in China. It includes as well an overview of the evolution of China's environmental protection apparatus and environmental policy. The presentation and analysis of the case study is provided in Chapters Four and Five. In Chapter Six the study is summarized, conclusions are presented, and the implications of this work are drawn.

CHAPTER TWO

SCOPE OF RESEARCH AND STUDY DESIGN

SCOPE OF RESEARCH

China faces serious environmental problems and is embarked on a concerted effort to address these problems. Whether the limited success presently achieved is simply due to the relatively short length of time since China's environmental protection policies were first initiated (less than two decades), and whether with time these trends of environmental degradation may ultimately be reversed, is of interest not only to China but also to the global community.

Scholars of Chinese environmental policies have tended to focus either on describing the existing infrastructure of environmental laws, policies and institutions or on analyzing environmental quality in China and the implications of the country's ecological conditions for economic growth. To understand China's prospects for resolving its environmental problems, however, analysis must go beyond an examination of the inputs of policy formation and the outcomes of the policy process to the investigation of the policy implementation process. It is necessary to ask whether the infrastructure that is in place can implement policy so as to reverse the trend of environmental degradation. The infrastructure here refers to China's environmental apparatus, political system and institutional settings. What constraints or challenges exist in trying to implement China's environmental policy and to promote sustainable development in the most populous

country on the earth? What opportunities can be identified and how might China take advantage of them? These are the issues with which this study is concerned.

There is no doubt that the Chinese government is now more than ever concerned about the degrading environment in China. In order further to develop China's economy, the central government is making a great effort to protect the environment. Jiang Zemin, General Secretary of Chinese Communist Party made the following comments on the Fourth National Conference on Environmental Protection.

Environmental Protection is very important. It is a strategic matter of overall significance which has a vital bearing on the long-term development of our country. The strategy of sustainable development must be implemented as a matter of tremendous importance throughout the socialist modernization drive. The idea of sustainable development originated from environmental protection and has now become the overall strategy of many countries in the world guiding their economic and social development. The economic development must be planned as a whole in line with the population, environment and resources. Not only good arrangements should be made for the development at present, but also better conditions should be created for the future development. We should never take the approach of resources waste and treatment after pollution, still less live off what has been left by the ancestors and leave nothing behind for our descendants (China Environment Year Book, 1996: 2).

This research focuses on the implementation of China's latest environmental policy endeavor--sustainable development. It directs attention to the role of organizational mechanism and political and economic systems in shaping policy outcomes. The study presumes that implementing sustainable development is highly necessary and feasible given the availability of advanced technology--if requisite public policies are formulated and implemented. The study also begins with the premise that to understand policy outcomes one must examine the implementation process and the institutional framework for policy implementation. It is through implementation that well-intended policies encounter the

realities of social systems. The study also acknowledges the fact that China's organizational settings have been undergoing a tremendous transformation in recent years.

RESEARCH QUESTIONS

Given the environmental problems in China, it is essential for the Chinese government to adopt an environmental policy of sustainable development and to promote rational environmental management. In order to realize the transition of environmental protection policy in China's reform setting, it is very important to study the process of environmental policy formation and implementation so as to determine the opportunities and constraints inherent in a sustainable development strategy. With the globalization of environmental problems, it is also beneficial to study the opportunities and obstacles for implementing the principles of Joint Implementation. Thus, this study seeks answers to the following research questions:

1. How has rational environmental management been promoted in China and how does this relate to Chinese development policy?
2. Is it feasible to have environmental policies that promote sustainable development in China's current reform setting and what are the constraints and opportunities inherent in this situation?
3. What is the promise and performance of the principle of *joint implementation* in China?

Study Objectives

This study has the following objectives:

1. To review environmental policy implementation process in the context of China's current political and economic setting.
2. To explore the constraints and possibilities of sustainable development in China.

3. To explore the relationship between China's central government and local government in a reformed political and economic environment.
4. To explore the constraints and opportunities for Joint Implementation.

This study is important in the following several respects. First of all, It helps people to learn about environmental protection effort and environmental policy implementation process in China. This study will also provide people a better understanding of China's current environmental condition and the opportunities and constraints of sustainable development. Through this case study, the unique and complicated institutional setting of Chinese politics is revealed. Therefore, it will add to the literature of organization theory and policy implementation theory. Finally, since the case study is about a joint research effort of an international support team and Chinese government on an environmental project, it will also shed light on implementing Joint Implementation.

STUDY DESIGN

The Yunnan Biomass-to-Electricity (BTE) Case

This study is an in-depth study of the Yunnan Biomass-to-Electricity (BTE) Program. The BTE program in Yunnan province is an excellent case for studying China's economic and environmental policies as they relate to sustainable development.

In 1989, the Yunnan BTE program started with locating renewable energy projects to promote economic development of rural areas in Yunnan Province. The BTE sites are scattered in southern and northern Yunnan, which suffered a chronic shortage of electric

power. The use of renewable biomass as feed stock for power plants also made this effort a legitimate environmental program. By combining energy production and environmental protection, the BTE projects serve both the environmental and economic needs of the local regions. Therefore, the Yunnan BTE program can serve as a model of sustainable development. Furthermore, since the BTE program in Yunnan has been a *cooperative* research effort involving Chinese and American institutions, it also provides an opportunity to study and assess international joint policy implementation efforts.

These BTE projects, which use the residues of the *retired* rubber trees and other biomass as fuel sources to generate electricity for the local areas that suffered from insufficient power supply, brought hope of sustainable development to Yunnan Province. The lack of electricity has greatly hindered the economic development in this region. These projects, by using renewable biomass as feedstock, can generate relatively cheap electricity to sustain local development, and they protect the environment through properly managing what is ordinarily considered *waste*.

Key Factors

In this case study, we expect to identify the key factors, both constraints and opportunities, that affect the implementation of the BTE program. We explore the role of environmental policy and the relationships among various relevant Chinese and American institutions and actors involved in the BTE program. Through the careful examination of these factors, and their roles in the process, we establish which facilitate and inhibit

program implementation. Finally, we gain vital information as to the kind of environmental policy and institutional settings affect program success.

Figure 2.1 shows the key factors that may affect the BTE program. As the figure shows, there are two sets of factors that may affect the Yunnan Biomass-to-Electricity Project. The set on the right is pushing the project forward, and the set on the left is holding the project back. Local area economic development is a factor that might work either way. Policy makers can solely determine some factors in the left set, such as the preferable policies for renewable energy and incentives for decision-makers to take risks for environmental projects. Of course, factors such as competitive energy sources and technology are beyond the control of environmental policy makers.

In this case, environmental policy plays an important role for the actual implementation of the Yunnan Biomass Project. The case shows that a renewable energy project that promotes sustainable development, such as the Yunnan Biomass Project, is essential for the economic development for the local areas. We could also foresee that renewable energy projects that promote sustainable development are possible if some of the counter-factors are removed by implementing the appropriate environmental policy. In this case study, we seek to determine which key factors (both constraints and opportunities) seem most to affect the implementation of such projects. Particular attention is paid to the role of environmental policy as a factor conditioning project design and implementation. Finally, we search for the policy means that will support sustainable development in China. Figure 2.1 shows the key factors that may affect the results of BTE projects in Yunnan. There are two sets of factors that may affect the Yunnan

Biomass-to-Electricity Project. The set on the left consists of positive factors that *facilitate* the project. The set on the right comprises the factors that *hinder* the project. The factor of economic development of local areas can be on either side. Policy makers can solely determine some factors in the right set, such as policies for renewable energy and incentives for decision-makers to take risks. Of course, factors such as competitive energy sources and technology are beyond the control of environmental policy makers.

Renewable energy programs, such as the one in Yunnan, that promote sustainable development are essential for the economic development for local areas. We could also foresee that renewable energy projects that promote sustainable development are possible if some of the negative factors are removed by implementing the appropriate environmental policy.

Among the factors listed in Figure 2.1, some will play essential roles in any environmentally sound program. Some are only important for this particular program. Therefore, the selection of these factors is based on both the general understanding of related literature and the site-specific information of this particular case.

The factor of scientific and financial support of international entities plays a very important role for the initialization of the project. But it might not be fit all the environmentally sound projects. Available technology and equipment will play a positive role in any environmentally sound project. The factor of local environmental organization's support is rather case specific. The Yunnan Institute of Environmental Science (YIES), together with the Joint Institute for Energy and Environment (JIEE), plays a very critical role for initiating and moving this project forward. On the other hand,

the factors of environmental degradation and environmental awareness are important factors for carrying out any environmental project.

The factors on the right are all universal for environmental projects except for the factor of other competitive sources of energy. The competitive energy source in this case happened to be hydroelectric power, which is relatively cheap to produce. Also, people in Yunnan were more familiar with the technology of hydropower generation.

The factor of economic development always plays an essential role in any developmental project. In this case, the factor has played both a positive and negative role. It was the demand of local economic development that gave a head start to the project. On the other hand, it was the pursuit of short-term economic gain by local decision-makers that prevented the project from moving forward.

The organizational setting within which the project was designed and implemented is an essential factor. Hopefully, this factor facilitates any project--but it is always a potential impediment as well. It proved both in this case.

Case Design

According to Yin, there are five major research strategies: experimental, survey, archival analysis, history and case study. Each is a different way of collecting data and analyzing empirical evidence, following its own logic. And each strategy has its own advantages and disadvantages (Yin, 1994).

A common misconception is that the various research strategies should be arrayed hierarchically. For example, people tend to believe that case studies were appropriate for

the exploratory phase of an investigation, that surveys and histories were appropriate for the descriptive phase, and that experiments were the only way of doing explanatory or causal inquiries. Yin argues that this hierarchical view is incorrect. The more appropriate way to view of these different strategies is a pluralistic one. Each strategy can be used of all three purposes-exploratory, descriptive, or explanatory. There may be exploratory case studies, descriptive case studies, or explanatory case studies (Yin, 1994: 5).

There are three conditions that determine what research strategy should be chosen among others. The conditions, according to Yin, are the type of research question posed, the extent of control an investigator has over actual behavioral events, and the degree of focus on contemporary as opposed to historical events (Yin, 1994).

The nature of the research question and objectives in this study requires the use of a qualitative method, specifically an exploratory case study. It aims primarily at discovering and generating ideas, rather than explicitly testing hypotheses. The case study method is widely used to study policy implementation. "Case studies do not lend themselves to broad theoretical generalizations, but they do often point to factors that must be considered the development of a theory" (Palumbo and Harder, 1981: xii). This study is conducted in a form of single case study design. The rationale for using this case is justified by two reasons. First, it is a unique and critical case in the implementation of sustainable development. Second, this case has not previously been investigated in this manner. Therefore, the descriptive information alone is revelatory. The unit of analysis is the biomass-to-electricity project, although different entities of the project will be examined.

The case study design is preferred when the purpose of the study is to address questions of “how” and “why” a certain contemporary phenomena occurs in an environment over which the investigator has little control. Thus, Yin defines the case study method as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. The case study as a research strategy comprises an all-encompassing method-with the logic of design incorporating specific approaches to data collection and to data analysis. In this sense, the case study is not either a data collection tactic or merely a design features alone but a comprehensive research strategy (Yin, 1994: 13).

While the experimental design has greater advantage because of the high level of control over the context or environment, by necessity, it deliberately divorces a phenomenon from its context so that attention can be focused on only a few variables. In contrast, the case study method does not divorce phenomenon from its context. Actually, its advantage is that a contemporary phenomenon can be investigated within its real-life context. In addition, case study design is advantageous for explanatory research because it allows vital operational links to be traced over time. A case study can also be the preferable strategy where preliminary information about a phenomenon needs to be gathered, with the purpose of using such information to generate hypothesis to be tested in larger studies.

While the case study method has proved to be a distinctive form of empirical inquiry, some scholars continue to view it as a less desirable form of investigative inquiry, as opposed to experiments or surveys. This is because it is viewed as lacking in rigor, and

due to its putative difficulty in achieving objectivity. Another methodological shortcoming commonly cited is that case studies provide little basis for scientific generalization. In response to this criticism, Yin argues that just as it is difficult to generalize from a single case, it is also difficult to generalize from a single experiment. In reality, scientific findings are rarely based on a single experiment; rather they are based on a multiple set of experiments, which over time have replicated the same phenomenon under controlled conditions. Likewise, case studies can be generalized to theoretical propositions, although not to populations.

According to Yin, data collection for case studies can rely on many sources of evidence: "Evidence for case studies may come from six sources: documents, archival records, interviews, direct observation, participant-observation, and physical artifacts" (Yin 1994, 78). In qualitative studies, data are in the form of words, sentences, and paragraphs rather than numbers. Analysis proceeds by extracting themes or generalizations from evidence and organizing data to present a coherent, consistent picture. "Qualitative researchers," according to Neuman, "emphasize the importance of social context for understanding the social world. They hold that the meaning of a social action or statement depends, in an important way, on the context in which it appears" (Neuman, 1997: 331).

For these reasons, the case study method was selected as the most appropriate approach for this research. The conditions that make the case study design the most appropriate research design indeed exist in the Yunnan Biomass-to-Electricity (BTE) case. First, the initiation and development of the Yunnan BTE program has been well

documented by the Joint Institute for Energy and Environment (JIEE) in the U.S., and by the Yunnan Institute of Environmental Science (YIES) in China. Therefore, comprehensive and accurate documents and archival records of the case are available. Second, this case, to a great extent, is an ongoing project. The participants in this project can be reached for participant-observation information. Third, the author was personally involved with the program. This made direct observation and participant-observation information readily available. Therefore, this study uses documents, archival records, interviews, direct observation, and participant-observation as sources. The case study covers a time period of nine years (1989-1998).

This case study is justified for its basic revelatory function of describing the state of China's sustainable development in the 1990s. Also, it is indeed a pioneer endeavor in the realm of environmental protection. It will give policy makers as well as the public a better understanding of the arguments, problems, and prospects for designing and implementing sustainable development in China.

Limitations of the Study

The main advantage of the case study methodology is that it can be used to examine not only what happened, but also why certain events took place in the way they did. This contrasts with survey research and statistical methods, which can answer question related to who, what, where, how many and how much, but are limited in their ability to answer *how* and *why* questions. People choose the case study approach because it allows in-depth analysis of causal relationships and organizational motivations, strategies, and interactions.

Case studies are especially valuable for explaining outcomes and identifying causal relations. This is important for an analysis that focuses on organizational interactions in the context of policy implementation. The case study method, of course, has important limitations. The ability to generalize results is limited because only a small number of cases can be examined within the constraints of the research. In this research we had, unfortunately, to restrict the number of BTE program projects studied. Constraints on time and resources compelled this. Further, in order to do a *thorough* study of the demonstration projects, a focus on a few important sites was required.

Since this research is conducted as a single case study, it suffers the inherent limits of all case studies. A case study suffers from the problem of *external validity*. Although the case study method is widely used to study policy implementation, case analysis does not lend itself to broad theoretical generalization. But the power of case study method is its exploratory nature and its potential to open the way for important discoveries.

As a qualitative study, the research process is subject to certain limits. Qualitative studies are usually rich in context and detail. The rich context and detail may lead to codification and subsequent interpretation difficulties. Since this is a single case study, it is definitely subject to such weakness. In qualitative studies, research procedures are particular and replication is rare (Neuman, 1997). The biomass-to-electricity program in Yunnan is a single case. The outcome of the case can be affected by a multiplicity of factors, some of which may well be unique. This requires caution in the interpretation of the findings and in the drawing of conclusions.

Case studies are sometimes criticized for yielding findings that are easily influenced by biased views. But, the danger of subjectivity is not unique to this methodology. It can also enter into the design of survey questionnaires and statistical studies. Regardless of the research approach selected, efforts must be made to minimize bias. In this study, assumptions are made explicit, multiple sources of information are used, and all related documents are carefully researched.

KEY CONCEPTS AND RELEVANT LITERATURE

This study employs several relatively new and controversial concepts. Thus, it should be helpful to review the definitions of these concepts. In considering the issues of environmental policy implementation and sustainable development in China, three bodies of literature are relevant: those of organization theory and policy implementation, the policy making process in China, development theory and sustainable development. Also, since the BTE projects received support, both scientifically and financially, and guidance from international entities, the related literature on Joint Implementation (JI) is also explored.

Environment

According to Caldwell, the environment is *whatever encompasses*. Specifically, it refers to the external and internal conditions affecting the existence, growth, and welfare of organisms. The environment, therefore, includes both that which *environs* and whatever is *enviored* (Caldwell, 1996: 13).

Public Policy

Policy is *a statement of goals that can be translated into a plan or program by specifying the objectives to be obtained*. Goals are far more general statement of aims than are objectives. The original sponsors of the policy or program may not have had a precise idea of the end results desired. Formal statements of objectives may be intentionally ambiguous if it is to obtain a consensus on action. Important groups may not share value judgments underlying the objectives (Shafritz, 1985: 410).

Public policy is *the web of authoritative decisions made by certain actors who serve as officials in a system of government*. This includes those individuals and groups who engage in the daily affairs of a political system and are recognized by most members of the system as having the responsibilities for formulating and implementing decisions. Their actions consistently are accepted as binding, most of the time, by most of the members of a polity as long as they act within the limits of their official roles. There are essentially two kinds of literature on public policy. One is process oriented and attempts to understand and explore the dynamic social and political mechanics and relationships of how policies are made. The other is basically prescriptive and attempts to examine how rational analysis can produce better policy decisions (Shafritz, 1985: 453).

Environmental Policy

Environmental policy is *a public policy made for the protection of environment*. Unlike many other public policies, Environmental policies are fairly new. In the U.S., during the 1970s, in what was known as the *Environmental Decade*, it became evident that if the nation was going to improve the quality of environment a new legal frame work

would be necessary. Thus, landmark legislation was passed dealing with most forms of pollution, endangered species, wilderness, and strip mining. Then, many countries, including some developing countries, followed the U.S. model and made their own environmental policies to protect the environment. Now, environmental policies are more popular than ever. Many countries have made environmental protection as one of their national goals.

Policy Implementation

The literature on policy implementation is relatively new but rapidly growing. Policy implementation from the perspective of Pressman and Wildavsky (1973), is a process of interaction between the setting of goals and actions geared to achieving them as well as an ability to forge subsequent links in causal chain as to obtain the desired results. Eugene Bardach (1987) holds that implementation is a process of assembling the elements required to produce a particular programmatic outcome. Meanwhile Charles O. Jones (1984) maintains that implementation consists of those activities directed toward putting a program into effect. This involves interpretation the translation of program language into acceptable and feasible directives.

Each of these definitions tends to highlight a somewhat different and important aspect of the process. The first definition calls attention to the interaction between setting goals and carrying them out. The second definition's portrayal of implementation as the playing out of inter-related games appropriately directs attention to the strategic aspect of the process. Implementation involves administrators, interest groups, and other actors with diverse values, mobilizing power resources, forming coalitions consciously in

strategic behavior designed to assure that their point of view prevails. A major virtue of Jones' definition is that it explicitly points to the role of routine and other aspects of organizational structure in implementation. In order to conserve time and energy, reduce the burdens of calculation, promote equal treatment of clients, and accomplish related function; organizations develop standard operating procedures. Any effort to comprehend how implementation processes affect program outputs and outcomes can not, then, ignore the collective impact of countless procedures and simple decision rules.

A large volume of literature in the West has been devoted to understanding the policy implementation process. This literature is different from the literature on organization theory in that it focuses predominantly on public sector organizations, is explicitly concerned with implementation, and views obstacles to implementation as related to factors other than internal organizational constraints—although organizational constraints are considered, too.

According to Switzer, the policy process follows a sequential pattern of activity that can be defined as follows:

1. Problem identification and agenda formation: Policy issues are brought to the attention of public officials in variety of ways. Some are uncovered by the media; others become prominent through crisis or scientific study. Organized groups may demonstrate or lobby officials to focus attention on the problem, or may enlist celebrities to bring it to government's attention on their behalf.
2. Policy formulation: After a problem is identified as worthy of government attention, policymakers must then develop proposed courses of action to solve it. Groups may participate in this stage as well, lobbying officials to choose one alternative or proposal over another.
3. Policy adoption: The acceptance of a particular policy is a highly politicized stage that then legitimizes the policy, often involving legislation or rule making. This is often referred to as the authorization phase of policymaking.

4. Policy implementation: To put an agreed-upon policy into effect, this fourth stage involves conflict and struggle as the administrative machinery of government begins to turn. Affected groups must now turn their attention from the legislative arena to the bureaucracy and, in some cases, the judicial branch to get the policy to work.
5. Policy evaluation: An ongoing process, this stage involves various determinations as to whether or not the policy is effective. This appraisal may be based on studies of program operations, systematic evaluation, or personal judgment, but whatever the method, the evaluation may start the policy process all over again (Switzer 1994: Prologue).

As a whole, this literature views policy implementation as dependent upon one the three variables: (1) the content of the policy implemented; (2) the institutional structures or mechanisms used to implement the particular policy; and (3) the context in which policy implementation efforts takes place.

Those who argue that policy content is the critical factor affecting policy success have pointed to such thing as the complexity of a policy, the clarity of policy edicts, the link between theory and practice, the time frame for achieving policy objectives, the types of goods or services to be delivered by a policy, and the inclusiveness of various interests in policy mandates, as factors which can lead either to poor implementation on the part of the policy enforcer or poor incentives for compliance on the part of the policy target (Mazmanian and Sabatier, 1983).

Those who have emphasized institutional structures for policy implementation have pointed to a variety of organizational features as essential: the number and caliber of the personnel staffing the implementing organization, the financial and other resources of

that organization, the institutional status of the organization, and the existence of an organizational mission (Lipsky, 1980).

Finally, some have emphasized the importance of the context in which a policy is implemented as a major influence on implementation. Within context, scholars include such things as the multiplicity of actors at the local level, the type of political system in which the policy is being implemented, cultural features of the political system, structural features of the political system, and the strength of the state (Migdal, 1988). In studying the implementation of the Yunnan Biomass-electricity program, policy context is an especially important factor. While emphasizing the policy context of policy implementation, this study leans more to the definition given by Bardach. *Policy implementation is a process of assembling the elements required to produce a particular programmatic outcome.*

Organizational Theory

Organizations or institutions are central to sustainable and beneficial economic growth. They create the policies, mobilize and manage the resources. Organization Theory literature as a whole focuses mostly on business organizations or firms (as opposed to public sector organizations) and is interested in understanding a range of behaviors, most notably, decision-making. Although little of this literature directly addresses the issue of policy implementation, it nevertheless provides a general framework for thinking about organizations.

What emerges from the organization theory literature is an understanding of the internal complexity of organizations and a strong sense of the different stages of an organization's life cycle. Organization theorists stress the ambiguity of goals in an organization; they point to routines and organizational missions as means of overcoming this ambiguity and achieving action; they emphasize that such routines and organizational missions do not exist automatically but develop over time.

Organizations are often observed to do nothing to implement a decision after having devoted much time, energy, and enthusiasm to making it; or to make apparently major decision with only minor participation by key administrators and significant constituents; or to combine a struggle over participation rights with an indifference to exercising them; or to make argument over ideology without affective action; or to separate the outcome of a major political dispute from the details of the political process involved (March, 1976: 10).

The organization theory literature thus implies that new organization will face internal obstacles which constrain action and will require resolution before policy implementation can be institutionalized (i.e., before policy can be routinely implemented). Applied to the case of Yunnan's biomass-to-electricity program, the literature is suggestive on two fronts: first, that there may be time lags in implementation until China's environmental protection apparatus reaches organizational maturity; second, that China's environmental protection apparatus is likely to adapt over time so as to overcome internal organizational constraints to action. A policy of sustainable development is new to related

organizations that are responsible for implementation. Therefore, it may take some time before implementing pioneering projects such as the Yunnan BTE program.

Sustainable Development

Since the concept of *sustainable development* was first introduced, it has been approached from many viewpoints without a concise or precise definition of exactly what it encompasses. The matter is made even more complicated when scholars attempt to define sustainability.

The modern idea of sustainable development was formed in late 1970s. Coomer (1981) defined the *sustainable society* as one that lives within the self-perpetuating limits of its environment. That society is not a “no growth” society. It is rather, a society that recognizes the limits of growth and looks for alternative ways of growing. Allen (1980) argues that sustainable development is a development that is likely to achieve lasting satisfaction of human needs and improvement of the quality of human life.

The most frequently cited definition of sustainable development appears in a report issued by the World Commission of Environment and Development in 1987. According to this report:

[Sustainable development is the] ability of humanity to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are made consistent with future as well as present needs (World Commission on Environment and Development, 1987: 32).

Since this definition of sustainable development appeared many other definitions and explanations of sustainable development have been developed. Goodland (1991)

defines sustainable development as a pattern of social and structured economic transformations, which optimizes the economic and societal benefits available in the present, without jeopardizing the likely potential for similar benefits in the future. A primary goal of sustainable development is to achieve a reasonable and equitably distributed level of economic well being that can be perpetuated continually for many human generations.

Sustainable development implies using renewable natural resources in a manner which does not eliminate or degrade them, or otherwise diminish their usefulness for future generations. Sustainable development further implies using non-renewable mineral resources in a manner, which does not unnecessarily preclude easy access to them by future generations. Sustainable development also implies depleting non-renewable energy resources at a slow enough rate so as to ensure the high probability for an orderly society transition to renewable energy sources.

The definition of sustainable development and sustainable principles issued by the Center for Policy Alternatives (1993), are provided in Table 2.1.¹ Sustainable development is a vision--a set of principles--for policies, relations, and behaviors that take time and require institutional changes. This study defines sustainable development *as the ability of humanity to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs*. Sustainable development is not a fixed state of harmony, but rather a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and

¹ All tables are in Appendix A.

institutional changes are made consistent with future as well as present (World Commission on Environment and Development, 1987).

The New Environmental Paradigm

Sustainable development entails a new way of thinking. The conventional way of thinking, what has been called *the dominant social paradigm* (DSP) was generated in European cultures and has become so manifestly "successful" in overpowering other cultures that the premises underlying it currently shape public discourse all around the planet (Smith, 1992: 7).

Recent scientific understanding as to how natural systems work, however, challenges many of the premises underlying modern industrial society. Environmentalists have adopted this new perspective on natural systems and apply it to a *New Environmental Paradigm* (NEP). Most of the rest of society, especially the leaders of its dominant institutions, still follow the conventional premises underlying the DSP (Smith, 1992: 7).

Human beliefs and values shape much that humans do; but we humans cannot repeal or alter the laws of physical systems. If we wish to survive, the only viable choice is to act in accordance with the imperatives of Earth's natural systems. The key imperatives concerning natural systems that govern human behavior, and that underlie the NEP, are listed below:

1. Biogeochemical patterns do change. Humans inadvertently can, and are changing them.

2. These systems constitute a web of life that is interlocked and highly complex. Human-induced perturbations can produce chaotic behavior in earth systems.
3. Species diversity is essential for ecosystem stability.
4. Earth is a semi-closed system in which space and resources are finite.
5. All creatures, plant and animal, seek organic maturational growth and development.
6. Growth in populations of reproducing species is exponential when unchecked. Since persistent doubling is impossible, given finite limits, population growth must be limited.
7. Most animal species survive by finding a niche, utilizing support from one or more other species. Cooperation not competition is the key to survival (Pirages ed., 1996: 277).

Based on the new environmental paradigm (NEP), the definition of genuine wealth has a much wider meaning than that of conventional thinking. The components of genuine wealth in this perspective are:

1. The societal provision of essential goods to all;
2. a mode of production that creates "right livelihoods" for all;
3. the use of material goods as a springboard to qualitatively enriching human spiritual nature;
4. the pursuit of material goods in function of their capacities to nurture life and enhance being rather than having;
5. a primacy given to public wealth, which fosters, more than do personal riches, the common good (Pirages, 1996: 193).

Economic Development

No less diverse than definitions of wealth are the multiple notions of development in circulation. No consensus exists as to how development should be defined, what its goals are, and what strategies should be adopted to pursue it. Economist Keith Griffin evaluates six development strategies: monetarism, open economy, industrialization, green revolution, redistribution, and socialism. He assesses empirical results yielded by each strategy in different countries on six dimensions: (1) resource utilization and income level; (2) savings, investment, and growth; (3) human capital formation; (4) poverty and inequality; (5) the role of the state, and (6) participation, democracy, and freedom. The inconclusive results found in the literature led Griffin to conclude that there is no best path to development (Griffin, 1989).

Other scholars supported Griffin's conclusion. Goulet points out:

There undoubtedly exists no single best path to development, applicable everywhere and at all times. Moreover, each development paradigm and strategy admits of countless variations. Although ultimately each society must create its own model of development, it nonetheless seems possible to subsume all known strategies and paradigms under four distinct general orientations (Goulet, 1996: 193).

Growth strategists aim at maximizing aggregate production so as to create a bigger economic pie. The way to create wealth quickly is to marshal domestic savings to the maximum or, if these are insufficient, to obtain foreign capital in some form (investment, loans, and grants) and apply it to productive investment. Rapid growth comes not only from widening the base of productive assets, but also from greater

productivity in utilizing factors of production. Therefore, great emphasis is placed on incorporating modern technology, the single greatest multiplier of productivity.

Other Attributes of Traditional Views of Economic Growth

Those concerned with defining and promoting economic growth have focused on a variety of additional attributes such as *redistribution*, *human needs*, *departure from tradition*, and *maldevelopment*.

Redistribution

Advocates of “redistribution with growth” argue that distributive justice—the elimination of great inequities in wealth—cannot result from trickle-down processes or even from corrective welfare policies (Goulet, 1996). Equity has to be planned as a direct objective of development strategy. Accordingly, they seek to maximize economic growth but to optimize it in the light of equity objectives. Within this paradigm, investments in education, job creation, health, and nutrition are treated not as consumer goods but as productive investments. Nutritious food and good health services add productive wealth to the nation’s workforce, leading to decrease in idleness caused by illness or absenteeism and to increases in economic demand among the poor classes. Champions of this approach contend that a high level of growth is compatible with equitable distribution.

Basic Human Needs

The basic-human-needs strategy goes beyond the redistribution model by specifying the quantifiable content of equitable redistribution. The primary task thus

becomes neither to maximize nor to optimize aggregate growth, but to satisfy the basic needs of those segments of a nation's population that lie under some poverty line. Basic needs include goods and services relating to nutrition, health, housing, education, and access to jobs. The basic-human-needs paradigm does not assume that equity is necessarily compatible with high rates of economic growth. Even under the basic-human-needs formula, however, the ultimate goals of development are accepted as being those endorsed in the first two strategies—economic welfare for large numbers of people, technological efficiency, and institutional modernity. The best means to achieve these goals is to use scarce resources primarily to provide for the poorest (Goulet, 1996).

Development from Tradition

Development from tradition departs radically from the three pathways just outlined. Its central premise is that not only the means of development but its goals are not to be borrowed from countries already *developed*: any such mimetic development is spurious and distorted. In “development from tradition,” the goal of development suited to a particular society should be sought within the latent dynamism of that society's value system: its traditional beliefs, meaning systems, local institutions, and popular practices. Given that culture, understanding should relate to the forces of the cosmos, certain ideal images of the good life and the good society emerge. Although modern ideas, behavior, and technology are not repudiated on principle, they are critically judged to determine whether or not they contribute to the sound development of individuals and communities as defined by the traditional values system (Goulet, 1996).

Maldevelopment

Development, to some, is an irresponsible, inequitable and destructive force that worsens the lot of poor people. The late Swiss anthropologist Roy Preiswerk judges that processes of change have led to "maldevelopment" in rich and poor countries. The most absolute attack, however, comes from those who totally repudiate development, both as concept and as project. Serge Latouche, the French economist, urges us to discard development because it is a tool pursued by advanced Western countries to destroy the cultures and the autonomy of nations throughout Africa, Asia, and Latin America (Pirages, 1996).

Sustainable and Authentic Development

The decision to pursue development confronts a society with three fundamental ethical questions:

1. What is the relationship between the enough of good and the excess abundance of good?
2. What are the foundations of justice in and among societies?
3. Criteria ought to govern the posture of societies toward the forces of nature and of technology.

Development generates multiple value conflicts over the meaning of the good life. In Ursula K. Lee Guin's science fiction novel *The Dispossessed*, two models of the good life vie for the loyalties of people. One model prizes collaboration friendship, health, and a high degree of equity, achievable in an austere communitarian regime of disciplined

resource use. The other prizes material comfort, individual selfishness, and competition, with its resulting inequities, and depends on abundant resources.

A second value conflict concerns the foundations of justice in society. Should justice rest on inherited authority, on the rule of the majority, on a social contract? Are political rights and individual freedoms to be given primacy over collective social and economic rights aimed at assuring that needs are met and that society's common good is served? Do human rights have a purely instrumental value, or are they ends in themselves, worthy for their own sake?

A third set of value conflicts centers on the criteria a society adopts to frame its stance toward nature. Is nature to be viewed simply as raw material for exploitation by humans, or as the larger womb of life in which humans live, move, and have their being, and whose rhythms and laws they must respect? Should the human stance toward nature be extractive and manipulative or harmony seeking.

Providing satisfactory conceptual and institutional answers to these three questions is what constitutes authentic development. It follows, therefore, that not every nation with a high per capita income is truly *developed*.

One illuminating formulation of the components of authentic development is that made by L.J. Libretto, founder of the *Economy and Humanism Movement*. Libretto defines development as "the series of transitions, for a given population and all the subpopulations which comprise it, from a less human to a more human phase of existence, at the speediest rhythm possible, at the lowest possible cost, while taking into account all

the bonds of solidarity which exist (or ought to exist) amongst these populations and subpopulation.”

Therefore, an adequate definition of development must include the following dimensions:

1. An economic component dealing with the creation of wealth and improved conditions of material life, equitably distributed.
2. A social ingredient measured as well being in health, education, housing, and employment.
3. A political dimension embracing such values as human rights, political freedom, legal enfranchisement of persons, and some form of democracy.
4. A cultural element, in recognition of the fact that cultures confer identity and self-worth to people.
5. Ecological soundness, understood as a mode of extracting, using, and disposing of resources that safeguards and revitalizes nature so as not to deplete it irreplaceably, poison it, or damage its life-restoration powers.
6. A final dimension one may call the full-life paradigm, which refers to meaning systems, symbols, and beliefs concerning the ultimate meaning of life and history (Pirages, 1996).

For any society, authentic development means providing optimal life-sustenance, esteem, and freedom to all its members. Therefore, the destruction of life-giving resources, the irreversible violation of nature's environments, and the indiscriminate adoption of technologies that destroy human freedom constitute destructive development, not creative development. Spurious development breeds opposition, contradiction, and self-destruction: it cannot be sustained.

Sustainability must be assured in five domains: economic, political, social, environmental, and cultural. Long-term economic viability depends on a use of resources

that does not deplete them irreversibly. Political viability rests on creating for all members of society a stake in its survival: this cannot be achieved unless all enjoy freedom and inviolable personal rights and believe that the political system within which they live pursues some common good and not mere particular interests. Environmental sustainability requires the maintenance of abundant diversity of life forms and biosystems, a restorative mode of resource use and disposal so wastes will be within nature's absorptive limits.

Sustainable authentic development is probably incompatible with present world order, with prevailing patterns of consumption, with the regnant development paradigm, and with existing configurations of competitive global resource use. It may prove to be possible only if profound transformations occur in precisely these arenas: world order, patterns of consumption, and patterns of resource use.

Is sustainable authentic development compatible with a global economy? The philosophy inherent in these accords is directly opposed to the idea of sustainable economic development promoted in Rio. Neoliberal free trade policies are being pushed by a worldwide corporate elite bent on defining the environment as a trade barrier expressed in dollars. Governments have abetted this transformation by forging agreements that ensure a nation's powerlessness to defend itself against commercial activities that harm its citizens or the environment.

Is authentic development sustainable? It may well be the only kind that can be. Authentic development, however, is monumentally difficult—difficult to desire, to

implement, to sustain. Here precisely lies the challenge: sustainable development must not remain untried simply because it is found difficult.

Although sustainable development is extremely difficult to achieve, it is the only way that can lead China out of the current environmental awkwardness. It is apparent that environmental unconscious development will eventually lead to environmental disasters. On the other hand, a stagnation of economic development may not further harm the environment, but it can not remedy the already damaged environment either. In addition, stagnation may also lead the decline of living standard and social unrest. Therefore, it is simply impractical. Nevertheless, there is still one last option that may improve the environment as well as people's life. That is sustainable development.

To reach the goal of sustainable development in China is an arduous task. It will take a concerted effort of the whole society to reach the goal (see Figure 2.2). This means that all governmental policies and social doctrines must be geared to both environmental protection and economic development. First of all, we need to develop a social paradigm that promotes sustainable development. The social paradigm of excess consumption and waste should be gradually discarded. This is most difficult and critical hurdle that needs to be overcome on the way to sustainable development. Second, national policies such as economic policy, environmental policy and energy policy should all be geared to balance economic development and environmental protection. Only a well-balanced policy can promote sustainable development. Finally, a more sound institutional setting is also essential for achieving the goal of sustainable development.

Joint Implementation

Joint Implementation is a policy instrument of the Climate Change Convention, which was created at the Rio United Conference on Environment and Development in 1992. Joint Implementation, or Activities Implemented Jointly, is a new name for the concept: bring investment capital, advanced technology, and managerial experience to developing markets through business ventures that provide mutual economic and environmental benefits for all involved. Essentially Joint Implementation is a form of foreign aid and investment that supports sustainable growth (Joint Implementation Network, April 1996). Joint Implementation is efforts undertaken cooperatively between countries or entities within them to reduce net greenhouse gas emissions. Joint Implementation could potentially achieve greater emission reduction than might be possible if each country pursued only domestic actions, and could achieve these reductions more cost-effectively. Joint implementation may also spur technology cooperation-increasing developing countries' access to energy efficiency and renewable energy technologies while stimulating export markets for industrialized countries.

Although the Yunnan BTE projects started before the concept of Joint Implementation was officially raised, the idea behind the cooperative BTE research effort is very similar to the principle of Joint Implementation. Most of the Yunnan BTE projects were located on the borders between China and Laos, and Burma. Reduction of CO₂ emissions from the BTE projects would not only benefit China but also the neighboring countries and the world. We will further explore the JI characteristics of the BTE projects at the end of the study.

CHAPTER THREE

ENVIRONMENTAL POLICY FORMULATION AND IMPLEMENTATION IN CHINA

INTRODUCTION

The Western literature on the Chinese policy formulation process has been heavily influenced by the American-initiated implementation literature. Literature on the Chinese policy process developed approximately fifteen years after the appearance of the policy implementation literature. This occurred, in part, as a result of increased access to the local data made possible by China's open door policy.

Overall, this literature has echoed the broader implementation literature in its focus on content, institutional structure, and context as critical to policy outcomes. As a whole, however, the tendency has been to emphasize policy context over either content or mechanisms as most influential in the formulation of policy in China (Ross and Silk, 1987).

The meaning of *context* in the Chinese policy process has been identified—either explicitly or implicitly—in a number of different ways. Some scholars, for example, have identified “context” as the social norms that relate specifically to a particular policy; they have shown how policies can be most expediently implemented when norms exist to support these policies (Manion, 1993). Others have defined context as a political arena characterized by competing elite (at both the local level and the central level) who help shape policy content and in so doing reshape policy context.

Most authors writing about the policy formulation process in China, however, have viewed the Chinese policy context in systemic terms and have emphasized the general, yet

unique, structural features of the Chinese political system. The specific structural characteristics highlighted in this literature have been the Leninist planned economy, with its vertical cleavages, the decentralized administrative structure of the reforms, with its resulting fragmentation of the political-economic system (David Bachman, 1991).

The Policy Context Redefined: China's Reform Setting

The reform setting initiated in the late 1970s is best characterized as an economic, political, and ideological setting in transition. It is a setting in which emphasis on market-oriented growth is increasingly displacing state planning institutions originally intended to support socialism.

The policy setting is characterized first and foremost by its ideology (or value system). It is also identified by its economic and political structures, its norms, and its systemic features, which themselves reflect the ideology of reform. This ideology is best captured by the now famous 1983 slogan endorsed by Deng Xiaoping: "To get rich is glorious!" Under this slogan, everyone, individuals, enterprises, and government organs alike, have been called upon to promote China's economic development through a burgeoning *for profit* system.

In structural terms, the pursuit of the ideological goals of the reforms has meant that, while state-owned industry still plays a major role in the Chinese economy, and socialist accounting procedures still exist for this sector, many features of market economies have been introduced. These are increasingly the dominant features of the Chinese political economy. Specifically, the new structural features defining the

contemporary Chinese political-economy include: (1) the decentralization of profit retention and economic investment decisions to municipal governments and individual enterprises; (2) the expansion of private and collectively-owned industry to the point where these industries have now overtaken state-owned firms as the leading contribution to GNP, and (3) the application of economic incentive systems including markets, bonus systems and the contract responsibility system. The result of these structural changes has been a vast increase in financial powers for the local government *vis-à-vis* the central government, which is marked increase in the ability of local governments to determine how money earned in their locale is to be used.

Amidst these major changes, certain structural features of the Chinese system before reform have remained intact or are only slowly being dismantled. Most notably, state-owned industries and enterprises have continued to play an important, if diminishing, role in the economy. For this sector, not all the vestiges of the planned economy have disappeared.

In the political/administrative arena, the reforms have meant structural changes as well. Less glamorous than the startling economic reform China has undergone, administrative reforms have nevertheless been quite significant for the government officials involved. These administrative reforms are designed to support the economic reform by creating a more efficient and well-educated bureaucracy. Young people with little political background have been promoted to important positions. Job positions for government officials have been reshuffled, and professionals and experts have replaced

politically appointed cadres. The reform setting may hinder the implementation of policy due the conflict between career politicians and the new cadre of technocrats.

In addition to the economic and administrative structural reforms undertaken by the Chinese government, attempts have been made since the later 1970s to alter systemic norms to further support the economic goals of the reforms. To be sure, the Chinese political system is still largely a system of *rule by the individual* rather than *rule by law*. As a result of the reforms, however, China's legal institutions and codes have been vastly expanded and a strong web of legal norms has begun to develop.

A final systemic feature of the reform setting is China's integration into the global market. Unlike the pre-reform period, under the reforms, China has pursued an open door policy of commercial and cultural exchange with the West. This is aimed largely at promoting domestic economic growth. With Chinese policy now intentionally crafted to allow participation in the global market system, international factors have substantial influence on Chinese society and its development path. In the early 1970s, the Chinese expressed their determination to eschew the *treatment after pollution* path to development that had characterized the West. But, China's recent responsiveness to the global market setting has led it increasingly in the direction of Western style economic development with its attendant environmental degradation. In sum, the reform setting has been a transitional stage in which market ideals have increasingly shaped the evolution of China's economic and administrative structures, its systemic norms, and its relations to the global economy.

The Effect of the Reform Setting on Policy Implementation

First, the reform setting has provided incentives for policy targets and local government officials to evade environmental policies. Fiscal decentralization to local government and enterprises, along with local-level profit retention policies, have produced local leaders and factory managers whose primary interests lie in profit-earning ventures. Factory managers have viewed EPB demands that firms put money into environmental protection as a drain on limited investment funds and on worker bonuses; Local government leaders have seen these EPB requests as an infringement on local tax revenues and finances. As a result, both factory managers and local government leaders have resisted environmental clean up, perceiving it to be in conflict with their moneymaking interests.

A second way in which the reform setting has affected the implementation of China's sustainable development can be traced to the administrative reforms undertaken to reduce the size of the China's bureaucracy and professionalize it. In some areas of the country, frequent personal changes (predominantly of those in leadership position) and organizational restructuring brought about by these reforms have disrupted nascent enforcement routines. In a political system characterized by the importance of personal relationships for getting things done, the impact of personnel rotations has in some cases instantly obliterated the significant strides in policy compliance made between and EPB officials and factory managers. The administrative reforms have adversely affected environmental protection efforts in another way as well. Over the course of the 1980s and

early 1990s, EPBs had developed a few highly effective administrative means to overcome obstacles to implementation. Reforms in the 1990s, aimed at undoing the remaining links between government and industry left over from China's earlier planned economy, had begun to affect these administrative means.

In many ways then, the reform setting posed obstacles for the implementation of environmental policies. There are *benefits* from the change as well. The emphasis on technically trained cadres under the reforms greatly benefited the environmental protection apparatus. Effective implementation of environmental policies, after all, depends to a great degree on accurate assessment of the environmental problems and the identification of scientifically feasible solutions. The open-door policy with the West under reform facilitates environmental policy development. It provides access to expertise, experience, and technology previously unavailable. Finally, decentralization under the reforms has allowed for a great degree of experimentation with policy implementation procedures at the local level. As result, new and innovative means to deal with pollution have developed. These in turn are disseminated throughout the country, something far less likely to occur under the previous system.

In these respects, China's reform setting and its attendant ideology have had profound positive and negative impact on the implementation of environmental policy. If China is to make consistent progress, it is essential to maximize the positive impact, and minimize the negative, while promulgating environmental policies in the reform setting.

THE EVOLUTION OF CHINA'S ENVIRONMENTAL PROTECTION APPARATUS AND ENVIRONMENTAL POLICY

In China, environmental protection apparatus and environmental policy have experienced many changes in the past two decades. Table 3.1 lists the major events in China's environmental protection history. Although environmental protection started in the early 1970s, it did not effectively enter the national policy agenda until the end of the decade. In order better to understand the current environmental policy making process, it is necessary to review briefly the evolution of Chinese environmental policy and the development of its environmental protection apparatus. China began developing a system of institutions to implement environmental protection programs in the 1970s. The Environmental Protection Law of the People's Republic of China was promulgated in 1979. This legislation marked the beginning of a decade in which both regulatory programs and institutions for environmental protection expanded tremendously.

In the early years of environmental protection, environmental policies, regulations, and programs were developed in response to a wide range of environmental problems, including air pollution, water pollution, and solid waste disposal. Efforts were also made to protect drinking water sources and to establish nature preserves. The development of environmental regulation coincided with, and was influenced by, the economic reforms of the 1980s--especially due to the increased openness toward foreign countries. Some regulations were modeled on those of other countries, especially those of Western nations. For example, China's national water quality standards and environmental impact assessment process drew largely from experiences in the United States. The new system

of pollutant discharge fees was based on experiences in France and Germany. The climate of economic and political reform provided an opportunity for environmental policymakers to borrow from foreign regulatory approaches in a way that would not have been acceptable a decade earlier (Sinkule and Ortolano, 1995).

Although China drew from the environmental protection experience in other countries, the Chinese system, even under reform setting, remains to a large degree unique. Therefore, the *effectiveness* of these *adopted* environmental policies has, to a great extent, been very much in doubt. In the 1980s, the major Chinese environmental protection programs became collectively known as the “three magic weapons.” This referred to the development three initiatives: (1) environmental impact assessment; (2) the three synchronizations (this policy requires that design, construction and operation of pollution treatment facilities be coordinated with the design, construction and operation of the overall project), and (3) the establishment of pollution discharge fees. By the late 1980s, however, experience in implementing the *three magic weapons* revealed some of their shortcomings. This led the government to introduce five new systems for handling environmental problems. The systems include: (1) a discharge permit system; (2) an environmental responsibility system; (3) an assessment of urban environmental quality; (4) a centralized pollution control system, and (5) limited treatment time (setting deadlines for cleanup projects) (Sinkule and Ortolano, 1995).

Despite all the policies and regulations introduced to protect the environment, the *key* national agenda under the reform setting has been economic development. Since the reform started, the overall environment in China continued to deteriorate. Some major

environmental disasters, it is worth noting, were prevented by utilizing these regulations. For example, in order to protect the Huai River, the government ordered the closing of hundreds of small paper mills and tanneries that used to pipe polluted wastewater into the river.

After the United Nations Conference on Environment and Development held in Rio in 1992, the Chinese government adopted an environmental policy of sustainable development. Great efforts have been made to balance the relationship between economic development and the environmental protection. Jiang Zemin, general secretary of the Chinese Communist Party made the following comments in the Fourth National Conference on Environmental Protection:

Some comrades ignore the work of environmental protection. They believe that it is most important to develop the economy and environmental protection can be put aside at the moment. This view is incorrect and harmful. Many economically developed countries took the approach of serious waste of resources and "treatment after pollution," thus causing grave damage to the resources and ecological environment of the world. This is a serious lesson drawn from the development of the world. We should never take such an approach. Our economic and social development should be based on the optimization of the industrial structure and coordinated economic, social and environmental development. The objective facts proved that economic growth based on unchecked expansion of the scale of investment and arbitrary establishment of projects is undesirable, because the faster the growth rate is, the more resources are wasted, the more serious environmental pollution and ecological destruction are caused, and the weaker the sustainable capability of development is (*China Environmental Year Book*, 1996: 5).

In line with these concerns, this chapter examines the evolution of the environmental protection apparatus and the development of this organization's policies in the past two decades. The study finds that during the first several years of its existence, China's environmental protection apparatus was weak and its policies only vaguely

defined. Nevertheless, some minimal efforts at environmental protection were undertaken. Since Deng Xiaoping's ascension to power in the later 1970s, attention to environmental problems had increased noticeably.

By the mid-to-late 1990s, an environmental protection apparatus was in place. It established a position of authority throughout much of the Chinese administrative system. It achieved this through several means: (1) by building a well articulated institutional structure replete with environmental protection units throughout the Chinese political system; (2) by expanding the number of people staffing this institutional structure, and (3) by increasing the bureaucratic rank of this apparatus within the Chinese political hierarchy.

As the central and local environmental protection apparatus attended to institution building, the national environmental protection agency worked on developing precise environmental policy measures and laws. By the late 1980s, the myriad efforts to specify environmental policy content, and to develop a well-articulated institutional apparatus, led to a significant increase in the environmental protection apparatus's authority within the policy implementation setting. Prior to this, environmental policy implementation often occurred on a piecemeal basis. In the 1990s, however, environmental protection organizations throughout China have developed the modicum of authority necessary to attempt to implement policy in an institutionalized way.

Historical Review

The history of environmental protection policies in the People's Republic of China is not long. While certain reforestation campaigns were conducted during the 1950s and

1960s, and occupational health standards were adopted from the former Soviet Union in the late 1950s, it was not until the early 1970s that the Chinese government really began to consider environmental protection in a broader sense. Short as this time span has been, however, it is useful to divide China's environmental history into three periods in order to examine the development of the environmental protection apparatus' organizational authority. These are the periods from 1972 to 1979, 1979 to 1987, and 1987 to present.

During the first period, 1972-1979, China came to accept the existence of its environmental problem and to make initial steps toward developing an environmental organizational apparatus and environmental policy. But the environmental apparatus was underdeveloped and weak, and policy at the time was limited to point-source pollution and focused solely on individual, egregious polluters. The Environmental Protection Law was promulgated only toward the very end of this period and only at this time were efforts made to staff environmental protection units with more than a few individuals. During this period, environmental protection units were virtually devoid of authority.

Countervailing trends marked the second period, 1979 to 1987. Overall, central government's attention to environmental protection heightened as China began its reform phase of rapid economic growth, which launched in the late 1970s. Headway was made to establish a code of environmental protection laws. Policy mechanisms were devised, focusing on prevention and management. However, early in this period, the environmental protection apparatus also experienced a setback. This occurred when the general organizational reforms of 1982 forced environmental protection units to merge with construction commissions resulting in a loss of bureaucratic and effective authority for the

environmental apparatus. As a result, much of the energy exerted by Environmental Protection Bureau (EPB) officials during this period was aimed at surmounting this major organizational setback. For all these reasons, then, the period from 1979 to 1987 is best described as *authority building*.

The third period, from about 1987 to the present, marks the beginnings of organizational and legal maturity. It produced an expanded diffusion of policy and policy mechanisms. In this stage, throughout much of urban China, the EPB's authority became commensurate with serious attempts at policy implementation. Further, an appreciable level of policy institutionalization occurred, although the degree to which this transpired varied tremendously from place-to-place. A significant increase in the authority of the environmental protection apparatus occurred at the central level, and in several cities at the local level. As a result, this period is referred to as the *EPB Proto-authority Stage*. The National Environmental Protection Agency (NEPA) was established as a sub-ministry in 1988. In 1998, National Environmental Protection Agency changed its name to the State Environmental Protections Administration (SEPA) and was promoted to the ministry level.

In sum, a chronological examination of environmental protection efforts in China through the lens of these three historical periods reveals the development, over the course of two decades, of EPB bureaucratic, legal, and effective authority.

1970-1979: Environmental Organization Devoid of Authority

A common view among contemporary Chinese environmentalists is that under Mao's leadership the belief was that socialist countries would never experience environmental problems. Prior to the 1970s, environmental protection was neglected because people thought that *only* capitalism could produce pollution. In this view, capitalism produced selfish exploiters who would do anything to earn maximize profits. In fact, when the West began to experience serious environmental hazards, China was secretly happy that capitalist countries had developed these problems. They used these environmental problems as additional evidence to prove that capitalism is a doomed social system.

Even those who recognized the existence of environmental problems during the Mao period were unable to talk or act. As Qu Geping has summed up:

Those citizens who complained about environmental destruction during the Cultural Revolution and called for environmental protection were ignored. And those who commented about the environment were easily labeled as "painting socialism black" (Qu, 1989: 34).

During the last years of the Maoist period, environmental problems captured the attention of people in the government as well as of the public. While denial of environmental problems in socialist countries may have continued to exist among some elements of the populace, it is evident that awareness of environmental problems existed among a few individuals by the 1970s. At least one important leader was willing to address the issue then. That leader was the late Premier Zhou Enlai, one of the founders of the People's Republic of China.

Early Environmental Protection Efforts

China emerged from the radical phase of the Cultural Revolution (1966-1969) and began to interact more with the outside world just as the environmental movement in the West was getting underway. The coincidence of China's reemergence into the international arena and the advent of the Western environmental movement influenced the development of Chinese environmental policy.

A key actor in Chinese government in this regard appeared to have been then Premier Zhou Enlai. According to those active in the environmental sector in its earliest days, beginning in the late 1960s Zhou started to demonstrate an interest in environmental protection. He spoke of the problem when touring factories or attending important government meetings. The Premier also followed the environmental situation in industrialized countries so as to learn from foreign experiences. Former NEPA administrator Qu Geping recalls:

From 1970 on, every time there was a National Planning Conference, Premier Zhou Enlai would take the experiences of foreign countries as an admonition and propagate the importance of environmental protection, directing that it was necessary to bring pollution prevention and environmental protection into national economic planning. He also took advantage of opportunities attending other meetings and visits with people from all over the world to deal with environmental problems . . . and to describe the meaning of environmental protection. . . . In 1970, when Zhou met with a delegation of Japanese guests there was an environmental correspondent. He stayed up talking with the correspondent all night amidst the masses so as to understand Japan's environmental situation; moreover, he made this Japanese correspondent explain Japan's environmental situation and information about environmental protection to responsible Chinese leaders. This helped promote the development of our country's environmental protection work (Qu, 1989: 45).

In short, Zhou Enlai acted as the early patron of environmental protection policy in China. He promoted the issue of environmental protection among top government leaders and facilitated the first organized efforts to deal with environmental problems in China.

By the early 1970s, China, as the industrialized West and Japan before it, began to experience significant pollution problems. In Shanghai, particularly in the summer, Suzhou Creek was often black and putrid. Several coastal cities, including Dalian, had experienced severe losses of shellfish and sea urchin due to pollution caused by waste disposed the sea. In 1972, the capital itself felt first the effects of industrial pollution. That year pollutants in one of Beijing's two main reservoirs, the Guanting Reservoir, caused fish sold in Beijing markets to emit a peculiar smell. The strong public reaction that resulted from this incident prompted Premier Zhou Enlai to order an intra-provincial, multi-ministry investigation. This marked the first time that the Chinese State Council directly addressed the environmental pollution problem.

During the same time period, the first institutional efforts toward industrial pollution control in China were made with the formation of *Industrial Three Wastes Office*. In 1971 the Chinese central government's Commission on Basic Construction created the Three Wastes Office and began urging provincial and city governments and enterprises to do the same. Prior to this time, big cities, including Beijing, Shanghai, Shenyang, and Tianjin had all established Three Wastes Office. These offices were set up within municipal People's Revolutionary Committees (the governments during most of China's Cultural Revolution from 1966-1976) and in large polluting enterprises. Their function was to urge the reduction of waste in the production process through use of

recycling of solid, liquid, and gaseous waste products. However, these Three Wastes Offices typically consisted of only one or two persons and were therefore severely constrained in their effectiveness (Ross, 1988). Although in many Chinese cities the Three Wastes Offices were the precursors of Environmental Protection Offices (which began to appear in 1974), many observers within the Chinese environmental protection community feel that China lacked any true environmental protection apparatus before 1974. To understand fully why many environmental policy scholars date the formation of environmental protection policy in China to 1973/1974, we must first understand an important international event that took place in 1972.

The Stockholm Conference and its Repercussions

The catalytic event that caused the Chinese Government to really begin to consider environmental protection in a broad sense was the June 1972, United Nations sponsored Stockholm Conference on the Human Environment. China, which had been admitted to the UN as a member only months before, was an active participant. Like many of the Third World countries in attendance, the Chinese viewed the Western-initiated global environmental movement with a degree of suspicion, seeing it as a First World means to suppress development in the Third World.

In a speech to the plenary session of the Stockholm Conference, Chinese Delegation leader, Tang Ke, stated,

The increasingly serious pollution and damage of the environment in certain regions . . . is mainly the result of the development of capitalism into imperialism and particularly the policies of plunder, aggression and war frenziedly pursued by the superpowers (Tang, 1972: 5).

Tang then went on to explicitly relate the issue of environmental protection to the war in Vietnam and the proliferation of nuclear weapons. He pointed out that the use of toxic chemicals and poisonous gas by the U.S. in the still smoldering Vietnam War had resulted in "unprecedented and serious destruction of the human environment." Because of the war, "great stretches of fertile land have been reduced to bomb craters, rivers and water resources have been polluted, forests and agricultural crops destroyed and certain biological species are faced with the danger of extinction" (Tang, 1972).

On the other hand, Tang defended "the right of developing countries to exploit their own resources without the interference from outside parties." This is because he believed Third World countries needed to protect their sovereignty through economic development. Moreover, Tang convinced other Third World countries to demand, although unsuccessfully, that these views be included in the conference declaration. Thus, as Ross has summed up, the statement by the Chinese delegation placed "primary responsibility for pollution on the large capitalist states . . . subordinating domestic causes of pollution in the Third World to international factors" (Ross, 1988: 137).

Nevertheless, during the conference the Chinese delegation also acknowledged the existence of environmental problems in China and put forth the principles (Later known as the *32-Character Guiding Principles*) that would guide China's environmental policy for the next decade. More importantly, although the Chinese delegation was confrontational, accusatory, and in the eyes of the Western world, uncooperative and polemical, the Stockholm Conference itself had a profound effect. It forced a small but influential group

of Chinese scientists and government leaders to awaken to the reality of environmental problems in socialist China. It was during the preparatory stages for the Stockholm Conference that the State Council called for its investigation into the pollution problem of Guanting Reservoir. Also, about the same time, a conference was held in Shanghai on industrial smokestack pollution, which led to the first coordinated efforts to deal with China's air pollution problem. As former NEPA Administrator Qu Geping noted in reference to the Stockholm Conference,

From this meeting we came to understand the world environmental situation and the great impact of the environmental problem on social-economic development; moreover, using this as a mirror, we recognized the seriousness of China's own environmental problems (Qu, 1989: 36).

Thus contrary to contemporary views, the topic of environmental protection was not completely off-limits in the early 1970s. Clearly the events surrounding the Stockholm Conference in 1972 revealed a new interest on the part of central government in addressing the issue more seriously.

The First National Environmental Protection Conference and its Aftermath

Following the Stockholm Conference, the central government showed an immediate concern for dealing with pollution management beyond the use of the industrial Three Wastes Offices. Zhou Enlai, after being briefed on the events at Stockholm, urged the convening of China's First National Environmental Protection Conference. Held in August 1973, the Conference adopted the *Basic Regulations on Protecting and Improving the Environment*, the centerpiece of which has since come to be known as the *32-Character Guiding Principles*. The 32-Character slogan for this guiding principle was:

“Overall planning, rational distribution, comprehensive utilization, turning the harmful into the beneficial, relying on the masses, everybody lending a hand, protecting the environment, and benefiting the people.” This Principle was later incorporated into the 1979 Provisional Environmental Protection Law as Article No. 4. This document stressed improved planning and recycling as a way to reduce resource waste and environmental pollution. The Conference also concluded it was necessary to set up capable environmental protection organizations, and to give them the responsibility of overseeing and inspection, so as to deal with environmental issues in a coordinated manner. As a result, in May 1974, the Environmental Protection Leadership Group (EPLG) was established under the State Council. It was composed of senior officials from twenty ministries and commissions and was headed by Yu Qiuli. Mr. Yu was a vice-premier and had previously served as the head of the Ministry of Petroleum. The EPLG was supposed to provide a forum in which leaders from different industrial sectors cooperate in tackling common environmental problems.

In actuality, the EPLG only convened *twice* in its nine years of existence! It was unable to develop the resources, or to organize the research needed, to address the problems with which it was concerned. Still, its establishment was important for the creation of its subordinate Environmental Protection Office. In its efforts to establish an organizational apparatus exclusively for environmental protection, the First National Environmental Protection Conference renamed China's national *Three Wastes Office* the Environmental Protection Office. Cities throughout China were urged to follow suit. The Environmental Protection Office now became the subordinate office to the EPLG. The

Environmental Protection Office acted as the chief locus of environmental policy activity until 1981.

The First National Environmental Protection Conference had several important results. It brought environmental problems to the attention of key leaders. It developed principles for an environmental protection policy and provided a foundation for the construction of a broader institutional framework. In the end, however, the progress was limited. Chinese society as a whole was virtually unaware of the occurrence of this conference and would remain devoid of an environmental consciousness for many years thereafter. The conference produced only very general policy principles with no real policy mechanisms or laws to achieve the goals of these principles. And, most importantly, the institutional apparatus created was small and lacked authority. But one has to be aware that China was experiencing many dramatic social changes during that period of time. It was the later phase of Cultural Revolution in China and this diverted resources, energy, and attention from other national problems.

The Environmental Protection Leadership Group itself was equivalent to a second-tier organization, not directly administered by the center, and therefore containing only limited bureaucratic authority. As Ross pointed out,

[T]he national unit's designation as an office indicated an absence of vertical or line authority over subordinated levels of government in the fashion of a ministry or bureau. Instead the office's duties were confined to coordinating and planning, yet it lacked the prestige of a central commission. Since even central commissions must struggle to impose a common purpose on disparate operating agencies, environmental protection was in a tenuous position (Ross, 1988: 138).

A look at the local level further demonstrates this organizational weakness. For the most part, at the local level the gradual establishment in some Chinese cities of Three Wastes Offices marked the period from 1973 to 1979. Later, Environmental Protection Offices emerged. But only one or two individuals usually staffed these offices; they did not grow much until 1979. Moreover, central-level coordination with local environmental protection organs was seriously lacking during this period.

The Late 1970s: A Fundamental Change and the Reasons for It

By the late 1970s the lack of significant attention to environmental protection and the related lack of institutional authority began to change. The central government started to appropriate tens of millions of Yuan to local Environmental Protection Offices for mitigation of factory pollution problems. In 1978 the importance of environmental protection and pollution control was stressed at several national conferences. Also in that year, environmental protection attained the constitutional status of a *state* responsibility (Ross, 1988).

In December 1978, just after the famous Third Session of the Eleventh Party Congress in which Deng Xiaoping gained effective control of the party and government leadership posts, the State Council issued *Document #79*. Also called *the State Council Environmental Protection Leadership Group's Ten Year Plan*, this document acknowledged that certain areas of China had experienced serious pollution problems affecting citizens' lives and causing serious public controversy. Furthermore, this document stressed that environmental protection must be an integral part of development,

saying: "Eliminating pollution and protecting the environment is a component part to developing the four modernizations. . . . We absolutely must not follow the windy path of first developing and then cleaning up" (Ross, 1988: 143).

Toward the end of 1978, the EPO was issuing orders to key industrial facilities to halt pollution or risk being shut down. Though only a threat, this nonetheless emphasized the new concern for pollution cleanup. Finally, in December 1979, nine months after the Third Session of the Eleventh Party Congress, the Chinese Government promulgated its *Environmental Protection Law*, for trial use.

What brought about this rapid change in state attention to the environmental problems in China? The most frequently given explanation is that this change resulted from the ideological shift away from Maoist socialism that took place with the overthrow of the "Gang of Four" and the assumption of power of the Deng Xiaoping administration. Ross suggests that between early 1974--when the succession struggle began to be waged in earnest--and the purge of the radical Maoists in late 1976, certain ideological factors prevented action toward environmental protection disappeared. According to Ross, during the Cultural Revolution,

[T]he political left actively sought to restore political redness to first place among credentials for office and to enforce the primacy of politics over all other consideration. Under the circumstances, official pronouncements and public disclosures had to be conducted within the narrow confines of class analysis. Since it was dangerous to question the political line, China's achievements in pollution control of necessity were effusively praised in public although the problem was actually getting worse (Ross, 1988: 139).

Ross argues that the return to power of pragmatists such as Deng Xiaoping deflected attention *from* revolution *toward* the practical problems of development and the rebuilding of the governmental and party structures. This allowed leaders to address environmental protection problems. Ross views the ideology of the market as conducive to environmental protection efforts.

1979-1987: Authority Building

Many scholars on Chinese environmental policies view the promulgation of the Environmental Protection Law in 1979 as signaling a fundamental change in the EPB's ability to successfully pursue environmental protection. Before then, China used administrative means to deal with environmental problems. Because there were no environmental laws, local EPBs depended on government orders to regulate polluters. When the Environmental Protection Law was passed, however, things changed dramatically. The local EPB, to a great extent, could now work independently in implementing environmental regulations. It is certain that the 1979 Environmental Protection Law reflected a change in central-level attention to environmental problem. Local actors readily recognized this change. It signifies the beginning of an increase in the authority position of the Chinese environmental protection apparatus.

The promulgation of the Environmental Protection Law in 1979 spurred an immediate expansion of the authority of the environmental protection apparatus throughout China. From the late 1970s to the mid-980s, subnational governments throughout China began seriously to establish environmental protection organizations.

These organizations in turn initiated efforts to strengthen themselves and establish a position of authority within society at-large. In different subnational governments efforts to construct a solid organizational apparatus and to invest this apparatus with the authority necessary to perform its job occurred at different times. By 1987, China could claim to have established environmental protection organizations down to the county level in much of the country. Also, several important environmental laws and numerous regulations and standards had been issued. EPBs were increasingly seen as legitimate governmental organizations.

The promulgation of the Environmental Protection Law had repercussions beyond institution building, however. It meant that enforcement methods were defined for the first time, even if only in general terms. It contained, for example, provisions regarding environmental impact assessments for all new construction projects, penalties for noncompliance with regulations, and a system of discharge fees for fixed-point polluters. (Ross, 1987) The fact that China's environmental protection apparatus and its legal system were both still relatively undeveloped at this stage, however, meant that actually implementing environmental policy was a very difficult process. Even though the Environmental Protection Law gave EPBs the legal authority to pursue certain policies, in reality EPBs lacked the effective authority necessary to enforce them. Enterprises, mostly state-owned, took advantage of the fact that the law was issued provisionally; non-compliance was routine. Nevertheless, the local EPB's authority position was still better than it had been just a few years earlier. A small number of leaders in the central government recognized the importance of environmental laws and regulations. They

emphasized the importance of environmental protection in such key government documents as the nation's five-year plans and its constitutions. But, the large majority of central government leaders, and an even greater proportion of local leaders, were either ignorant of the environmental problems. Or, they believed economic growth was far more important than environmental protection. As a result, for every advance made at this time, there were setbacks, too.

The 1982 Setback

By the early 1980s, it was commonly recognized within the environmental community that further progress on environmental problems required changes in the organizational structures around the country. Although several local EPBs had won first-tier status, the central Environmental Protection Office remained a second-tier organization. The central EPO was incapable of issuing mandates to other industrial sectors and had no powers to command lower-level EPOs to obey orders. The central EPO was also small as far as personnel were concerned. Most importantly, it needed more independence to quickly write and propose laws and regulations for promulgation. For all these reasons, those within the environmental community recognized that the environmental protection apparatus needed to be a first-tier organization.

In 1982 the Chinese government adopted a policy that actually aggravated existing problems in environmental protection organization and enforcement. In an effort to pare down the state bureaucracy and promote efficiency, the central government began its first round of comprehensive structural reforms. Among the institutional changes made was

the creation of the Ministry of Urban and Rural Construction and Environmental Protection. This ministry was created to combine three functional sectors believed to be increasingly in need of attention and somewhat related to each other: urban and rural construction, environmental protection, and surveying and mapping. At the same time, the Environmental Protection Leadership Group was eliminated. The Environmental Protection Office, which had previously functioned under the EPLG, was transferred to the newly formed Ministry of Urban and Rural Construction and Environmental Protection. Putting the EPB under the Ministry of Urban and Rural Construction and Environmental Protection on the surface looked like an increase of power. In actuality, however, at the provincial and local levels it meant a decrease in power.

From 1979 to 1982, some provinces and cities throughout China had established independent Environmental Protection Bureaus. In response to the change in the Central Government's attitude toward environmental protection, some active localities had on their own, and with the backing of the Environmental Protection Law, taken the initiative to increase the status of their Environmental Protection Offices to that of bureaus. In so doing, they assured these environmental organizations *direct access* to local government leaders. They also vested them with the power to call meetings and issue orders without supervisory approval. Now these local governments felt constrained to heed the central government calls for structural simplification by consolidating government organizations and, in the process, demoting their environmental protection bureaus to their previous office status. Thus, to a great extent, the 1982 administrative change meant a decrease in

power for the local environmental protection organs. As the China Environment Yearbook, 1990 explains the situation at the time:

Since those in subordinate position follow the example set their superiors, many locals placed their already existing Environmental Protection Bureaus under the local Bureau of Urban and Rural Construction And Environmental Protection even though their EPBS had previously been under the direct administration of the local government and had independent managerial powers; as a result, their status was lowered and they lost personnel, subjecting an originally fragile environmental management organization to a serious assault and generally weakening managerial power (*China Environment Yearbook*, 1990: 7).

In many localities, the effect of the 1982 institutional reforms was long-term and profound. As a whole, since most counties did not begin to establish environmental protection organs until the early to mid-1980s, the effect of the 1982 administrative reforms were probably greatest on rural EPOs. Their status in the local government was so low that they could hardly implement any environmental policies and regulations. Until late 1980s and into the early 1990s, the effect of 1982 institutional change could still be seen throughout the country.

Rebuilding the Authority of the Environmental Protection Apparatus

Given the events described above, it is not surprising that dissatisfaction with the incorporation of environmental protection into the Ministry of Urban and Rural Construction and Environmental Protection was immediate and negative. Although the emphasis on structural austerity remained strong after 1982, several factors came together to create significant institutional change by the end of 1984.

First, in 1982, members of the environmental protection community sent a letter to the State Council under the name of the Environmental Science Association, pleading the

case of the importance of increased institutional status for the environmental protection work. Second, in the early 1980s, a significant increase in the awareness of the leaders of the central government occurred. In 1980, Hu Yaobang, then general secretary of Chinese Communist Party, arranged for scientists to present a series of lectures on environmental problems to Politburo and State Council members. It was these classes that created the first basis for an understanding of environmental problems among the top leaders. It ultimately led to important transition toward environmental concerns that characterized the Second National Environmental Protection Conference in 1983.

Third, also in the early 1980s a report analyzing the monetary value of environmental damages was produced. It demonstrated that damages from industrial pollution amounted to over 70 billion-Yuan annually. It estimated that ecological damages accounted for the loss of another 40 billion-Yuan. This study had a great effect on high-level leaders and directly influenced the proceedings of the Second National Environmental Protection Conference. The fourth factor pushing environmental problems higher on the national policy agenda was the worsening environmental situation throughout China. All four of these factors (agitation from the environmental community, increased leadership knowledge of the environmental problems, ominous estimates of environmental costs, and the worsening of environmental problems) served to heighten the importance of the Second National Environmental Protection Conference. This meeting marked the tenth anniversary of the First National Environmental Protection Conference and was a turning point in the history of environmental regulation in China.

The Second National Environmental Protection Conference

The Second National Environmental Protection Conference was held in December 1983. Held to summarize the experiences and lessons of ten years of environmental protection work in China, this conference is as one of the most important events in China's environmental protection history.

The second National Environmental Protection Conference produced five major contributions to environmental protection work in the PRC. First, the central government indicated a new level of recognition concerning the importance of the environment as a national priority. The conference proclaimed environmental protection a "fundamental national policy." In an opening address to the conference, then Vice Premier Li Peng reviewed the severity of China's air pollution, acid rain, water pollution, ground water contamination, soil erosion, desertification, noise pollution and solid waste problems.

Second, the Conference stressed the importance of prevention for controlling pollution through a policy mechanism called the *Three Synchronizations*. The Three Synchronizations refers to "the simultaneous planning, design, and development of economic construction, urban and rural construction and environmental construction." Together with the environmental impact assessment system and the discharge fee system, these policies (also known as the *Three Magic Weapons*) became the *core* of China's industrial pollution policy control policy. In 1988 they were incorporated with other new policy mechanisms to create what is called *The Five New Systems* (China Environment Year Book, 1990).

Third, an emphasis was placed on environmental management as China's key to environmental protection. Most leaders in the environmental community realized that they needed to stress management because China lacked a legal norm in environmental protection. And, China lacked the requisite money and advanced technology to do more. As Li Peng put it in his closing address to the Second National Environmental Protection Conference:

Sometimes you have to spend a little money to accomplish good things, but its not always a question of spending money. Some problems can be resolved just through strengthening management. The important thing is that you have a strong will and manage things strictly, and that leaders keep a close hand on the situation; otherwise, nothing can be accomplished (Li Peng, 1984).

Fourth, and perhaps most importantly, the conference was significant because it gained explicit central-level acknowledgment of the need for environmental institution building--even in the climate of institutional retrenchment. Li Peng acknowledged his closing remarks:

During this Conference, everyone has been concerned with strengthening environmental protection leadership, establishing the organizational apparatus, and developing the ranks. . . . Several comrades have brought up their hopes that he state will establish an environmental protection Commission to assist the State Council in deciding upon policies or directives related to environmental protection, to help coordinate various relationships between different government organs, and to push forward environmental protection work. The Central Finance Leadership Small Group discussed this issue at an office meeting and requested the advice of Comrade Wan Li. All felt that the suggestions made were very good ones, and very important ones. We will bring the idea up before the State Council's Standing Committee for discussion and we will go through the legal proceedings to establish an Environmental Protection Commission (Li Peng, 1984).

In sum, the Second National Environmental Protection Conference was important because it increased EPB authority by boosting the status of environmental protection work, by creating specified policy, and by encouraging organizational promotion.

The 1984 Institutional Changes and Their Effects at the Center

The Second National Environmental Protection Conference was the direct catalyst for the institutional changes that developed in 1984. In May 1984, the State Council responded to concerns raised at the Conference by issuing the *Decision Concerning Environmental Protection Activities*. This edict created an inter-organizational arm for environmental protection, the Environmental Protection Commission (EPC). The Environmental Protection Bureau, now within the Ministry of Construction, served as the office of the EPC. It performed staff functions for the Commission, taking care of daily affairs and producing policy documents for EPC review.

The idea behind the EPC was to formalize and enhance the functions performed by the now defunct Environmental Leadership Group. Unlike the EPLG, the Commission is *directly* under the State Council. This enhanced its organizational status. Its membership is larger and far more inclusive. It is comprised of ministers and vice ministers representing over thirty ministries and commissions. It includes as well representatives of the mass media and large corporations. At the time of its creation, then Vice Premier Li Peng was appointed as the head of the Commission. According to those in the environmental community, the Commission really has performed a coordinating function, working out problems between various ministries and various Environmental Protection

Bureaus at different administrative levels. It has also hammered out controversial aspects of proposed environmental laws. Unlike the EPLG, the Commission agreed to meet four times a year and to pursue an active agenda.

As important as the establishment of the Environmental Protection Commission was another administrative change that soon followed. In December 1984, The State Council increased the status and capacity of the EPC by changing its name and increasing its personnel budget. Although it remained under the Ministry of Urban and Rural Construction and Environmental Protection, the new National Environmental Protection Bureau (NEPB) had much more administrative power.

In terms of writing laws, regulations, and formulating policy positions, the Bureau's authority increased greatly. The NEPB was essentially higher in rank than other second tier organizations. This afforded it had more independence. It now had two superiors, the Ministry of Construction and the State Council's Environmental Protection Commission. Instead of having to get approval from the Ministry of Construction to issue documents, the Bureau could circumvent the ministry and get approval from the Environmental Protection Commission. This had distinct advantages. Unlike rules approved by the Ministry of Construction, the NEPB ministerial rules and regulations approved by the Environmental Protection Commission could be applied externally to ministries other than the Ministry of Construction. The change in bureaucratic status provided other benefits, too. The NEPB could now issue orders directly to provincial EPBs. The reports it issued were now of equal status to those of the Ministry of Construction. It could schedule and conduct its own national meetings. It directly

received funds issued by the Ministry of Finance for environmental protection programs rather than having to wait for these funds to be channeled through the Ministry of Construction. Finally, the Bureau gained virtually independent status to deal with international affairs. All these changes vastly enlarged the National Environmental Protection Bureau's capacity to conduct environmental protection activities.

Local Effects of the 1984 Institutional Changes

What effects did these institutional changes have at the local level? Referring to the local effects of the 1984 institutional changes, Qu Geping observed:

In accord with the spirit of the State Council's decisions, many places also established provincial, city, and county Environmental Protection Commissions . . . and those environmental management organs which had been weakened during the administrative reforms continued to recover their strength (Qu, 1989).

In sum, 1984 was a pivotal year for the establishment of the EPB's status, capacity, and authority. The various events of this single year served to increase EPB institutional authority, legal authority, and effective authority through bureaucratic promotion, legal promulgation, and personnel change. Without these changes, the effects of the Luoyang Conference, to which we turn next, would not have been nearly as profound.

The 1985 Luoyang Conference and its Effects on EPB Authority

The Luoyang Conference of October 1985 stands out, along with the Second National Environmental Protection Conference, as one of the most significant events in China's environmental protection history. Also known as the National Urban Environmental Work Meeting, the Luoyang Conference was held because of the central government's new emphasis on the macro-management role of local governments. It was

also spurred by the worsening urban pollution problem in China. The meeting served mainly to share the positive experiences of a few cities in attempting to gain control over their respective pollution problems.

Of particular focus were the experiences of the cities of Luoyang and Harbin. In each of these communities, the mayor had voluntarily signed environmental protection responsibility contracts with the city EPB. These contracts committed the mayors to assuring completion, by a stated deadline, of specified environmental protection projects. In both Luoyang and Haerbin, this system had proved highly successful in mobilizing resources to deal with environmental protection. In convening the Luoyang conference, the NEPB invited mayors throughout China to come and learn first-hand about China's environmental problems and ways of addressing them. The meeting concluded that clean up of the urban environment required comprehensive control. For this to be achieved, several factors were important. In order to deal with the inter-departmental coordination necessary for environmental protection, city governments would have to establish Environmental Protection Commissions along the lines of the Environmental Protection Commission recently by State Council. These entities were expected to function locally as management centers for environmental protection activities. In furtherance of environmental protection, local governments were also called to allocate money for monitoring stations and research personnel. EPBs were to exert greater efforts in collecting funds for environmental protection. Local governments were to include environmental protection as a feature of urban construction and reconstruction. Municipal governments were to formulate annual plans for environmental improvement projects.

Localities were to develop their own environmental protection regulations to implement national legislation. Finally mayors were challenged to accept responsibility for the environmental quality of the cities and increase their leadership efforts in this regard. In sum, the Luoyang Conference proved to be vital for the establishment of subnational environmental protection programs. It represented a major step toward the creation of a national and subnational framework for environmental policy implementation.

1987 to the Present: the Stage of EPB Proto-Authority

By the end of the 1980s significant progress was made toward the establishment of a large-scale national environmental protection regime in China. Pollution discharge fees were being systematically collected. Local EPB officials were routinely being included in government meetings to consider the viability of proposed large-scale development projects. The environmental impact of development projects was being given at least cursory consideration. Mayors were accepting responsibility for improving their city's environment through annual projects. Extensive training courses were being conducted to educate government and factory officials about industrial pollution. Finally, public awareness of environmental problems had grown tremendously. Now, rural and urban residents alike were alert to pollution and were regularly contacting the local EPB to complain about problems. Environmental education programs, however, and extensive public participation in environmental monitoring was largely confined to big cities.

The vast expansion of EPB activity was directly attributable of the increase in EPB authority brought about by the establishment of a workable environmental organizational

apparatus, and the new legal code. By close of the 1980s, local EPB institution building had extended down to the county level throughout most of China. In addition to organization maturation, the late 1980s witnessed the maturation of the environmental legal code. By the end of the decade, China had promulgated a series of industrial pollution laws and regulations covering a wide array of environmental concerns. This included, for example: the *Oceanic Environmental Protection Law* (1982); the *Regulations on the Collection of Discharge Fees* (1982); the *Water Pollution Prevention and Control Law* (1984); the *State Council's Regulation on Improving the Environmental Management of Town and Village and Street-level Enterprises* (1984); the *Environmental Management Rules for Construction Projects* (1986); the *Air Pollution Prevention and Control Law* (1987); the *Detailed Rules and Regulations for Implementing the PRC's Water Pollution Prevention and Control Law* (1989), and the *People's Republic of China's Regulation on Noise Pollution Prevention and Control* (1989).

The increase of EPB authority brought about by local level institution maturation and central-level legal development made it much easier for EPBs to implement environmental policy. Of course, this does not suggest that all areas experienced a drastic increase in their ability to implement policy. Some EPBs, particularly those in small cities and counties, remained devoid of *real* power. Short of staff, and still lacking organizational independence, these EPBs continued to be impotent to act. In other locales, the caliber of EPB officials is low and these officials themselves are uninterested in pursuing environmental protection. They often act as rubberstamps to the construction and development projects that are promoted by local governments. Of course, even those

EPBs that have diversified their functions, properly staffed themselves, and emphasized environmental policy implementation, are not entirely free of local government interference. We will discuss this matter more fully later in this chapter.

The 1988 Reforms

Just as the first round of structural reforms had consequences for the environmental protection apparatus, so did the second round of structural reform in 1988. This time, however, unlike the initial reforms that inhibited the development of environmental protection, the latest reforms had a *positive* impact.

In October 1987, the Chinese Communist Party held its Thirteenth Party Congress. Here the future course of China's economic reforms and the reform of the political system took center stage. Several things happened at the Congress that proved significant for environmental protection. First, Li Peng was promoted to Party General secretary and he was an important supporter of the environment. Also, the Congress *explicitly* recognized the negative effect of environmental degradation on economic growth and discussed ways this could be ameliorated by organizational change and policy change. Finally, a second round of structural reforms was decided upon which meshed well with the NEPB's mission and organizational strengths. In consequence, the Congress provided a better foundation for the authority and independence of the National Environmental Protection Bureau.

As head of the State Council's Environmental Protection Commission, Li Peng was aware of the constraints that NEPB's lack of organizational independence placed on

environmental protection efforts. With the announcement of a second round of structural reform in 1988, an opportunity lay open for the organizational promotion of the NEPB. Li Peng was aided in his efforts by two factors. First, a major report appeared at about this time that showed the estimated annual costs environmental destruction. The Congress's concern with the effects of environmental protection on economic development may in part have been instigated by this report. Second, the National Environmental Protection Bureau stood as a perfect experimental model to implement the scientific management goals of the new administrative reforms. NEPB was still a new and, comparatively speaking, small government organization. It readily fit the requirements of the kind of modern agency envisioned by reformers. The fact that it had subunits throughout the country, which themselves came into contact with many other Ministries and Bureaus, gave the NEPB a high degree of visibility. This meant that it could serve as a familiar model for many other government organizations. In addition, the fledgling environmental protection statute was relatively a *complete* basic law--especially in comparison to laws in other governmental sectors. Therefore, the NEPB had relatively ample legal authority upon which to operate. Perhaps most importantly, the head of NEPB, Qu Geping, was viewed as someone in support of the administration's main goals. Qu sought to implement policy through the rigorous use of the law. He was committed to building a fully functional, modern, and professional agency. He believed that China's environmental protection apparatus required technically trained leaders and a career civil service. Qu was determined to eliminate the personalistic conduct that characterized traditional Chinese administrative organizations. In this Qu largely was successful. Many

current NEPA leaders once trained under Qu, Geping and are technocrats with advanced degrees. They are also relatively young for ministry-level administrators.

For all these reasons, then, NEPB's promotion fit well into the goals and overall policy of the *Deng Reforms*. As a part of these changes, in March 1988, the NEPB was granted independence from the Ministry of Urban and Rural Construction and Environmental Protection and reconstituted as the National Environmental Protection Agency. (NEPA)¹ Its organizational status was now just below that of a *ministry*. This was a significant boost in its status. As a result of this administrative change, NEPA reported directly to the State council. Its personal allotment was significantly increased, from 120 to 321. Its administrative structure was further differentiated and quickly expanded. Still, the fact that NEPA was not made a full ministry at this point, on a par with the various industry ministries, is also significant. It reflected the common understanding that environmental protection was still *less* important than economic development.

The main impact of NEPA's revitalization occurred in two areas. First, environmental protection work was given a boost in importance throughout the society. A common purpose for raising the rank of any organization is often to raise its perceived importance, and thereby to *enhance* its authority. In the case of the NEPA, the promotion

¹ It should be noted that in Chinese language the name for the newly formed National Environmental Protection Agency (Guojia Huanbao Ju) is the same as that of National Environmental Protection Bureau. This is because the Chinese character "Ju" can be translated into either "bureau" or "agency" depending on the context. However, in English, an agency connotes an independent organization whereas a bureau does not necessarily. Since newly formed environmental protection organ in 1988 was granted direct links to the State Council, it should be translated into National Environmental Protection Agency (NEPA).

of environmental protection to a semi-ministerial level raised the perceived importance of the issue in the public's mind. The 1988 administrative change made people realize the importance of environment protection as a national priority. In the minds of government officials, this was likely enhanced when Qu Geping, the head of NEPA, was given the rank of a *deputy minister*. This engendered respect and included some of the perquisites of a minister. Second, the NEPA substantially increased its role as a service provider for local EPBs. This is a direct result of the increase in the number of NEPA personnel and of the consolidation of the environmental institutional and legal systems. After reform, the NEPA provides more than just information on how to educate public on environmental affairs and the law; it provides essential services. It organized annual meetings for the purpose of exchanging local experiences, and it conducts studies and provides technical information for local EPBs--which themselves have neither the financial resources nor the ability to conduct such studies. The NEPA also cooperates with foreign entities in the conduct of environmental research. The Yunnan BTE Program was, for example, initiated in the NEPA. The first two visits of the international study team to Yunnan were arranged through the auspices of NEPA. Agency officials accompanied the team to the province (Russell, 1991).

The Third National Environmental Protection Meeting

The National Environmental Protection Agency sponsored the Third National Environmental Protection Meeting in April 1989. At this conference EPB and industrial ministry officials expressed deep concern for China's deteriorating environment. The

speeches and papers delivered at the meeting demonstrated a particular concern for the severe economic losses attributable to China's water pollution situation. The meeting produced additional authority for local EPBs and provided the forum for the Qu Geping's announcement of State Council approval a major new environmental policy initiative. This policy package became known as the *Five New Management Tools*. It was comprised five elements designed to enhance environmental protection activities throughout the country: (1) a contract responsibility system for city government officials; (2) a comprehensive clean up system; (3) the collective control system; (4) a water pollution permits system, and (5) deadlines for clean-up activities. None of these mechanisms were really new; until now they had only been tried experimentally. But now they were included in formal policy. The *Five New Management Tools* and three existing policy instruments formed China's eight major environmental protection mechanisms. These are listed in Table 3.1.

The Third National Environmental Conference was an important step in the development of Chinese environmental policy. It focused national attention on environmental problems and the need to strengthen the implementation process. It adopted the lessons NEPA had learned from local experiences during the course of the mid-1980s, and legitimated them through the new central government mandate. Finally, the new administrative measures increased the power and capacity of environmental agencies around the country to implement policy.

Since the Third National Environmental Protection Conference, the authority of the Chinese environmental protection apparatus has continued to grow. The 1989

Tiananmen Incident, ironically, appeared to boost the importance of environmental protection in the minds of Chinese central government Leaders. To protest the Tiananmen Incident, developed countries throughout the world canceled trade relations, and cultural and scientific ties with China. Environmental protection exchanges were exceptions. Not only were such ties not severed, they actually increased. For example, the Yunnan Biomass-to-Electricity Program started in 1989, and right after the Tiananmen Incident, Dr. Milton Russell made his first visit to Yunnan as part of the joint implementation effort. As a result of this, and increased international interest in Chinese environmental protection, NEPA's status was enhanced. The Chinese environmental protection effort in general gained new respect from central leaders. By mid-1991 the State Science and Technology Commission, perhaps realizing the international value of environmental protection, assumed certain aspects of environmental protection work from NEPA. This signaled that the environment was moving even higher on the national government's policy agenda.

Environmental Protection after the Rio Conference

In June of 1992, the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro adopted five important documents, including the *Rio Declaration* and *Agenda 21*. These documents reflect new international thinking about the sustainable development of human society. They reflect political commitments at the highest level, and a global consensus, on the need for extensive international cooperation to promote both environmental protection and economic development.

The Chinese Government attached great importance to the UNCED. Chinese Premier Li Peng attended the meeting and made a commitment to conscientiously implement the resolutions adopted at the Conference. This Conference was another *milestone* for environmental protection, as well as a turning point for China's foreign policy after the Tiananmen Incident. Not long after the UNCED, the Chinese government announced a new initiative, *The Ten Policies*, for promoting environmental protection and economic development in China. At the 23rd Session of the Environmental Protection Committee of the State Council, held in July 1992, important decisions were made regarding China's environmental policy. Especially significant was the Council's directive for the formulation of an integrated national plan for environmental protection and economic development. This groundbreaking effort was to be coordinated by the State Planning Commission and the State Science and Technology Commission. They were charged with involving all of the relevant governmental and non-government organizations in the formulation of China's version of *Agenda 21*. What emerged from this process was the *White Paper on China's Population, Environment, and Development in the 21st Century*.

Through concerted efforts, a first draft of China's Agenda 21, with 120,000 Chinese characters and forty chapters, was completed in April 1993. In March 1994, Agenda 21 was approved at the Executive Meeting of the State Council of the PRC. The passing of China's Agenda 21 pushed China's environmental protection to a higher level. It demonstrated the central government's concern on China's worsening environment and its long-term commitment to dealing effectively with the situation:

The Chinese Government is determined to implement China's Agenda 21. This is not only because Chinese highest leaders take it seriously, but also because it will help to create a sound environment for sustainable economic development, for deepening reforms and opening to the outside world and for establishing a socialist market economy (CA21MC, 1994b: 5).

While the development of China's Agenda 21 focused tremendous attention on environmental protection, it did not raise environmental protection to the same level as that of economic development. Agenda 21 makes clear the perspective that, for a developing country like China, the *precondition* for sustainable development is *development*. By the middle of 1990s, however, environmental protection was almost as important as economic development. This was largely due to the worsening urban environment in major cities. For example, the air in Beijing is so bad that it smells even in the suburbs. In March 1998, NEPA was promoted to a full ministry-level organization at the Ninth National People's Congress Meeting. The reconstituted ministerial-level organization is called the State Environmental Protection Administration (SEPA).

CHINA'S RESPONSE TO SUSTAINABLE DEVELOPMENT

According to Agenda 21, China's sustainable development strategies will emphasize the *social* aspects of the sustainable development. To this end, family planning should be implemented; i.e., the population should be strictly controlled, and its quality and composition improved. A heightened awareness of sustainable development will be fostered through broadly based public education to mobilize the active participation of all people in achieving sustainable development. Particular attention will be paid to educating officials at all levels so as to improve their ability to promote sustainable development.

China's future development, according to Agenda 21, will be based upon the *sustainable* utilization of resources and preserving a healthy environment. The country is obliged to shoulder the following obligations: protect all life supporting systems; protect the integrity of ecological systems and biodiversity; address major ecological issues such as soil erosion and desertification; protect natural resources; maintain sustainable supply capabilities; reduce damage to fragile ecological systems; extend forest coverage; improve urban and rural environmental condition; prevent and control environmental damage and pollution; reclaim and restore damaged and polluted environments, and take an active part in international cooperation in the fields of environmental and ecological protection. As envisioned in this plan, environmental pollution should basically be brought under control, and the quality of the environment in major cities should have been improved, by the year 2000. The degradation of natural ecological systems will be reduced and protection of resources and the environment will be coordinated with economic and social development. (CA21MC, 1994a) No decisive progress toward a globally sustainable civilization can be achieved without a gradual transformation of the Chinese environment and society. This is not impossible--but it will be exceedingly challenging (Pirages, 1996).

China, to summarize, has adopted a sustainable development policy in June 1992. The following August, the Chinese government put forward ten major measures to enhance its environmental and developmental policies. This set China on the road of sustainable development. Two years later, the Chinese government approved and promulgated China's Agenda 21 *White Paper on China's Pollution, Environment, and Development in the 21st Century*. This document, recognizing the country's unique

conditions, put forth a coherent strategy for sustainable development. Each relevant national and subnational organization developed their respective plans to implement the strategy for sustainable development. In order better to understand environmental policy formation and implementation, it is essential to learn about the evolution of China's environmental protection apparatus and environmental policy.

CHINA'S ENVIRONMENTAL POLICY IMPLEMENTATION PROCESS

Environmental policy implementation is greatly influenced by the sociopolitical and institutional setting in which it takes place. China's public policy process is best characterized as one of *fragmented authoritarianism*. Governmental authority below the highest national level is fragmented and disjointed. Authority is fragmented in the sense that government departments have substantial control over their individual functional areas. When two or more functional areas are involved, the source of authority and responsibility tends to be unclear. The two agencies can either coordinate with each other or appeal to a higher level of government for clarification. Fragmentation also results because central government decisions are followed to varying degrees in different regions of the country; this leads inevitably to local interpretation and modification. This is certainly true in provinces that are physically far away from Beijing, where the Chinese saying "heaven is high and the emperor is far way," largely characterizes the local attitude toward directives from the central government. Local leaders are open about their focus on regional economic development and play an important role in determining how national policies are implemented.

While fragmented authoritarianism can explain much about how things work in China, it has limitations. For one thing, not *all* organizational relationships are fragmented. The very peak of the Chinese political system, where the elite national leaders make many key decisions, is highly integrated. In addition, since the recent economic reforms, government leaders at the city and county level have sought to pursue their own goals, and to protect themselves from the conflicting demands of higher levels, by concentrating power over fiscal resources and integrating local level decision making (Sinkule and Ortolano, 1995: 13).

Lampton uses four concepts to characterize the context within which policies are implemented in China: *Units*; *Systems*; *Too Many Mothers-in-law*, and *Independent Kingdoms* (Lampton, 1987). An understanding of these four concepts provides insights into the nature of organizational interactions in China and is helpful in distinguishing between different types of authority and power relationships.

A *unit* (*danwei*) is roughly equivalent to a firm, enterprise, school, or government office. A unit should not be thought of as only a place of work; for the urban population it also provides housing, retirement benefits, health care, and education. A common question is literally "what work unit do you belong to? Or, alternatively, "whom do you work for?" But a work unit is much more than an employer; it is also responsible for providing housing, granting permission to have children or change jobs, and many other aspects of people's lives. Although recent economic reforms have made it easier for individuals to change work units, most Chinese still remain with a single unit for life. Those who do not change, nevertheless, expect a long association with their colleagues

and neighbors. Perhaps this has something to do with Chinese tradition of honoring family attachment. It is necessary to point out that the functions of *unit* are more and more being replaced by other social entities. For example, the new round of housing reform encouraged employees to buy the apartments from their unit. Also, people are starting to buy medical and life insurance, which is an emerging business in China.

Chinese organizations are divided vertically into functionally defined *systems* (xitong), and each work unit is part of a system. For example, one system comprises the NEPA and all of the local environmental protection bureaus and offices under the jurisdiction of the NEPA. The more than two thousand environmental protection bureaus and offices throughout China are all part of a system over which NEPA presides. The system defines organizational relationships. Typically, the relationships within systems are hierarchical, with clear lines of authority. A relationship between two units in which one has direct authority over the other is called a *leadership relationship* (lingdao guanxi). A leadership relationship can be contrasted with a *professional relationship* (yewu guanxi), in which neither unit has authority over the other. Yewu guanxi often characterize the relationships between units from different sectors, for instance, environmental protection and light industry.

Relationships between organizations are described as “tiao tiao kuai kai” literally, *lines and pieces*. This refers to *vertical* (or functional) relationships within a system, i.e., a unit’s connection with central leading organs. Kuai kuai refers to territorial (or lateral) relationships; for example, a unit’s connection with local government. Sometimes, a unit’s rank may be higher than a local government. But the unit is always willing to cooperate

with local government since the daily supply of goods comes from the local area. On the other hand, the local government tends to establish a good rapport with units belonging to the central government system. This is because the leader of the unit may have a higher bureaucratic rank than a mayor, and often has connections with leaders in the central government. For example, if the chairman of a large state-owned enterprise happened to be a high-ranked revolutionary, and the mayor of the city in which the enterprise located was a newly appointed technocrat, the relationship between the two *units* can be very subtle. If, for instance, the enterprise needs more farmland to expand its production, it has to get permission from the city. On the other hand, if the mayor wants to have a brighter political future, he is highly likely to need to please the enterprise's chairman, who may have allies working in the central government. Figure 3.1 illustrates the Tiaotiao (vertical lines) and Kuaikuai (territorial pieces) relations.

Implementation of a project can be impeded if a unit is expected to fulfill conflicting demands from its supervisory unit and other organizations and priorities for meeting those demands are not dictated. For example, Mengpeng Rubber plantation is required to meet production quotas set by the provincial and prefecture bureaus of agriculture. It is also subject to environmental protection standards set by the prefecture EPB. It is not unusual for leaders of organizations, especially in the lower level, to be subject to conflicting demands. This is what is known as having *Too Many Mothers-in-law*.

The frustrations inherent in the *Too Many Mothers-in-law* phenomenon are compounded by the lack of lateral coordination that results from the nature of systems.

Because units have so many obligations, and so few resources, and since systems do not easily coordinate with each other, it is not surprising that Chinese organizations are reluctant to share resources--or rely on other organizations. This leads to the development of *Independent Kingdoms* (Sinkule and Ortolano, 1995). An independent kingdom controls its resource supply, budgetary systems, personnel, planning, and operations as much as possible. It is not only individual units, such as EPBs and Plantations that strive to build independent kingdoms. An entire county or city may strive to become an independent kingdom under the leadership of the chief executive. It is common to find many small independent kingdoms within a larger independent kingdom. For example, the Mengpeng Rubber Plantation is a sub-independent kingdom under the larger independent kingdom of the Yunnan Bureau of State-Owned Farms. The reform setting is a fertile soil for spawning independent kingdoms.

At a highly abstract level, the problem faced is the same whether under a central planned economy (CPE) or a free market system. How can the system arrange for the efficient provision of an economic livelihood for a population (widely conceived to include environmental amenities), while taking into account the interaction between production and ecology? The main differences lie in the institutional constraints impinging on the pursuit of the goal of environmental quality. The CPE *seems* to have an advantage, at least in principle, because the leadership has direct control of the production units responsible for generating and dealing with pollution. It ostensibly has the authority to allocate capital to pollution control technologies, for example, and to insure their use by industry. The issue is how to incorporate environmental concerns into the economic

planning process. Guidance of state-owned enterprises could be expressed as internal control as opposed to the external control problems of regulators in private enterprises, or in hybrid systems, when they confront polluting enterprises not owned by the state.

This seeming advantage is, however, thwarted by two key features of centrally planned systems. First, control over enterprises in reality is imperfect. While the broad thrust of plans cannot be ignored, enterprise managers can exercise discretion. This is of particular significance regarding pollution control due to the difficulty of monitoring problems. The second feature arises from the political economy of planning itself. The reality of economic planning is that it is not a coordinated team working to maximize social welfare; but rather it often is a struggle of competing economic and political interests represented by the various ministries. The role of ideology comes to the fore as it presents guiding principles to resolve conflicts among these competing interests. Historically, the prevailing ideology of the centrally planned economy has emphasized economic growth and industrialization. Environmental concerns were marginal. This led to power relations among administrative bureaucracies that favored *production* ministries over agencies responsible for environmental control.

Three systemic aspects of centrally planned economies have proven particularly detrimental for the environment. One is the limited possibility of direct citizen involvement in environmental policy formulation and implementation. In large part this derives from the repressive political systems that characterized central planning. While those systems were primarily established to repress dissent with the existing power structure, they also had the effect of limiting citizen involvement in environmental issues.

The second feature is an obsession with growth, industrialization and militarization, all of which have great potential for environmental degradation. Since no strong pro-environmental constituency was allowed to develop, the direction of development planning marginalized environmental concerns. Producing more steel is more important than producing steel in an environmentally *clean* manner. The third feature is the high material intensity of production methods which is promoted by low valuations of natural resources, and performance criteria based on production rather than net social payoff.

In considering the inefficiency of natural resource utilization in the centrally planned economy, one encounters the following. Enterprises do not respond to price signals--as firms do in free enterprise systems--because the measures of managerial success are plan fulfillment rather than profit maximization. This leads to inefficient utilization of resources--unless such efficiency is incorporated into the goal structure of enterprises as established by the central planning authorities. Typically, it was not. Recent literature on environmental policy in transition economies, however, cautions against relying on market-type instruments for environmental control, since enterprises may not respond to the signals in the way intended. On the other hand, observers note that the problem of inefficiency is exacerbated by the failure to establish appropriate prices for natural resources and by extension of environmental disposal services (Sinkule and Ortolano, 1995).

Centrally planned economies may have some advantages in dealing with environmental problems. Some scholars argue that such economies will be more successful in controlling environmental degradation because their nature facilities the kind

of governmental regulation inherent in such systems (Sinkule and Ortolano, 1995). That is, environmental protection requires governmental management activities utilizing a hierarchical administration that would process information, promulgate regulations and enforce compliance. In the centrally planned economy, the requisite apparatus was already in place. All that would be required is official direction from the planning leadership to place more emphasis on environmental concerns. This view has some support in how environmental regulation, and its concomitant institutions, have evolved in free enterprise economies. The American approach, for example, is basically a hierarchical structure involving interaction of federal and state level bureaucracies endeavoring to enforce compliance through command and control approaches.

To the extent that the Chinese economy is undergoing transition to a different system these lessons need to be modified. Reform of both natural resource pricing mechanisms and enterprise management can be expected to have some positive environmental impacts, since improved efficiency will reduce the material intensity of production. But this is not enough to guarantee good environmental behavior. Environmental services must be assigned a price to enter into enterprise cost calculations. Or, the enterprises must be made subject to an effective regulator that controls their behavior regarding pollution emissions. Moreover, to the extent that economic reform results in extensive economic growth, environmental problems could be exacerbated. Although better economic performance brings a greater capacity to control pollution, the implications of economic reform for environmental quality are not clear.

The Chinese effort to control pollution has three primary facets. One is the establishment of standards in the form of environmental quality goals pertaining to ambient conditions and standards for polluting behavior. The process has largely been completed, but the system continues to undergo development. An important supplement to such goals is to require environmental impact statements for all economic development projects. The second facet is the direction given to state owned enterprises. An example of this is found in the *Three Synchronizations* policy. Environmental goals are to be *synchronized* with production *at each stage of enterprise activity*, planning, construction and operation. Since 1983 Chinese economic planning has sought to link investment in new technology to environmental concerns. Thus, as China's industrial base is renewed environmental performance should improve. Incorporation of the ecology into economic planning, for example, is reflected in the environmental protection goals and directives found in the Five-Year Plans, which guide economic activities. It is also reflected in the allocation of capital resources to state-owned enterprises (SOEs) for installing pollution control equipment.

To be sure, as China moves toward a more liberal economic system, central allocation of resources to SOEs will diminish in importance as their share in China's aggregate output declines. The third facet of China's approach to environmental regulation will accordingly become more important. This consists of the regulation of enterprise behavior by an environmental authority that is independent of the administrative structure of production. For non-SOEs this is obviously crucial, but the environmental authority in China also interacts with SOEs in a regulatory capacity. This has led at times

to bureaucratic conflict within the state administration. The general thrust of the effort has been of a *command-and-control* nature. Environmental authorities seek to impose direct regulations on polluting enterprises. For wastewater and gaseous emissions, a hybrid system has evolved that includes both direct regulation and costs based on a discharge permit system.

Four levels define the bureaucratic apparatus for environmental regulation: national, provincial, county, and municipal. The administrative units having direct contact with enterprises are the local (city and county) environmental protection bureaus (EPBs). EPBs have formal authority to inspect factories, levy fines and charges, revoke environmental permits and intervene in production operations--including shutdowns in the most egregious cases. Effective enforcement of environmental laws in China faces several difficulties. To a large extent it depends *directly* upon the support of the officials at the senior levels of the Chinese government. This direct support is required because enforcement through the weak judicial institutions is unreliable. This reflects the style of governance in China. Compliance with environmental policy relies heavily on appeals to enterprise managers to follow the directives of by the national leaders, and on the influence of the economic planning bureaucracy, rather than on legal sanctions. Achieving compliance in the early years of environmental regulation was especially difficult. In the 1980s this improved substantially as the state began to provide resources to enterprises specifically for the purpose of pollution abatement. Environmental concerns for urban areas were introduced with urban planning in 1979, but became integrated with overall economic planning only later--beginning with the sixth Five-Year Plan (1981-1985).

Despite this positive beginning, environmental protection soon was subordinated to economic development. For example, in the early 1980s only about one-fifth of industrial effluent and municipal wastewater was treated before release into natural waterways. Moreover, environmental plan fulfillment indicators were de-emphasized in favor of output and financial performance criteria. Chinese economic planners emphasized growth through industrialization, and the political leadership supported production interests.

The guiding philosophy of environmental regulation in China is the *polluter pays* principle. Although they receive financial support from the state, enterprises are responsible for bearing the cost of pollution abatement and must pay fines imposed for not following regulations. The number of enterprises subjected to such levies has risen in recent years; it increased roughly 300% from the early 1980s to 1993. Reparations and fines fell along an erratic path across the time period. While financial incentives could be expected to have some impact even on state-owned enterprises, the charges for non-compliance are often small relative to abatement costs, leaving enterprises an incentive to continue polluting while paying the fines.

CHAPTER CONCLUSION

In this chapter we reviewed the emergence of the environment and environmental problems on the public policy agenda of the Chinese political system. We then reviewed in detail the long and complex process by which an environmental protection focus emerged among the senior national leadership. Eventually, environmental policy, and an implementation apparatus necessary for its implementation, developed--but effective

environmental regulation proved difficult within the centrally planned Chinese economy. Nevertheless, in large part due to international influences on Chinese thinking about sustainable development, a new approach to balancing environmental protection and economic development is taking root.

We found that the problems of environmental degradation in China have become quite serious over the past three decades. Negative repercussions include the loss of natural resources such as fisheries, as well as increased incidence of disease related to a deteriorated environment. Aspects of the centrally planned economic system, such as the lack of citizen participation, planning emphasis on growth and industrialization, and the tendency toward material intensive production, have exacerbated the problem.

Although many of the environmental policy instruments used in China have counterparts in other countries, the Chinese approach to environmental protection is unique in some significant ways. The new national policy toward the economy is to build a socialist system shaped by the *Chinese Character*. Under this guiding principle, environmental protection in China is an environmental protection system with Chinese characteristics. Of courses, the definition of Chinese characteristics has been modified constantly since the economic reform started. Recently, especially after the UNCED in 1992, Environment protection with Chinese characteristics had two major components: (1) *environmental protection is incorporated into economic development plans and programs*, and (2) it adheres to the three major policies of *intensified management, prevention first, and the polluter pays principle*. (Sinkule and Ortolano, 1995: 200)

China's environmental protection system is characterized by not only the principles and policies mentioned above, but also by the nature of China's political and economic system. It is shaped especially by the organization of environmental agencies and their relationships with subnational governments. Even though some of the Chinese environmental programs, as currently conceived, closely resemble those used in other countries, the institutional setting for policy implementation can lead to very different outcomes.

Because EPBs are an integral part of local government, and are mostly funded at the local level, their capacity to enforce environmental regulations is related to the workings of local government. EPBs rely on local government for financial and political support. Moreover, they are largely dependent on the cooperation of other government departments--some equal in rank and some with higher rank--to carry out regulatory programs. The implementation of environmental policy is greatly influenced by *Kuai Kuai* (territorial) relationships, especially after the economic reforms reached its full scale.

Since Chinese environmental protection is closely related to China's economic and political system, environmental protection policies have been strongly affected by recent economic and political reforms. The Chinese economy continues to grow rapidly, and the environmental regulatory system is struggling to keep pace with it. Finding ways to implement environmental policy, such as *prevention first*, in a reformed economic setting is *essential* for the future of china's environmental protection. The BTE program in Yunnan will serve as a good example for testing the policies.

To illustrate and better understand the complicated policy implementation process in China, we now turn our attention to the Yunnan BTE Program. The next chapter is a comprehensive analysis of the BTE Program in Yunnan Province with a specific focus on the Mengpeng BTE Project.

CHAPTER FOUR

THE YUNNAN BIOMASS-TO-ELECTRICITY PROGRAM

INTRODUCTION

This chapter examines the Biomass-to-Electricity (BTE) Program in Yunnan Province, China. First, the events leading to the program are reviewed. Then, the environmental and economic development situation in Yunnan is discussed. The results of the original program feasibility study are presented. Finally, the Yunnan demonstration project at the heart of the program is examined in detail.

The chronic shortage of energy and the deterioration of the environment are two of the most troublesome problems confronting the modern world. Economic development after the Industrial Revolution has relied on the consumption of ever increasing amounts of energy. Further development requires more energy still, and energy shortages will restrict further development. On the other hand, energy production has greatly damaged the environment. Soil erosion, caused by decreased forest coverage, and the greenhouse effect brought about by excessive burning of fossil fuels, cast a shadow on the future of the global environment (Mathews, 1991; National Academy of Sciences, 1990; World Commission on Environment and Development, 1987).

In August 1981, the United Nations convened a conference on new and renewable energy in Nairobi, Kenya. After the meeting, many countries around the world began to explore the development and application of new and renewable energy. Biomass energy, characterized by its great variety, large quantity and being renewable, occupies a more and more important role in the world of new energy and renewable energy. In fact,

biomass energy, being renewable, is not a new energy source. The problem is how to develop and use it more efficiently.

The earth has two main energy resources, namely, the energy contained in the earth and the energy emitted by the sun. The first is limited and non-renewable. The latter is renewable and almost unlimited. The energy from the sun (solar energy) can be collected through the photosynthesis of green plants. The development of biomass energy is an effective means of utilizing solar energy through plants. Conditions for developing biomass-to-electricity projects include long hours of daylight, a warm climate, ample rainfall, vast territory, and appropriate plant species. Yunnan province has all these conditions and hence it is an ideal place for developing biomass energy projects (Huang, et al., 1992). As such it offered an excellent opportunity for the creation of a viable model program of the sort required to implement a Chinese policy of *sustainable development*.

YUNNAN BTE PROGRAM BACKGROUND

The Yunnan Biomass-to-Electricity (BTE) Program was first proposed in 1989. The project was then called *the Study of Biomass Energy Development in Yunnan Province, China*. It was a *joint* research effort between China and the United States. The primary responsible American organization was the Oak Ridge National Laboratory (ORNL). Chinese participation was through the auspices of the Yunnan Environmental Protection Commission.

The ORNL has been studying biomass energy conversion for many years, and it is one of the world's leading research centers for biomass energy conversion technology. The Yunnan Provincial Environmental Protection Commission was connected to ORNL

though the Chinese National Environmental Protection Agency (NEPA). A joint research proposal was proposed in 1989. The project was initially organized and coordinated by NEPA.

Dr. Milton Russell, then a senior research fellow at ORNL and a former assistant administrator of U.S. Environmental Protection Agency, was the initiator the BTE Program in Yunnan. Accompanied by officials from NEPA, Dr. Russell made his first visit to Yunnan in July 1989. A Chronology of Events for the Yunnan BTE Program is provided in Table 4.1. Subsequent to this visit, Dr. Russell led several different research teams to Yunnan to investigate the viability of the BTE Program. This extensive, landmark research study was a joint effort of many Chinese and American organizations and institutions. The list of participating entities is indeed impressive:

A cooperative effort to investigate the prospects for use of plantation-grown biomass to generate electricity in Yunnan Province, People's Republic of China was begun in 1989. This cooperation has involved numerous parties on the U.S. side: the U.S. Department of Energy, the Oak Ridge National Laboratory, the University of Tennessee, the Rockefeller Foundation, and Winrock International. The Chinese efforts have been under the overall direction of the Yunnan Environment Commission and have involved the National Environmental Protection Agency, the Forestry Bureau, the Electricity Bureau, and the Planning Commission, the Science and Technology Commission, the Environmental Research Institute, the Academy of Forestry Research, the Provincial Institute of Forest Survey and Planing and local governmental departments of Chuxiong Prefecture, Yongsheng County and Baoshan City (Jantzen and Russell, 1992: 1).

Over a period of seven years, the BTE program in Yunnan was thoroughly investigated and studied. The international study teams conducted four site visits between 1989 and 1992. The team members included a variety of scientific and technical specialists. The program started with exploring the feasibility of using plantation-grown trees to generate electricity. In 1991, preliminary studies were done on two potential sites. In 1992, the conversion of sugar mill boilers to firing with wood chips was also

investigated. The findings revealed that the program was technically feasible and would not be particularly difficult or expensive. In 1992, the Joint Institute for Energy and Environment (JIEE) was founded with Dr. Milton Russell as the director. The Oak Ridge National Laboratory (ORNL), the Tennessee Valley Authority (TVA), and the University of Tennessee (UT) established the JIEE to conduct collaborative researches among the three institutions. JIEE implements joint activities involving people and facilities at all three institutions in areas related to energy, environment, and economics. Thereafter, the study of the BTE program in Yunnan was jointly executed by the JIEE in the U.S. and the Yunnan Institute of Environmental Science (YIES) in China. Out of a pool of 24 prospective sites, twelve priority sites were selected. Among the priority sites, two were chosen as *demonstration* projects: the Mengpeng Rubber Plantation in Mengla County and the Qina Sugar Mill in Yongsheng County.

THE BTE PROGRAM FEASIBILITY STUDIES

Yunnan lies in the southwest of China. It has an area of approximately 394,000 square kilometers and population of about 40 million. The terrain in Yunnan is quite varied, with elevations ranging from as low as 76 meters to as high as 7,6000 meters above sea level. Generally speaking, the landscape slopes downward from the northwest toward the southeast with many basins and lakes located among the mountains in between. The southeastern and western monsoons and the great variation in elevation combine to form highly variable local climatic regions within relatively short distances. These climatic regions in Yunnan range from the subtropical to the frigid. Precipitation is relatively high in much of the province, being over 1,000 millimeters annually in most

areas. These geological and climatic features lead to considerable biodiversity, particularly among plants, for which Yunnan is well known.

In Yunnan, about 87% of the total population live in the rural areas. Two-thirds are of minority nationalities. Yunnan has not yet reached the level of development of China's coastal provinces. In recent years, however, the economy has grown at a rate above the national average (Guo, et al., 1995).

As is true of most areas in China, Yunnan is suffering from a critical shortage of energy. Rural energy problems in the province have produced a pervasive environmental degradation from biomass fuel collection. In the household sector, the labor and effort required in the collection of fuel wood has prompted many of the rural poor to use inferior fuels (e.g., crop residues) and to cut back on basic energy needs. The unavailability and unreliability of electric power during the dry season has impeded industrial production and constrained the development of fledgling rural industries. For these commercial energy users, there are shortages and no economically viable substitutes. Coal is in limited supply in Yunnan. When it is available, coal is expensive because it must be transported over a constrained transportation system. There is considerable hydroelectric potential in Yunnan, but low-head hydroelectric power plants have highly seasonal output (due to monsoon conditions) and there is competition for water between energy production and irrigation needs. The prospects for developing large hydroelectric projects with dry season water storage are poor at for a number of economic and institutional reasons.

Energy is a driving force for social and economic sustainable development and also a necessity for the living of human beings. The energy shortage and unreasonable

use and development of biomass energy have caused serious degradation of the ecological environment and hindered the social and economic sustainable development of Yunnan province. It also made the protection of the rural environment in Yunnan very difficult.

In Yunnan province, the heavily rural population has a need for economic and social development. At the same time, the rural areas have great potential for the effective use of the biomass energy, which could fuel sustainable development. Therefore, the development and effective use of the biomass energy is of great important significance in the development of the energy resources in the vast rural areas of Yunnan.

A complete transportation system has been developed in the whole province and highway with a total length of more than 100,000 kilometers is the main transportation corridor. All of the counties and most of the townships, in the province are now connected by paved ways and some important stem lines have been improved and their transport capacity strengthened in recent years.

As of 1996, the annual energy consumption in Yunnan rural areas equaled 16.5 million tons of standard coal, which is 49% of the energy consumption of the whole province. The average per capita energy consumption in the rural areas is much lower, about 0.5 tons of standard coal, of which the commercial energy is only about 0.1 tons of standard coal. The national averages for per capita energy consumption and commercial energy are 0.7 and 0.3 standard coal respectively.

The components of the energy consumption in the rural areas in Yunnan are: firewood, 69%; coal, 12.4%; crop stalks and night soil, 12.3%; electricity, 4.2%; and others, 2.3%. Nearly all of this energy consumption, about 90%, is non-commercial and

primitive. The current structure of energy consumption cannot meet the needs for the development and modernization of the rural economy in Yunnan Province. The energy consumption in Yunnan's rural areas is embodied with the following characteristics:

1. Most of the energy consumed in the rural areas is used domestically in the form of burning firewood, which accounts for about 70% of the total rural energy consumption.
2. With the rapid social and economic development, the growth rate of energy consumption for industrial production is higher than that of domestic use, the former is 12% and the latter is 2-3% per year.
3. There is an urgent demand for commercial energy that is mainly in the form of electricity. The yearly increase rate of the demand of commercial energy is 20-30%, much higher than that of the overall increase rate of rural energy consumption.
4. The energy utilization efficiency is very low, and the waste of energy is very serious in the rural areas because of the undeveloped energy use methods and the outdated facilities.
5. In many rural areas, the demand on and the supply of the energy are unbalanced, leading to excessive abstraction of all kinds of biomass energy.
6. Being a mountainous province with 94% of the total land in mountainous areas, many rural areas face big difficulties in obtaining commercial energy because of the lack of large power grids. They have to rely on the development of small power stations.
7. At present, most of the small power stations are hydropower stations which depend greatly on the runoff during the raining seasons and cannot run all year round because of the significant difference in precipitation between raining and dry seasons (Guo, et al., 1995).

DEVELOPMENT TRENDS IN RURAL YUNNAN

Economic development, the improvement of people's living standards and the protection of the ecological environment are greatly hindered by the chronic shortage of energy in rural Yunnan. This is caused by the low efficiency of the energy consumption and the limited energy production capacity in rural areas. The effective supply of energy

in these areas depends on the sound development of the local energy resources and the effective use of the commercial energy on the basis of the market principles. The current trend rural Yunnan's energy situation consists of the following features:

1. The rapid development of the rural economy requires the development of rural energy and this must be accelerated. The total consumption of energy will be increased and components of energy consumption changed.
2. With the expanding rural population, increases in living standards, changes of the living style, requires the production of more, high-quality energy. This can be met by the development of new energy resources, advanced technologies in the utilization of biomass energy, and improved energy efficiency.
3. The number of township and village-owned enterprises increase at a rate of 30% annually. Therefore, the demand on commercial energy increases daily, especially for electricity.
4. With the relocation of labor, the construction of the market economy, and the reform of the management and administration mechanism of the town and village-owned enterprises, more diversity of energy resources and production will appear. The supply and the consumption of the energy in the rural areas will be more dependent on market forces (Guo, et al., 1995: 4).

Projection of Energy Demand in Rural Yunnan

Based on the average annual growth rates of the GNP (about 8-10%), the population, and the demand for energy in the rural areas in Yunnan during the 1990s, it is projected that by the year 2000, the energy consumption of rural areas will be 0.6 tons of standard coal per capita. Commercial energy will account for more than 40% of the total energy consumed. The total energy needed for all the rural areas in Yunnan will be more than 25 million tons of standard coal per year. By the year 2010, the per capita demand will increase to 0.8 ton of standard coal. The total energy needed for the rural areas will be more than 30 million tons of standard coal, of which commercial energy accounts for 70% of the total energy.

Domestic energy consumption currently accounts for more than 60% of the total energy use. But, with the rapid development of commercial energy, the conservation of domestic energy consumption, and the increased efficiency of biomass energy use, the present situation will change significantly. Soon, the gap between the supply of and the demand on the commercial energy in the rural will be even larger. The shortages of coal, oil and electricity will continue to exist. Therefore, the development of alternative energy resources will become the key task of rural development in Yunnan. Being renewable and plentiful, biomass energy is definitely a very good alternative.

In the development of rural commercial energy, rural electrification is the most viable approach. By the year 2000, 95% of the residents in the rural areas of Yunnan will have electricity supplied from the large provincial power grids, or from smaller local systems. Then, the proportion of electricity as a form of energy in the rural energy consumption will be increased greatly. And it is most likely that other kinds of energy resources will be replaced by commercial electricity.

In order to meet the requirements of the development of the national economy and the society, and to direct the exploitation of the energy resources in the rural areas of Yunnan, four *demonstration regions* are recognized by Yunnan provincial government. Their purpose is to carry out rural energy development demonstration projects. The demonstration regions are:

1. The region located in the valleys of three rivers (Jinsha River, Lancang River and Nujiang River), including 5 prefectures of Nujiang, Diqing, Lijiang, Dali and Lancang. This region is short of coal resource and the reliable energy resource will be mainly electricity and supplemented by firewood and other energy sources.
2. The region along the border areas including six prefectures of Dehong, Baoshan, Simao, Xishuanbanna, Wenshan and Honghe. This region is also

short of coal and the reliable energy sources will mainly be biomass energy supplemented by a rather limited coal resource.

3. The region in the northeast Yunnan including two prefectures of Zhaotong and Qujing and Dongchuan city. This region is rich in coal resource, which is the main energy source supplemented with firewood and biogas.
4. The region in the central Yunnan including two prefectures of Yuxi and Chuxiong, and Kunming city. The main energy sources of this area are coal, biogas, and liquefied petroleum gas supplemented with electricity and firewood (Guo, et al., 1995).

From the projections of energy demand and supply as these must support development efforts, we can see that the BTE program in rural Yunnan is in accordance with the market needs and the related government policies.

FAVORABLE BIOMASS PRODUCTION CONDITIONS

A Variety of Topography and Soil Types

Being a part of south-extended Qingzang Plateau, Yunnan is a mountainous province on a high plateau. The western part of the province is the region with high mountains and deep valleys of the Hengduan mountain Range running from north to south; the eastern part of Yunnan is Yungui Plateau; and the south is varied from wide valleys to medium and small hills. There are many basins and fault lakes scattered among the mountains in Yunnan province. The elevation ranges from 76.4 6,740 meters above sea level. The elevation of the east is about 2,000 meters, the western part 1,500-2,000 meters, the north 3,000-4,000 meters, and the southwest 600-1,000 meters.

Various Climatic Types

Being subject to the southeast and the southwest monsoons of the Northern Hemisphere, and the influences of its complex landforms, Yunnan has highly variable climatic conditions--ranging from the subtropical to the frigid. Generally speaking, Yunnan has very favorable climatic conditions in terms of sunshine, temperature, and rainfall, for biomass production. The average annual temperature difference is 10-12 centigrade. Most areas have an annual precipitation of more than 1,000 mm. The frost period is short and the southern part of Yunnan is frost-free all year round.

Vast Land Resources

Yunnan province has a total land area of 394,000 square kilometers, of which 94% is mountainous land. The forest coverage of Yunnan is 24.3%; the farmland area is 7% of the total; the uncultivated land areas are 45% of the total. The majority of the provincial population lives in the valleys. Yunnan has 16 different soil types with obvious characteristics of vertical distribution--red soil accounts for half of the total land and yellow soil for 20%. The soil with high fertility is about 20%; that with medium fertility 47%; and that with low fertility 32%. Again, the conditions are suitable for biomass production.

Plentiful Biomass Species

Known as the *Kingdom of Plants*, Yunnan has abundant plant species including all kinds of tropical, subtropical, temperate and frigid zone plant species. It is the province with most plant species in China. Of the 230,000 higher plants species recognized over the world at present, Yunnan possesses 18,000, being about 8% of the

world's total, providing great potential for the energy-producing development of the local plant species. It is also most suitable for the introduction of foreign species for energy production purposes as well. Yunnan has favorable conditions of viable climates, rich land, and abundant plant species resources, which provide a solid basis for the production of biomass and the development of the biomass energy (Guo, et al., 1995).

The Presently Available Biomass Resources in Yunnan

Sugar Cane

Sugar production is a major industry in Yunnan province. Being one of the three largest sugar bases in China, Yunnan produces one million tons of sugar each year. There are 340, 000 hectares of farmland with excellent natural conditions of high temperature, sunshine, rich precipitation and long growth period that are viable for the growth for sugar canes in Yunnan province. There are three major sugar cane plantation areas in Yunnan.

1. Southwest: this area covers 33 counties in 6 prefectures of Dehong, Baoshan, Lincang, Simao, Xishuangbanna and Nujiang with a total of 230,000 hectares farmland for sugarcane production.
2. Southeast: this area includes 20 counties in three prefectures of Honghe, Yuxi and Wenshan with a total of 67,000 hectares for sugarcane production.
3. The valley of Jinsha river: This area includes 9 counties in five prefectures of Lijiang, Dali, Chuxiong, Zhaotong and Dongchuang with a total of 40,000 hectares for sugarcane production.
4. Yunnan produces 10 million tons of sugarcane each year. Each ton of sugarcane can produce 0.21 ton of bagasse. So Yunnan produces 2.1 tons of bagasse each year, a small amount is used as raw material for paper production, most of which is used as fuel for the boilers in the sugar mills (Guo, et al, 1995).

Rubber Plantations

Being one of the three provinces with largest rubber production capacity in China, Yunnan started to build rubber plantations in the southern tropical areas in the 1950s. After 40 years, many large rubber plantations have been built in southern Yunnan. The total area of rubber tree plantations in Yunnan is now more than 130,000 hectares, 75% of which is located in the Xishuangbanna prefecture. The rest is found in the prefectures of Dehong, Lincang, Honghe and Wenshan. Half of the rubber trees have started to produce rubber. The output of rubber in Yunnan accounts for a quarter of the national total. Most of the rubber tree plantations are located in the relatively remote mountainous regions and half of them are owned and managed by State Farm Cultivation Bureaus. The rotation time of rubber trees is 30 years in Yunnan. Some trees that were planted in the 1960s are ready to be retired. Sawmills to make veneer boards and other kinds of timber will use a small amount of the retired rubber trees. The residues of the retired rubber trees can be used as biomass fuels to generate electricity. Since the rubber trees have to be rotated every 30 years, the rubber plantations can provide steady feedstock supply for the biomass-to-energy project (Guo, et al., 1995).

Plantation-Grown Energy Forests

In recent years Yunnan province has increased the investment in its forestry. It plans to plant trees on vast mountainous areas of 3.33 million hectares by the year 2000. These forests will mainly be used to provide shelter for farmland and firewood. There will also be some fruit trees to create extra income for local farmers. Therefore, the structure of the forests will be improved and the comprehensive benefits of the forestry increased. In accordance with the energy development plan for the rural areas of Yunnan,

large-scale energy forests with fast-growth, high-productivity, strong regeneration and high heat value will be constructed to meet ever-increasing energy demand of rural areas.

In the past a few years, some counties with plans to develop biomass-to-electricity projects have already planted trees for biomass energy. For example, Yongsheng County has started constructed energy forests near Qina Sugar mill, in which a BTE project is being planned.

THE SELECTED BTE PROJECTS IN YUNNAN

Based on their promising climatic and natural resource conditions, their conformance to the requirements of the plan designed Yunnan Provincial Planning Commission, the opinions of a team of experts in the fields of energy, forestry, and economics, 24 counties were chosen for participation in the BTE program. These counties qualified because, in short, they are rich in *reliable* biomass resources, lack fossil fuel power capacity, and cannot rely on hydroelectric power because of severe seasonal variation in the availability of water. Two general types of biomass-to-electricity projects were identified in Yunnan. The first is based on the conversion of sugarcane mills to cogenerate electricity and heat for on-site processing needs. This enables constant power production for export to the local distribution grid using bagasse and plantation-grown biomass. The second project-type is a stand-alone BTE project, which relies primarily on plantation-grown wood as feedstock (Guo, et al., 1995).

Because of limited financial resources, the Joint Institute for Energy and Environment (JIEE) team was unable to help the Yunnan Institute of Environmental Science (YIES) identify other potential types of biomass-to-electricity projects. Limited financial resources also meant that not all sugar mills, or counties, in the province were

evaluated for suitability. The JIEE and YIES teams therefore developed a simple and rational procedure to identify the best biomass-to-electricity projects. A two-step procedure was used. The first step was the initial screening. Here, a number of technical filters were applied to eliminate projects that were deemed currently infeasible, or impractical to develop. The filters include:

1. Unavailability of sufficient land located in the close proximity to the mill or stand-alone site to grow trees.
2. Counties where climatic and geographical conditions (e.g., low rainfall, elevation, slope temperature, etc.) are not suitable.
3. In the areas surrounding the mill or stand-alone site, there is no need for power. For example, there may be inexpensive hydropower available or these areas nearby to outside transmission grids or larger distribution grid.
4. Costs are prohibitively high to develop the facility or the project is too small.
5. The area is too remote and inaccessible, or there are few productive uses of electricity.
6. There is a general lack of interest at the local level for biomass-to-electricity projects, or there are no capabilities at the local level to manage and operate a facility even if the project is desired (Perlack, 1996: 5).

The outcome of the first step was a list of twelve prospective projects. Figure 4.1 shows the location of the projects. Preliminary *pre-feasibility* analysis was then undertaken for each site. From Figure 4.1, we can see that all the sites are located on the borders of Yunnan Province. This is the most underdeveloped area in the province.

These prospective projects all share the following characteristics:

1. They are all located in the southern and western Yunnan. 80% percent of the projects are located on the borders between China and Vietnam, Laos and Burma.
2. They are located between 21.2 to 27.05 degrees north latitude. Many kinds of plants can grow well and the natural conditions are viable for developing man-made forests.

3. These areas are economically lagging behind other parts of Yunnan and determined to catch up. They have made development plans according to natural conditions and government policies.
4. Because of the shortage of electricity, the price of power is rather high comparing to the level of economic condition.
5. These areas are not connected to the large provincial power grid. Power is transmitted by local grids, which receive electricity from small hydropower stations.
6. Finally, the local governments of these areas are supportive to the BTE projects. They want to have these projects built as soon as possible.

Table 4.2 is a list of the 12 selected BTE projects. It shows the names of the counties and prefectures where the projects are located. It also identifies the type of BTE facility (stand-alone or sugar mill conversion) for each project, and the distance from the provincial capital. There are four stand-alone projects, and eight-sugar mill conversion projects. These projects are away from big cities and major power grids. The distance from the nearest project to Kunming is 220 kilometers. The furthest one, Mengpeng Plantation is 900 kilometers from Kunming.

The major parameters of sugar mill conversion plants and stand-alone plants are listed in Tables 4.3 and 4.4. These parameters include locations, generating capacity, total investment, cost for electricity and net present value (NPV) of the selected BTE projects. These two tables show us the location, installed capacity and cost of each of the BTE projects. From the unit cost of electricity, they were all economically viable.

Table 4.5 summarizes the investment cost for upgrading sugar mills and for constructing new stand-alone facilities. We can see that both sugar mill and stand-alone facilities are sized at either 3 or 6 MW. Unit capital costs are lowest for the 3 MW sugar mills (under 2000¥/KW installed) and highest for the 6 MW stand-alone facilities.

According to Perlack, these costs are very low by U.S. standards. They reflect the use of local manufactured equipment. Annual operation and maintenance (O&M) is about 10% of installed capital for the stand-alone plants. It is slightly higher for the sugar mill conversions. The low installed costs associated with Chinese made equipment are however consistent with the assumed wood-to-electricity rates. They assume a net plant efficiency of about 12.5%. The annual wood feedstock requirements and cost assumed for each project are also summarized in Table 4.5. The statistics showed that the BTE program would have ample feedstocks. And the price raw material was rather cheap.

The feasibility of the BTE projects is dependent upon the number of KWH exported, sold to the local grid, and the purchase price of power. Table 4.6 summarizes the assumptions for these elements for each of the projects. Generally, plants are assumed to sell power to the grid for about 4500 to 5000 hours each year at prices ranging from 0.25 to 0.40 Yuan per KWH. The relatively low overall capacity factors reflect the fact that the plant would operate near full capacity during the cane crushing season, and at about 50% capacity during the remainder of the year. This is also the dry season when hydro resources are at their lowest availability. Power rates appear to somewhat flexible and are subject to local negotiation, especially during the dry season.

A financial summary (net present value, levelized cost of power, and internal rate of return) of the twelve projects is provided in Table 4.7. The projects are ranked in Table 4.8. In calculating these measures, a number of key and often simplifying assumptions were made. Many of the assumptions are rather conservative. They are:

1. First, the net present value and levelized cost of power was calculated over a 30-year time horizon using a real discount rate of 10%.

2. Conversion of sugar mills and construction of stand-alone facilities were assumed to be completed in one year. No financing was assumed (investment was charged completely in year one).
3. No secondary income was assumed from plantation operations.
4. Costs of wood feedstock are much lower than local firewood costs. Using market firewood prices would significantly lower financial performance measures for a number of projects.
5. For the sugar mill conversions, it was assumed that sufficient bagasse was available to meet on-site steam and power needs, and all purchased wood is used for export power. Usually, excess bagasse is available to meet some of the plant's fuel needs in the off-season.
6. Power plant designs are based on the availability of Chinese equipment and are probably sub-optimal. Heats rates for power plants are very low. Substantial wood fuel savings are possible especially when excess bagasse is accounted for.
7. Power purchase rates reflect what small-scale industrial and domestic users are currently willing to pay. No escalation of rates was considered. A tax of 5% was levied on all power sales.
8. On-site power needs were assumed to be 10%. An additional 10% of generation was assumed to be plant losses (Perlack, 1996:16).

The financial results in Tables 4.7 and 4.8 are highly sensitive to certain assumptions; especially those related electricity exported and power rates. However, the Mengpeng Rubber Plantation in Mengla County clearly outranks all other projects. The Xinping project is second on the net present value basis with Menghai and Baoshan somewhat less. The latter projects are sugar mill conversions. The relative rankings of the projects change somewhat on the basis of the internal rate of return measure. The Yongsheng Qina sugar mill conversion is followed closely by Menghai and Mengla. Each of these projects has an internal rate of return higher than 30%. Finally, on the basis of levelized cost of power, all plants are capable of generating power at costs ranging between 0.20 and 0.30 Yuan per KWH with the exception of Yongsheng

Manguohe stand-alone facility. Changes in the electricity sales price, wood cost, and capital cost can all affect the internal rate of return. The second step after conducting prefeasibility analysis was to rank-order the prospective projects to determine two projects that could be promoted as demonstration sites. For the two demonstration projects, American private sector involvement would then be actively solicited. The demonstration projects were Mengla and Yongsheng.

The feasibility analysis produced several projects possessing high current values and offering internal rates of return in excess of 30%. However, other criteria are potentially important in determining which projects are best suited for initial investment and development. To provide a more comprehensive ranking than one on the basis of financial performance alone, additional criteria were developed. These criteria included the size of the biomass resources base, a measure of power demand, and a measure of local capabilities.

Table 4.9 summarizes the four criteria that were used to rank the twelve projects. These are internal rate of return, biomass resources, local power demand and local capabilities. The internal rate of return and assumptions were discussed above. The other three criteria are also important for ranking the projects correctly. Biomass resources are the amount of wood feedstocks believed to be sustainable for power production. The power demand criterion reflects anticipated shortfalls in electricity supply or power needs that are likely to be unserved in the near future given expected economic growth. The fourth criterion is a local capability index that was used to rate each county for the capacity of local people to organize and implement a project. This index was difficult to develop. Given the time and resources available, all that could be done was to roughly try

to discriminate among the counties. As a result higher ratings were given to Mengla and Yongsheng counties. It was felt that these two counties had superior local capabilities relative to the other counties. The ranking is made operational in the following sequence:

1. Evaluate each project separately on each criterion (a 0-10 scale was used);
2. Assign weights to the criteria;
3. Aggregate the criterion weights and the single-criterion evaluations of the project to obtain an overall measure of value or worth;
4. Conduct sensitivity analysis; rank-order the projects.

The result of the ranking, under three alternative set of weights, is shown in Table 4.10. This set of weights was developed and applied by the staff of YIES. The results clearly show that the Mengla project prevails under each of the three weight sets. The Qina sugar mill conversion is second highest ranked project among the 12. If the weight on local capability is reduced relative to the other criteria weights, the Baoshan project becomes the second highest ranked project. Other weight sets did not produce substantially different results. Of course, reducing the weight of the financial criteria relative to the other weights would change the project rankings considerably. This was not done, however, as the financial criterion was deemed to be the most important of the four criteria.

Criteria for Selecting *Demonstration* Projects

Among the 12 selected BTE projects, two *demonstration* projects were chosen according to certain criteria. Eventually, the Mengla (Mengpeng Rubber Plantation) and Yongsheng (Qina Sugar Mill) were chosen as the demonstration projects. The role of the demonstration projects is to establish the feasibility of BTE projects in Yunnan. Their

success is essential to carry out other BTE projects. Therefore, they were selected because extensive analysis showed them to be the most promising projects; i.e., they could demonstrate that the BTE program could be brought to fruition. The detailed selection rules employed included:

1. Most obvious financial benefits: The financial benefit of BTE projects could best be represented by internal rate of return (IRR). The higher the IRR is the better the profit. Therefore, IRR of the demonstration projects should be the highest among the selected projects.
2. Most attractive investment settings: Investment settings include 1. Investment environment and policies; 2. Attitude and action of local government and related organizations of the BTE project. Therefore, the demonstration projects should have the most favorable investment environment and positive policies toward BTE project. Also, the local government and related organizations (including those performing reforestation, power plant construction and so on) should enthusiastically support the BTE project.
3. Most adequate infrastructure: adequate infrastructure here includes management and technical conditions; road and water supply, etc. BTE demonstration projects should have reliable managerial and technical organizations and staff such as in reforestation, wood chipping, and power generation; sufficient road and water-supply facilities; and established local grid (Guo, et al., 1995).

THE MENG PENG BTE PROJECT

Mengla County

The Mengpeng project is located on the Mengpeng Rubber plantation, Mengla County. Mengla County is located in the southern tip of Yunnan, on the border with Laos and Burma. It covers an area of 6,857 square kilometers with a population of 189,000. Mengla country is very mountainous; level land accounts only 3.6% of the total area. Mengla's elevation varies from 480 to 2023 meters from south to north. The Luoshuo and Nanla rivers, tributaries of the Lancang River, flow through the county.

Mengla has three climatic zones: the northern tropical, southern tropical, and central tropical. The yearly average temperature 20.7-21.5 degrees centigrade; average rainfall is in the range of 1290-2240 mm, and mean daylight time is 1856 hours. The average relative humidity is above 80%.

Due to its remote location and mountainous terrain, transportation facilities are not fully developed in Mengla. Highways are the main means of transportation. The distance from Kunming to Mengla is 865 kilometers, and from Jinghong--the capital of Xishuangbanna prefecture--to Mengla is 193 kilometers. The demonstration project in Mengla is located on one of the largest state-owned rubber plantations in Yunnan. The BTE project will be developed and owned by Mengpeng Rubber Plantation.

The Mengpeng Plantation

The Mengpeng Rubber Plantation is one of four state-owned rubber plantations located in Mengla County. It has about 10,000 hectares of rubber trees. This will be expanded to 12,000 hectares in a few years. The Mengpeng Plantation will retire approximately 400 hectares of mature rubber trees per year. Rubber trees normally reach maturity in about 30-35 years. After reaching maturity, they stop producing rubber. Then, the mature rubber trees will have to be cut down to make room for productive ones. The retired rubber trees will feed a new sawmill, which is under construction, and a stand-alone 6 MW biomass power plant, which will use the residue of the trees. The sawmill will use about 20% of the biomass harvested from the retired trees. The remainder will be used for the power plant. In order to reduce the cost of transportation, the power plant will be in close proximity to the sawmill.

The plantation has about 8000 employees, 700 have higher than secondary education. There is a good local power system. It is supported by hydroelectric power plants located on small rivers. The plantation also has diesel-fueled power generators with a capacity of 6 MW. These are used only during the dry season because the fuel is very expensive. The latent demand of power at the plantation and the county is large. For example, the sawmill itself alone will consume 0.6 MW when it is put into production. Also, economic development in Mengla County has been rapid over the past decade. The development of local industries, however, has been hindered due to the lack of electricity. As the living standards of the local residents improve, it is likely that they will consume significantly more electricity as they acquire domestic appliances.

The Mengpeng Rubber Plantation was founded in 1964. Since then, new rubber trees have been planted almost every year. The average actively producing plantation area is about 400 hectares per year. Based on a retirement age of roughly 30 years, there are 117.9 hectares of rubber trees, which were planted in 1964, soon to be out of rubber production. There will be 265 hectares of retired rubber trees by the year 2000 and 2702 hectares by the year 2010. The plantation now has 8 sub-farms and 131 production teams. In 1994, they produced 13,400 tons of dry rubber with sales revenue of 156 million yuan. According to the development plan, the plantation will be 2000 hectares larger than the current size by the year 2000. As a result, it is estimated that 400 hectares of rubber trees will need to be cut each year. The average biomass output is 125 ton/ha. Therefore, the plantation will produce 50,000 tons of biomass each year.

Electricity Consumption and Demand

The provincial power grid does not cover Mengla County, including Mengpeng Rubber Plantation. There are 15 small power stations with 25 units and an installed capacity of 2.5 MW. In addition, Mengxing Rubber Plantation, another a state-owned plantation in Mengla, has a hydroelectric station with an installed capacity of 3.2 MW. In Mengla County, the per capita electricity consumption is 66 KWH per year. This is among the lowest consumption rates in the province. The price of electricity is as high as 0.5 yuan/KWH in the dry season. Rapid social and economic development in the county will exacerbate the chronic electricity shortage. The Mengpeng Rubber Plantation currently draws most of its electricity from the station on the Mengxing Rubber Plantation. Due to the limited capacity of that facility, the area's commercial, industrial, agricultural and residential energy demands can not be satisfied. For rubber processing, the plantation has to use diesel generators occasionally. The cost of the electricity from diesel generation can be as high as 1.3 yuan/KWH. In order to relieve the shortage of electricity at the plantation and nearby areas, the Mengpeng plantation was planning to build a 15 MW hydroelectric power station. Since it is a run-of-the-river hydroelectric station, the generating capacity will be only 5 MW in dry season. Therefore, the future hydroelectric station can not relieve the shortage of electricity when the power is needed most--which is during the dry season

There is no indigenous source of coal in Mengla County. Coal has to be transported from other parts of the province. Therefore, it is not practical to build a coal-fired power plant in the county. The extreme seasonal variation in the water flow of rivers in this reason precludes the construction of large hydropower stations. The high

cost of the fuel makes the use of diesel generators practicable only in emergency situations. Therefore, it is essential for the plantation to find a reliable, cost-effective, long-term supply of electric power.

In the light of the natural conditions, which highly favor biomass production, the Mengpeng Rubber Plantation is an ideal site for a demonstration of the BTE program. The demonstration project could be built in conjunction with the sawmill under construction at the plantation. The sawmill is projected to generate about 7,680 tons of wood wastes annually. This would provide a stable fuel source for the BTE facility. The advantages of integrating the BTE facility and the sawmill operations are clear. The wasteful byproducts of processing lumber would become feedstock for the BTE facility and the mill is relieved of a major part of its waste disposal problem. Also, the sawmill needs steam to dry its products. If the BTE facility is built near the sawmill, its waste hot tail gas can be used as a heat source for the drying of the wood products. In these ways, the cost of the products and operation of the sawmill can be reduced.

If the tail gas can be used, The BTE project will be more profitable than a stand-alone project. The BTE project will first relieve the plantation of its chronic power shortage. Second, the plantation can sell the surplus electricity it generates to consumers in Mengla County and nearby Laos and Burma. Therefore, the potential power market for the BTE project at Mengpeng is large.

For the BTE project in Mengpeng, there is ample feedstock and a large potential market for the electricity produced. The next question is whether the project is economically viable when it is carried out. The following is more detailed financial

assessment for the project, which was carried out Yunnan Institute of Environmental Science (YIES).

Financial Assessment of Mengpeng Rubber Plantation BTE Project

Table 4.11 shows the equipment needed for the BTE project including quantity and price. This is a very comprehensive list of all the costs of the equipment, from pumps to boilers. The prices are all calculated in RMB (yuan). Table 4.12 itemizes the costs for each component of the power plant. The costs include construction, equipment and installation. The table also shows the each item's percentage of the total cost of the project. Table 4.13 shows the cost analysis of the Mengpeng BTE project. Table 4.14 itemizes project cash flow. The Internal Return Rate (IRR) is 20.87% with a simple investment payback period of 4.6 years. Even with the 10% increase in power cost and 10% decrease in power output, the IRR of Mengpeng BTE project is 11.7%, which is higher than the base rate of return (BAR) of 10% (Perlack, 1996). The feasibility study had showed that Mengpeng BTE project was very economically competitive. Even in the worst scenario, this project is economically viable. Besides the apparent economic advantage, there were also the obvious environmental benefits the BTE project would bring.

The feasibility study shows that the Mengpeng BTE projects has very strong ability to resist the risk from the changes in power production cost and power output, both of which are the most sensitive factors determining the financial aspects of the BTE projects. The implementation of the Mengpeng BTE project would firstly relieve electricity shortage at the plantation and Mengla Country in the future. Even if there were other power sources, the surplus could be sold to Laos and Burma, which also suffer

power shortages. So the potential of electricity market in local areas is large. (Guo et al., 1995) So far, we have reviewed the feasibility studies on Mengpeng BTE projects concerning feedstocks, economic viability and electricity market. All of the study results had shown that Mengpeng BTE project was ready to be implemented by 1995.

YUNNAN BTE PROGRAM--BEYOND THE FEASIBILITY STUDIES¹

When the feasibility study phase of the Yunnan BTE Program approached its conclusion, attention turned toward project implementation. The first step in implementation took the form of a conference held in Knoxville, Tennessee in July of 1995. The American location signifies the importance of American support for the program.

The conference was organized as a *workshop* under the auspices of the JIEE. It had two major purposes: First, the meeting exposed representatives of the relevant Chinese organizations to the American experience in, and expertise with, biomass-to-energy projects. Second, the workshop presented the Yunnan BTE program to American companies that might be interested in investing in the program. The Yunnan Provincial Government sent an official delegation to the workshop. The six delegation members included representatives from the Yunnan Provincial Economic and Trade Commission, the Provincial Planning Commission, the Mengpeng Rubber Plantation, the Yongsheng Electric Corporation, and the Yunnan Institute of Environmental Science (YIES). There were six American companies participating in the workshop, including large companies such as General Motors Corporation, Bechtel, and Westinghouse.

¹ The author worked as interpreter at the workshop. The information provided below based on the author's direct observation unless otherwise noted.

The composition of the Chinese delegation members showed that the Yunnan Provincial Government was serious about the implementation of the BTE program. The delegation members included the managers of the proposed demonstration projects as well as officials of government departments. The project managers were Mr. Zhou Bingsheng of the Mengpeng Rubber Plantation and Mr. Duan Kezhen of the Yongsheng Power Corporation.

The three-day workshop started with a project background briefing by Dr. Milton Russell of the JIEE. Dr. Russell, who was a leader of the American contingent of the joint implementation team, reviewed the successful six-year effort to design and evaluate the feasibility of the Yunnan BTE program. Next, the head of the Yunnan delegation, Mr. Wang of the Yunnan Economic and Trade Commission, provided an overview of the investment conditions and business environment in Yunnan. Then, Mr. Guo and Mr. Li of Yunnan Institute of Environmental Science, which carried out the feasibility studies for the various proposed BTE projects, provided a comprehensive review of each of the proposed projects. They gave special attention to the Mengpeng and Yongsheng projects. Mr. Zhou, of the Mengpeng Rubber Plantation, and Mr. Duan, on behalf of the Qina Sugar Mill, also made presentations. After the presentations of the Yunnan delegation, Dr. Robert Perlack, an economist at ORNL who had been studying the program and visited several BTE sites in Yunnan, assessed the Yunnan BTE Program from a point of view of a foreign expert. Dr. Bill Barron, an environmental economist of University of Hong Kong who personally visited Mengpeng Rubber Plantation and studied the BTE project in early 1995, also briefed the workshop with updated slides of the Mengpeng Rubber plantation.

The workshop was well organized and proved a very encouraging event for those promoting the Yunnan program. The presentations given by the Yunnan BTE Delegation were well received. Among the American companies attending the workshop, two companies, Bechtel and Energy Performance Services, Incorporated (EPS) displayed great interest in the BTE projects in Yunnan. Indeed, EPS invited the Chinese delegation to their headquarters in Philadelphia. EPS is a Pennsylvania based corporation. Its expertise among others includes innovative energy conservation technologies and energy and energy projects financing.

After the workshop, the delegation visited the headquarters of EPS in Philadelphia, Pennsylvania. It also visited several BTE facilities in the U.S. At the headquarters of EPS, the delegation held a preliminary talk with the EPS officials about the BTE joint venture in Yunnan. According to the delegation, the Yunnan Provincial government would support the joint venture. It promised as well to assure a favorable business environment for implementing the program. EPS agreed that the Mengpeng BTE demonstration project would be the first joint venture. The Chinese partner for the joint venture was the Mengpeng Rubber Plantation. Both sides had agreed that the formal negotiations about the joint venture would be held in Yunnan in the spring of 1996.

The Yunnan delegation's visit to the U.S. turned out to be a tremendous success. It elevated the Yunnan BTE Program to the final stage-actual implementation. An important component of this success was the feasibility studies which showed the BTE projects in Yunnan to be sound from both technological and economic perspectives. EPS

was also pleased with the business environment described by the delegation. As summarized in the workshop report:

The business environment in Yunnan is encouraging and flexible. The Yunnan people want biomass electricity plants if they can get them with foreign investment. The size of the investments is such (less than \$30 million and 50 MW) that the deals can be made strictly at the provincial level. Any reasonable arrangement will be entertained from a simple loan to a build, own, operate type of contract. There is no cap on profits as long as Chinese partners can share. In fact electricity is such a priority that the US partner would be allowed to get a larger profit since Yunnan will get the electricity. Also, biomass electricity is considered environmentally preferred so profits will be taxed at a lower rate. There is no problem with repatriating the investment in US dollars and the taxes or fees for doing so are negligible. The price paid for electricity is set more or less at the local level. It can be set to ensure a good profit with speedy payback (JIEE, 1995: 8).

The interest of the American firm, EPS, is easily understood given the business climate described above.

CHAPTER CONCLUSION

In this chapter, we first reviewed the initiation and development of Yunnan BTE program, and the natural and economic conditions of Yunnan province. The natural and economic conditions showed that the BTE program was suitable to Yunnan. Then we analyzed feasibility studies of Yunnan BTE program. Finally, a more detailed review of Mengpeng and Qina BTE projects was provided. According to the feasibility studies, Mengpeng and Qina were the two most favorable projects among the twelve selected BTE projects.

Up to this point, all signs showed that the Yunnan BTE Program would be implemented soon. The Mengpeng Rubber Plantation would carry out the first BTE project in Yunnan. As we have discussed above, the feasibility study showed that Mengpeng met all the requirements for successfully carried the first BTE project. And

this project was apparently greatly supported by Yunnan government. Would the joint venture be carried out as planned? Are there any constraints for implementing a joint venture such as this one? To answer these important questions we will examine the Mengpeng BTE project in more detail in the next chapter.

CHAPTER FIVE

MENGPENG: AN UNFINISHED STORY

INTRODUCTION

This chapter chronicles the story of the effort to implement the demonstration project at the Mengpeng Rubber Plantation. This project was one of the two BTE demonstrations chosen for implementation from among the sites studied for the Yunnan Program. As we discussed in Chapter Four, the successful implementation of the demonstration projects was essential for the future of the program. Program promoters expected to gain valuable experience, and expertise, from the demonstration projects. They hoped to apply the lessons learned at Mengpeng to other BTE projects. They also hoped to impress national and subnational Chinese leaders with a successful model of sustainable development.

The exhaustive feasibility studies showed that the Mengpeng project was technologically possible, economically viable, and environmentally beneficial. In this chapter, we examine the Mengpeng Rubber Plantation as a demonstration site and explain what happened to the project there. Special attention is paid to the social, political, and economic aspects of the plantation and their impact on the project. Then, we analyze the joint venture negotiations and the actors involved in them.

MENGPENG'S SELECTION

The Yunnan BTE research endeavor started in 1989, but the Mengpeng Rubber Plantation did not become a candidate project until quite late in the site selection process. This was due to a shift in the nature of the sites being studied. For the first a few years,

the BTE research in Yunnan focused on the study of *plantation-grown forests*. The 1991 Study Report summarizes the initial intention of the Yunnan BTE research projects:

The purpose of this project [BTE program] is to explore the feasibility and desirability of plantation, short-rotation tree, fueled electricity production in Yunnan Province and, if appropriate, to facilitate the initiation of an enterprise utilizing this technology (Russell and Shen, 1991: 2).

When the researchers learned that retired rubber trees could be used as feedstock, the Mengpeng site soon emerged as a highly promising candidate. The most attractive feature of the Mengpeng site was its vast, readily available, long-term supply of potential biomass feedstock—the retired rubber trees. Therefore, in the final iteration of the long series of feasibility studies, Mengpeng was chosen as one of the two BTE demonstration projects. Indeed, Mengpeng was viewed as the better of the two demonstration projects.

In March 1996, just a few days before the joint venture negotiations between EPS and the Mengpeng Rubber Plantation opened in Kunming, China, the JIEE study team, Dr. William Fulkerson, senior fellow and Qingguo Gao, graduate research assistant of JIEE toured the Mengpeng Rubber Plantation. Dr. Russell was not able to make the trip to Mengpeng due to a time conflict with a meeting in Beijing. The study tour, which was organized and supported by YIES and Mengpeng Rubber Plantation, aimed at learning more about the Mengpeng BTE project at first hand. Mr. Weimin Yang, deputy director of YIES accompanied the JIEE team to the plantation. The study team visited rubber farms and the BTE project site at Mengpeng. The leaders of the plantation briefed on the economic and energy situations of the plantation. The trip to Mengpeng strongly reaffirmed the conviction of the JIEE team that the Mengpeng plantation was an ideal site for the first BTE project in Yunnan. The following is a brief overview of the trip; it will

help us learn more about the geographical, economical and cultural conditions of Mengpeng Rubber Plantation.

PERSONAL IMPRESSIONS OF MENG PENG

The Mengpeng Rubber Plantation is located on the southern tip of Yunnan Province. Some of its rubber farms are on the borders between Laos and China. To get to the plantation the JIEE team took an airplane from Kunming to Jinghong, the capital city of Xishuangbanna Prefecture. From Jinghong it was a six-hour automobile trip to Mengpeng. Although Jinghong is the capital of Xishuangbanna prefecture, and a major tourist attraction, the city was far from developed. The airport was small and rather shabby. Passengers were asked to pick their luggage right beneath the airplane when we arrived at the airport. Two young men from the plantation greeted us when we were checking out at the gate.

We were told that the distance from Jinghong to Mengpeng is 200 kilometers and the road condition is not very good. However, we were very much relieved when we saw the vehicle that would take us through the mountainous roads. Our guides from the plantation Mr. Zhang, secretary to Manager Zhou and Mr. Lin, the manager's personal driver took us to an almost brand new Toyota Land Cruiser. It was parked in an almost empty parking lot with chickens and ducks roaming around it. Mr. Lin chased the chickens away and put our luggage into the Cruiser.

When we were in the jeep, I told Mr. Lin that I liked his fancy Land Cruiser very much. I thought that Dr. Fulkerson, our team leader, was also impressed by our transportation. Mr. Lin smiled and replied modestly, " Thank you. We just got it half a year ago". "Are cars in this region more expensive?" I asked. Mr. Lin smiled again and

said: "Yes. But this is a *smuggled* car. We paid only half a million yuan." The exchange rate was 1: 8 when we were in China in 1996. Therefore, half a million yuan is a little over sixty thousand US dollars. Automobiles in China are extremely expensive compared to average income. Only the "very rich people" could afford private cars. Therefore, most of the cars running in China belong either to big companies or government agencies. The Chinese government urged government officials to use relatively inexpensive domestic-made cars. But in practice, very few government officials pay attention to the central government's regulations. They normally try to obtain the most luxurious and expensive vehicles since a decent transportation is an effective way to impress people. So the question is how to avoid these bothersome government regulations to purchase luxury automobiles. The most popular slogan in China, however, has been that "where there is a policy above, there is a countermeasure below." Anyway, we were indeed impressed by the new Land Cruiser. Apparently, Mengpeng did well in the "car games."

Even though it was March, the weather in southern Yunnan was warm. We were glad we could enjoy air conditioning in the luxurious Land Cruiser. But we had to cruise very slowly; we were travelling along a one-lane road and it was very narrow and bumpy. And, we had to share the road with water buffaloes and pedestrians. Mr. Lin was indeed a super driver (Dr. Fulkerson gave him the nickname after we arrived at the plantation that evening). For many times, my heart almost stopped beating when the Cruiser's bumper was only inches away from an animal or a person. At last, I gave up worrying. I tried to convince myself that Mr. Lin just wanted to show off his driving skills and had no

interest of hitting anyone. And I was right; we arrived at the plantation safely after six hours of rough travel.

On the way from Jinghong to Mengpeng, the natural beauty of Xishuangbanna stunned us. Several sections of the road cut through tropical forests. The weather in Mengpeng was even warmer than in Jinghong. The area was very green; flowers were blooming even though it was early spring. The mountains were decorated with patches of the white clouds and heavy mists. It was the middle of the dry season. The rivers surrounding the mountains were low and ran clear. The enthralling beauty of the region reminded me of a popular novel I'd read as a little boy. The novel, *Songs from the Borders*, told the story of a group of young people from big cities that were sent to Xishuangbanna to build rubber plantations during the Cultural Revolution. Apparently, the novel was based on real stories of frontier life as experienced by the transplanted young city intellectuals. Because the book was written during the Cultural Revolution, the author draws a romantic picture of the experience of these young people. It depicts city kids who were thrilled to be so close to nature. The life depicted is idyllic: The youths drink pure spring water when thirsty and eat wild fruits when hungry. They make wreaths of wild flowers for lovers. They gather peacock feathers in the forests to decorate their rooms. As I recalled the novel, and was struck by the beauty of the region through which we drove, I wished that I could meet its characters at the real plantation. But, notwithstanding the accurate depiction of the region's natural beauty, in truth the life of the real workers on the state farms was far from idyllic. Existence for the real pioneers who built the plantations was extremely hard when they first arrived.

As other rubber plantations in southern China, the Mengpeng Plantation was founded in the late 1950s. When the plantation was first established, most of the employees were from other parts of China. As the novel depicted, they were a bunch of young people with "revolutionary ideals." They were young, energetic and, to some degree, fanatic. They came to the borders and remote areas of the new republic to respond to the call of Chairman Mao. A very popular slogan at that time was "Go to the countryside, go to the borders, where you will create a brand new world." These young people were determined to dedicate their youth, even their entire lives, to the building of the rubber plantations. Their dreams came true when the plantations began producing thousands of tons of rubber years later. Many of the young city intellectuals remained to become plantation leaders and model national workers. They are proud for what they have done for the country.

The Mengpeng Rubber Plantation remained largely isolated from the outside world until the mid-1990s. The plantation had 8,000 employees in 1996, not including retired workers and family members. Since the majority of workers lived at the plantation with their families, the Mengpeng Rubber Plantation community actually had a population about 20,000. Most offspring of the older plantation workers chose to follow their parents' footsteps. The current manager of the plantation, Mr. Zhou is the oldest son of the former manager, Old Zhou. Even though he was relatively young compared to other leaders of the plantation, he was very much respected due to the fact that he is the son of Manager Old Zhou.

For about thirty years, the life style at the plantation changed very little. Many traditions of the 1960s were still kept. The delayed change was to some degree due to the

fact that the plantation is far away from the political center. In Chinese history, Yunnan had always been viewed as one of the outer frontiers of China due to its physical distance far away from the political centers. The economic reforms in the early 1980s did not have any significant impact on Mengpeng until the 1990s. Perhaps the leaders of plantation did not want to give up their long-held ideals that carried them through life for so many years. Even in the 1990s, visitors from outside could still feel the political climate was somewhat different from other parts of China. While staying at the plantation in 1996, we experienced the remnants of something that was unique during the Cultural Revolution, which is lost from most of the rest of the nation.

During our stay at the plantation, we were awakened each day by loud music pumped from loud speakers mounted on utility poles near the hotel. This was the reminiscence of life in China more than two decades earlier. At that time, loud speakers were ubiquitous; they blared constantly throughout communities--at schools, factories, farms, and public buildings. The loud speakers were mainly used to propagate government policies and revolutionary slogans. They were also used to remind people the coming events in the community and to play revolutionary music. Each morning at Mengpeng was a reminder of the horrible "old days" of the Cultural Revolution. But it was not the same. The music coming out of the speakers now were popular songs and classical music. No longer were they the songs of the revolution—but they were broadcast just as loudly as in the old days. Nowadays, the music was not for the promotion of revolutionary zeal; it was played simply to awaken the workers at the plantation who had to rise early to gather rubber from the trees. Things had changed in

China and they were changing in Mengpeng—but the hard work and long hours remained the same.

The aging leaders, who in their revolutionary zeal had cut the plantation out of the wilderness, gradually realized that their ways of thinking and doing business had lost their power. Now, even to maintain a modicum of self-sufficiency, they had to merge with the outside world. In our conversations with Mr. Liu, general secretary at the plantation, we could see his reluctance to surrender his long-held socialist doctrine.

Our plantation is just like a big family. We take care of each other. Unlike you western companies, we do not lay off our employees. Also, unlike your young people who often get involved with drugs and violence, our young people here all behaved well.

On the other hand, the leaders of the plantation increasingly saw that the plantation could not isolate itself from the outside world anymore. They knew the only way to catch up with the outside world was through economic development. They recognized as well that this had to be done as soon as possible. The region was already lagging behind many other areas of China. To develop its economy, and raise the living standard of the people at the plantation, Mengpeng needed ample and inexpensive power for industrial and residential use. During the dry season especially, the power for rubber processing comes mainly from plantation's diesel generators. This is very expensive. On this matter, even the proud Secretary Liu had to put away his pride. He said to Dr. Fulkerson, the JIEE Team Leader:

We are grateful that you can help us to build this BTE project. It will help our people greatly in many ways. We need power for rubber processing, sawmill, schools, hospitals and household appliances. We believe in your advanced technology even though we do not know much about it. We also need your financial support as well as technological support because we are determined to improve the living standard of our workers.

The lack of electricity had greatly impeded the plantation's economic development. The use of electricity, especially during the dry season, is rationed for industrial as well as residential use. Normally, electricity was supplied only during the first a few hours in the evenings. Although air conditioners and refrigerators were very much desired by local residents, they had to be put away during the dry season. Even during the rainy season, electricity supply was not always reliable.

While staying at the well-equipped hotel at the plantation, we experienced the inconvenience of rationed electricity at first hand. And, we learned this the hard way. When we were checking in the first day, the receptionist told us to store a basin of water in the evening before going to bed. This was in case there was an outage of water. At first, I did not quite understand the need for this precaution. Later that night, I woke up amid unbearable heat and humidity. I thought the air conditioning must have been shutdown. I tried to turn on the lights to check the air conditioner, but the light did not work. Finally, I realized that there was complete power outage. Intending to wash my face with some cool water, I felt my way through the dark into the bathroom. But there was no water coming out from the tap. The community water pumps were also not working due to the power outage. Thereafter, I always stored a basin of water before going to bed.

As a state-owned enterprise, the plantation is supposed to be responsible for the well being for all the people living on the plantation. The plantation provides housing for employees according to the positions they hold. A manager of a production unit may have a three-bedroom apartment. On the other hand, a new single worker may have to share a one-bedroom apartment with another new worker. The plantation also provides

free elementary and secondary education for the children of its employees. The plantation's hospital is capable of treating most of illnesses and performing general surgery. The plantation solely funds the schools, the hospital, and other community facilities.

Before the economic reform, people at the plantation normally lived a higher standard of life than that of local farmers outside the plantation. As the economic reform progressed, however, many farmers living in nearby villages got rich quickly. People at the plantation realized they were falling far behind those outside the plantation's boundaries. The situation, they knew, would only worsen if they tried to keep the status quo. Young people started looking for other greener pastures. The economic security and priority of state-owned enterprises lost heavily in the transition from the planned economy to the so-called socialist market economy.

Under the planned economy, the government bought all the rubber the plantation could produce. Under the socialist market economy, however, the plantation had to sell its rubber in the competitive domestic and international markets. This transition was not necessarily a bad one. It meant that sometimes the plantation could sell its rubber at a much higher price than that previously stipulated by the government. The other side of the coin, however, was that they would hardly sell any rubber when the market was not good. In order to survive in a market economy, the plantation had to modernize and diversify if it was to assure profitability. For example, the plantation was building a hotel at Jinghong as an investment in the growing tourism industry in Xishuangbanna. The plantation was also planning to invest in other industries such as timber and food processing by utilizing local resources.

The chronic lack of electricity was a monumental hurdle for further economic development at the plantation. During the dry season, when power supply was short and power demand was high, they had to use diesel generators to run the rubber processing equipment. The cost of diesel power could be extremely high since the diesel oil had to be transported from far away. Therefore, the plantation had no other choice but looking for alternative energy sources in order to obtain a stable power supply. The most practical and viable energy sources at the plantation were hydroelectric and biomass. Hydropower was very popular in southern Yunnan due to its rich water resources. In fact, most of the electricity for southern Yunnan came from small hydroelectric stations scattered around the region. As we have discussed above, the major problem with hydropower in this region is that it is extremely seasonal. Because almost all of the small hydro stations rely on river flow, they could generate only a portion of the installed capacity, or even stopped operation entirely, during the dry season.

Biomass (BTE) energy is another promising alternative, especially during the dry season. Since BTE operations do not rely on river flow, electricity could be generated from the facility throughout the year. Unlike hydroelectric power, however, biomass energy was new to most people when it was first introduced. In fact, many people had never heard of BTE technology before. If the BTE project was proven to be superior, and received government support, the decision-makers at the plantation might choose to build the BTE facility rather than a hydroelectric power station. On the other hand, if they believed the BTE project was too risky, they would pick up the hydropower alternative with which they were more familiar. Years of experience in managing within the

planned economy had ingrained a strong sense of risk aversion. This attitude created a certain liability for the BTE project as a new technology.

During our three-day stay at the plantation, we learned a lot about the BTE project and the plantation through talking to leaders and workers of the plantation and taking field trips. Since the study team was there to study the condition of the BTE project, we were taken to see the site of the future BTE project and the rubber tree farms that were ready to retire, which would eventually be used as feedstocks for the BTE power plant. The BTE project was to be located in the center of the plantation camp near a small creek. It would be next to the sawmill that was under construction when we were there. Manager Zhou also showed us the newly arrived equipment for the sawmill. Even though the majority of the equipment was domestically made, some key components were imported from Germany. Mr. Zhou told Dr. Fulkerson that the BTE project could adopt the same model concerning the procurement of equipment. That was to rely on the domestic manufacturers to supply the equipment and import only the critical components that China could not make. This would greatly reduce the initial cost of the project.

The rubber trees that were to be retired were planted in the early 1960s, mostly located in the northeastern part of the plantation. These were among the first rubber trees grown in Yunnan province. The retired rubber trees would first be processed into timber at the sawmill; the residues and sawdust would be used as the feedstock for the BTE power plant. On the other hand, the power plant would provide steam for lumber processing at the sawmill. That was why they were to be built next to each other. And the creek running by could supply water for both the sawmill and the BTE power plant.

The plantation also had a transportation department that maintained a fleet of trucks and tractors. These trucks and tractors were used to transport rubber and supplies during rubber production season. They could be used for transporting raw material for the BTE power plant. Mr. Zhou also showed us the repair shop of the plantation. On the third day at the plantation, the study team toured the plantation's middle school and hospital. The study team's general impression was that the plantation had a well-established infrastructure and well-trained workforce. All the signs showed that the BTE project would be a successful endeavor that could greatly benefit the plantation and the local region.

THE FINAL IMPLEMENTATION NEGOTIATIONS

The implementation of the Mengpeng demonstration project was envisioned as a joint venture between the Americans and the Chinese partners. The negotiations for the joint venture were carried out between representatives of the Mengpeng Rubber Plantation and the American firm, Energy Performance Services (EPS). In reality, there were several other organizations in a position to significantly affect the negotiations. Some organizations were close to the principals, other were quite remote. In any event, all played roles in the project implementation process. As we shall see, the relationships among the players tended to be subtle and complicated. It turns out, there were many Mothers-in-law for the Mengpeng BTE Project—indeed too many. In order to understand the Mengpeng implementation process, it is essential to learn about the players. Therefore, before discussing the negotiations, it is best to identify the key players—those behind the scenes as well as the negotiators themselves.

Players Affecting the Mengpeng Project Negotiations

Entities involved in Yunnan BTE Program can be divided into three categories- *environmental*, *non-environmental*, and *foreign*. Figure 6.1 shows the institutions involved in the project and the relationships among them. Institutions within the Chinese environmental system included the National Environmental Protection Agency (NEPA), the Yunnan Environmental Protection Bureau (YEPB), and the Yunnan Institute of Environmental Science (YIES). The non-environmental institutions included the Yunnan Provincial Bureau of Forestry, the Yunnan Provincial Economic and Trade Commission, and the Yunnan Provincial Planning Commission.

The two foreign organizations were the JIEE, and Energy Performance Services (EPS). Although JIEE had played a very important role for the initiation and feasibility study phase of Yunnan BTE program, it did not directly get involved in the negotiations of Mengpeng BTE project. Its role was more an observer and consultant than a decision-maker. Before the negotiation started Dr. Russell explained to Yunnan hosts that JIEE in collaboration with YIES had successfully completed its work on the Yunnan BTE program. This included research into the biomass feedstock potential particularly those afforded by the massive afforestation in progress in Yunnan, evaluating the technical and economic feasibility of biomass to electricity conversion for both stand alone and sugarmill cogeneration technology, and organizing the trip to the U.S. by Yunnan officials and the return visit to Yunnan by EPS. Having brought the parties together JIEE became an interested observer prepared to help if requested (JIEE, 1996: 2).

EPS was the key foreign player in the negotiation. It was EPS that would negotiate with Mengpeng Rubber Plantation and make the final decision. As a financing

company, EPS would find investor(s) in the U.S. to finance the project. Therefore, it was essential for EPS to have a favorable contract in order to impress and attract potential investors.

Two other important Mothers-in-law with a stake in the outcome of the negotiations were the Yunnan Provincial Bureau of State-owned Farms and the Bureau of Electricity. Although these two organizations did not send representatives to observe the negotiation, they both influenced the outcome of the negotiation greatly, which we will discuss in more detail later.

The National Environmental Protection Agency (NEPA) was the initiator of the Yunnan BTE Program. But as we have discussed in previous chapters, NEPA's influence on the Yunnan Program grew more and more remote as the feasibility research progressed. By the time the BTE projects reached the implementation phase, NEPA was almost out of the picture. But NEPA remained at the top of environmental system; it could still influence the project indirectly through its influence with the Yunnan EPB and YIES.

When the initial stage of the BTE feasibility research was getting underway, NEPA gradually transferred oversight responsibility to its counterpart in Yunnan—the YEPB. The YEPB was the first provincial organization to be involved in the prospective program. Thus, when Dr. Milton Russell first visited Yunnan in 1989, it was the YEPB that hosted his tour. The YEPB also hosted several subsequent visits by the international support group's study teams. The feasibility studies themselves, however, were carried out by YIES. YIES has a certain degree of status as a national institution conferred because it is a part of China's Academy of Environmental Science system. It,

nevertheless, is viewed as subordinate to the YEPB because YIES is located in Yunnan. Both organizations belong to the national environmental system, but they are not organizational equals. Therefore, the YEPB (at least in theory) was the Chinese partner for the BTE research and feasibility studies. YIES (in actual practice) served as the agency managing the project. Organizational status and formal power relationships notwithstanding, the most critical institution for the BTE feasibility research effort was YIES. Since the first study team of American experts visited Yunnan in 1990, YIES had worked closely with the international study teams. In fact, YIES, in coordination with the JIEE, designed and organized the BTE research effort. The feasibility studies were actually carried by the scientists of YIES. YIES remained highly influential well into the final stages of the feasibility work. It was a major factor for the progress that made the joint venture negotiations possible. Unfortunately, because of the constraints of institutional settings, YIES was not able to influence the outcome of the proposed joint venture, which we will discuss in more detail later in this chapter.

Outside the environmental system, other provincial departments involved in the BTE projects included the Forestry Bureau, Economic and Trade Commission, and Planning Commission. The Yunnan Electricity Bureau was involved at the very early phase of the BTE research. But it was not included at the project implementation phase. The Forestry Bureau's involvement also occurred in the early phase of the BTE research. As we have discussed, the BTE research effort was first focused on the plantation-grown forests. The Forestry Bureau was the provincial department that was in charge of forestation in Yunnan. As the BTE research shifted from plantation trees to bagasse and rubber tree residues, the Forestry Bureau's influence in the project diminished. In

contrast, the Economic and Trade Commission and the Planning Commission got involved with the BTE projects at the later stage of the feasibility studies. Their influence at this stage was significant. In order to implement any economic development project—especially a joint venture such as that envisioned for Yunnan, the approval of the two commissions was required.

The Joint Institute for Energy and Environment (JIEE) played an essential role in the BTE research endeavor. JIEE was not the *first* foreign institution got involved with the Yunnan BTE research. In fact, the research project started before JIEE was formed. Scientists and other professionals at the Oak Ridge National Laboratory (ORNL) first managed the joint research effort before JIEE was established. When JIEE was created as the joint research facilitator among Tennessee Valley Authority (TVA), The University of Tennessee (UT), and Oak Ridge National Laboratory (ORNL) in 1992, the Yunnan BTE research project fell within the responsibilities of the new American institution. The transition was smooth and work was uninterrupted because the initiator and organizer of the joint research, Dr. Milton Russell, was appointed as the director of the JIEE. Following the establishment of JIEE, the BTE research project moved forward with dispatch. The JIEE provided not only expertise concerning BTE research, but also funding for the feasibility studies. Unfortunately, JIEE is a research-oriented institution. While very influential in the design and study phases, its influence on the BTE projects at the implementation stage proved very limited.

Energy Performance Services (EPS) was the American company that would actually implement the BTE projects in Yunnan. As a for-profit company specializing in energy and environmental projects, EPS seemed a perfect match for the Yunnan BTE

program. EPS proved very cautious about investing in China. The Chinese, in turn, were cautious about their exposure to risk. Thus, both sides agreed that the Yunnan Program would proceed on a limited basis; the Mengpeng BTE project would be established first as a *demonstration* project. If Mengpeng were successful, they would proceed with the other projects. Upon that, the principals in the joint venture then turned to negotiating the details of a final agreement for implementation.

The Kunming Meeting

The three-day negotiations started in Kunming, China on March 25, 1996. The negotiations were between EPS's Vice President Dan Witcher and the representatives of the Mengpeng Rubber Plantation led by Mr. Zhou, the general manager of the plantation.¹ A company consultant, Mr. C. H. Zhang, accompanied Mr. Dan Witcher. Other attendees at the negotiations were representatives of various organizations who were there as interested observers and consultants. They were the officials from the Yunnan EPB, the Yunnan Provincial Planning Commission, the Yunnan Provincial Economic and Trade Commission, the Yunnan Provincial Forestry Bureau, and Scientists from the YIES. JIEE representatives Dr. Bill Fulkerson and Mr. Qingguo Gao were also present. Mr. Gao also worked as one of the interpreters for the meeting. The negotiations were serious, businesslike and, it appeared at the time, *successful*. An *Energy Service Agreement* was agreed to. This agreement was subject to ratification by the Management Committee of the plantation. Once this ratification was obtained, Manager Zhou and Mr. Witcher would sign the agreement. The *Energy Service*

¹ Information about the negotiations is based on the author's personal observation unless otherwise noted.

Agreement was for EPS to establish a company in partnership with the Mengpeng Rubber Plantation. The plantation, as the majority partner was to build, own and operate a biomass thermal plant and possibly a hydropower facility.

The negotiations went well. Most of the items in the agreement were quite easily settled. One serious problem emerged and was to remain unresolved. This was issue of the purchase of surplus power by the plantation. Article 4 of the Energy Service Agreement included the *Power Purchase Agreement* (PPA). It provided that:

MBTE, Inc. [Mengpeng Biomass-to-Energy, Incorporated] will enter into a PPA with OWNER to sell electricity produced by the Project at a rate which is 100% of the current Mengla electric rates, during the dry season, as adjusted for any published future increases, and at a market rate during the wet season, but in no event less than the electric rates reflected in the Final Scope Report. All heat available from the Project will be sold to Owner by MBTE, Inc. at a price equal to the actual cost of current heat produced by Owner as reflected in the Final Scope Report, as adjusted for any variations to future fuels costs. Owner agrees to purchase all electricity and heat supplied by MBTE, Inc. at the above mentioned rates, but in no event shall the commitment from Owner for such purchases be less than the amount required to generate sufficient revenues for MBTE, Inc. to cover its fixed operating and fixed project financing costs in both the dry and wet seasons (EPS, 1996: 4).

This is a rather one-sided agreement with EPS taking on risk and getting the guaranteed benefits. According this provision, the Mengpeng Plantation assumed complete responsibility for the consumption and/or sale of the power produced by the joint venture. The feasibility study indeed projected that the BTE facility would operate at a profit. The projection, however, needed to be proved. The Mengpeng Rubber Plantation was now reluctant to assume *all* of the financial risk. They preferred to have a *third* party assume, or at least *share*, the risk with them. The third party could be either the Energy Conservation Company, which operated under the Provincial Planning Commission, or the Department of Electricity of Yunnan Province.

Unfortunately, at the critical stage of the negotiations, the leaders of the plantation were unable to get the support required from the appropriate governmental departments at the prefecture and provincial level. The Provincial Planning Commission earlier had promised to support the project by purchasing the surplus power from the BTE project. But, the promise remained only a promise since the planned power company was not formed. The lack of government support made the plantation delegates have second thoughts about the technological maturity and economic viability of the project. Therefore, the Mengpeng delegation did not sign the contract at the negotiations. They said they needed to go back to the plantation to consult other leaders at the plantation to make the final decision. At this point, the Mengpeng delegation was still hesitating about their final decision, leaning to terminating the negotiation unless a new leverage came up. Finally, both parties (EPS and Mengpeng) agreed that they would sign the contract at the next meeting. Unfortunately, this meeting never took place.

About a month following the Kunming negotiations, the plantation advised EPS of its decision not to proceed with the joint venture at the present time. The reasons given for the withdrawal were financial constraints at the plantation and inadequate feedstock. These justifications do not appear valid. First, the earlier analysis of project feasibility showed that the project was within the plantation's financial resources. Its share of the BTE cost was after all limited. Most of the funding was being provided by EPS. Second, the feasibility study conducted two years previously showed that current levels of feedstock were ample for the proposed BTE facility. Further, it would increase as the number of rubber trees retiring each year expanded.

The Mengpeng plantation's decision not to proceed with the project was more a disappointment than a surprise to those involved in the project. Some bad signs were already shown at the negotiations. They started to wonder why such a good project could not be implemented. There must be something going wrong. The question is when, where and how things went wrong. Perhaps there are no ready and simple answers to the questions. And there must be more than one reason for the unfortunate result. One of the apparent reasons was that the plantation does not want to take the responsibility of selling the surplus power of the BTE project. At this juncture, when the plantation leaders began to fear the BTE project could be a liability rather than a moneymaking endeavor, they chose to put the project on hold. Unfortunately, this reason is rather a superficial one. It might be more helpful and revealing to find out what caused the decision-makers not take any risk for the project.

ANATOMY OF AN IMPLEMENTATION BREAKDOWN

What can account for the sudden breakdown in what, until the last moment, appeared to be a settled implementation agreement? Two things in particular appear to have led to the breakdown. First, when Manager Zhou visited the U.S. with the Yunnan BTE Delegation in 1995, he displayed a total commitment to the BTE project. The Yunnan government was also very supportive. At the preliminary discussions about the joint venture with EPS, it was agreed that an semi-independent company named Yunnan Provincial Energy Conservation Investment Limited Liability Company would be formed under the Yunnan Planning Commission to oversee and support the BTE projects. According to the blue print, the company would integrate the administrative power of government and the flexibility of private enterprise into a coherent whole. While

remaining an affiliate of the Planning Commission, the company would operate as an independent company, which might not follow all the rules for government organizations. This company was supposed to be in place *prior* to the final negotiations to be held in China. The purpose of the new company was to assure a favorable environment for the carrying out the BTE projects in Yunnan. An important component of this favorable climate was the responsibility for purchasing the surplus power generated from the BTE projects. This company, however, was not formed by the time the formal negotiation started in Kunming in March 1996. One of the reasons for the failure to form the company was lack of cooperation among different government departments. To form such a multifunctional company would have taken total support from provincial government and a consensus for cooperation between different government organizations. Apparently, the related governments did not reach consensus on the functions of the company. Also, the timing was not right. It just happened that the central government was trying to do away with government department-affiliated companies. And government department owned companies had been a sensitive topic in Chinese politics since the economic reforms started. Given these circumstances, a company of this nature could hardly get support from the provincial government.

Second, in the spring of 1996, the Mengpeng Plantation started the construction of the small hydroelectric station, which had been planned two years earlier. In *theory*, the relationship between the hydro station and BTE project should be mutual supportive not competitive. First, the BTE facility would compensate for the lost hydropower generating capacity that inevitably occurs during the dry season. Second, it takes longer to build a hydropower plant than a BTE facility. The BTE project therefore could be

brought on-line faster than the hydropower station. The BTE facility, therefore, could alleviate the chronic power shortage at the plantation more quickly than the hydropower plant. On the other hand, in *reality*, the hydropower plant posed a threat to the implementation of the BTE project. The installed 16 MW capacity of the plant might well suffice for the plantation's *own* electricity consumption. In that case, the plantation could only recoup on its investment in the BTE facility if the surplus power could consistently be sold at a profit. This created a situation in which the plantation decision-makers would proceed with the BTE project *only* if they were convinced the facility could profit from the surplus power. Of course, had the EPS been willing to share some risk in the *Power Purchase Agreement*, the plantation could have proceeded differently. Unfortunately, EPS was proved to be a rather shortsighted company. It went bankrupt in 1998.

During the final negotiations, the Mengpeng Plantation was left alone to make its decisions. From a purely business point of view, this made perfect sense. After all, the plantation was the Chinese partner of the joint venture for the initial demonstration project in the program. But, when we consider the BTE program *as a whole*, the benefits of a successful demonstration extended well beyond the plantation. It should, therefore, not have been expected to assume the financial risks on its own. It seems reasonable that the plantation should have been helped by those organizations that were initially involved, and nurtured, the BTE projects. It certainly appears the Mengpeng plantation managers came to this conclusion. It is worth remembering that Mengpeng Rubber Plantation was determined to be the most favorable demonstration site late in the feasibility research. The plantation, in carrying out the demonstration project, was

providing a crucial service to the rest of the Yunnan BTE program. But, why did these organizations suddenly become so distant? In order to find out the reasons for the deadlock of the Mengpeng BTE project, it is necessary to track the organizational setting of the BTE research efforts. Here we will find that the factors that stymied the Mengpeng BTE project existed, undetected, from the very beginning.

The Yunnan BTE Program when it was proposed had the attention and support of the senior levels of the Chinese political system. It was supported and endorsed by many central government agencies and ministries in Beijing. At this stage, the BTE program was considered as an environmental and an energy plan. Accordingly, the National Environmental Protection Agency (NEPA) played a leading role in promoting the program. NEPA leaders enthusiastically supported the project. In fact, for the first two trips to Yunnan, NEPA officials accompanied the international study teams. A 1991 project summary, for example, observed that:

Organization and arrangements for this project were provided by NEPA, which made all appointments in Beijing and supplied a senior member of their staff (Cheng Weixue) to accompany the team in Yunnan. (Mr. Cheng performed similar services in 1990). Local arrangements in Yunnan were organized by the Environmental Research Institute of Yunnan under the direction of its head, Liu Fu Chan, who also accompanied the Study Team (Russell and Shen, 1991:3).

When the feasibility research started, responsibility for the BTE program gradually shifted from NEPA to the Yunnan EPB and the YIES. As the program moved forward, the EPB's involvement did not extend much further than verbal support. But, BTE research was considered as an *environmental* program since it functioned within the environmental system. The Yunnan EPB played the leading role in the evolving research effort. It is important here to note that, although they are beneficial to the environment and important tools for sustainable development, the BTE projects remained essentially

energy projects. Having a program in one policy area (energy) housed within another (environment) is *taboo* in the Chinese political system. As the BTE program moved within the environmental system from conception to feasibility study, this problem did not emerge. But, when it came to implementation--which involved an investment with an element of risk--neither environmental nor energy systems assumed responsibilities. In effect the BTE program could not establish a bureaucratic home.

As we know, one of the characteristics of the Chinese organizational setting is *too many mothers-in-law*. It is often a nightmare for policy implementation. On the other hand, many mothers-in-law for one project may not be always bad. Sometimes a project needs the support of many mothers-in-law (cross-system organizations)--especially in its formative years. The essential element for project implementation in China, however, is to find the *right* mother-in law. In this case, the BTE projects needed to develop entities within the energy system as the *right* mother-in-law. If, for example, the BTE research had been under the Bureau of Electricity, the BTE projects would have had the right mother-in-law. Had the Bureau of Electricity adopted the BTE program at the phase of implementation, the Mengpeng story would have had a different ending! One obvious reason was that the Bureau of Electricity had the resource to help the BTE projects. If the bureau were to implement the BTE project, it would had no problem with the surplus electricity. If the surplus electricity had not been consumed locally, it could be sold in other parts of Yunnan through the bureau's power grid.

Another problem for the implementation of the BTE program was the time period of the research. Chinese organizations experienced many major changes in the late 1980s and early 1990s. This likely hurt the BTE projects. The organizations that made the

commitment at the beginning might have had experienced internal changes. For example, the key officials who were supportive to the program might have resigned or promoted. For example, when the Yunnan BTE program started, Mr. Qu Geping was the head of NEPA. He was as well a personal friend of Dr. Russell. In 1994, Mr. Xie, Zhenhua, succeeded him. Mr. Qu then became the director of Environment and Resource Committee under the People's Congress. Also, there were personnel changes within YIES. Mr. Guo, Huiguang was the general engineer of YIES when the program started and later promoted to the head of the institute, which, by the way, was beneficial to the program. It was Mr. Guo who led the YIES research teams through the all the feasibility studies.

On the other hand, the program itself shifted its focus from plantation-grown biomass to sugar mills and rubber plantations. The change of the direction of the program was not supported by any changes of sponsorship. For example, the Mengpeng Plantation is under the direct authority of the Bureau of State-owned Farms in Yunnan Province. The BTE project at Mengpeng was not able to get enough support from the bureau because the organizers did not actively seek help. For example, the Yunnan biomass delegation to the U.S. did not include a representative from the bureau. And the reality was that only the Bureau of State-Owned Farms could provide plantation leaders the incentive to implement BTE project. We have learned that the Chinese organizational setting consists of *lines* and *pieces*. *Lines* are systems in the government. In the system of State-owned Farms, the provincial bureau has direct authority over plantations. When we were touring the Mengpeng Plantation, a bureau official also happened to be visiting there. We could tell that all the leaders of the plantation showed great respect to the

official. If the Bureau of State-owned Farms had supported the project, the decision-makers at the plantation would have weighed the support differently than that of other authorities of other systems. In the Chinese political system, a line leader's political future relies very much on the recognition of leaders on a higher level, especially immediate leaders. That was why the leaders of plantation were working hard to make the officials of the Bureau of State-Owned farms happy by doing things that could please them. For example, since the bureau officials supported the hotel project in Jinghong, the plantation leaders did not hesitate to carry out the project. On the BTE project, the "silence" of the bureau officials made the plantation leaders assume that their authority was not interested with the project. Unfortunately, their lack of interest about the BTE project was probably due to the fact that they were not informed about the feasibility study of the BTE project. Had the organizers of the BTE program kept the bureau officials better informed about the project, they might have changed their attitudes toward the project. Of course, the timing and the way of letting them know about the project also mattered.

The failure of the Mengpeng BTE project may prompt us to reconsider the connotation of too *many mothers-in-law*. Sometimes, a successful project does need the involvement of many mothers in law. And most importantly, one has to learn to find the *right* mothers-in-law. In the Mengpeng, two very important organizations--the Bureau of State-Owned Farms and the Bureau of Electricity-- should have been included as part of the *team* of mothers-in-law. Of course, as is usual with *too many mothers-in-law*, their inclusion might well have significantly slowed the implementation process. But, it is usually better to be late than never to arrive at the destination. That is, in the Chinese

system, a project may *never* be implemented without the involvement of many mothers-in-law. Whether we like or not, this is reality of Chinese politics. Unfortunately, we learned the truth the hard way in implementing Mengpeng BTE project.

Another embedded problem that likely contributed significantly to the failure of the Mengpeng project was a strategic one. At the phase of implementation, the Mengpeng BTE project had to compete with other energy sources. It seemed people had forgotten that the Yunnan BTE program started as an *environmental friendly* renewable energy plan. Without the environmental benefit consideration, the program would not have started at the first place. That was why NEPA was the initiator of the program. Since was is an *environmentally friendly* energy program, the Mengpeng BTE project--as a demonstration of sustainable development--should have been advantaged in comparison to other energy projects. In one of the early study reports, the researchers argued that the BTE projects as renewable energy projects should enjoy preferable policies. For example, they recommended that since biomass electricity is to be environmentally preferred, its profits should be taxed at a lower rate (Russell, 1991). Unfortunately, the later study reports focused more on the *economic feasibility* of the BTE projects. The environmental benefits of the BTE projects were not explicitly defined or promoted. The environmental characteristics of the BTE projects became more and more vague as the research went on. By the time the BTE projects reached the implementation stage, they were treated as just another *energy* project--albeit one that employed new technology. The environmental benefits of the BTE projects were barely mentioned during the Mengpeng BTE project negotiations.

This strategic miscalculation was most likely due to the researchers tremendous confidence in the economic competitiveness of the BTE projects. They believed that the BTE projects could be implemented as energy projects *without* needing to emphasize the environmental benefits. The feasibility studies showed that BTE projects to be such highly competitive conventional sources of energy that they tended to pay relatively little attention to the environmental benefits. For example, in the 1995 JIEE Report we find:

In August 1995, after 6 years of research and feasibility studies on the BTE projects, the organizers and scientists both American and Chinese sides agreed that it was time to move to the actual implementation of the project. Results of prefeasibility studies showed that biomass-to-electricity projects in Yunnan Province are financially and technically viable. Biomass can be grown and converted to electricity at costs lower than other alternatives and can yield favorable internal rates of return. Study teams judged that biomass energy can ease power shortages and help sustain the region's economic growth. Also, the external environmental benefits of biomass-to-electricity are potentially large, if replicated on a region-wide scale. There are very clear energy and economic development benefits to the Chinese if these projects are realized. There are potentially important benefits to the U.S. as well. Chief among them are new opportunities for private power producers and deployment of US technology in a potentially large and important market. And there is much to learn about our own biomass program regarding scale-up, logistics, and integration of dedicated production and conversion from the demonstration of a biomass energy system in Yunnan. On the general level, utilization of renewable grown biomass will result in net CO₂ fixation and in displacement of fossil fuels, with beneficial effects on climate change. These magnitudes could become significant if the Yunnan experience proves transportable to other regions in China and to similarly situated countries in Southeast Asia. The projects in Yunnan could provide one of the first demonstrations of biomass-to-electricity generation relying exclusively on renewably-grown plantation feedstocks (JIEE, 1995: 3).

We can see from the study summary that the Yunnan BTE projects were treated just like competitive energy projects. The environmental benefits of the projects, although briefly mentioned, were not further investigated. It surprised the JIEE team when the Mengpeng project, possessed of such obvious economic competitiveness, failed.

Looking back to the development of the Yunnan BTE Program, we can discern the flaws in organization and strategy that eventually compromised the implementation of the Mengpeng Plantation BTE project. There are additional factors that likely contributed to the failure of the implementation. These we will discuss in more detail in Chapter 6. Without a proper organization setting and a consistently heavy emphasis on its environmental benefits, the influence of the factors facilitating implementation at Mengpeng (such as the ready raw material, matured technology, international involvement, etc.) was greatly compromised.

Dr. Fulkerson, one of the earlier supporters of the Yunnan BTE projects, witnessed the whole process of the negotiations. When talking about the obstacles for implementing BTE projects in China, he made the following comments:

Developing biomass energy projects in China is difficult for several reasons. First, the projects are small (less than 10 MW) and consequently the transactional costs are too large a fraction of the total costs. Second, biomass electricity is virtually unknown in China except the burning of bagasse at sugarmills to produce electricity and steam for internal consumption. There are no stand-alone biomass plants in China. Perhaps the transactional costs can be decreased by developing boiler plate contracts applicable to many projects, but the difficulty of assuring that power purchase agreements will be honored is a strong deterrent to private investors. If World Bank or any of the other multi-lateral development banks can provide power purchase insurance for these small projects, it would greatly stimulate private financing. With regard to the second problem, China needs a successful demonstration. Hopefully the Mengpeng Farm will provide that demonstration (JIEE, 1996: 3).

Many of those who participated in the BTE feasibility research program, however, continue to believe that the BTE projects have a promising future. When talking about the future of BTE projects, Mr. Guo, Huiguang, president of YIES made the following comments.

I still believe Yunnan BTE projects have a promising future. Given its unique natural conditions, Yunnan is the ideal place to implement demonstration BTE

projects. The current constraints will soon be removed when the social and economic conditions are improved. The question is not *whether* we will implement the BTE projects in Yunnan. It is *when* will we put the first BTE power plant into production.²

Even today, both JIEE and YIES researchers are still looking for ways to rekindle the Yunnan BTE projects. Leaders of Mengpeng Rubber Plantation, however, remain skeptical of further pursuing the project.

CHAPTER CONCLUSION

In this chapter, we reviewed the general impression of Mengpeng held by the JIEE study team when they were visiting the plantation in 1996. The background and players of the Mengpeng BTE project negotiations were also discussed. Finally, we analyzed the roles different entities played in the Mengpeng BTE project and the main reasons decision-makers placed the project on hold. In Chapter Six, we will discuss in more detail the factors that might have influenced the outcome of the Yunnan BTE program.

Although the first attempt was halted, the Mengpeng BTE project is not forgotten. Officials and scientists in China and the U.S. are looking for ways to promote the project. As the Chinese environmental policies become more geared to sustainable development, renewable energy sources will be further explored and studied in China. The BTE projects in Yunnan will serve as good examples for renewable demonstration. Therefore, the Mengpeng BTE project is an unfinished story.

² This was a conversation between the author and Mr. Guo, Huiguang after the Kunming meeting in 1996. Mr. Guo was also one the YIES scientists who conducted the BTE feasibility studies.

CHAPTER SIX

CONCLUSION

INTRODUCTION

The international community now recognizes that the environment and economic development are interdependent. The concept of *sustainable development* is rooted in the notion that environment and economic development can and must be *mutually supportive* (Caldwell, 1990: 207-208). For the past two decades nation states and international organizations have struggled to promote sustainable development. This task is difficult and progress is limited. It involves hard choices and long term vision--nationally and internationally. As Frank Press, the president of the American National Academy of Sciences observed, "difficult policy decisions must be made on the basis of judgments between dimly perceived future risks and possible or other consequences that may be more immediate" (National Academy of Sciences, 1990: iv). Any hope of making sustainable development a reality heavily depends on international *joint implementation* programs. China is no exception. This study traced the Chinese struggle to develop a viable environmental protection regime at the same time it reinvigorated its economic development efforts. It described the successful Chinese-American joint effort to design and evaluate the feasibility of sustainable development projects in Yunnan Province. This effort progressed to the point where Chinese officials entered into negotiations with an American firm for the implementation of the first joint venture project at the Mengpeng Plantation.

The findings in the Mengpeng Plantation case are summarized and their implications are drawn in this chapter. The analytic model presented in Figure 2.1 of

Chapter Two is revisited so as to evaluate the relative contribution of its components to understanding what happened in the case. Final conclusions are drawn and their implications for China's future are presented.

STUDY SUMMARY

This study focused on the failed Chinese-American attempt to construct a BTE facility at the Mengpeng Plantation in Yunnan Province. The Mengpeng case was selected for inquiry because it represents the first attempt at joint implementation of sustainable development within China's reformed economy.

The Yunnan BTE Program started as a series of environmentally *friendly* energy projects. The rationale for initiating the projects was the obvious environmental benefits. Therefore, the coordination and organization of the research and feasibility studies occurred within the environmental protection system. It began at the NEPA and then devolved to the Yunnan BPB and YIES. In a 1991 Study Report, the projects were summarized as the follows:

The conclusions of the study were that a site was identified where the preconditions for adequate biomass supply were met, that economic costs appeared lower than alternatives, that adequate demand existed to support the output of a plant at cost-covering prices and that local authorities (and Beijing officials) were enthusiastic in their support. Further conclusions were that the external environmental benefits were large (erosion control and improved water quality; reduced CO₂ emissions, etc.) and that this project was consistent with and would support Chinese national policy with regard to energy, reforestation and protection of Yangtze system (Russell and Shen, 1991: 6).

The report pointed out that the Yunnan BTE projects were consistent with and would support China's national policy. Since the term *sustainable development* was not officially raised in China at that time, the study report did not use those exact words. But the implication is clear. The later feasibility studies showed the BTE projects in Yunnan

to be economically competitive given the natural conditions of the sites. These projects would not only promote local economic development by supplying affordable energy, but also protect the environment through using biomass as fuel source. The Yunnan BTE projects are consistent with the national policy of sustainable development.

We learned that the implementation of the BTE Program is essential for the sustainable development of rural areas of Yunnan. The unique natural condition of Yunnan province also provides the most viable environment for the BTE projects. Sustainable development is the ultimate goal of environmental policy, but the way to reach that goal may vary at different places or times. A successful strategy of sustainable development at one place or one time may not be suitable at another place or time.

Careful selection of sustainable development options means looking at not just what is desirable but what is desirable over the long term and what is doable at the present. ... The right sustainable development policy must be a win-win no regrets policy which is beneficial both for the economy and for the environment. Sustainable development strategies must vary greatly by locality to match different local conditions (Zhang and Qian, 1998: 206).

The joint efforts of the Chinese and the American JIEE produced the design of an integrated BTE Program for Yunnan. It produced as well a series of studies establishing the feasibility of the constituent projects at specific sites. Preliminary discussions with American firms eventually brought forth joint venture negotiations between the Mengpeng Plantation and EPS. At the very end, however, the Mengpeng Plantation backed out of the agreement. This made the first attempt to implement the Yunnan BTE Program a failure—although certain Chinese officials insist it is merely a matter of *postponement*.

The Yunnan BTE projects, given the local conditions, are renewable energy projects that will promote sustainable development in Yunnan rural areas. With all of the

favorable conditions, why did these projects fail to be implemented? Let's take Mengpeng BTE project as an example and revisit the factors that were expected to affect the implementation of the project.

EVALUATING THE ANALYTIC MODEL

In Chapter Two an analytic model of the Yunnan BTE Program was offered in Figure 2.1. Based on the findings in the Mengpeng case, how well do the factors that comprise the model help us understand what happened? The general answer is—very well. But, the relationships among the factors proved complex and not entirely consistent.

The Dual Impact of Reform on Environmental Organizations

Economic reforms no doubt upgraded in many important ways China's environmental protection efforts. On the other hand, the rapid political and economic changes brought by the reforms also posed several new problems for environmental policy implementation. As the market sector of the economy grows and the planned sector decreases in size, some local government institutions that were previously important in environmental policy implementation will have diminishing control over new projects. For example, the local EPB's ability to influence projects significantly has been reduced. In the BTE case we found the Yunnan EPB's influence was *essential* for the initiation and development of the program. It, however, proved *minimal* at the critical implementation stage. This was because Mengpeng Rubber Plantation is an economically independent unit that is not under the environmental system. The EPB does not have direct authority over the plantation's business. That is to say, when the

first joint venture project reached the final decision point, pleasing the EPB would not advantage the plantation within the organizational hierarchy. Therefore, the plantation did not have to respond to the EPB--unless it clearly was beneficial for the economic wellbeing of the plantation.

The transition to a market-based economy significantly affects the motivations of Chinese enterprises to comply with environmental requirements, especially those involving substantial capital investment. Under the planned economy, investments for pollution control were generally funded by allocations from government through an enterprise's *Xitong* (i.e., vertical authority system). In the current market economy setting, foreign and joint ventures, and increasingly, domestic ventures, may not have a supervisory authority; others may nominally be under a bureau or company of some sort, but are tied only loosely to that organization. In the case of Mengpeng, none of the organizations involved in the *final* negotiation had a direct supervisory relationship with Mengpeng Plantation. The Bureau of State-Owned Farms is the direct authority of Mengpeng Plantation. But as we discussed in Chapter Five, the Bureau was not included in the team of *Mothers-in-law*. This fact makes it very hard for these organizations such as EPB and Bureau of Forestry to influence the results. Sinkule and Ortolano points out that the reform setting sometimes can hurt environmental protection efforts.

In these new configurations, enterprises no longer have soft budget constraint relationships with their supervisory units, which allowed some pollution control costs to be absorbed by the larger industry system or defrayed through favorable loan or tax arrangements negotiated with local government by supervisory units. Under recent reforms, funding allocations from government are lower, and enterprises often fund new projects with bank loans and retained profits. If an enterprise wants funds for a waste treatment plant, it may have to borrow a larger portion of the funds from a bank or use its own retained profits (Sinkule and Ortolano, 1995: 205).

The reform context is one of the factors that contributed to the failure to implement the Mengpeng BTE Project. The Mengpeng Project, after all, was a technologically viable, economically profitable, and environmentally sound power plant. What role did the other factors in the model play?

The Demand for Economic Development

The Mengpeng Rubber Plantation, as a production unit, is responsible for the economic wellbeing of its workers. Under the planned economy, the government was both the funds provider and the product buyer. Although the budget sometimes could be tight, the plantation, like other state-owned enterprises, always had a sense of security. Under the reform setting, the plantation was becoming more and more economically independent. Becoming economically independent connotes two meanings. First, the government funds would be limited; the plantation had to be totally or partially responsible for the funds. Second, the government would not be the *sole* wholesale buyer of the plantation's products. The plantation had to look for customers and compete in domestic or international markets. Generally speaking, competing in the market would bring more profit. On the other hand, market competition could also result in stockpile of products and shortage of operating funds. Recently, the plantation had experienced several financial uncertainties due to the changeable rubber markets. Therefore, the plantation was forced to look for other means to maintain the economic well being of its workers.

In fact, most of the plantation workers had become better off economically since the economic reforms started. On the other hand, economic reforms had brought prosperity to almost all parts of China, including the remote villages in Xishuangbanna.

Many poor villagers became rich very quickly by taking advantages of the booming tourism industry in Xishuangbanna. The workers at the plantation used to have a better and more secure life than the villagers. Now, their economic superiority suddenly disappeared under the waves of economic reforms. Witnessing the relative economic gains of people beyond its borders led plantation workers to demand more.

When we visited the Mengpeng Rubber Plantation in 1996, it was in the midst of building a three-star hotel in Jinghong. The hotel was built to take advantage of the growing tourism industry of Xishuangbanna. Although tourism development was not a core business of the plantation, the hotel project was very beloved and supported by the prefecture leaders as well as by people from the plantation. Since the plantation would solely own the hotel, the funds for building the hotel also came from the plantation. As a result, the plantation would be able to keep the profits from running the hotel. The hotel project, to a great extent, had affected the implementation of other projects at the plantation due to the limited funds at the plantation. But the decision-makers were highly confident that the hotel would be a ready source of money when it was finished. And it is almost risk-free investing in this project. For the sake of economic well being of the plantation and their political support, the decision-makers treated the hotel project as the first priority among other programs, including other long-term projects such as the BTE project.

On the way to the plantation in the 1996, we were also taken to the construction sites of the hotel for a short visit. The construction work was also finished. It is a fancy five-story building with a glazed tile roof, which is a typical architectural style in Xishuangbanna area. Apparently, the plantation leaders were very proud of the hotel

project. Mr. Zhou, the general manager of the plantation sent a senior manager to oversee the construction. After the hotel tour, the manager proudly invited us to stay in the hotel when we visit Jinghong next time. He said:

We are going to invest more money to make the interior better and make our hotel one of the best in Jinghong. We plan to receive our first guests in three months. Of course, the main function of the hotel will be a place that provides accommodations for leaders in our state-owned farms system and officials of the provincial government. You may stay here when you come to visit the plantation next time.

The plantation leaders paid special attention to the hotel project for two reasons: first, it would bring money to the plantation; second, it would bring them political capital by accommodating the officials of higher tiers in the system. Actually, this is how the system works in the Chinese organizational setting. When officials of higher tiers of the system, especially from the central government, come to visit the affiliates in the local areas always try their best to please the leaders. In return, they will get funds and promotions. The bottom line is that the hotel project was expected to be an effective tool for the plantation's economic and political gain.

On the other hand, the BTE project was just viewed as an economic project. In order to implement the project, the leaders of the plantation had to be convinced that the project would be economically competitive and risk free. And both of the criteria were hard to prove. The economic competitiveness of the project only showed on the paper of the feasibility studies. Because this was the *first* demonstration project, it was impossible to empirically prove its economic competitiveness beforehand. A certain degree of faith in the project was required. The leaders of the plantation also had doubts about the rather new biomass-to-electricity technology. Although it is a proven technology in the West, the BTE project at Mengpeng would be the first in Yunnan, indeed in China. They

thought it was too risky to proceed with a project that relied on new technology. When we were at the plantation, many people had expressed their concern about the biomass technology. Although we provided a vast array of technical information about the biomass technology, they were not totally convinced. Most people at the plantation, including some of the key decision-makers, were conservative and not willing to take any risk.

Although the economic reform and open-door policy started in the late 1970s, the idea of establishing a joint venture with a foreign company was rather new to most people in the plantation. It would take some time to adjust to the new way of thinking. Most people in the plantation had lived pretty much a semi-isolated life at the plantation over the past 30 years. Consequently, their knowledge of the outside world was rather limited. Nevertheless, the decision-makers in Mengpeng showed great interest in the BTE projects. They needed electricity to further their economic development. They would be willing to carry out the BTE project if it was proven to be profitable and with minimum risk.

Therefore, the demand for economic development at the plantation proved to be a double-edged sword. On the one side, the plantation definitely needs more power to support its further economic development. On the other, for the sake of improving its current economic situation quickly, the plantation is more willing to invest its money on projects that can bring cash more immediately—especially if it appears to carry little risk. In this case, it was the construction of the three-star hotel. Had the BTE project, like the hotel project, been first recommended and totally supported by the Bureau of State-Owned Farms (or a senior bureau leader) the plantation decision-makers likely would

have treated it differently. They likely would have been more willing to take an economic risk—if only for the sake of *political* gain. This would have changed the fate of the BTE program in Yunnan.

International Support

International support was essential for the BTE program in Yunnan. Without the technical and financial support of international entities, there would not have been the BTE projects in Yunnan. It was Dr. Milton Russell, through the help of NEPA, who initiated the biomass program in Yunnan. Without his efforts, the Yunnan BTE program would not have been there in the first place, at least not as early as 1989. The international support, led by JIEE, provided scientific and financial support from the pre-feasibility study to the final stage site selection. In a period of seven years, international teams consisting of scientists from different fields visited Yunnan many times to conduct on-site studies.

Unfortunately, although international support played a very important role in the initial design of the program and subsequent feasibility studies, it was not able to influence the BTE projects at the implementation stage. This was due to the organizational setting of the research efforts and the nature of the research support. As we know, the JIEE's BTE program work unfolded within China's environmental system—in its cooperation with NEPA, the Yunnan EPB and YIES. When the Mengpeng Rubber Plantation, which is *not* under the environmental system, was chosen as the demonstration project, both the EPB and YIES did not have direct authority over the plantation. It was very difficult for the Yunnan EPB and YIES to influence the plantation decision-makers to implement the project unless they were willing to of their

own volition. Therefore, the capacity of the international support to influence the project was compromised. Also, the international support was for research and development. It could not provide funds to implement the project.

Even at the early stage of the BTE research, the nature of international support effort was clearly defined. In the executive summary of the 1991 Study Report, Dr. Russell pointed out:

Foreign technical assistance would be required to enhance the probability of success in these projects, and additional assistance (perhaps capital access) and encouragement could be necessary. . . . A continuing, low-key involvement of a foreign expert to provide a trouble shooting, problems identification, encouragement, communication and other "watching brief" services would be desirable. . . . Large-scale foreign assistance is not necessary and could be counter-productive to the extent that it encouraged delay waiting for such assistance, that it induced excessive interference from central authorities, or that it encouraged "gold plating" of facilities or the use of advanced technologies inappropriate to the state of development in this region (Russell and Shen, 1991: 5).

The international support team's approach to the Yunnan BTE projects had been consistent throughout the research effort. They realized that there was strong support from the national and provincial level for the BTE project. They also believed that indigenous resources, expertise and capital appeared to be sufficient to bring the projects into being. Therefore, they preferred to remain low-key in their involvement by undertaking trouble shooting and problem identification. The low-key involvement indeed helped the BTE research efforts proceed quickly and without interference. During the later phase of the research, JIEE cooperated closely with Yunnan Institute of Environmental Science (YIES) on feasibility studies and sites selections. JIEE, working on behalf of international support team, also provided financial support to the YIES for the study.

For all of its strengths, the *low-key approach* had one important weakness. It created an effort with a very low public profile. As a result, especially at the last phase of the effort, publicity for the BTE projects was essential so as to catch the attention of related government systems--such as the energy system and state-owned farms system. The international support entities did make an effort to publicize the Yunnan BTE projects in the U.S.. For instance, through hosting Yunnan BTE Program Workshop in Knoxville, JIEE has contacted many U.S. companies that might be interested in the program. Six companies attended the workshop. Several U.S. companies had shown interests in the program. Besides EPS, Bechtel also sent representative to Yunnan to study the BTE program. Unfortunately, the publicity work within China did not match. The timing of domestic publicity was not optimal. Efforts to generate elite and public awareness about the need to implement the joint venture especially were needed--but did not occur. Public outreach designed to secure new and more appropriate Chinese sponsors for the program was also needed--but not done

All in all, the international support played an essential and positive role in the BTE program. The international support team might have been more active in exploring appropriate sponsors and opportunities for implementing the BTE program. But it would be very difficult, if not impossible, for foreigners entirely to be effective in the unique Chinese political and organizational setting. As helpful as international efforts proved, the ultimate responsibility for implementation success or failure always rested within China itself.

Biomass-to-Electricity (BTE) Technology

The technology of using biomass to generate technology is relatively new. When competing with cheap fossil fuel, biomass is seldom considered as an alternative. However, in those places where fossil fuel is not accessible, which is common in those areas of China most in need of development, biomass is a very viable energy source. Also, environmental benefits brought by biomass energy make it even more attractive. In fact, people have long used biomass as fuel source for cooking and heating. The new technology will make biomass burn more efficiently and environmental friendly by converting biomass energy into electricity.

The combustion of biomass in domestic stoves and other appliances is highly variable. Emissions can be quite high, due to badly managed fires. Particulate and carbon monoxide are often the main problems. The combustion of biomass in modern stoves and boilers, where economic, is an environmentally sound substitute for conventional fossil fuels, particularly coal and oil. The carbon cycle is not affected if trees regrow or are replanted at the same rate as they are being burned, and soil degradation does not occur. Sulfur emissions are much lower than for fossil fuels. The particulate can be controlled well at the source, particularly in larger installations (Pasztor and Kristoferson, 1992: 35).

The combustion of solid fuel is based primarily on a gasification process, after which the resulting gases burn and deliver heat at temperatures between 1200 and 1800 °C. This oxidation takes place in combustion chambers that can be anything from very small to very large; hot (dry) chambers or cool (wet) chambers both have a considerable effect on combustion quality. Depending on the design of the chambers, combustion proceeds as a one or two-stage process. Fuel can be charged discontinuously or continuously.

The main influences on combustion quality are the temperature in the combustion chamber, and the gas-retention time. Solid biomass fuel has to dry to attain a high

combustion quality (i.e. high temperature). More than 40 per cent moisture content will lead to critically low temperatures in the combustion chamber, followed by emissions of CO, higher carbon hydrates, soot, tar and different components of dust.

Different varieties of biomass can be used as fuel. The most important are straw and wood from conventional production, as a by-product from processing, or complete from energy plantations. The original biomass resource often has to be processed before utilization in the combustion device. Since the energy content of biomass is usually lower than of coal, for example, considerable volumes may need to be transported to the point of use (Pasztor and Kristoferson, 1992).

Apparently, the BTE technology is the original dynamo of the BTE projects as a whole. Without the technology, the projects would not have entered the agenda. On the other hand, in the Mengpeng BTE case, since the biomass technology is a new technology and less known to the people who will carry out the project, it can also be a negative factor if the techniques of the technology is not thoroughly conveyed to the decision-makers. The technology is a proven technology in the U.S. and the West. The Yunnan BTE delegation visited several BTE facilities in the U.S. in 1995. However, since the Mengpeng BTE project will be the first Chinese power plant utilizing BTE technology, some of the decision-makers expressed their doubts about the technology during the negotiations. Like the factor of economic development demand, BTE technology played both the negative and positive roles. Had the demonstration project been successfully implemented at Mengpeng, the prospects for the diffusion of BTE technology as a tool of sustained development would have been greatly enhanced.

Local Environmental Organizations

The Yunnan BTE Program, to summarize it in a single sentence, was a joint Chinese-American renewable energy research program initiated and managed by China's environmental protection system. The project was initiated in NEPA and the research program was managed by the Yunnan EPB. The project assessment and feasibility studies were executed by the YIES. Especially at the later phases of the research endeavor, YIES played a very important role in supporting and coordinating the Yunnan BTE research. Together with the experts from JIEE, YIES conducted the feasibility studies on the projects and the final screening of the prioritized projects. The leaders and scientists at YIES devoted a great amount of time and energy to the investigation of possible BTE facilities. They strove hard to inform people about the new BTE technology. As JIEE's direct contact in Yunnan, YIES served as semi-official organizer of the joint BTE projects. YIES also worked as a go-between organization among different provincial departments and BTE sites managers. It would be difficult to overstate the importance of this organization to the program.

Regrettably, as a research institute YIES is not a first-tier organization in the Chinese government. Thus, it alone did not enjoy the prestige and power to determine the fate of the BTE program. Due to this fact, YIES's ability to further the BTE projects was very much compromised at implementation. Realizing the organization problem inherent in the BTE program, promoters sought a solution. Thus, in 1995, JIEE and YIES jointly recommended the formation of the *Yunnan Provincial Energy Conservation Investment Limited Liability Company*. They advised that the company be affiliated with the Economic Planning Commission to coordinate the implementation the BTE projects.

The formation of such an entity was an important component of the preliminary joint venture talks held in the U.S. between representatives of the Yunnan Plantation and potential American investors. At that time its formation was assumed to be part of the positive business climate to be assured by the Chinese government. But, this organization was not formed. The inherent weakness of the *ad hoc* organizational arrangements now being applied to implementation was increasingly apparent to project promoters. In the spring of 1995, YIES scientists and organizers once again offered their solutions to the organizational problem:

First, a management organization--such as a Renewable Energy Development Corporation organized at the provincial level--should be created to provide an effective implementation vehicle for the projects. This organization would be in charge of carrying out more detailed analyses of the potential BTE projects. It would also prepare master implementation plans and coordinate relations among the domestic departments at different levels, foreign organizations and both private sector investors and agencies for international cooperation. Such activities would include efforts to solve technical difficulties and financial issues, training of local technicians for the further administration and operation of the projects, as well as directing and managing the systematic implementation of the these projects at the provincial level. . . . Another important step to be undertaken to promote BTE in Yunnan is that domestic and international information channels be more widely opened to better explain the technology feasibility and economic and environmental benefits of the BTE Projects (Guo, et al., 1996: 31).

The recommended BTE management organization was not formed in time for the implementation of Mengpeng Project. This case indicates that the design, development, and implementation of sustained development projects is going to be a long, complicated process filled with trial and error. For its part, the YIES did everything it could given its status and authority within the larger Chinese system. We found that the Yunnan EPB and YIES were definitely positive factors for the BTE projects in Yunnan.

Public Environmental Awareness

Yunnan Province is one of the most visited tourist attractions in China. It is known for its natural beauty and tropical plants. Environmental protection is essential for the sustainable development of the tourist industry. Dianci, a lake outside of Kunming used to be one of the tourist attractions in Kunming. But in recent years, Dianci has been heavily polluted. Due to the eutrophication of the water body, aquatic plants grow pervasively in the lake. The once sparkling lake has become a stinking pond. The cruel reality made local people realize the importance of environmental protection. People learned the hard way that a healthy natural environment is the foundation for further development. Disasters caused by environment degradation forced people to look for ways to protect the environment. Although good intentions are often aborted when they meet reality, they sometimes nevertheless influence people's way of thinking. The BTE program was well accepted by the local people. An important reason was that, in addition to being an energy program that would boost economic development in rural Yunnan, it would also help protect the environment.

According to a 1992 international support team's BTE study report, the BTE program would bring sound environment as well as economic prosperity to rural Yunnan.

Plantation-grown biomass from otherwise low productivity land can be a source of fuel for electricity production and other uses. It has the potential to provide energy services at lower cost than alternatives while meeting other goals as well. Soil stabilization, flood control and greenhouse gas sequestration can be achieved with less air and water pollution as compared to burning coal and less diminution of productive farm land as compared to hydropower. This technology can provide effective annual stabilization of the electricity supply in regions where a monsoon climate leads to seasonal power shortages. It can also provide local employment in labor-rich areas, which adds to income and diminishes the drive to migration to cities. It also can provide the energy basis for additional employment in manufacturing and processing and increased agricultural productivity. Biomass use reduces the demand for bulk transportation of fuels

into coal-short regions and diminishes the demand for liquid fuel that has to be transported from other countries. By reducing transportation capital and foreign exchange demands, it can have positive macrocosmic benefits that go beyond the positive direct effects on employment and factor productivity. For these reasons and others, biomass-to-electricity installations have been seen as a promising technology for use in special situations in developing countries (Jantzen and Russell, 1992).

Biomass energy, like any other energy systems, might result in some adverse environmental impacts. In the case of bioenergy, the actual impact often depends more on the way the whole system is managed than merely on the fuel or the conversion technology. It is important to realize that the impacts are both in quality and in quantity. The objective of an environmentally conscious energy policy would be to arrive at patterns of energy consumption and supply where the total environmental impact could be minimized, in accordance with local economic and social realities.

When biomass energy systems are compared to conventional centralized electricity supply systems, the analysis should try to include all adverse and beneficial impacts possible for both sides. In addition to the often favorable environmental performance of bioenergy systems when compared to conventional systems, their relatively decentralized nature can be a significant socioeconomic advantage, especially when considering their potential for promoting a more balanced and more evenly distributed pattern of investment and resource use. However from an overall socioeconomic perspective, the environmental advantages of bioenergy systems are not a sufficient condition for their selection. What is crucial is that when environmental advantage exist, whether quantifiable or not, they should be *properly valued* in an integrated *framework*. It turns out this did not happen in the Mengpeng case.

The rising environmental awareness among the population created an acquiescent opinion climate for the BTE projects in Yunnan. Nothing was done, however, to further develop public awareness and mobilize support for program implementation. It is understandable, given the nature of the Chinese political system, that the elite promoters of the program failed to appreciate the need for grass roots public support. But, an opportunity was lost nonetheless; the BTE program promoters should have taken advantage of the environmental awareness of the public to publicize the environmental benefits of the projects. As we have discussed, the environmental benefits were not be further explored when the BTE research focused more on economic feasibility studies. And the failure of using public environmental concerns fully greatly affected the next factor--the need for policies that weighted BTE projects for their environmental benefits.

Preferential Policies for BTE Projects

When the BTE program started in 1989 it was treated as environmentally friendly energy projects. The rationale for implementing the program was to provide a reliable alternative energy source for the rural areas in Yunnan. As a renewable energy source biomass would benefit the environment. The BTE program over time, however, essentially was promoted as an energy project. All the technical reports and feasibility studies were carried out according to the requirements of energy project. The feasibility studies showed that as an energy program it was so economically competitive that the environmental benefits became secondary.

The environmental benefits were mentioned in virtually every article and document produced for the BTE program. But, these benefits were never systematically investigated or calculated. Nor were efforts made to publicize the environmental benefits

of these projects. The failure to produce environmental benefits studies contributed to the disappearance of environmental benefits as an important factor at the implementation stage. In consequence, the BTE program emerged in the minds of key decision-makers as just another energy project. Its crucial environmental benefits were not considered in the final decision. This is ironic because the Chinese *energy* system, at both the national and provincial levels, did not participate in any of the studies associated with the BTE program. The project's organization and feasibility studies were undertaken by the *environmental protection* system. In China, success in implementing programs across system boundaries is a complex, arduous process. It requires the cooperation of numerous other systems and levels of government. This is all the more true in the case of a relatively new system such as that serving environmental protection. The Mengpeng BTE project required several systems to work together, including environmental system, energy system, forestry system, the state-owned farms system, and of course, the support of local government departments.

Treated as energy projects without considering their environmental benefits, the BTE projects received no preferential policies. And they had to compete with other forms of power generation, such as hydro and fossil. In the case of the Mengpeng BTE project, the direct competition came from the small hydroelectric project on the plantation. At it turned out, one of the biggest disadvantages of the BTE project was that the decision-makers knew very little about the rather new BTE technology. Therefore, it is understandable that the plantation would rather put their money into the projects that they were more familiar with in order to reduce risk.

While there were no preferential policies for the BTE projects, the costs for competing energy projects that might pose potential environmental damages tended to be ignored. The result was that all energy projects were judged by their potential economic performance (that would bring direct benefits), not the environmental benefits or costs--which would normally not bring immediate positive results. Therefore, not only did the Mengpeng Project did not receive any preferential policy consideration, it also lost its competitive edge when the environmental cost-benefits of various energy sources was ignored. The unfavorable position of the BTE Project was worsened by the fact that the hydropower facility was already under construction when final negotiations between the plantation and EPS took place.

Had there been any preferential policies for the Mengpeng BTE project, the results could have been different. Preferential policies such as financial support, tax breaks, and financing incentive, would have boosted the confidence of the decision-makers about the project. They would be more convinced that what they did were indeed beneficial to the environment. Of course, what the decision-makers weighed most were economic and political gains. But, if the other factors could be made equal, they would prefer to choose the project that had the potential to benefit the environment.

Preferential policies could have been a positive fact in the BTE projects.

Public Participation

Public participation in environmental protection is becoming more and more popular, especially in big cities like Shanghai and Beijing. But given the awkwardness of the Chinese political system and its organizational setting, public involvement in environmental affairs has been far from effective. As a matter of national policy, all

major construction projects in China now must do an environmental impact assessment (EIA). The procedures for environmental impact assessment in China are largely based on EIA procedures established in Western countries. In China, however, unlike most other countries with EIA requirements, there is no public review of the environmental impact assessment documents. The national regulations for EIA in China rely on local environmental protection bureaus and offices to enforce procedures and review individual EIAs. In theory, the local EPB has the sole power to decide the fate of a project. In reality, it is far more complicated. To be sure, the enforcement of EIA requirements and the review EISs are the responsibility of the EPB. But, to win compliance this department needs the cooperation of such other departments as the planning commission, the economic commission, and the banks. This, as Sinkule and Ortolano observe, is because "the other government departments are at the same level in the local government hierarchy as the environmental protection department, [thus] the latter does not have the authority to impose its decision on them" (Sinkule and Ortolano, 1996: 12). Moreover, the *political reality* is that when the mayor favors a project, the local EPB normally has no choice but approve it--even though the EIA shows problems.

Since there are very few, if any, interest groups in China, public participation in decision making is basically absent. Citizens have the legal right to bring lawsuits to reduce damage-causing pollution. This is, however, exceedingly rare; the courts in China are not used by people in this way. Further, citizens often are unaware of their legal right to sue for relief from pollution or other environmental damage. Moreover, there is no tradition in China, as there is in the U.S. for example, of citizens bringing suit against enterprises or government agencies for failure to reduce pollution.

In the Mengpeng case, public participation was very limited. Because the proposed BTE facility was to be constructed within the plantation, it was considered a matter for that enterprise--especially its leaders. The project was virtually unknown to the citizens beyond the plantation. The rubber plantations in Yunnan operate largely as semi-autonomous enterprises--something like the ancient semi-isolated *kingdoms*. The plantation workers constitute its effective *public*. As employees they are responsive to and trust the plantation leaders. As a matter of course its leaders made decisions concerning the plantation and the workers seldom cared about how the decisions were made. They believed that the leaders would work on behalf the well being of the plantation. The hydropower project remained unknown to the workers until the implementation started. The plantation employees learned about it only when they were called upon to build the dam. As for the BTE project, workers were generally aware a new project was under consideration because of the intermittent presence of the foreign experts who were conducting the associated on-site-studies. Foreign visitors at the plantation were rare so their presence drew attention. But, beyond the possession of certain awareness that some sort joint venture to convert the residue of sawmill operations to make electricity, the employees had no role in the project. This lack of public participation did not *directly* affect the fate of the BTE project because the final decision rested with the administrative committee at the plantation.

The cost of not having the means to mobilize the public that characterizes Chinese politics becomes apparent at this point. For, there is reason to believe that public participation could *indirectly* have helped the BTE project--had its proponents been in a position to mobilize citizens against the hydropower project. The hydropower plant was

built on a small tributary of the Lancang River, which runs through the plantation. Even with the relatively small low-head dam, the reservoir would flood a large area of the most productive land in the valley. This flooding had obvious adverse impact on the environment and on the area farmers. The seeds of grassroots protest were there; but the system does not provide fertile soil. Had the public the opportunity to choose between another hydroelectric dam and the BTE project, there is a good chance it would support the latter.

Competing Energy Sources

Since Mengla County does not produce any coal and is far away from any fossil fuel sources, the only competitive energy source for the BTE project at Mengpeng is the small hydropower station with a 16 MW of installed capacity. The feasibility study of for this facility started almost at same the time with that of Mengpeng BTE project. By the time the BTE project reached the negotiation stage, unfortunately, the construction of the hydro station was underway. Therefore, the hydro station became the *de facto* competitive energy source for the BTE project at Mengpeng. When the power station is finished, it will generate enough power to meet the plantation's needs and might even produce a modest surplus during the rainy season. For the dry season, it can only generate one-third of its installed capacity. Thus, while this facility relieves the severity of the plantation's power shortage, it cannot solve it.

If the plantation decided to build the BTE project, it would have no trouble selling the surplus power during the dry season. However, it might pose a potential market problem during the rainy season. Although feasibility study showed that the economic development in Mengla country and neighboring areas, the demand for electricity would

grow rapidly. Some even suggested selling the surplus power to Laos, where power shortages were also severe. These projections, however, did not change the minds of the decision-makers at the plantation. They were not willing alone to take even the limited risk associated with the project. Had the *provincial* power system been willing to commit to the purchase of surplus power during the rainy season--to support an environmentally friendly power project, the result might have been different. But, the Bureau of Electricity had not been brought into the project. Thus, the plantation leaders refused to sign the power purchase agreement for the joint venture. What could make leaders take risks such as those associated with the Mengpeng BTE project?

Incentives for Decision-makers to Take Risks

The Mengpeng Plantation was chosen as the demonstration site because it possessed the required conditions for a successful project. If the Mengpeng project were carried out successfully, as most people expected, many others would likely follow it. Being a demonstration project, to a great extent, was somewhat risky. Therefore, the Mengpeng Rubber Plantation, as the Chinese partner in the joint venture assumed a certain degree of risk. Like pioneering experimental projects in other fields, the Mengpeng BTE project would be the first of its kind in China. This fact itself connotes risk even though the feasibility study showed that that project was highly likely to succeed.

As we have discussed, the leaders of the plantation were not willing to participate in the joint venture unless they were convinced the project would economically benefit the plantation. The nature of the Chinese system invites the assumption of some risk if there is a good chance of making *political* gains however. In the case BTE project, the

strictly economic incentive was hardly there. Plantation leaders were not convinced that project would bring quick money like the hotel project. On the contrary, they were worried that project would become a burden for the plantation if they could not sell the surplus power. The requisite political incentive, however, could have been obtained if the Bureau of State-Owned Farms had supported the BTE project. But the Bureau of State-Owned Farms was not included in the team of mothers-in-law. Therefore, there were no effective incentives for the leaders of the plantation to take risks in the BTE project.

Because the Mengpeng BTE project in essence was an *experimental* project, its success or failure was bound to benefit other programs and projects. If the Mengpeng were carried out *successfully*, it would provide guidance for the other projects. If the project failed, lessons would be learned for other projects. Therefore, it was not *fair* for the Mengpeng Rubber Plantation to take the risk alone. To be fair, all the potential beneficiaries should have shared the risk. In this case, the Yunnan Provincial Government was the ultimate beneficiary since all the BTE projects were located within Yunnan Province. But, the Mengpeng Plantation leaders received no substantial support from the provincial government and departments for the carrying out the first BTE project. When the negotiations with Energy Performance Services (EPS) started, the leaders of Mengpeng Rubber Plantation were left alone by the authorities. This had indeed given the plantation total autonomy in decision making. On the other hand, the plantation had also lost support of the government. It seemed that no organization wanted to get involved with the project any more. The leaders of the Bureau of State-Owned Farms, which had direct authority over the plantation, were not even included in

the group of supporting departments. Other related important provincial departments such as the Department of Energy did not even attend the negotiation session. When it came down to negotiating about the *Power-Purchasing Contract*, the Departments of Electricity on the provincial and prefecture levels were not willing to back up the plantation.

All these factors showed that the decision-makers received neither sufficient political or *economic* incentives for implementing the BTE project. This is in contrast to the hotel project, which enjoyed strong support from higher authority. Therefore, the lack of incentives or support for the plantation decision-makers to take risk was among the most important factors contributing to the breakdown of the joint venture at the implementation stage. Although unnoticed, this lack of incentives was present and indeed exacerbated by the initial organization of the BTE projects.

Organizational Setting of the BTE Projects

So far, we have analyzed the key factors that contributed to the failure of the Mengpeng BTE project. Several of these factors related to problems inherent in the organizational setting of the Yunnan BTE Program. The root of the organizational problems is the nature of the Chinese political system. We reviewed the unique characteristics of the Chinese organizational setting in Chapter Three. Let us now examine how these characteristics adversely affected policy implementation in the Mengpeng case

The organizational setting of Chinese political system is even more complicated than it sounds. The proper handling of relationships between vertical (system) and

horizontal (units) and within systems and units is essential to carry out any project or policy. Lieberthal characterizes it this way:

In a system geared to governing all major aspects of economic and social life, there is virtually no way to rule effectively without both vertical and horizontal bureaucratic domains. The leaders' determination that the Communist party dominates the system adds further complexity to the bureaucratic leviathan. Western scholars of organizational dynamics term this cross-hatching of horizontal and vertical lines of the authority a "matrix" problem and all large-scale organizations must deal with matrix issues. Since China has developed the largest bureaucracy in the history of the world, its matrix muddle is of unprecedented scale (Lieberthal, 1995: 169).

The Yunnan BTE Program started in Beijing and eventually ended up in the remote areas of Yunnan. It was obvious that the path from conception, through feasibility study, to actual implementation would involve many organizations belonging to different systems and units. Fortunately, there was only one primary organization on the central level, which is NEPA, involved in the BTE projects. Therefore, the coordination work on the central level was easy and simple. After setting up the initial stage for the research, the BTE projects were transferred to Yunnan province. In order to keep the organizational work convenient and efficient, the projects were kept within the environmental system in Yunnan. This made perfect sense at the first stage of the project studies. The low-key involvement policy worked very well for keeping the research moving forward without interference. But sooner or later, the BTE projects had to be adopted by another organization or system *because the environmental system did not have the capacity to implement these projects*. The problems occurred when coordination among related organizations failed to materialize. In fact, the problems started at the early stage of the research and remained there ever since. The reason why people failed to address the problems at the later phase of the research was not because the problems

were solved. It was because they were neglected--despite early warnings. For example, in 1991 Dr. Milton Russell warned "no local organization with the authority, dedication and resources had been identified which could take command of the project and carry it to fruition" (Russell and Shen, 1991: 2).

The organizational setting for the BTE program was efficient at the first phase of the research. All the work was coordinated and carried out within the environmental system. But as the research moved closer to implementation, the organizational setting needed to be restructured. The transition from a research project to a BTE facility required a major organizational change. And it needed be planned ahead of time. The organizational setting of Yunnan BTE projects was not able to make the transition. Failure to recruit the Electricity Bureau and the Bureau State-Owned Farms as mothers-in-law eventually caused the breakdown of the Mengpeng BTE project. The organizational setting proved essential for the success and failure of the BTE projects. Concerning the implementation of Mengpeng project, that organizational setting played a negative role.

STUDY IMPLICATIONS

The Future of Sustainable Development in China

Sustainable development is only way for China to survive environmentally. The Chinese government is determined to adopt and implement a sustainable development policy. Some major environmental protection programs such as the clean-up initiative of Huai River have been very effective. On the other hand, China's overall environmental condition continues to deteriorate. To achieve all the goals of sustainable development,

however, is going to be extremely difficult; if it is possible at all. Some scholars of China's environment are even more pessimistic about the future of China's sustainable development:

No decisive progress toward a globally sustainable civilization can be achieved without a gradual transformation of the Chinese environment and society. This is not impossible--but it will be exceedingly challenging. Emulating the Chinese, who have a fondness for numerical labels--Three Bad Years, Gang of Four, Five Black Elements--I will concentrate on the Five Great Barriers to China's sustainable development: limited ecosystemic resources and services; large--and in absolute terms, still rapidly growing--population; high rates of economic expansion; a historic lack of concern about environmental degradation; and the demise of the best, most sustainable traditions (Smil, 1996: 175).

The newly published book *Grave Concerns--Problems of Sustainable Development for China* also expressed deep concern about China's sustainable development. One problem was that environmental pollution has moved from big cities to small cities, even the countryside. People living in big cities use to go to the countryside to breath fresh air. If the countryside is polluted, where do people find fresh air in China?

Pollution in the larger cities is being brought under control, but it is rapidly spreading to the rapidly growing medium and small cities, and into the countryside, where pollution is getting worse. The township and village enterprises may well become the main source of pollution in China. Perhaps one day Beijing, Shenyang and other large Chinese cities will no longer be among the most polluted cities in the world, but by then pollution sources will have spread far and wide throughout the country. This kind of pollution situation may be even worse than what we have today (Zhang and Qian, 1998: 132).

Although urbanization has absorbed more and more people from the countryside into cities, almost 80% of China's population are still living in the countryside. Protecting the environment of the countryside is essential for realizing sustainable development in China. The Yunnan BTE Program, if successful, could serve as a perfect model for sustainable development in rural China. According to the researchers of YIES, Yunnan BTE projects would:

1. provide a sustainable, clean and renewable energy resource to overcome the power shortages;
2. promote the development of the local industries, agriculture and village enterprises;
3. create and enlarge employment opportunities for local people;
4. upgrade the low technological utilization methods for biomass and improve the utilization of biomass energy on the whole in rural Yunnan;
5. increase the tax income of the local communities for further advancement;
6. plant energy crops, and reduce and prevent soil erosion through planned afforestation in suitable barren areas;
7. fix the carbon dioxide in a form of standing biomass and reduce the net emission of green house gases to the atmosphere; and
8. promote the introduction and dissemination of more advanced technologies, administration systems and economic information into rural areas of Yunnan, and speed up the process of allowing Yunnan to more quickly towards world recognition (Guo, et al., 1996: 39).

The Yunnan BTE Program, once executed, could become a model for the development of renewable energy in other provinces of China and even other countries in the world, which are facing similar problems. The future of sustainable development in China relies in exploring new ways to protect the environment and promote economic development simultaneously.

Yunnan BTE projects and Joint Implementation

The Yunnan BTE research was a joint research effort between the Chinese government and a consortium of American institutions. The efforts of the international group were focused on project development and technical assistance concerning plantation forestry and energy production and estimation of economic feasibility of the BTE projects. Although the concept of *joint implementation* was not officially raised

when the BTE projects first started in 1989, the research cooperation in essence was such a project. The following is a paragraph excerpted from the 1992 *Agreement for Cooperation* between the international support group and Yunnan EPB, which was about the purpose of cooperation:

In recent years countries all over the world have started to pay increasing attention to the potential problem of global climate change caused by the buildup of greenhouse gases, especially carbon dioxide. This problem may cause serious ecological damage to the human environment and has lent increasing importance to the development of biomass energy. Biomass energy can substitute for fossil fuels and reduce the rate of carbon release to the atmosphere, slowing the process of global climate change. Biomass production can also reduce soil erosion and improve water availability to agricultural lands. The development of biomass energy can clearly achieve important environmental, economic and social benefits (Jantzen and Russell, 1992: Appendix E-2).

As we know, *joint implementation* is a part of United Nations' Framework Convention on Climate Change (Climate Change Convention) which is an international environmental law to deal with global warming. Completed at the Earth Summit (UNCED) in 1992, the Climate Change Convention came into existence after an intensive process of negotiation. As scientific concern increased over the prospects of global warming, international attention focused rapidly on the issue in the 1980s. Then in 1990 the UN General Assembly created the Intergovernmental Negotiating Committee calling for the adoption of a global convention on climate change at UNCED in 1992. Though there was a substantial political base which desired long-term quantitative emission limits, eventually a "go-slow" approach prevailed (Guruswamy and Hendricks, 1997: 133).

The Climate Change Convention, however, is not an empty framework treaty whose substantive details entirely await further elaboration. Instead, it is a framework convention with a number of built-in requirements. First, developed countries must strive

to reduce their overall emissions of greenhouse gases to 1990 levels by the year 200. Second, developed countries have a general commitment to make financial and technological transfers to developing countries. Third, all parties-both developed and developing countries-must create inventories for GHGs, as well as national mitigation and adaptation programs. The Climate Change Convention, however, provides different timetables and requirements for developed and developing countries with regard to inventories and other programs (Guruswamy and Hendricks, 1997).

As a policy instrument of Climate Change Convention, *joint implementation* contributes towards a *global* regime of tradable emission permits. Although controversial ever since its initiation, the idea behind joint implementation is simple.

In brief, JI means that the investor country invests in emission abatement projects in another (host) country where the costs of abating GHG emissions are lower than trying to achieve an equivalent abatement within the own country (Zhang, 1998: 32).

Since the BTE projects Yunnan started before the Climate Change Convention was created, they did not originate as projects of joint implementation. On the other hand, it could indeed have served as a trailblazer for joint implementation.

According to Zhang, there are three forms of JI. The first form is a multilateral approach to JI through an international entity such as Global Environment Facility (GEF). Specifically, countries wishing to *invest* in JI projects pool their resources to an independent fund and other countries *offering* JI projects compete for the funding resources. During the duration of the selected JI project, each investor country receives the credit proportional to its share of the project portfolio. The second form of JI deals through government agreements between two countries. In this form JI contracts are concluded at a government level. The execution of JI projects can be commissioned to

public entities at a national, regional or municipal level, or to private companies and organizations. In either case, state authorities must be informed of the progress projects are making before issuing a certificate of approval.

The third JI form deals can be carried out by the private sector. Private companies may become actively involved in JI projects, if financial or legal incentives for them to abate emissions are provided. To some extent, the incentive for their involvement could come from a "first-mover advantage," which strengthens the international competitiveness of such companies that take the lead in developing climate-benign technologies. To a lesser extent, the involvement of the private sector is also because of a fear of new regulations at home and a desire for a positive environmental profile. This type of JI provides opportunities to attract additional funds from the private sector. Given the limited amount of public funds available, this approach is considered particularly important in order to obtain the necessary investments in JI projects (Zhang, 1998: 35).

The third form of JI is most closely applies to the BTE program in Yunnan. Although the program started before the Climate Change Convention, the idea behind the project was similar to that of JI:

There is in Yunnan great diversity of climate, topography, soils and plant species. Yunnan can be used as a test bed for biomass energy development and research, and will serve as an example for other developing countries needing energy supplies and desiring to improve global environmental conditions. This project has the potential to change the local conditions of minimal forest cover and serious soil erosion. The project will provide technical assistance to sugar mills in Yunnan and assist them to effectively use their existing generating equipment. The cooperation will promote biomass energy development in Yunnan province. The projects, if successful, can provide a model suitable for wide scale deployment, which has the potential for sustainably improving the quality of life while enhancing environmental quality (Jantzen and Russell, 1992: E-2).

As we know, the cooperative research of Yunnan BTE projects effort had revealed many opportunities and constraints of implementing environmentally friendly energy projects. What we have learned in the Yunnan BTE projects could shed light on the future JI projects in China and developing countries around the world.

Institutional Constraints in China

One of the key characteristics of the Chinese institutional setting is *fragmented authoritarianism*. It means that the Chinese political system, below the highest level, is fragmented and disjointed. Authority is fragmented in the sense that government departments have substantial control over their individual function areas. On the other hand, the top of the Chinese political system, where the elite national leaders make many key decisions, is highly integrated. Under economic reforms, government leaders at the city and county level are seeking to pursue their own goals and protect themselves from the conflicting demands of higher levels by concentrating power over fiscal resources and integrating local level decision making.

As we know, under *fragmented authoritarianism*, Chinese politics has four distinct characteristics concerning policy implementation. They are *units*, *systems*, *too many mothers in law*, and *independent kingdoms*. In the Mengpeng BTE case, we encountered all of the four characteristics of Chinese institutional setting. First, we had the environmental system initiating and coordinating the BTE research effort. Second the Mengpeng Rubber Plantation as a unit was chosen to carry out the project. Third, in order to carry out the project, it took many organizations' (mothers-in-law) involvement and cooperation. Failure to include the right "mothers-in-law" also brought serious problems to the project. Finally, to protect the economic well being of the unit, the

plantation became an *independent kingdom* when it decided not to pursue the BTE project.

From this study, we have learned that it takes more than advanced technology and funding to implement sustainable development. We need not only good environmental policy, but also effective environmental policy. It was not that China lacks good environmental policy to support sustainable development. It was rather that the policies were not thoroughly implemented. This case once again reveals the problems of the Chinese institutional setting.

THE FUTURE OF ENVIRONMENTAL POLICY IN CHINA

The framework of environmental policy in China is basically established. The major issue, however, has been and will be how to perfect the policy mechanism for implementation. Therefore, the future of environmental policy in China lies on the transition from the general to the specific, from theoretical to practical. For example, the policy makers should keep the viability and practicality in mind while making environmental policies.

In the past two decades, China's environment has gotten worse as the economy has improved. The good news, however, is that the Chinese government is paying more and more attention to environmental protection and sustainable development. The sixth plenary meeting of the Standing Committee of the Ninth National Committee of the Chinese Political Consultative Conference (CPPCC) was held in June 1999. This meeting was dedicated to solving the problems of development and environment, giving special attention to environmental protection in China.

Zhang Qia, director of CPPCC's Subcommittee of Population, Resources, and Environment, submitted suggestions to the meeting on improving the country's environment. According to Zhang, China's environment had worsened in the past few years. The trend, having not been yet stopped, has become a big problem endangering people's health, affecting the public order and limiting the country's sustainable development (*China Daily*, June 15, 1999). Zhang argued that because the current environmental problem was an accumulated result of the country's long-time development in the past, it would be difficult to solve at one shot. The most urgent task for now is to deal with water pollution, air pollution, urban garbage, desertification and encourage afforestation so as to curb the worsening of the country's environment as soon as possible. It is critical to set a long-term environmental protection strategy and effective emergency measures should also be adopted. The measures should be comprehensive, covering sectors of government administration, economy, law, technology and education.

According to Zhang, the reduction of air pollution can be achieved by upgrading the energy consumption structure, cutting the use of coal, curbing excessive land reclamation and tree-cutting, promoting the environmental protection industry and clean production. (*China Daily*, June 15, 1999). Song Ruixiang, vice-minister of the State Environmental Protection Administration (SEPA), points out that the *polluters pay* system is part of the country's reform of the present environmental management mechanism that relies heavily on administrative mandates. The central government must develop plans and supervise overall implementation of environmental protection schemes in accordance with laws and regulations. But a market management mechanism must

also be introduced to protect the environment, to alleviate financial burdens on the government and to ensure sufficient input for sustainable development (*China Daily*, July 1, 1999). Song also points out, in addition to governmental investment, the central government will gather commercial capital and social funds from communities and the public to set up environmental treatment enterprises.

In the past several years, nevertheless, the Chinese government has invested a relatively great amount of money on environmental protection. As Mr. Chen Wenyan, vice-chairman of the CPPCC, said: "the country has made remarkable progress in environmental protection." During the time period of Ninth Five-Year Plan (1996-2000), a total of 450 billion Yuan (US\$54.2 billion) is expected to be invested in environmental protection, accounting for 1.3% China's gross national product (GNP) (*China Daily*, July 1, 1999).

Although adequate funding is critical for environmental protection, the allocation of the money and appropriate policies are also very important in carrying out the work more efficiently. For example, preferential policies are essential for the initial implementation of renewable and new energy project. Some people suggested that the government should establish a green tax system, to levy heavier taxes on those using underground water and rare resources, and causing air pollution, and levy less on those engaged in clean production. In fact, some areas have already adopted preferential policies for new and renewable energy project. Recently, the Asian Development Bank (ADB) did a case study of the Inner Mongolia Autonomous Region. The study was about utilizing preferential policies to meet energy and development objectives. Although this

study is more about policies on wind power and solar energy, it can also shed light to making preferential policies for other forms of renewable energies.

According to the report, the major constraint for the development of wind power and solar energy is economic issues. The initial investment for wind power system is relatively large and beyond the financial abilities of potential users. The average initial investment for each system is 8000-10000 Yuan. The survey shows that a household with annual income of 20000 Yuan can afford this system. In Inner Mongolia, however, only 10% of the households have reached this income level. Therefore, in order to extend this program, government subsidies are critical and necessary (ADB, 1999)

In fact, governments at different levels of Inner Mongolia have paid great attention to this program, especially when it is connected to poverty reduction program. According to the new energy development subsidy policy of Inner Mongolia Autonomous Region, for each 100w Capacity of Wind power and each 16W of solar energy (PV), the government will subsidize 200 Yuan. If the subsidies come solely from government finance, they may pose a big burden for the government. Therefore, in order to extend this project widely, the government should first start with demonstration projects. Successful demonstration projects will serve as good publicity means to let more people know the benefits of the system (ADB, 1999). Thus, what the ADB recognizes is essential regarding the promotion of wind power technology in Inner Mongolia applies to biomass-to-energy technology in Yunnan. The Chinese government must develop a policy that provides incentives for the choice of environmentally friendly technologies over those that degrade the environment.

Environmental protection in China has long been considered a purely public issue. Many people believe the government is responsible for everything related to environmental protection and pollution treatment. Therefore, using market mechanisms to address environmental problems may take some time. Therefore, government's "interference" in environmental affairs will be the dominant mode of environmental management in China for the present and near future. A sound environmental policy is essential for carrying out the tremendous task of environment protection and sustainable development.

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APPENDICES

APPENDIX A

Table 2.1. Principles of Sustainable Development

Integrate the environment and the economy in all levels of decision-making
Utilize economic appraisals that fully value the cost of goods and services (including environmental and social impacts)
Revised how growth is measured and valued to make it equitable and long-term, and to reflect the quality of life elements;
Reorient technology to better manage risks and to efficiently use materials and energy
Conserve and enhance the natural resource base (air, water, soils, biological diversity)
Enhance interdisciplinary science and education to improve understanding of and to make information available on natural systems and their inter-relationships
Adjust the use of natural resources and the ability of environmental and economic to reflect carrying capacity
Ensure population stabilization through access to education, health care, and family planning services;
Improve governance through coordinated efforts that : link agencies, departments, and central government with local government; incorporate project appraisal techniques that include environmental and social costs and benefits; and involve citizens in decision-making;
Promote values and ethics that reflect sustainable development-the interdependence of the environment and economy, the importance of fairness and equity for long-term prosperity, and the need for cooperation and community

Source: Center of Policy Alternatives. *State Level Sustainable Development*. September 1993.

Table 3.1. Major Events of China's Environmental Protection efforts

1972	China sent a delegation to Stockholm Conference of the Human Environment, sponsored by United Nations.
1973	The First National Environmental Protection Conference was held in Beijing. "Three Wastes Offices" were created.
1974	Environmental Leadership Small Group was established under the State Council.
1979	Environmental Protection law was promulgated at the Third Session of the Eleventh Party Congress.
1983	The Second National Environmental Protection Conference was held.
1984	National Environmental Protection Bureau (NEPB) was established under the Ministry of Urban and Rural Construction and Environmental Protection
1988	NEPB broke away from the Ministry of Urban and Rural Construction and Environmental Protection. A new organization National Environmental Protection Agency (NEPA) was created.
1989	Third National Environmental Protection Conference was held.
1992	Chinese delegation led by Premier Li Peng attended United Nations Conference of Environment and Development (UNCED).
1994	China's Agenda 21--White Paper on China's Population, Environment, and Development in the 21 st Century was passed.
1998	NEPA was promoted to a full ministry-level organization at the Ninth Nation People's Congress. The New organization was named State Environmental Protection Administration (SEPA).

Table 3.2. China's Eight Environmental Protection Mechanism

1. Environmental Impact Assessment Statement (Huanjing Baohu Yinxang Baogao Shu): a policy that requires that an environmental assessment of a project be conducted if a new firm is set up or an existing firm is expanded.
2. The "Three Simultaneous" Policy (San Tongshi Zhidu): a policy that requires that environmental issues be addressed along with economic and social issues at each of the three states of project development: planning, design, and construction.
3. The Discharge Fee System (Paiwu Shoufei Zhidu): a policy requiring that firms which discharge wastes in excess of legally set standards pay a fee for exceeding standards.
4. The Environmental Protection Target Contract Responsibility System (Huanjing Baohu Mubiao Zeren zhi): a system whereby local government leaders acknowledge their responsibility for the environment under their jurisdiction and commit themselves to improving the quality of this environment.
5. The Quantitative Assessment System (Dingliang Kaohe Zhidu): a system in which 20-odd indicators of China's environmental quality are assessed across 32 provincial capitals and major cities.
6. The Centralized Pollution Control System (Jizhong Kongzhi Zhidu): a system for dealing with pollution problems collectively by amassing funds and utilizing economies of scale.
7. The Deadline Clean-up Order (Xianqi Zhili Zhidu): a system whereby the local government issues an order requiring that firms deal with a particular pollution problem by given deadline.
8. The Water Pollution Permit System (Shui Wuran Xuke Zheng Zhidu): a system under which rights are distributed to firms to discharge specified quantities of pollutants into waterways.

Source: Sinkule, Barbara and Leonard Ortolano. 1995. *Implementing Environmental Policy in China*. Westport, Connecticut and London: Praeger.

Table 4.1. A Chronology of Yunnan Biomass-to-Electricity (BTE) Projects

1989	Dr. Milton Russell, sponsored by the National Environmental Protection Agency in Beijing, discussed potential collaboration with the Yunnan Provincial Environmental Protection Commission. Opportunities to use biomass for power generation in rural Yunnan Province were identified.
1990	An Oak Ridge National Laboratory (ORNL) team consisting of Milton Russell, Robert Perlack, and Jack Ranney completed a prefeasibility assessment of stand-alone biomass power generating facilities. Prefeasibility assessment focused on plantation activities (site inspection) and determining whether trees could be grown for power production. The study concluded that the resource base for tree production was sufficiently large to support power plants in the 20 MW size and that power from these plants could be generated at costs competitive with alternatives. The study team also judged that the development and environmental benefits were large.
1991	A study team consisting of Milton Russell, Zhongmin Shen (A graduate student of the University of Tennessee), and Dan Jantzen (An engineer of Winrock International) visited sites and collected additional information to refine the 1990 feasibility assessment. Efforts focused on the conversion technology. Cogeneration opportunities at sugar mills were also identified. Cogeneration on developing biomass projects was discussed with related government entities of Yunnan.
1992	An international team consisting of Milton Russell, Zhongmin Shen, Dan Jantzen, Phil LaRocco (Rockefeller Foundation), J. Mullen (boiler consultant), and D. Chandler (plantation forest expert) studied in detail the feasibility of converting sugar mills to cogenerate power and to sell excess power to the local grid. Biomass feedstocks would be grown and used to supplement the bagasse feedstocks for year-round power generation. The study team (Russell, Shen, and Jantzen) refined the feasibility analysis of the sugar mill conversion and conclude that internal rates of return were likely to be quite favorable and potentially high enough to attract U.S. investors.
1993	The study team (Russell, Shen, and LaRocco) visited Yunnan Province to discuss project status and to negotiate a cooperative agreement on future research. They consulted with local officials on forming an autonomous enterprise for electricity production. (It was not formed eventually). They also consulted with the Yunnan Environmental Science Institute on setting up a semi-autonomous energy and environmental service enterprise.

Table 4.1. (CONTINUED)

1994	1994: Joint Institute for Energy and Environment (JIEE) initiated market assessment activities to identify specific investment opportunities. Yunnan Institute of Environmental Science (YIES) was conducting the feasibility study research. The feasibility study revealed that the biomass resource in Yunnan is large. For the twelve project sites investigated, the combined potential feeds stock was equivalent to 1.42 GW of power flow in a year. At the assumed very low power conversion rate of 12% and assuming a capacity factor of 80%, the resource could support 213 MW of electricity generating capacity. The study also showed that the Competition from other energy sources is weak. Yunnan is a land of energy diversity. It has abundant coal resources in the east and very large hydroelectric resources on the major rivers of the west. It has a major transmission grid running east to west across its middle. Nevertheless, many rural areas in the South, southwest, north and the extreme eastern tip are not connected except to very local grids. These grids are served mostly by run of the river hydroelectric power stations, which can not meet demand during the six month long dry season. These are the places where small biomass electricity plants make sense. They can produce electricity to meeting growing and latent demand at a projected cost that competes with hydro and is much less expensive that diesel or coal
1995	Dr. Bill Barron of Hong Kong University began field activities to identify specific Opportunities and corroborated analysis performed by the Yunnan Institute of Environmental Science. A workshop was organized by JIEE so that a delegation from Yunnan Province could present specific investment opportunities to U.S. investors and private power producers. Half a dozen investors and power companies came to the workshop. Some of the companies showed great interest about the project.
1996	JIEE coordinated the visits of two U.S companies to Yunnan. Two preferred sites-MengPeng Rubber Plantation and Qina Sugar Mill were identified for the first two target projects. A representative from Energy Performance Services, Inc. and a help team of JIEE (Milton Russell, Bill Fulkerson, and Qinguo Gao) went to Yunnan to explore the possibility of establishing a joint venture for biomass generation. The negotiation halted due to the lack of support from government entities.
1997	The Project was on hold. JIEE was doing following up studies, seeking to resume the project.

Table 4.2. Locations and Administrative Regions of Selected BTE Projects in Yunnan

Prefecture	County or City	Type	Distance to Kunming, km
Yuxi	Xinping	Sugarmill Conversion	220
Lijiang	Yongsheng	Sugarmill Conversion and Stand-alone	520
Wenshan	Guangnan	Stand-alone	560
Wenshan	Funing	Stand-alone	620
Baoshan	Baoshan City	Sugarmill Conversion	600
Baoshan	Tengchong	Sugarmill Conversion	760
Lincang	Shuangjiang	Sugarmill Conversion	750
Lincang	Yongde	Sugarmill Conversion	780
Dehong	Luxi City	Sugarmill Conversion	800
Xishuang-Banna	Menghai	Sugarmill Conversion	790
Xishuang-banna	Mengla Mengpeng Farm	Sugarmill Conversion	900

Source: Yunnan Institute of Environmental Science. 1995. *Determination of Market Size and Potential Opportunities for Biomass-to-Electricity Projects in Yunnan Province, China*. Final Report, Kunming, July 1995.

Table 4.3. Selected BTE Projects with Sugarmill Conversion Plants

Sugarmill Name	County or City	Capacity (in MW)	Investment (million yuan)	Cost (yuan/kWh)	NPV (I=10%) M. yuan/year
Qina	Yongsheng	Phase I: 3 Phase II: 6	4.29	0.21	7.27
Dongfeng	Baoshan	6	10.05	0.14	8.87
Huanjiao	Luxi	6	15.65	0.10	13.465
Xinping	Xinping	6	15.65	0.22	4.25
Hehua	Tengchong	6	15.65	0.11	10.012
Yongkang	Yongde	Phase I: 3 Phase II: 6	4.29	0.14	4.665
Shuangjiang	Shuangjiang	6	15.65	0.13	6.197
Liming	Menghai	3	5.79	0.16	3.68

Source: Yunnan Institute of Environmental Science. 1995. *Determination of Market Size and Potential Opportunities for Biomass-to-Electricity Projects in Yunnan Province, China*. Final Report, Kunming, July 1995.

Table 4.4. Selected Stand-Alone BTE Power Plants

Sugarmill Name	County or City	Capacity (in MW)	Investment (million yuan)	Cost (yuan/kWh)	NPV (I=10%) M. yuan/year
Mengpeng	Mengla	6	18.15	0.21	16.123
Maguohe	Yongsheng	3	8.02	0.24	0.696
Guangnan	Guangnan	6	18.15	0.12	9.16
Funing	Funing	3	8.79	0.17	0.563

Source: Yunnan Institute of Environmental Science. 1995. *Determination of Market Size and Potential Opportunities for Biomass-to-Electricity Projects in Yunnan Province, China*. Final Report, Kunming, July 1995.

Table 4.5. Summary of BTE Projects Investment, Fuel and O&M Costs

Plant Type-Capacity Project	Wood Fuel Requirements & Cost		Investment (Million ¥)	Annual O&M (Million ¥ Yr)
	Dry Tones Yr	Yuan/Dry tone		
Sugarmill-3 MW				
Menghai	19,440	20.70	5.79	0.798
Yongde	21,600	47.60	4.29	0.728
Yongsheng	21,600	83.30	4.29	0.758
Sugarmill-6MW				
Baoshan	43,200	47.60	10.50	1.314
Luxi	43,200	33.10	15.65	1.570
Shuangjiang	43,200	35.00	15.65	1.600
Tengchong	43,200	41.30	15.65	1.580
Xinping	43,200	71.30	15.65	1.709
Stand Alone-3MW				
Funing	17,280	39.70	8.79	0.977
Yongsheng Maguo	21,600	83.30	8.02	1.100
Stand-Alone-6 MW				
Guangnan	34,560	23.90	18.15	1.790
Mengla	41,470	27.40	18.15	1.890

Source: Perlack, Robert. 1996. *Prospects for Biomass-to Electricity Projects in Yunnan Province, China*. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Table 4.6. Summary of BTE Power Generation and Export Power Sales

Plant Type-Capacity Project	Hours of Generation	Export Generation (MWH)	Purchase Price (Yuan per KWH)
Sugarmill-3 MW			
Menghai	4500	10,800	0.30
Yongde	5000	12,000	0.25
Yongsheng	5000	12,000	0.35
Sugarmill-6MW			
Baoshan	5000	24,000	0.25
Luxi	5000	24,000	0.25
Shuangjiang	5000	24,000	0.25
Tengchong	5000	24,000	0.25
Xinping	5000	24,000	0.35
Stand Alone-3MW			
Funing	4000	9,600	0.30
Yongsheng Maguo	5000	12,000	0.35
Stand-Alone-6 MW			
Guangnan	4000	19,200	0.30
Mengla	4800	23,040	0.40

Source: Perlack, Robert. 1996. *Prospects for Biomass-to Electricity Projects in Yunnan Province, China*. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Table 4.7. Financial Summary of Yunnan BTE Projects

Plant Type-Capacity Project	Net Present Value (Million Yuan)	Levelized Cost of Power (Yuan/KWH)	Internal Rate of Return (%)
Sugarmill-3 MW			
Menghai	10.489	0.188	31.01
Yongde	5.094	0.2101	23.47
Yongsheng	8.019	0.273	31.08
Sugarmill-6MW			
Baoshan	9.782	0.203	20.95
Luxi	8.134	0.211	16.30
Shuangjiang	7.141	0.216	15.54
Tengchong	4.962	0.226	13.89
Xinping	12.267	0.291	19.36
Stand-Alone-3MW			
Funing	0.472	0.294	10.66
Yongsheng Maguo	1.405	0.337	12.12
Stand-Alone-6 MW			
Guangnan	7.035	0.258	14.74
Mengla	31.965	0.241	30.93

Source: Perlack, Robert. 1996. *Prospects for Biomass-to Electricity Projects in Yunnan Province, China*. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Table 4.8. Ranking of Project on Basis of Financial Measures

Net Present Value Million Yuan	Levelized Cost of Power Yuan per KWH	Internal Rate of Return %
Mengla-31.9	Menghai-0.19	Yongsheng Qina-31.0
Xinping-12.3	Yongde-0.20	Menghai-31.0
Menghai-10.5	Baoshan-0.20	Mengla-30.9
Baoshan-9.8	Luxi-0.21	Yongde-23.5
Luxi-8.1	Shuangjiang-0.22	Baoshan-21.0
Yongsheng Qina-8.0	Tengchong-0.23	Xinping-19.4
Shuangjiang-7.1	Mengla-0.24	Luxi-16.3
Guangnan-7.0	Guangnan-0.26	Shuangjiang-15.5
Yongde-5.1	Yongsheng Qina-0.27	Guangnan-14.7
Tengchong-5.0	Xinping-0.29	Tengchong-13.9
Yongsheng-Maguohe-1.4	Funing-0.29	Yongsheng Maguohe-12.1
Funing-0.5	Yongsheng Maguohe-0.34	Funing-10.7

Source: Perlack, Robert. 1996. *Prospects for Biomass-to Electricity Projects in Yunnan Province, China*. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Table 4.9. Summary of Criteria used to Rank-Order Yunnan BTE Projects

Project	Internal rate of return (%)	Biomass resources (dry tones /year	Power demand (million KWH/year	Local capabilities
Baoshan	21.0	74,200	79.38	1
Funing	10.7	107,900	11.78	1
Guangnan	14.7	462,100	38.71	1
Luxi	16.3	201,100	45.00	1
Mengla	30.9	266,800	52.50	2
Menghai	31.0	246,800	12.08	1
Shuangjiang	1.55	279,200	7.27	1
Tengchong	13.9	141,000	32.34	1
Yongde	23.5	179,900	22.38	1
Yongsheng Qina	31.0	81,900	22.50	2
Yongsheng Man	12.1	81,900	22.50	2
Xinping	19.4	48,600	18.45	1

Source: Perlack, Robert. 1996. *Prospects for Biomass-to Electricity Projects in Yunnan Province, China*. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Table 4.10. Ranking of BTE Projects under Alternative Criteria Weights

Criteria-Weight		
IRR-0.4	IRR-0.25	IRR-0.4
Power Demand-0.3	Power Demand-0.25	Power Demand-0.4
Local Capability-0.2	Local Capability-0.25	Local Capability-0.1
Biomass Resource-0.1	Biomass Resource-0.25	Biomass Resource-0.1

Project-Ranking Value		
Mengla-8.3	Mengla-7.8	Mengla-7.9
Yongsheng Qina-6.6	Yongsheng Qina-5.6	Baoshan-6.1
Baoshan-5.1	Guangnan-4.0	Yongsheng Qina-5.7
Menghai-4.5	Baoshan-3.9	Menghai-4.5
Yongde-3.3	Menghai-3.7	Yongde-3.5
Guangnan-3.0	Yongsheng Magouhe-3.3	luxi-3.4
Luxi-2.9	Luxi-2.8	Guangnan-3.4
Yongsheng Magouhe-2.8	Yongde-2.8	Tengchong-2.1
Xinping-2.0	Shuangjiang-1.8	Xinping-2.1
Tengchong-1.8	Tengchong-1.7	Yongsheng Magouhe-2.0
Shuangjiang-1.3	Xinping-1.3	Shuangjiang-1.7
Funing-0.1	Funing-0.4	Funing-0.1

Source: Perlack, Robert. 1996. *Prospects for Biomass-to Electricity Projects in Yunnan Province, China*. Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Table 4.11. Investment of Main equipment of Mengpeng BTE Project

No.	Equipment	Quantity	Price (Million Yuan)
1	20 ton/hour boiler	2	2.60
2	Air Blower (Push)	2	0.05
3	Dust remover	2	0.18
4	Air Blower (Extract)	2	0.05
5	Oxygen Remover	2	0.08
6	Waste Discharge	2	0.09
7	Water Supply Pump	4	0.12
8	Turbine	2	2.40
9	Condensing Water Pump	2	0.06
10	Steam Condenser	2	0.10
11	Extractor	2	0.10
12	Oil Pump	2	0.08
13	Heater	2	0.06
14	Oil Cooler	2	0.05
15	Water Discharge Pump	2	0.06
16	Power Generator	2	2.20
17	Others	2	0.98
18	Total		9.78

Source: Guo, Huiguang et al. 1995. *Determination of Market Size and Potential Opportunities for Biomass-to-electricity Projects in Yunnan Province*. Yunnan: Yunnan Institute of Environmental Science.

Table 4.12. Total Investment of the Mengpeng BTE Project

Million Yuan

No.	System	Construction	Equipment	Installation	Sum	%
1	Heating	1.10	3.87	0.80	5.77	31.8
2	Feedstock Supply	0.25	1.70	0.05	2.00	11.0
3	Water Treatment	0.18	0.15	0.02	0.35	2.0
4	Dust Removal	0.02	0.05	0.01	0.08	0.4
5	Water Supply	0.10	0.15	0.01	0.26	1.4
6	Power-Steam	0.10	5.91	0.70	6.71	37.0
7	Control		0.65	0.30	0.95	5.2
8	Other Facilities	0.20	0.15	0.01	0.36	2.0
9	Living Quarters	0.08			0.80	4.4
10	Inflation		0.87		0.87	4.8
11	Total	2.75		1.90	18.15	100.0

Source: Guo, Huiguang et al. 1995. *Determination of Market Size and Potential Opportunities for Biomass-to-electricity Projects in Yunnan Province*. Yunnan: Yunnan Institute of Environmental Science.

Table 4.13. Annual Costs of the Mengpeng BTE Project

Million Yuan			
	Item	Amount	Remark
1	Feedstock	2.79	39.789t/y*70yuan/t
2	Wages	0.60	100 people, 500 Yuan/people/Month
3	Fixed Asset Depreciation	0.64	No.
4	Repair	0.32	2.5% of Fixed Asset
5	Interest for Circulating Capital	0.08	15% of Annual Interest Rate
6	Welfare	0.08	13% of Wages
7	Workshop Fund	0.10	(No.1+No.2+No.5)*3%
8	Administration Fund	0.07	(No.1+No.2+No.5+No.6)*2%
9	Annual Total cost	4.68	

Source: Guo, Huiguang et al. 1995. *Determination of Market Size and Potential Opportunities for Biomass-to-electricity Projects in Yunnan Province*. Yunnan: Yunnan Institute of Environmental Science.

Table 4.14. Cash Flow of Mengpeng BTE Project (Years 1-28)

Million Yuan						
No.	Item	Amount	Year 1	Year 2	Year 3	Years 4-28
1	Output, %		20	100	100	100
	Income					
2	Power Sale	250.672	1.84	9.216	9.216	230.40
3	Subtotal	250.672	1.84	9.216	9.216	230.40
	Expenses					
4	Feedstock	78.961	0.58	2.903	2.903	72.575
5	Construction	18.15	18.15			
6	Operation	52.92	1.89	1.89	1.89	47.25
7	Tax	12.512	0.092	0.46	0.46	11.50
8	Subtotal	168.213	20.71	5.253	5.253	136.995
9	Net Cash Flow		-18.972	3.963	3.963	93.405
10	Total	34.854	-18.972	-14.909	-10.946	

Source: Guo, Huiguang et al. 1995. *Determination of Market Size and Potential Opportunities for Biomass-to-electricity Projects in Yunnan Province*. Yunnan: Yunnan Institute of Environmental Science.

APPENDIX B

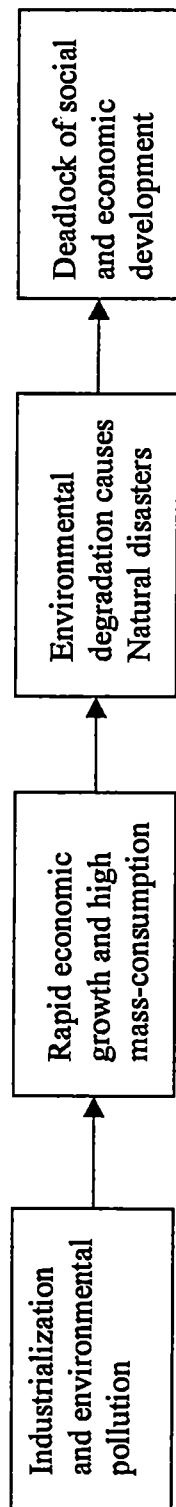


Figure 1.1. The Tradeoff Model of Development

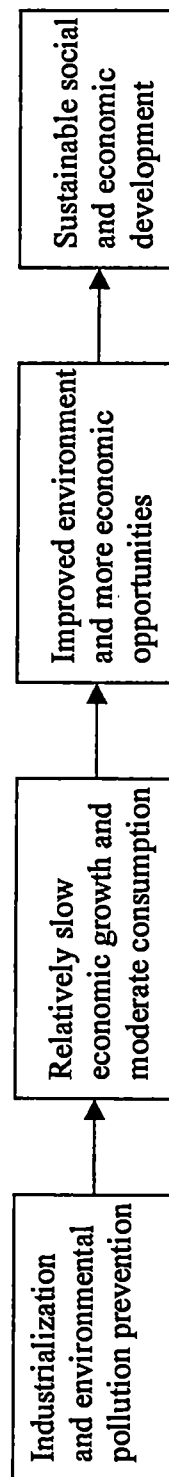


Figure 1.2. The Model of Sustainable Development

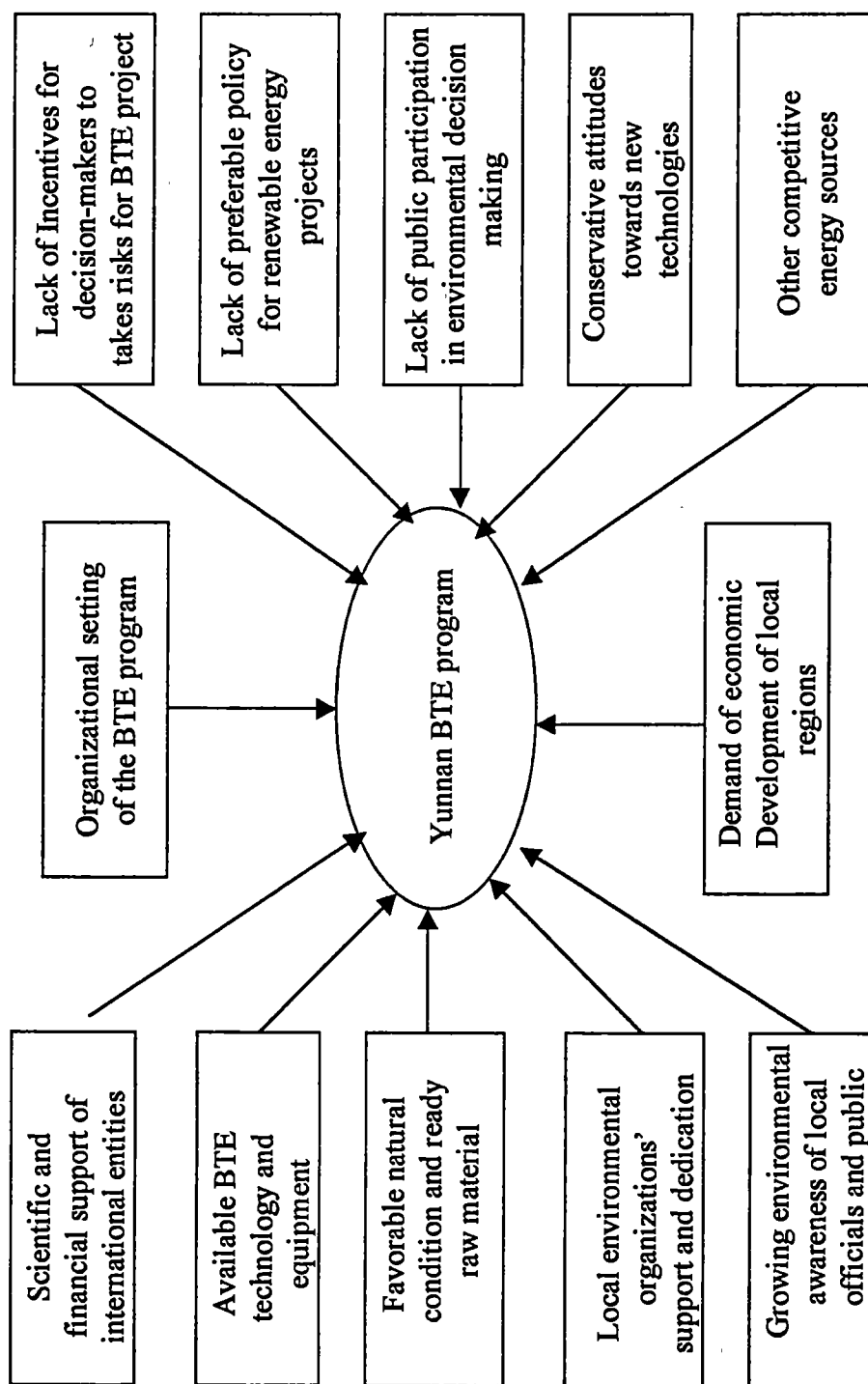


Figure 2.1. Factors Affecting the Implementation of Yunnan BTE Projects

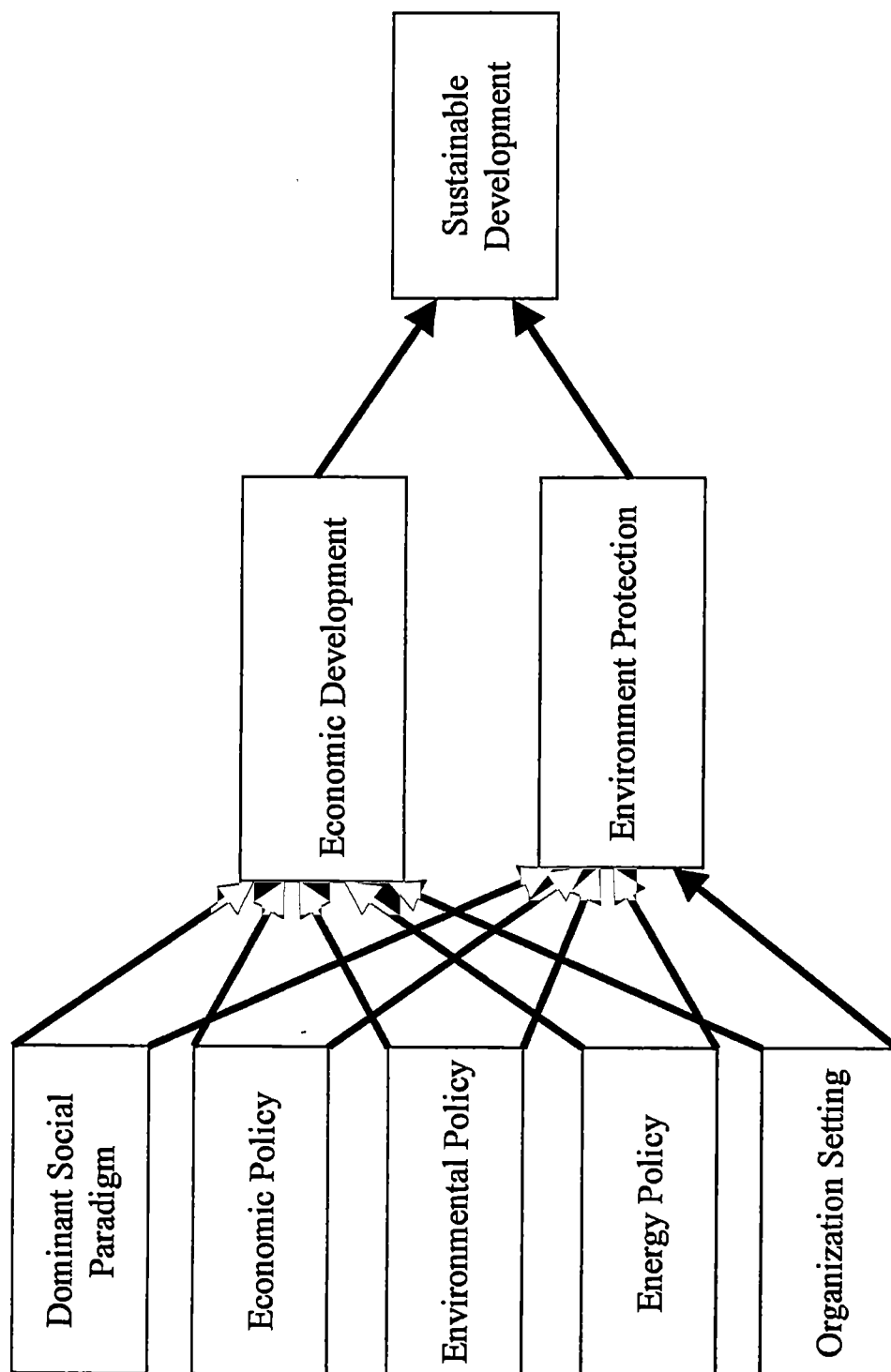


Figure 2.2. The Way to Sustainable Development

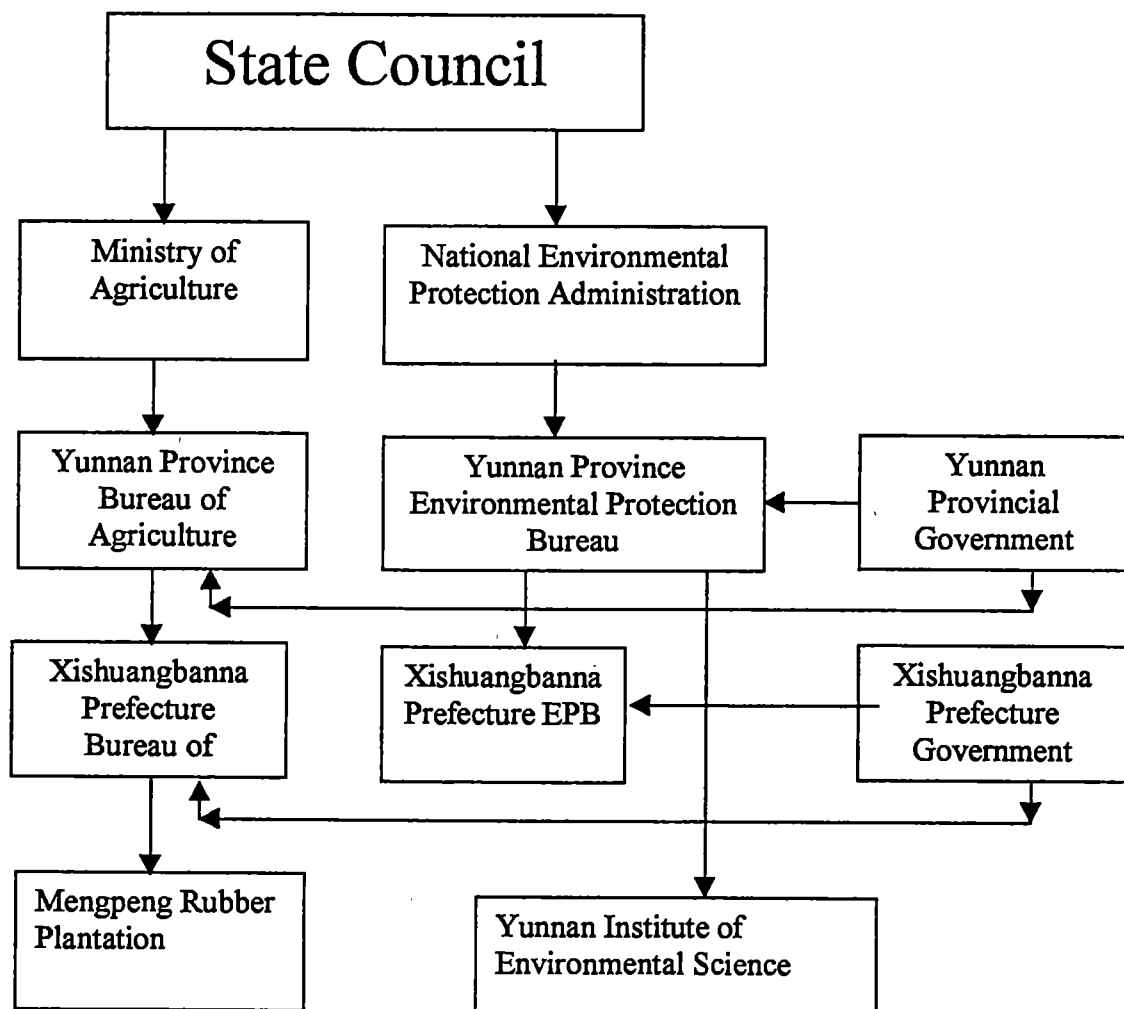


Figure 3.1. Illustrative Tiao Tiao Kuai Kuai (Vertical and Territorial) Relations.

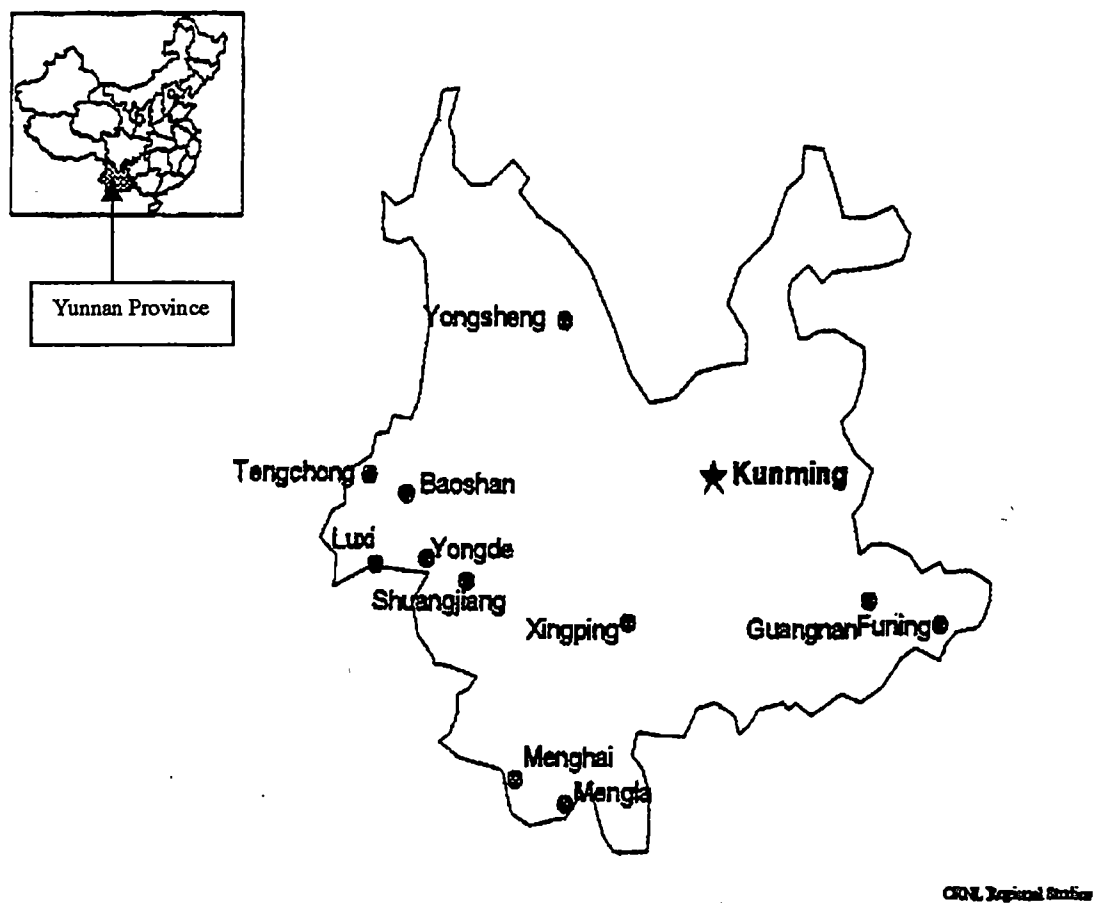


Figure 4.1. Locations of BTE Projects in Yunnan Province

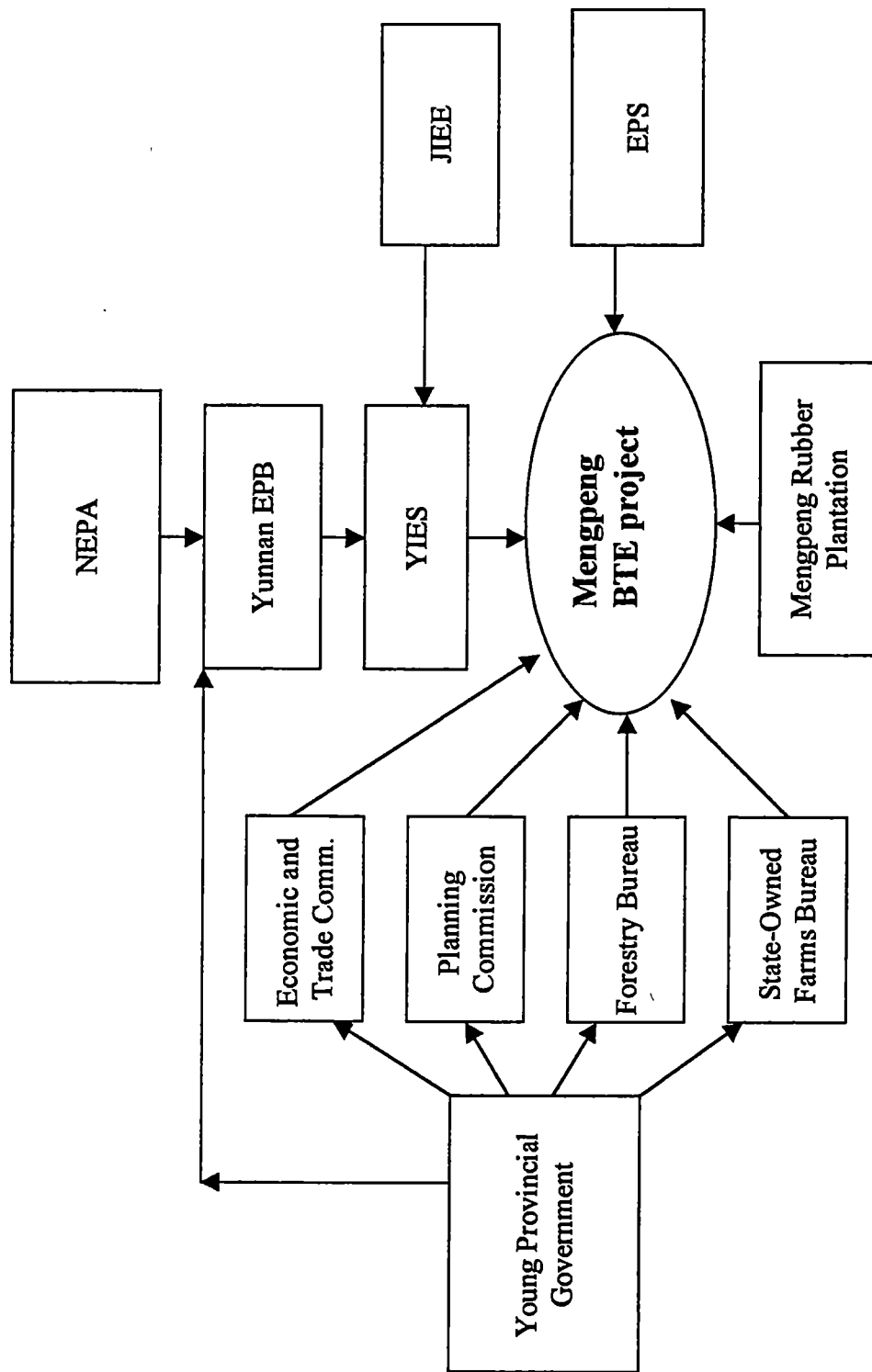


Figure 5.1. Major Players of the Mengpeng BTE

VITA

VITA

Qingguo Gao was born in Liaoning, China on August 20, 1962. He graduated from Hongluoxian High School in Liaoning in 1980. Upon graduation from high school, he attended Huaibei Teachers College, Anhui, China where he earned his Bachelor of Arts degree in English in 1984. Following the graduation, he worked as interpreter and translator at China University of Mining and Technology, Xuzhou, China. In 1985, he started working at Huaibei Teachers College as English teacher, interpreter, and then deputy director of the Foreign Affairs Office.

In 1992, he started his graduate study at Tarleton State University, Stephenville, Texas where he earned his Master of Arts degree in Government in 1993. While studying at Tarleton State University, he worked as graduate teaching assistant. In 1994, he entered the University of Tennessee-Knoxville for his Ph.D. program in Political Science. From 1995 to 1998, he worked as graduate teaching assistant and research assistant at the Department of Political Science and the Joint Institute for Energy and Environment respectively. In 1998, he started working as an intern at the Tennessee Valley Authority (TVA). His work at the TVA includes coordinating international projects and environmental policy research.

In August 1999, he received his Ph.D. in Political Science at the University of Tennessee.