

**ADB, GEF, UNEP**

in collaboration with IGES and NIES

National Performance Assessment and Subregional Strategic  
Environment Framework in the Greater Mekong Subregion

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**YUNNAN PROVINCE, PR CHINA  
NATIONAL ENVIRONMENTAL PERFORMANCE  
ASSESSMENT (EPA) REPORT**

Prepared by  
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For Asia and the Pacific



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## Executive Summary

The mountainous Yunnan Province remains predominantly rural despite rapid industrial development in and around Kunming and lake plateaus. Sustainable management of renewable resources and mitigation of adverse effects of economic growth are important in Yunnan. The Environmental Performance Assessment (EPA) presented here examines the degree of success that Yunnan provincial authorities and other provincial stakeholders have had in achieving the objectives set for safeguarding Yunnan's environment and environmental health. The assessment focuses on seven principal environmental concerns in the Province, namely land degradation, threats to biodiversity, inland water pollution, inadequate waste management, forest degradation, the impact of natural disaster and climate change.

In broad terms, over the last decade or so, a period of rapid economic growth, the environmental quality of Yunnan remained stable with a somewhat uneven performance in different environmental concern areas. The main improvements were registered in forest cover, water quality in rivers and pollution abatement performance by the industry. The disappointments were a stagnating municipal solid waste management and the water quality in the Province's principal lakes. The Province largely succeeded in countering the loss of farmland and had some success in fighting soil erosion. Improvements in energy efficiency and urban air quality became much harder to sustain after a period of rapid improvement in the early 1990s. The quality of environment-related information and access to data remain inadequate.

Disaggregated by individual concerns, efforts to arrest soil erosion have yielded moderately positive results in some areas while being set back in other areas by aggressive growth of commercial farming. The cost effectiveness of soil conservation interventions would merit a closer study.

Forest cover appears to have steadily increased since 1990. Forest rehabilitation projects have had a positive impact although the increase in area has outpaced the forests' standing volume. The average quality of the larger forest may have declined and if so, may have adversely impacted biodiversity. This is significant as Yunnan is home to about half of China's biodiversity. The Government has taken important initial steps to establish a benchmark for future assessments of the state of biodiversity in the province. The area under natural reserves doubled between 1989 and 2004. By the end of 2004, there were 193 nature reserves in Yunnan, with a total area of 347.3 million hectares covering 8.8% of the total area of the province. Of these, 13 were classified as national-level nature reserves, 51 were provincial-level reserves.

Yunnan is rich in water resources with no fewer than four international river systems (of which the Mekong is one) located in the Province. The rivers and lakes in close vicinity of population centres have traditionally suffered from high levels of pollution and eutrophication (in the case of lakes). The quality of water in Yunnan's major rivers deteriorated up to 1999 as the volume of untreated municipal and industrial wastewater discharged grew. After 1999, water quality began to improve as a result of pollution control measures such as commissioning of centralized wastewater treatment plants in major cities and greater efforts by industrial enterprises in response to the application of the pollution levy system. Large investments were made to improve water quality in 9 principal lakes of the Province but the results are believed to be much more modest. Government expenditure in wastewater management is on the rise.

Combined with difficult topography and hydrology, Yunnan's location in a seismically active zone makes the province vulnerable to natural hazards. There is a long history of natural disasters the seriousness of which is affected also by man-made factors such as the degree of disaster preparedness and the value of human and material assets at risk. Activities such as unsuitable and unauthorized location of housing, poor quality of housing and infrastructure, removal of protective vegetative cover, unsafe storage of hazardous waste, and others have exacerbated the impact of natural phenomena. Managing natural disasters and mitigating the economic losses associated with them remains a major challenge for Yunnan's authorities and population.

While the solid waste discharge and re-cycling performance of the industry improved significantly during the last decade, no such improvement has been achieved in dealing with municipal waste. The relatively poor performance by the municipal segment may be due to the difficulties and high cost of developing safe landfills.

With respect to climate change; there has been a significant improvement in Yunnan in the efficiency with which coal is used to generate electricity. The consumption of coal has remained largely unchanged since 1997. Energy intensity declined rapidly until 1996 and the emissions of GHGs per unit of output (though not in absolute terms), can be presumed to have declined in line with this improvement.

## Abbreviations

ADB	Asian Development Bank
BOD	Biological Oxygen Demand
CBIK	Center for Biodiversity and Indigenous Knowledge
CDM	Clean Development Mechanism
COD	Chemical Oxygen Demand
EE	Environmental Education
EIA	Environmental Impact Assessment
EPA	Environmental Performance Assessment
EPB	Environmental Protection Bureau
EPL	Environment Protection Law
GDP	Gross Domestic Production
GEF	Global Environment Facility
GHG	Greenhouse Gases
GIS	Geographic Information System
GMS	Greater Mekong Subregion
GPS	Global Position System
IGES	The Institute for Global Environmental Strategies
IUCN	International Union for the Conservation of Nature
MOA	Ministry of Agriculture
MOST	Ministry of Science and Technology
MWR	Ministry of Water Resource
NDRC	National Development and Reform Commission
NGO	Non Governmental Organization
NIES	National Institute for Environmental Studies
OECD	Organization for Economic Co-operation and Development
PEPB	Provincial Environmental Protection Bureau
RRCAP	Regional Resource Center for Asia and the Pacific
PRC	People's Republic of China
RMB	Renminbi, the Chinese currency (with Yuan as a basic unit)
RS	Remote Sensing
SCPC	Standing Committee of the People's Congress
SEF	Strategic Environmental Framework
SEPA	State Environmental Protection Administration
TNC	The Nature Conservancy
UNEP	United Nations Environment Program
WWF	World Wildlife Fund
YEN	Yunnan Eco-network
YIES	Yunnan Institute of Environmental Science
YNPEPB	Yunnan Provincial Environmental Protection Bureau
YNEMCS	Yunnan Environmental Monitoring Center Station
YNPRA	Yunnan Participatory Rural Association

Note: A rate of exchange of 8.27 RMB to 1 US dollar is used in this report

# Table of Contents

I. INTRODUCTION	1
<b>1.1 Background</b>	<b>1</b>
<b>1.2 Yunnan Province: An Overview</b>	<b>4</b>
1.2.1 Physical environment	4
1.2.2 Population	5
1.2.3 Economic development	5
1.2.4 Institutional Structure for Environmental Protection in PRC and Yunnan	5
II. MANAGEMENT OF PRINCIPAL ENVIRONMENTAL CONCERNS AND ITS ASSESSMENT	8
<b>2.1 The method</b>	<b>8</b>
2.1.1 The performance assessment model	8
2.1.2 Rating guidelines	9
<b>2.2 Land Degradation</b>	<b>14</b>
2.2.1 The Context	14
2.2.2 The State	14
2.2.4 The Response	17
2.2.5 Conclusions	19
<b>2.3 Threat to Biodiversity</b>	<b>22</b>
2.3.1 The Context	22
2.3.2 The State	22
2.3.3 The Pressure	24
2.3.4 The Response	25
2.3.5 Conclusions	27
<b>2.4 Inland Water Pollution</b>	<b>29</b>
2.4.1 The Context	29
2.4.2 The State	29
2.4.3 The Pressure	30
2.4.4 The Response	33
2.4.5 Conclusions	34
<b>2.5 Inadequate Waste Management</b>	<b>36</b>
2.5.1 The Context	36
2.5.2 The State	36
2.5.3 The Pressure	38
2.5.4 The Response	40
2.5.5 Conclusions	41

<b>2.6 Forest Resources</b>	<b>43</b>
2.6.1 The Context	43
2.6.2 The State	43
2.6.3 The Pressure	44
2.6.4 The Response	45
2.6.5 Conclusions	48
<b>2.7 Natural Disasters</b>	<b>50</b>
2.7.1 The Context	50
2.7.2 The State	50
2.7.3 The Pressure	52
2.7.4 The Response	53
2.7.5 Conclusions	54
<b>2.8 Climate Change</b>	<b>57</b>
2.8.1 The Context	57
2.8.2 The State	57
2.8.3 The Pressure	57
2.8.4 The Response	59
2.8.5 Conclusions	60
<b>III CROSS CUTTING ISSUES IN EPA</b>	<b>62</b>
<b>3.1. Integration of environmental concerns in economic decisions</b>	<b>62</b>
3.1.1 Policy and Institutional Integration	62
3.1.1.1 Institutional structure for environmental protection in PRC and Yunnan	62
3.1.1.2 Institutional strengthening and capacity building	62
3.1.1.3 Legislative and policy development	63
3.1.2 Environmental expenditure and financing	65
<b>3.2 Implementation issues</b>	<b>66</b>
3.2.1 Regulatory and economic instruments	66
3.2.2 Enforcement	68
3.2.2.1 Environmental management system	68
3.2.2.2 Special pollution control actions	70
<b>3.3 Environment and civil society</b>	<b>71</b>
3.3.1 Environment, health and safety	71
3.3.2 Access to information and public accountability	71
3.3.3 Environmental awareness and education	72
<b>IV. CONCLUSIONS AND RECOMMENDATIONS</b>	<b>76</b>
<b>4.1 Management of Environmental Concerns</b>	<b>76</b>
<b>4.2 Cross cutting recommendations</b>	<b>79</b>

# I. INTRODUCTION

## 1.1 Background

1. Both geographically and through the Mekong River, Yunnan Province of the People's Republic of China (PRC) is closely linked to other countries of the Greater Mekong Subregion (GMS). The environmental dimensions of this association go well beyond the conditions of the Mekong River itself and extend to biodiversity, forestry, and land degradation in the GMS. There is a need to understand more fully the changing environmental conditions in each of the countries of the basin and their combined effect on the basin, the reasons for such changes and the effectiveness of the authorities' responses to principal environmental challenges.

2. The National Performance Assessment and Strategic Environmental Framework for the Greater Mekong Sub-region Project ("SEF II Project"), supported by the Asian Development Bank (ADB), the Global Environment Facility (GEF), the United Nations Environment Program (UNEP), the Institute for Global Environmental Strategies (IGES) of Japan and the National Institute for Environmental Studies (NIES) of Japan, was formulated to help improve this understanding and formulate appropriate policy adjustments thereafter .

3. Yunnan's Environmental Performance Assessment (EPA) Report presented here examines the developments under selected environment concerns over a period of time and the degree of success the national authorities have had in influencing environmental outcomes. The report is one of six prepared to a similar format by each of the countries of the Great Mekong Sub-region as part of the SEFII project.

4. The Yunnan Provincial Environmental Protection Bureau (YNPEPB) was responsible for preparing this report under the guidance of the State Environmental Protection Administration of China (SEPA) and with support from other provincial and national agencies concerned with environment and economic development in Yunnan. The report itself was prepared by a national team comprising SEFII national consultants, YNPEPB staff participating in the SEFII project and an EPA advisory team consisting of government and non-governmental stakeholders.

5. The overall efforts were guided by

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The initial draft of the EPA report was prepared by national technical consultants:

Liu Xin                      National Consultant on Environmental Issues

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Wu Yusong             WWF, Yunnan Office

Lu Wenbo              Project officer, Oxfam Hong Kong

Cheng Fan              Deputy Director, Yunnan Environment Monitoring Station

The report was reviewed by the subregional expert group and international consultants and edited by Messrs. Mike Comeau, Mohit Kumar and Ivan Ruzicka.

6.     January 2005 to agree the approach to the EPA and determine the scope of the assessment. The first National Workshop identified six (from a list of fourteen potential) environmental concerns considered the most pressing in Yunnan, to be assessed under the project. They included land degradation, threat to biodiversity, inland water pollution, inadequate waste management, forest resource depletion and natural disasters. Climate change was adopted as an environmental concern given its global significance and the importance of reporting on actual performance to Global Environment Facility (GEF), a key partner to the SEFII Project. The workshops also reviewed the conditions for a meaningful assessment of performance such as availability of appropriate data, and a clearly defined policy target or objective against which performance under the chosen concern can be assessed. It was also concluded that other concerns not included in the present EPA might be evaluated in the future.

7.     After the present introductory Part I, the report is organized as follows:



Part II assesses performance under the priority concerns selected.

“Performance” is understood as an assessment of the observed outcomes against the targets set under each concern. The assessment is based on a Pressure-State-Response (P-S-R) model and a rating approach explained at the beginning of the chapter.

Part III discusses cross-cutting factors, i.e. those elements that affect the overall environmental performance of the province without necessarily neatly falling under any one of the selected concerns.

Part IV draws conclusions and makes recommendations. It is a summary of where the country stands in terms of recent performance under the chosen concerns and a menu of recommendations to improve performance as well as the assessment process itself.

The Annex provides statistical information organized in the form of “factsheets” that supports the analysis of Parts II and IV of the report.

8. Besides its potential usefulness for Yunnan, the EPA reporting as developed under the SEF II Project offers wider benefits. The method used here can be applied at different levels of analysis, not only the provincial one (as in the present case) or national level (as done for other GMS members<sup>1</sup>). The commonality of approach to indicator selection, the presentation of data and their analysis also facilitates sub-regional environmental assessments, one of the objectives of GMS environmental program that seeks to respond to transboundary environmental challenges in the Mekong River Basin. Additionally, at the local level, an EPA can be utilized as a project monitoring and evaluation tool or even a tool of assessing performance of a development initiative at a local (e.g. municipal) level.

9. Finally, the EPA process typically looks at performance under concerns that are simultaneously local and global (such as threat to biodiversity in this report) and it therefore becomes a form of reporting to the bodies set up to help protect the global commons (e.g. most notably GEF). Last but not the least the report can also form a basis for designing future assistance programs for Yunnan. For instance, the findings of the EPA can serve to guide the preparation of the Asian Development Bank’s Country Assistance Plan (CAP) or Country Strategy Program (CSP) for PR China and for Yunnan.

10. The EPA team wishes to thank all the participating agencies of the Yunnan provincial government and other collaborating ministries and departments for making information available for undertaking this assessment.

## 1.2 Yunnan Province: An Overview

### 1.2.1 Physical environment

11. Yunnan is the eighth-largest province of the PRC with a total land area of 396,790 sq.km. (about the size of Germany), bordered to the south and west by Lao PDR, Myanmar, and Viet Nam. Located on the lush Yunnan–Guizhou Plateau, 94 per cent of its territory is hilly or mountainous. Upland eco-systems with diverse and rich but fragile ecotypes dominate the landscape. The valleys contain the headwaters of major rivers that include the Lan Cang (Mekong), the Nu (Salween), the Du Long (Irrawady), the Yuan (Red River), the Jin Sha (Yangtze), and the Nan Pang (Pearl River). The first four are international rivers. Yunnan has many high plateau lakes, 46 of which are greater than 5 sq km in surface. The lake basins tend to be the centers of population and economic activities and thus subject to considerable environmental pressures.

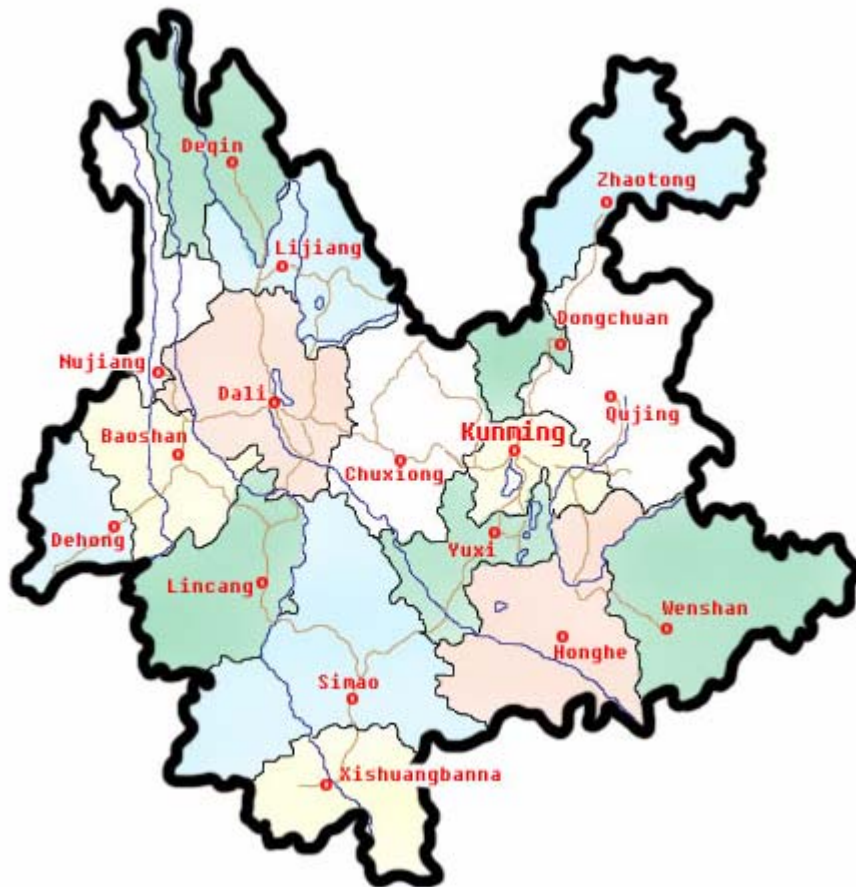


Figure 1.1 Map of Yunnan Province

### **1.2.2 Population**

12. In 2004, the population of the province was 42.9 million. Less than 4% of the population live in the provincial capital, Kunming. Eastern river basins and the center of the province are the most densely populated, while population is sparse in the mountainous and semi-mountainous areas of the western, northern and southern areas of the province. Twenty-five non-Han ethnic groups make up almost a third of the population. Prominent among these are the Yi (the most populous), Bai, Hani, Zhuang, Yao, Dai and Miao.

### **1.2.3 Economic development**

13. Yunnan is one of the least developed parts of China with a high incidence of poverty and a large gap between urban and rural incomes. In 2001, Yunnan's GDP per capita was \$594 but it was \$829 for urban dwellers and only \$187 for rural inhabitants.

14. Agriculture remains the single most important economic sector despite shortage of suitable land for cultivation, only marginally less severe in per capita terms than the Chinese average. The mountainous character of the province limits cultivable land to less than 10% of the total land, yet farmers constitute about three fourths of the labor force. Sugarcane, tobacco, kidney beans, and tea are the main commercial crops.

15. The industries in the province are located mostly in Kunming and the industrial towns of Yuxi, Qujing, and Hong River. The major output categories were beer, cement, cigarettes, phosphates, jade ornaments, garments, tin, and machine tools.

### **1.2.4 Institutional Structure for Environmental Protection in PRC and Yunnan**

16. At the national level, the State Environmental Protection Administration (SEPA) is the nodal agency for environmental protection in the country, under the State Council, the highest level of the executive part of government. SEPA sets the strategic direction and formulates policies, and drafts laws, regulations and administrative rules for environment protection. It conducts environmental impact assessments (EIA) of major economic and sectoral policies upon the State Council's request, and develops programs and major plans. In every province, a Provincial Environmental Protection Bureau (PEPB) is responsible for implementing national policies and managing environmental protection activities.

17. The organizational structure of Yunnan PEPB is given below in Figure 1.2. As one of line agencies of Yunnan's Provincial Government, Yunnan Provincial Environmental Protection Bureau (YNPEPB) has the overall responsibility referred to in para. 16. In this, it is supported by local environmental protection bureaus in 16

prefectures (normally, cities) and 90 counties (normally, rural districts).

18. There are approximately 3,000 staff and researchers working in the area of environmental protection in Yunnan, of which 1,700 are technical professionals. There are 90 environmental monitoring stations in the province, one environmental supervision and law enforcement team and 102 environmental supervision and management offices.

19. Besides SEPA and PEPB, a large number of other central and provincial bodies influence environmental outcomes. Forestry, water resources, and agriculture departments play important roles in the management of water resources, forests, biodiversity and soil conservation. These agencies often undertake joint projects to address the management of resources under multiple jurisdictions. For example, the twin objectives of biodiversity protection and management of soil erosion are being managed as part of the Conversion of Farmland to Forest project carried out under by the Agriculture and Forestry departments.

20. More discussion is provided in Part III of this report that describes the influence of institutional arrangements and integration of policies and related instruments on environmental outcomes.

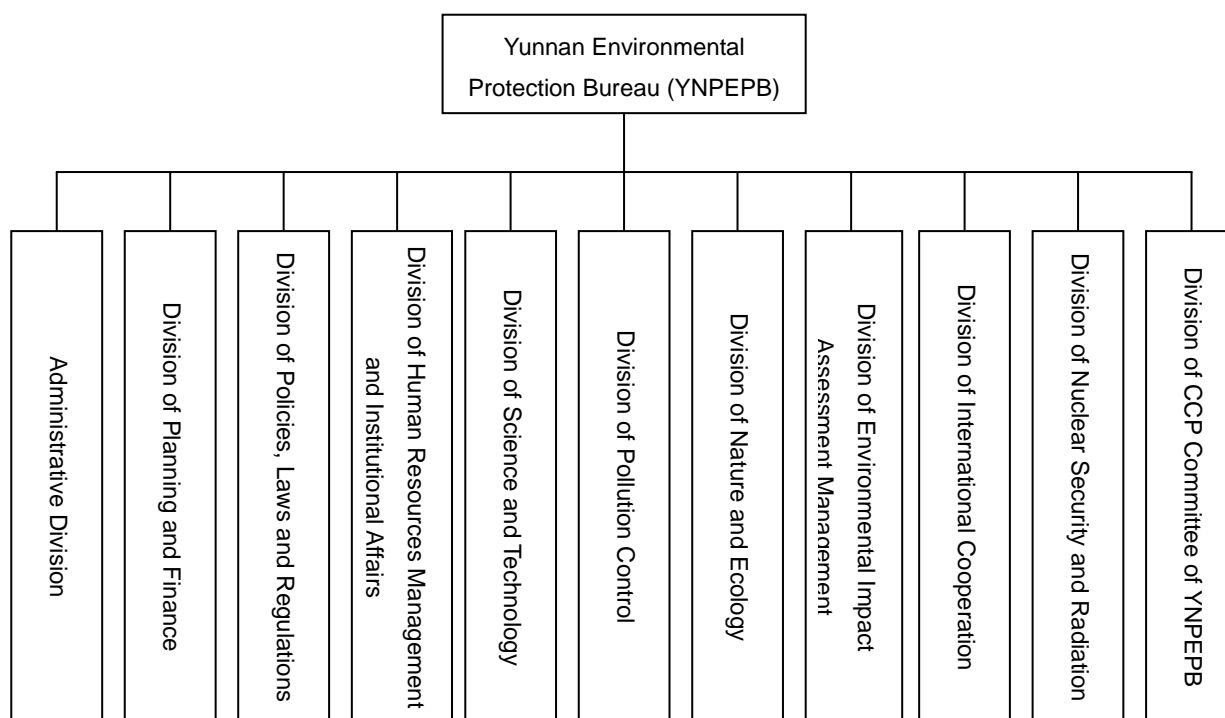


Figure 1.2 Yunnan EPB Organization Structure

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Yunnan Provincial Environmental Protection Bureau

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E-fair

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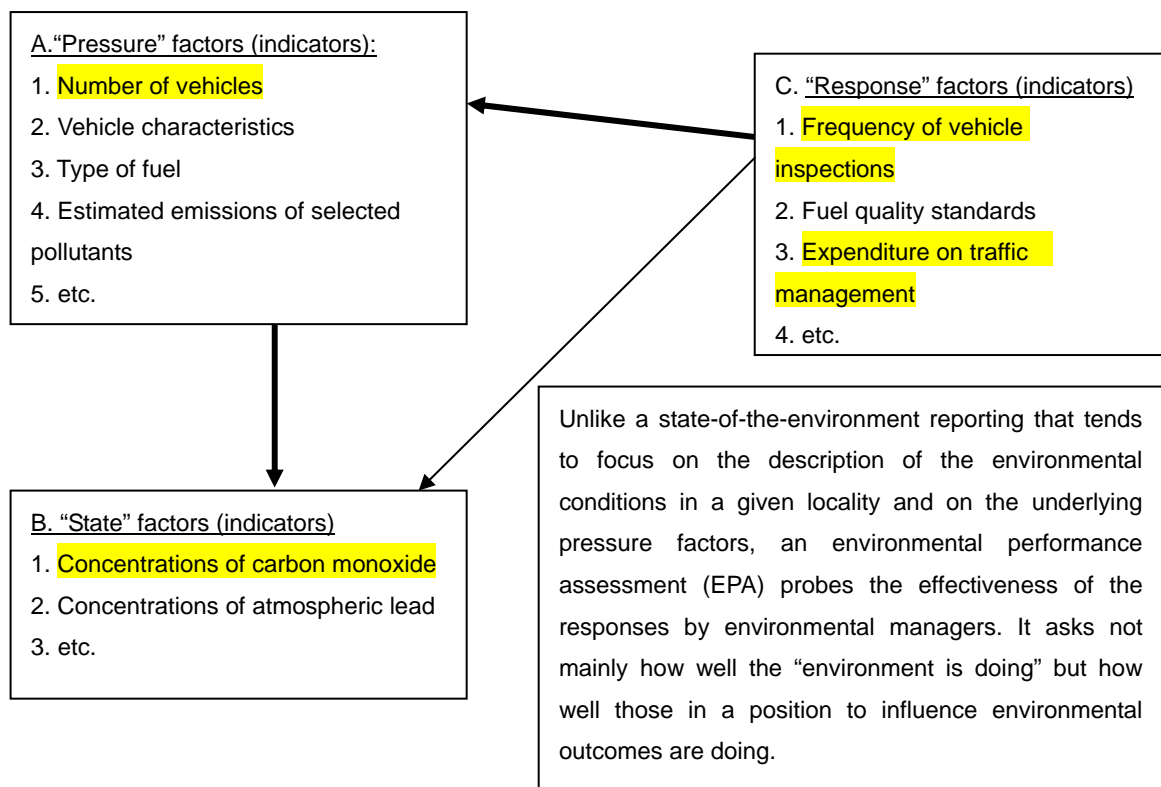
## II. MANAGEMENT OF PRINCIPAL ENVIRONMENTAL CONCERNS AND ITS ASSESSMENT

### 2.1 The method

#### 2.1.1 The performance assessment model

21. The approach to assessing performance under any selected environmental concern is anchored in a Pressure-State-Response (P-S-R) model that logically links the sources of environmental problems (the “pressure” factors) with the resulting “state” of the variables of concern, and the policy and institutional “responses” intended to influence the pressure factors, and through them, the state (see Figure 2.1 below). The desired values of the state variables typically (but not always) feature in state authorities’ plans and strategies. The assessment of performance is a matter of judging how successful the responses adopted have been in reaching the target values of state (and/or pressure) variables.

Figure 2.1. Simplified representation of a P-S-R model (hypothetical example of air quality management with four indicators of performance, marked in yellow)



22. In most situations, the number of pressure factors, state variables and types of responses will be large. Complex inter-relationships will often exist among them. Full analysis of each concern is demanding and many specialists devote their time to describing selected segments of the P-S-R “circle”. At the same time, there is a clear need for a simplified picture of “what is going on” if national environmental authorities are to communicate with others in positions of influence and the public at large. The simplification is a matter of selecting only the most telling of the P, S, and R factors and using them to describe past trends, and through them, performance. The selected variables then become environmental indicators. Suitably analyzed they facilitate the assessment of performance. This is what is being attempted in the present EPA report.

### **2.1.2 Rating guidelines**

23. The assessment itself is a matter of rating (1) individual indicators (each supported by a “factsheet”) under a given concern and (2) the overall performance –an interplay of all indicators-- under that concern.

24. A double-word description is utilized to rate each indicator. The first word describes the magnitude of the indicator relative to some benchmark (such as an international standard, an average for several countries etc.). The second word describes the observed trend of the indicator value, as depicted by long or short-term historical data. The magnitude and the trend keywords are typically combined (e.g. “relatively poor and deteriorating”). In the case of baseline indicators with only one or few observations, the trend-keyword (and the “and” conjunction) are omitted. The descriptions applied to each class of indicators are contained in Tables 2.1 to 2.3 below.

Table 2.1 Rating used in evaluating “state” indicators

<b>STATE INDICATOR</b>			
<p>In order to qualify the magnitude of the state indicator using the recommended keywords below, the values of the state indicator are compared against known benchmark figures. The national policy target for the indicator is one such possible benchmark. In many cases, a GMS average values or an international standard would be more suitable if the indicator is to tell us something about the relative performance of each GMS country. If no such figures exist, the magnitude keyword is omitted. The “poorness” or “goodness” of the magnitude is dependent on the interpretation of the indicator value. In some cases a high state indicator value is “good” (e.g. % forest cover); at other times a low value is preferred (e.g. # threatened species).</p> <p>The trend of the State indicator is easy to rate as either deteriorating, stabilizing or improving, provided it is based on long-term historical data. In other cases or for benchmark indicators, the indicator value may not show any trend at all, in which case the trend keyword is left blank or specified as “Undetermined Trend”.</p>			
<b>Relatively Poor</b> and ....	<b>Average</b> and ...	<b>Relatively Good</b> and ....	<b>Unknown State</b> and ....
<p>As evidenced by an indicator value which is far below (or far above) the same indicator value for other GMS countries or far below (or above) other benchmark figures such as international standards or national targets</p>	<p>As evidenced by an indicator value which is close to the same indicator value for other GMS countries or within the range of other acceptable benchmark figures such as international standards or national targets</p>	<p>As evidenced by an indicator value which is far above (or far below) the same indicator value for other GMS countries or far above (or below) other benchmark figures such as international standards or national targets</p>	<p>This rating is used if the value of the indicator cannot be compared against the value of the same indicator in other countries or regions and there are no other benchmark figures, such as international standards or national targets</p>
<b>Deteriorating</b>	<b>Stabilizing</b>	<b>Improving</b>	<b>Undetermined Trend</b>
<p>As evidenced by a steady long-term deteriorating trend and with no immediate signs of improvement.</p>	<p>As evidenced by a steady long-term deteriorating trend but with short-term signs of leveling or even improvement, or a long-term level trend.</p>	<p>As evidenced by a long-term deteriorating trend but with sure signs of improvement based on more than one observation in the positive trend.</p>	<p>This rating is used if the selected indicator is inconclusive in terms of long or short-term trends or if the indicator is based on a single observation over time.</p>



Table 2.2 Rating used in evaluating “pressure” indicators

<b>PRESSURE INDICATOR</b>			
<p>There will always be some magnitude of pressure and the trend over time can simply be rated as increasing or decreasing. Qualifying the magnitude of the indicator value may at times be difficult, especially if the pressure indicator is unique to one country and no comparative figures are available from other countries. It is also unlikely that international benchmark figures will exist for pressure indicator. Judgment is required to rate the magnitude of unique pressure indicators.</p> <p>The trend of pressure indicators should be easy to rate, provided that long-term historical data exists. If only one or few observations exist, the trend keyword can be left blank.</p>			
<b>High and</b>	<b>Medium and</b>	<b>Low and</b>	<b>Non-Comparable and</b>
<p>As evidenced by the value of an indicator which is much higher than the value of the same indicator in other GMS countries or much higher than other benchmark figures, such as international standards or national targets.</p>	<p>As evidenced by the value of an indicator with a value more or less equal to that of other GMS countries or other benchmark figures such as international standards or national targets.</p>	<p>As evidenced by the value of an indicator which is much lower than the value of the same indicator in other GMS countries or much lower than other benchmark figures, such as international standards or national targets.</p>	<p>This rating is used if, through lack of comparative numbers or other information, an order of magnitude cannot be assigned to the value of the indicator.</p>
<b>Increasing</b>	<b>Steady</b>	<b>Decreasing</b>	<b>(blank)</b>
<p>As evidenced by a long-term trend of increasing pressure, with very little sign of relief or stabilization.</p>	<p>As evidenced by a long-term steady or near-constant pressure that shows no sign of increase or decrease in the past or future.</p>	<p>As evidenced by a long-term trend of declining pressure, with perhaps fluctuating short-term oscillations.</p>	<p>The keyword is left blank if there is only one observation, or if there is no observed trend over time in the indicator value.</p>

Table 2.3 Rating used in evaluating “response” indicators

<b>RESPONSE INDICATOR</b>			
<p>Since responses tend to be very diverse, there may be few benchmarks to rate the magnitude of response indicators other than the national targets for the indicator selected. Once more, judgment is required to rate the magnitude of unique indicators to say how “big” or “small” the response was.</p>			
<b>Low and</b>	<b>Average and</b>	<b>Significant and</b>	<b>Non-Comparable</b>
<p>If the magnitude of the response is significantly below the national target or below the average in other GMS countries or other comparable regions.</p>	<p>If the magnitude of the response is in line with national targets or the average responses of other GMS countries or comparable regions.</p>	<p>If the magnitude of the response exceeds national targets of the average of other GMS countries or comparable regions.</p>	<p>This rating is used (or the keyword left blank) if there are no data or information to compare the magnitude of the response with, or there are no other benchmark figures.</p>
<b>Sporadic</b>	<b>Intermittent</b>	<b>Consistent</b>	<b>(blank)</b>
<p>If the response has been irregularly applied over time with no set program or budgets to continue the response in the future.</p>	<p>If the response has not been consistently applied but there are programs and budgets to continue the application of the response in future.</p>	<p>If the response has been consistently applied, calibrated to the pressure, with plans to continue until the pressure has been reduced to a desired level.</p>	<p>The keyword is left blank if there is only one observation, or if there is no observed trend over time in the indicator value.</p>

25. The description used to rate overall performance under each concern is given in Table 2.4 below.

Table 2.4 Rating used to evaluate performance under a selected environmental concern

<b>ENVIRONMENTAL CONCERN</b>			
<p>For purposes of communicating the EPA results, rating of performance under each priority concern is required. In this EPA, a star-rating system is used where any performance counts but with different levels of merit. The star-rating is based on what the indicators are saying, backed up by hard evidence presented in factsheets, not on what a consensus view or expectations may be.</p>			
<b>1-Star *</b>	<b>2-Stars **</b>	<b>3-Stars ***</b>	<b>Un-Rated</b>
<p>If the pressure continues to increase, the state continues to deteriorate and the response(s) do not appear to have any effect on the pressure or the state.</p> <p>Additional criteria for 1-Star rating:</p> <ol style="list-style-type: none"> <li>1) Reasonable targets have not been set or have not been met.</li> <li>2) International conventions have not been ratified or adhered to.</li> <li>3) No ongoing monitoring or data collection.</li> <li>4) No clear and precise institutional role &amp; responsibilities management of environmental concerns have been assigned or where they have been, no tangible progress has been achieved suggesting an inappropriate response and non-compliance of the target.</li> </ol>	<p>If there are signs that the responses will or have had an effect on releasing the pressure, even though the state does not yet show signs of improvement.</p> <p>Additional criteria for 2-Star rating:</p> <ol style="list-style-type: none"> <li>1) Targets have been set and generally met.</li> <li>2) International conventions have been or will be ratified and most of the reporting requirements have been met</li> <li>3) Plans exist for ongoing monitoring and data collection.</li> <li>4) Institutional responsibilities assigned though limited progress achieved due to weaknesses in institutional arrangements e.g. lack of coordination, duplication of roles, multiplicity of authorities etc.</li> </ol>	<p>If there is clear evidence that the responses have reduced the pressure and/or there is a clear sign that the state is improving.</p> <p>Additional criteria for 3-star rating:</p> <ol style="list-style-type: none"> <li>1) Effective targets have been set and met.</li> <li>2) International conventions have been ratified and reporting requirements have been met.</li> <li>3) Ongoing monitoring and databases exist.</li> <li>4) Specific institutions with targeted roles and responsibilities assigned.</li> </ol> <p>Institutional measures in place for the management of the concern e.g. EIA process, adequate budgetary and resources for environment monitoring, staff with appropriate technical skills and know-how, regular interaction with industry and NGOs on environm. management matters etc.</p>	<p>If the trend in the state indicator cannot be explained by the pressures or the responses.</p> <p>The label “unrated” is a sign that we have failed to identify appropriate indicators backed by factsheets, and/or have failed to apply the PSR model, and/or have failed to apply the PSR model to performance assessment.</p>

26. In the rest of this section, the method described above is applied to the principal environmental concerns of Yunnan.

## **2.2 Land Degradation**

### **2.2.1 The Context**

27. Land degradation is one of the Provincial most serious environmental problems. In 1999, the area subject to water and soil erosion covered a total of around 141,000 sq.km. The volume of soil displaced is estimated at 500 million tons p.a. In 2004, the total expenditure on land conservation programs exceeded 406 million RMB. Other types of land degradation in Yunnan, such as stone desertification and pasture degradation aren't analyzed here as adequate data are not available. Land management programs in Yunnan have been structured around the concept of "development through conservation and conservation through development" that is typical of the Provincial Government's efforts to reconcile economic growth with environmental protection.

### **2.2.2 The State**

<b>Indicator – Total Area Affected by Soil Erosion 1987 – 2000</b>
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28. This indicator measures the area subject to soil erosion in a given year expressed in sq. km. Six classes of erosion are distinguished by the provincial government: slight erosion, light erosion, moderate erosion, strong erosion, deep-strong erosion, and severe erosion. The details are described in the corresponding factsheet.

29. Research conducted by the Yunnan Province Water Conservancy and Hydroelectric Power Department in 1999 confirmed that the bulk of erosion in the mountainous Yunnan was due to impact of water rather than wind. In 1999, the total area affected by water erosion was 141,300 sq.km. or approximately 36.9% of the total land area in the province. Expressed in volume it translates into 513.5 million tons of soil, or about 10 per cent of the national annual volume of soil erosion.

30. Figure 2.2 indicates a reduction in the estimate of the total area subject to soil erosion between 1987 and 1999. Behind the overall decline lay significant differences across erosion classes. For "light", "slight", "deep-strong" and "severe" classes, reduction was achieved due to efforts by the government to encourage a

change of farming practices, terracing, establishment of production forests, other reforestation programs, etc. However, aggressive diversification of agriculture activities by farmers into cash crops like tobacco, sugar cane etc., has slowed down the overall progress and the areas of “moderate” and “strong” erosion categories actually increased.

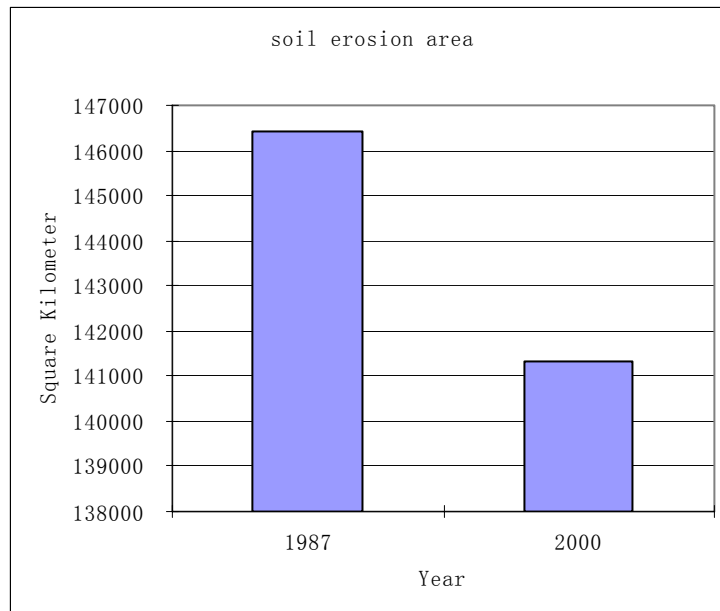


Figure 2.2 Area vulnerable to soil erosion, 1987-2000

31. No directly applicable target is available to assess performance. However the Law on Water and Soil Conservation (1991) prescribes measures for prevention, rehabilitation and monitoring of soil erosion. Article 14 of the law prohibits cultivation of crops on slopes greater than 25 degrees. The law also assigns responsibility for monitoring compliance with this law to the Department of Water Administration.

**Suggested Rating:** Average and undetermined trend

**Justification:** Efforts to arrest soil erosion have yielded moderate positive results in certain areas, although in other areas aggressive commercial farming has aggravated the problem. Continuous monitoring is required to judge the seriousness of the problem and calibrate responses. The difference observed between 1987 and 1999 is too small to speak of a significant trend.

### 2.2.3 The Pressure

#### Indicator – Farmland per Capita 1984 – 2004

32. This indicator is an indirect measure of the pressure by rising population on the limited farmland in Yunnan, traditionally resulting in the cultivation of erosion-prone sloping lands. In conditions of underlying scarcity of farmland, higher values of the indicator will normally indicate increasing pressure to convert less suitable (and environmentally fragile) areas to farming, especially under rapid population growth.

33. The population of Yunnan increased by 30% from 1984 to 2004 (see Figure 2.3). Farmland increased also. Although the indicator value fell in 1997 and 2001 indicating a temporary decline in pressure, the values of the indicator recovered by 2002 and remained stable since then. Over a longer period, between 1984 and 2004, the value of the indicator increased by 68%. The increase probably hides a change in the composition of the extra land with low-class categories accounting for most of the increase. This, at least, is the prevailing view of the local specialists, for now not backed by solid evidence. The increase in the total amount of farmland took place despite the transfer of some farmland to non-agricultural purposes such as industry, transportation, and mining. The total farmland area in Yunnan in 2004 was 91.8 million *mu* equivalent to 6.1 million hectares.

34. Some regulations and laws have been promulgated to protect farmland, such as Basic Farmland Protection Statute of Yunnan (1996) and Land Administration Measures of Yunnan (2004). Implementation of the Land Administration Law of the People's Republic of China (1999) in Yunnan remains a priority. According to Land Use Plan of Yunnan Province 1997-2010, by 2010, the area of farmland should not be less than 91.3 million *mu* and the appropriation for construction should not be exceed 839,908 *mu*.

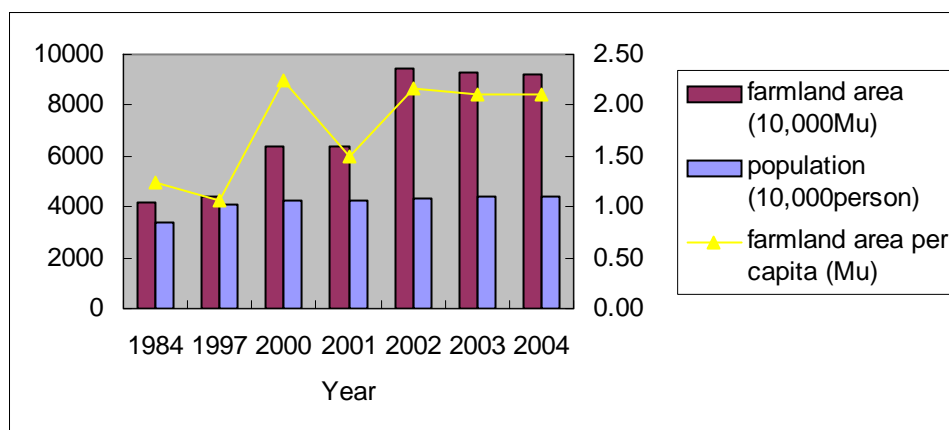


Figure 2.3 Farmland area and population, 1984 - 2004

**Suggested Rating:** Non-Comparable and increasing

**Justification:** As in any rapidly urbanizing society farmland is being converted to other forms of land use. In Yunnan this trend has been countered by measures that recovered previously unused or degraded land. However, the pressure exerted by conflicting land requirements is still very high.

## 2.2.4 The Response

### 1<sup>st</sup> Indicator – Government Expenditure on Soil Conservation 2001 – 2004

35. This indicator uses government's spending on soil conservation over time as a proxy for overall efforts to counter land degradation.

36. Available figures (Figure 2.4) suggest no particular pattern of expenditure on soil conservation programs in Yunnan. In 2004, the total expenditure on water and soil conservation was 406.6 million RMB, of which, RMB 188.8 million was provided from the State budget, 138.6 million RMB from local government budget, and RMB 79.2 million from other sources.

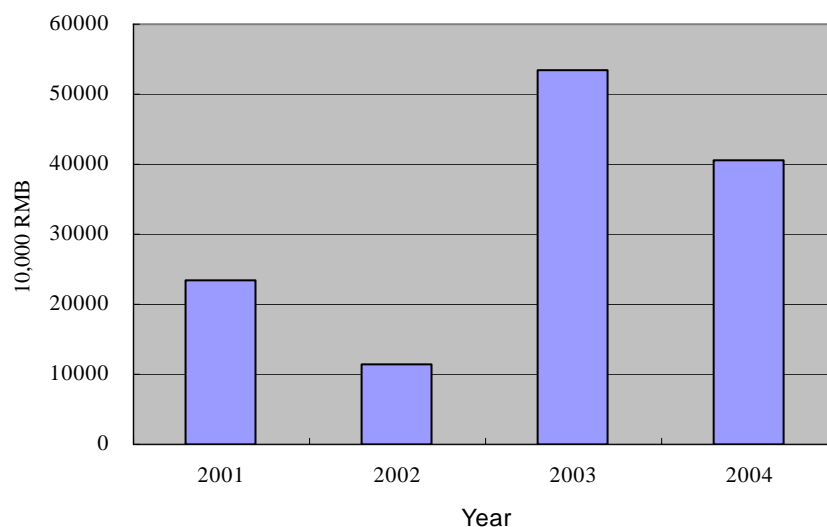


Figure 2.4 Government expenditure on soil conservation 2001-2004

37. Other elements pertinent to the topic of land degradation though not directly related to the indicator include, first, the adoption by the government of laws and regulations for improved soil management. Articles 29-31 of the Law of the People's Republic of China on Water and Soil Conservation assign responsibility for the Law's implementation to the Department of Water Administration under the State Council. Among other things, Article 30 of the Law gives the personnel in charge of supervision over water and soil conservation in the departments of water administration at or above the county level the right to carry out on-the-spot inspections of soil erosion and initiate the prevention and control measures. The Department has the authority to impose fines in case of the Law's violations.

38. The Law gives indirect support to schemes promoting state- and province-level planning processes that integrate soil conservation and water development. The Law requires that in regions prone to water erosion, a comprehensive system of prevention and control of soil erosion be set up on the basis of a plan of rehabilitation for the entire affected region. The State encourages the setting up of collective agro-based organizations in such regions better to be able to carry out soil rehabilitation measures.

**Suggested Rating:** Average and intermittent

**Justification:** Expenditure has been incurred on soil management over the years, though information at hand does not make it possible to establish an observable trend that would demonstrate if Government's policies are having major impacts.

**2<sup>nd</sup> Indicator – Total Soil Erosion Area Rehabilitated 1989 – 2004**

Table 2.5 Total soil erosion area rehabilitated, 1989-2004

	Soil Erosion Area Rehabilitated (sq. km)
1990	13086.0
1991	14059.7
1992	14731.0
2000	2439.0
2001	2007.5
2002	2596.0
2003	2439.0



2004	7413.0
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39. This indicator measures the area subject to soil erosion “treated” per year. “Treatment” or rehabilitation is understood to be measures such as terracing, contour planting, etc.

40. As shown in Table 2.5, in the early of 1990’s, the erosion areas rehabilitated averaged around 13,000 sq.km p.a. The totals dropped sharply in 2000 to around 2,000 sq.km indicating perhaps a temporary sense that the worst affected areas had been tackled. In 2004, the pace of rehabilitation efforts increased again and the area rehabilitated rose to 7,000 sq.km.

41. In 1988, State Council approved the Upper Yangtse River Water and Soil Conservation and Comprehensive Rehabilitation Project. 29 counties of Yunnan were located in the project area. In 1992, the Ministry of Water Resources of China approved a similar Upper Pearl River Water Soil Conservation Comprehensive Rehabilitation Project. Yunnan’s Qujing prefecture was located in the project area. With these project initiatives, fighting the soil erosion was given a high profile.

42. In 1998, the National Water and Soil Conservation Program was launched including 20 key counties (10 of which located in the Yangtse watershed). In 1998, Yunnan province chose 12 counties including Yuanjiang to be included in the first provincial-level Water and Soil Conservation Program.

43. 2000-2005 targets of the total soil-erosion area rehabilitated of 12,000 sq.km and a soil conservation area of 24,000 sq.km were set out in The Tenth Five-Year Environmental Rehabilitation and Environmental Protection Plan of Yunnan (2001) (henceforth T5YERP). This target was reached and maintained from 2002 to 2004. In 2004, the total erosion-prone area rehabilitated was 12,448 sq.km.

**Suggested Rating:** Significant and intermittent  
**Justification:** The water and soil conservation projects are given high profile, but the level of efforts shows wide fluctuations from year to year.

### 2.2.5 Conclusions

44. Efforts undertaken by the state and provincial authorities to slow down the rate of soil erosion, the primary cause of land degradation in Yunnan, seem to have yielded results in certain soil erosion categories but in some others the trend is still towards soil loss. The overall reduction in the area subject to soil erosion was a very modest 3 per cent of the total between 1987 and 2000.

45. Pressure on land in Yunnan has eased off somewhat in the past five years but it remained significant reflecting competing demands upon the land resources in the province. The greater expenditure on soil conservation and several high-profile projects appear to have had surprisingly small overall impact suggesting that the effectiveness of these programs ought to be reviewed.

**Suggested Rating: 2 STARS**

**Justification:** More farmland has become available in Yunnan over the last decade or so countering the increasing demand for land. The problem of land degradation continues, however, even if active policies of the Government have been partially successful in stabilizing the situation.

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## 2.3 Threat to Biodiversity

### 2.3.1 The Context

46. PRC ranks eighth in the world and first in the north hemisphere in terms of the richness of species. Of these, more than half are found in Yunnan province. That makes Yunnan an area with the most complex and valuable biodiversity in China if not in Asia. Many areas such as Xishuangbanna and the southern part of the Hengduan Mountains have been classified priority tropical and subtropical protection areas by the Biodiversity Conservation Action Plan of China. However these and other biodiversity habitats are under threat from growing urbanization and other forces.

47. During its history, the Yunnan plateau supported many mammal species now gone as a result of millennia of human activity. Examples include tigers (*Panthera tigris*) and other large cats as well as their prey base of deer and other mammals. Although most of the plateau consists of low mountain ranges and basins below 2,300 m, the western third includes outlier ranges of the Hengduan mountain system that exceed 2,500 m. These ridges have a cooler, more humid climate with persistent cloud cover during the summer growing season, and cool winters with some snow accumulation at the higher elevations. These ridgetop habitats support a temperate cloud forest community distinct from the subtropical forests of the Yunnan Plateau.

48. Mammal species that occupy these ridge crest mountain refuges include black gibbons (*Hylobates concolor*), bamboo rats, Asiatic black bears (*Selenarctos thibeticus*), and some large cats. Severely threatened populations of black gibbons occur in the Ailao Mountain Nature Reserve (504 sq.km). This species could act as an effective "umbrella species" under which to protect the habitat of this elongated, ridgetop protected area. The Yunnan Mountains are an endemic bird area (Stattersfield et. al. 1998) included within the Yunnan Plateau Ecoregion. Three restricted-range bird species [Yunnan nuthatches (*Sitta yunnanensis*), Brown-winged parrotbills (*Paradoxornis brunneus*) and White-speckled laughingthrushes (*Garrulax bieti*)] occur here, and their habitats tend to be fragmented because the mountain habitat is generally restricted to ridgetop locations. There are several other threatened bird species with a broad habitat range.

### 2.3.2 The State

<p style="text-align: center;"><b>Indicator –Threatened Species as Percent of Globally Threatened Species 1996 – 2004</b></p>
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49. This indicator tracks, over time, the number of threatened species expressed as the percentage of the number of threatened species at the provincial level over the number of threatened species at the global level. Threatened species are those defined as vulnerable, endangered or critically endangered in the “Red List of Threatened Species”.

50. It is understood that the smaller this number is for a specific country or region, the better the country or region is at the maintenance of species diversity. However the rise and fall of the indicator value over the years may or may not be indicative of the government responses within the country or region. Assessment of species outside the country or region leading to a rise in the denominator may result in the fall of the indicator value. Further assessments for species contained primarily within the country or region may temporarily inflate the value of the indicator.

51. As can be observed from Figure 2.5, Yunnan Province is a tentative sanctuary to approximately 1.2% of the globally threatened species. This standing includes approximately 2.91% of globally threatened mammals, 1.5% of globally threatened birds, 4.0% of globally threatened reptiles, and 0.1% of globally threatened amphibians. Globally threatened fish species were not considered as part of the indicator.

52. The rise in the share of globally threatened species from 0.6% in 1996 to 1.2% in 2004 is largely attributed to the progress of the evaluation work and is not necessarily indicative of a trend of loss of biodiversity in Yunnan Province during that period. The 0.6% value in 1996 is based on the first version of the IUCN Red Book at which time most relevant mammals had been evaluated, few reptile species had been evaluated and at which time amphibians and birds were not part of the equation. The relevant amphibians and birds were in fact not evaluated until 2004 and therefore the indicator value and trend before 2004 has very little meaning.

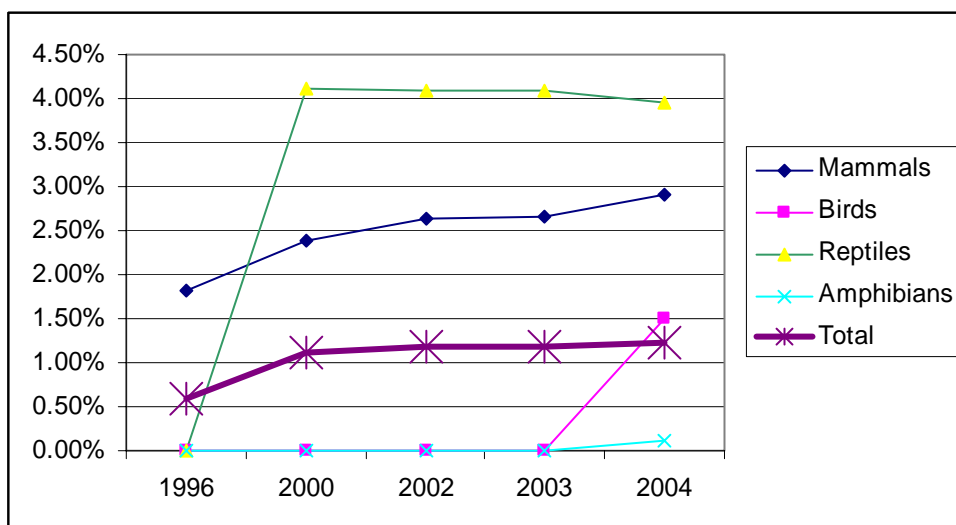


Figure 2.5 Threatened Species as Percent of Globally Threatened Species 1996- 2004

53. Apart from the IUCN Red List, no specific target value of this indicator has been set by the Government of China. The Law on the Protection of Wildlife (1989) makes the State responsible for protecting wildlife and the environment essential for its survival, and for preventing illegal hunting or destruction of wildlife by any unit or individual. The state is tasked to give special protection to the species of wildlife which are rare or near extinction. The wildlife under state protection is divided into “first class protection” wildlife and “second class protection” wildlife. Lists of wildlife under state protection and their revisions are approved by the State Council and posted and enforced by the relevant departments of wildlife.

54. The Action Plan for Biodiversity Protection in China was promulgated in 1996 as part of China’s obligations under the Convention of Biodiversity. The Action Plan formulated 7 distinct targets and 26 action schemes. Among the targets was the creation of a biodiversity information and monitoring network in the whole country, and a more vague target of making biodiversity protection a component of sustainable development.

55. In Yunnan, inspections of wildlife and compliance with the existing biodiversity legislation did not begin until 2003. The results of these inspections will form the basis for improved administration and protection of biodiversity, research, as well as improved assessment of performance.

**Suggested Rating:** Relatively Good with no Observable Trend  
**Justification:** The Government has taken important initial steps to establish a benchmark for future assessments of the state of biodiversity in the province. There is however a strong likelihood that the global share of Yunnan Province’s threatened species will rise when fish species are included or if a more comprehensive analysis of threatened species had be conducted.

### 2.3.3 The Pressure

#### Indicator – Area of Natural Forests 1979 – 2002

56. Natural forest is defined as forest area undergoing natural re-generation. Natural forests are the single most important category of habitats and the area of natural forests was therefore chosen as a proxy indicator of the pressure on all habitats available to the threatened species of Yunnan. From Figure 2.6 it can be

observed that there was a steady growth in the natural forests cover of Yunnan after 1992. However information on the quality of those forests is insufficient to provide an accurate assessment of the degree of protection these forests actually give to their biodiversity.

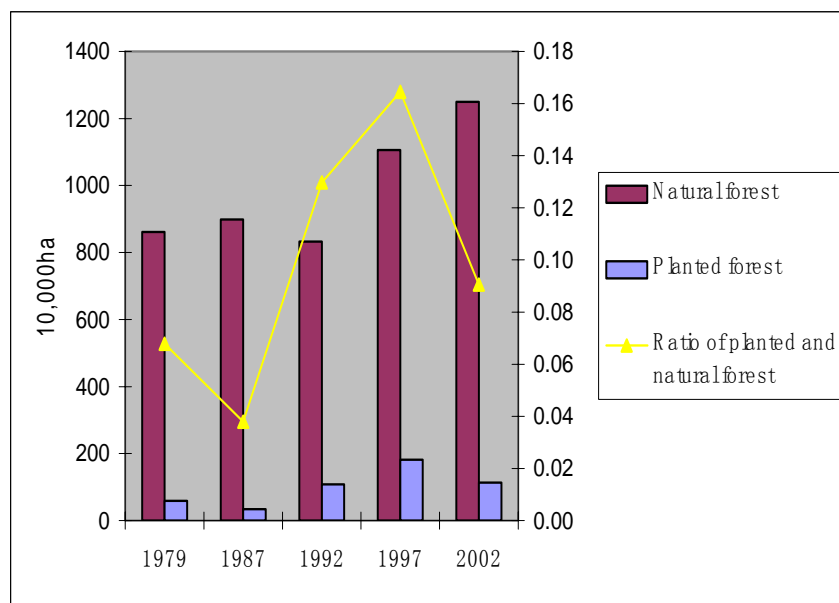


Figure 2.6 Area of natural forests, 1979-2002

**Suggested Rating:** Medium and decreasing

**Justification:** The area of natural forest increased during the last decade. However the conditions of the natural forest in Yunnan are not known well enough to judge whether the increase in the area alone amounted to a reduced pressure on biodiversity.

### 2.3.4 The Response

**Indicator – Protected Area as Percent of Total Land Area 1989 - 2004**

57. Protected areas as a percentage of total land area of Yunnan was taken as the indicator of the response to threats to biodiversity. The higher the value of the indicator, the greater is likely to be the protection given to the underlying biodiversity. As already noted above, the Law on the Protection of Wildlife (1989) governs the protection of biodiversity and wildlife in Yunnan. The law assigns institutional responsibility for the protection of wildlife and provides for penalties in the event of

violation of any of its provisions.

58. Yunnan has made progress in biodiversity conservation spearheaded by the establishment and improved management of nature reserves. As shown in Figure 2.7, the area under natural reserves doubled between 1989 and 2004. By the end of 2004, there were 193 nature reserves in Yunnan, with a total area of 347.3 million hectares covering 8.8% of the total area of the province. Of these, 13 were classified as national-level nature reserves, 51 were provincial-level reserves. Further 68 reserves were at a city level, and 61, at a county level. Two national-level nature reserves, namely Xishuangbanna Nature Reserve and Gaoligongshan Mountain Nature Reserve, entered the Man and Biosphere network of UNESCO. The reserves are believed to contain the bulk of the principal eco-systems and nearly 90% of rare and endangered wildlife species of the province.

59. In recent years, conservation of biodiversity in Yunnan has attracted attention of international nature conservation organizations. Since early 1980s, GEF, WWF, IUCN, International Cranes Foundation and MacArthur Foundation have carried out exchange programs with the Yunnan Province in the field of biodiversity conservation.

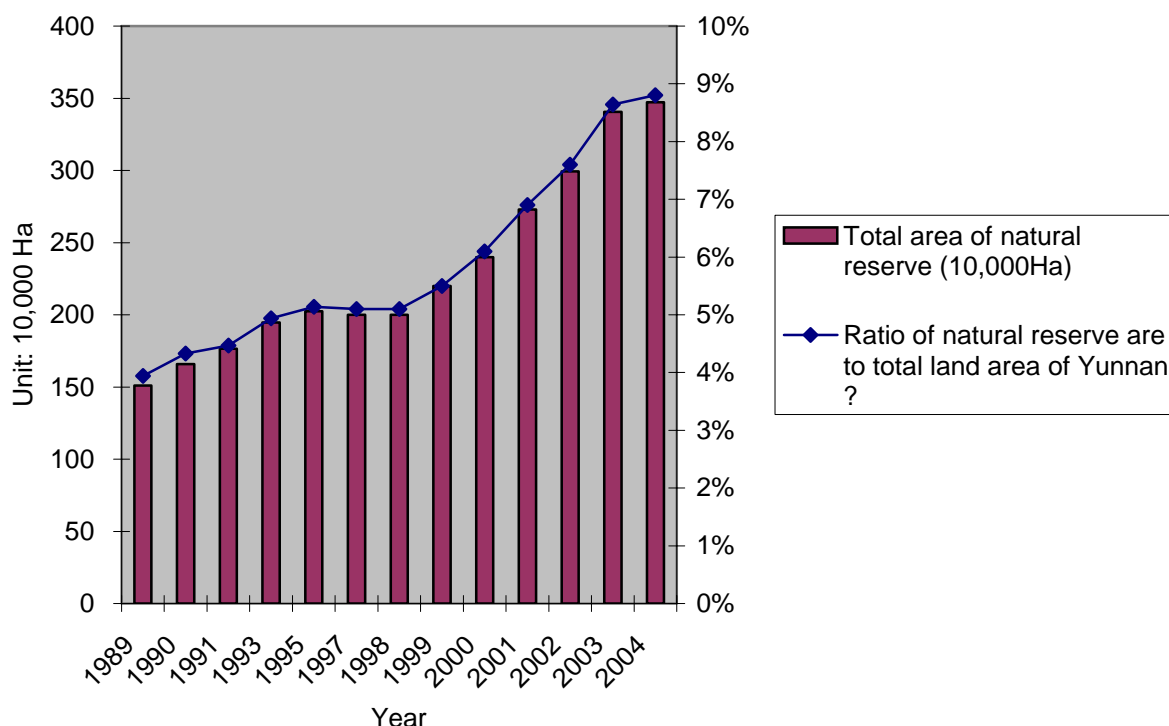


Figure 2.7 Protected areas as percentage of total land area, 1989-2004

60. By 2003, the percentage of protected areas in the provinces land total exceeded the target of 8% contained in the Tenth Five-Year Ecological



Rehabilitation and Environmental Protection of Yunnan. While reaching the target in simple area terms, the real degree of protection achieved is more difficult to judge. In general, the funding and resulting degree of protection is believed to be higher in national- and provincial-level natural reserves than in the lower-level natural reserves but the information is too patchy for now to allow for a systematic assessment . Also, it is increasingly recognized by provincial experts that the original delineation of the boundaries of nature reserves was far from ideal in some cases and modifications or even cancellations of some NRs may be justified on ecological and economic grounds.

**Suggested Rating:** Average and consistent

**Justification:** Efforts by government as part national and international initiatives to protect biodiversity have been significant and areas set aside for protection have more than doubled since 1989.

### 2.3.5 Conclusions

61. Yunnan has rich and varied biodiversity. However, the continuing urbanization and other pressures pose a threat to it. Yunnan's provincial government and environmental agencies have adopted several measures to protect biodiversity, the creation and expansion of nature reserves foremost among them.

**Suggested Rating: 2 STARS**

**Justification:** Protection of biodiversity in Yunnan has acquired a higher profile during the last decade. A significant progress was made in establishing and expanding a system of nature reserves in the province. The system is believed to be reasonably representative of the principal ecosystems. The actual degree of protection given to the fauna and flora contained within these reserves has varied and for now, cannot be reliably established.

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2004 IUCN Red List of threatened Species

[www.redlist.org](http://www.redlist.org)

## 2.4 Inland Water Pollution

### 2.4.1 The Context

62. Yunnan lies at the upstream of several major rivers of China and the world. This includes six large river systems namely the Lancang (the Mekong), the Nu (the Salween), the Du Long (Irrawady), the Yuan (Red River), the Jin Sha (the Yangtze) and the Nan Pang (Pearl River). Four of these are international rivers. There are also a number of lakes. Pollution -- especially organic pollution-- of rivers and lakes from both urban and rural sources is a significant issue in Yunnan. Policies have been formulated under the Tenth Five-Year Plan for Ecological Rehabilitation and Environmental Protection of Yunnan (2001) and the Tenth Five-Year Plan for Lake Dianchi Drainage Area's Pollution Prevention (2001) to deal with the problem.

### 2.4.2 The State

#### Indicator – Percent of Major Rivers Meeting Grades I-III Water Quality Standard 1990 - 2004

63. This state indicator was developed to track the water quality of Yunnan river over time. It's an integrated expression of water quality. It measures the percentage of good water quality in pre-selected key segments of the rivers. Good water quality means the quality that meets Grade I, II and III as defined by the National Standards of Surface Water (GB3838-2002) I (see Factsheet No. 3.1 for definition of quality grades).

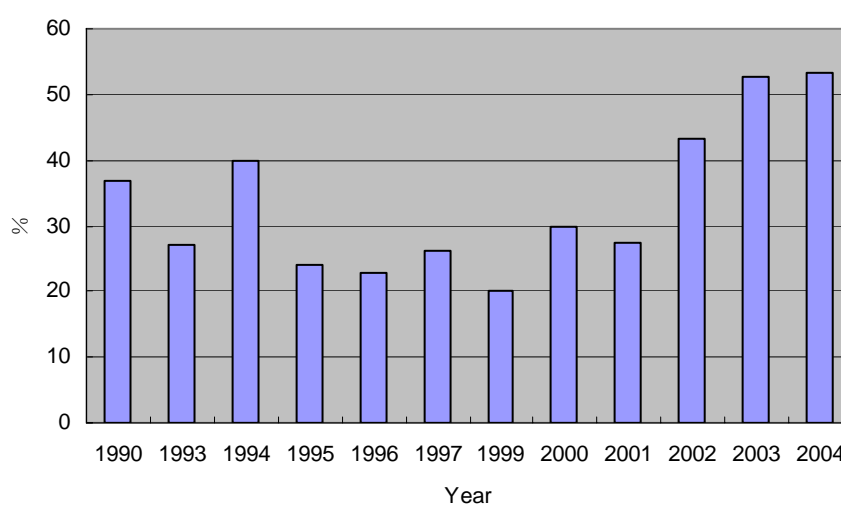


Figure 2.8 Percent of major rivers meeting Grades I-III water quality standard, 1990-2004

64. Most of the province's major rivers suffered from organic pollution, and particularly those flowing through or near urban areas. In terms of relative severity of pollution from severe to slight during the 1990s, the six large river systems were ranked as follows: the Nan Pang, the Jin Sha, the Lan Cang, the Honghe, the Nu and the Irrawaddy.

65. As shown in Figure 2.8, the quality of water in Yunnan's major rivers deteriorated up to 1999 as the volume of untreated municipal and industrial wastewater discharged grew. After 1999, water quality began to improve as a result of pollution control measures such as commissioning of centralized wastewater treatment plants in major cities and greater efforts by industrial enterprises in response to the application of the pollution levy system.

66. In 2003, in the sections of the major rivers that were monitored, the percentages of good, lightly polluted and severely polluted water were 52.7%, 26.7% and 20.6% respectively. The percentage of major rivers meeting Grades I-III in 2004 was 53.3%, i.e. 16.3% higher than in 1990. The Tenth Five-Year Plan for Ecological Rehabilitation and Environmental Protection (2001) of Yunnan sets the target of 70% for the percentage of major rivers meeting Grade I-III Water Quality Standard by 2005. That target appears unlikely to be achieved despite major improvements in the last decade. Those improvements contrast with the quality of the Province's lakes, not dealt with in this report, that continued to stagnate.

**Suggested Rating:** Relatively poor but improving

**Justification:** The pollution of the major rivers was serious and become more serious until the end of the 1990. Since then, major improvements have been achieved.

### 2.4.3 The Pressure

#### 1<sup>st</sup> Indicator – Volume of Municipal Wastewater Discharges 1989 - 2004

67. This indicator presents the trend of municipal wastewater generation from 1989 to 2004. Data points to an overall (and unsurprising) increase in discharges in Yunnan since the beginning of the period under review (see Figure 2.9). Increasing urbanization and migration of the rural poor in search of jobs and income resulted in increased consumption of water and, hence also, wastewater. With increasing attention paid to water conservation and waste discharges after 1995, the rise in municipal wastewater discharges slowed down somewhat since then. No convincing explanation other than a change of the statistical procedure is available for the

massive decline in reported figures between 1995 and 1997.

68. Total volume of municipal discharges is a not a particularly good indicator of pressure once (as in China in post-1995 period) the percentage of treatment begins to depart from the historical near-zero percent. The volume of total discharges will then begin to overestimate the real pressure of pollutants reaching the receiving bodies of water. The Tenth Five-Year Plan for Ecological Construction and Environmental Protection (2001) of Yunnan expects the rate of municipal wastewater treated in Yunnan's major cities to reach at least 70% by 2005.

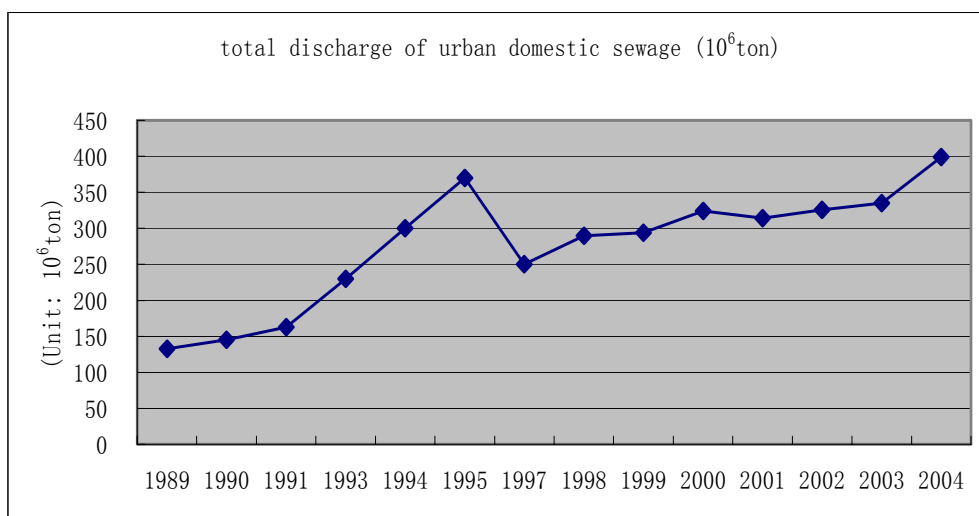


Figure 2.9 Volume of municipal wastewater discharged, 1989-2004

**Suggested Rating:** High and increasing

**Justification:** Water consumption in Yunnan's cities and consequently the municipal wastewater discharges were relatively low in per capita terms (by international standards) but growing. The rate of growth of municipal discharges slowed down since the introduction since mid-1990s of a variety of measures designed to improve the management of water resources.

**2<sup>nd</sup> Indicator –The Volume of Un-Treated Industrial Wastewater Discharges 1993-2000**

69. This indicator presents the trend of untreated industrial wastewater discharges from 1993 to 2000. It tracks the pressure of untreated industrial wastewater on natural water.

70. The main sectors responsible for industrial wastewater discharges in Yunnan were agro- processing, chemicals, paper-making, metallurgy, mining and ore-dressing. All these industries experienced strong growth during the period of assessment and continue to grow. The principle locations of industrial wastewater discharges included Kunming City, Honghe Prefecture and Qujing City. The main river basins of industrial wastewater discharge were those of the Nan Pang, Jin Sha and Lan Cang river systems.

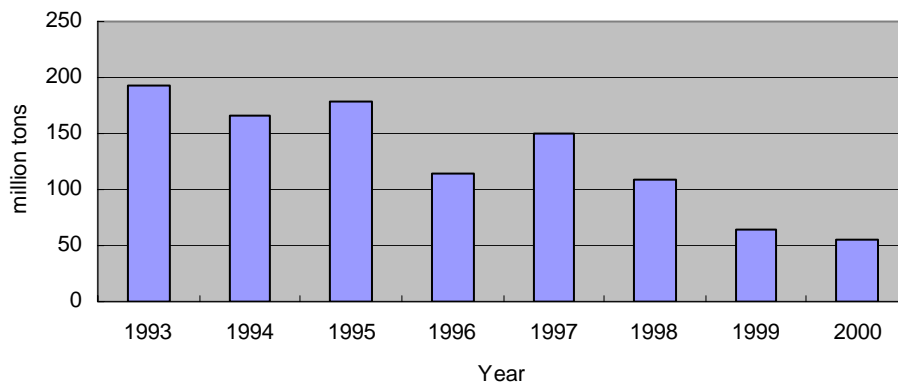


Figure 2.10 Volume of untreated industrial wastewater, 1993-2000

71. As the Figure 2.10 shows, the volume of untreated industrial wastewater discharges decreased from 192.0 million tons in 1993 to 55.8 million tons in 2000. The reduction was due to the implementation of many projects and measures, such as the Treatment and Prevention of Pollution of Nine Larger Plateau Lakes project, installation of more wastewater treatment facilities, greater water recycling and reuse by the industry in part reflecting higher water tariffs etc. By 2003, the combined capacity to treat industrial wastewater in Yunnan had increased to 0.15 million tons/day suggesting that recycling of water began to play an important part in the overall efforts.

**Suggested Rating:** Medium and decreasing

**Justification:** Efforts by the government and enterprises resulted in a significant increase in the percentage of industrial wastewater treated prior to discharge and in greater water re-use.

## 2.4.4 The Response

### Indicator – Percent of Industrial Wastewater Treated Prior to Discharge 1993 - 2000

72. This indicator is intended to capture the efforts of the government and the industry to alleviate the pressure on the receiving water bodies.

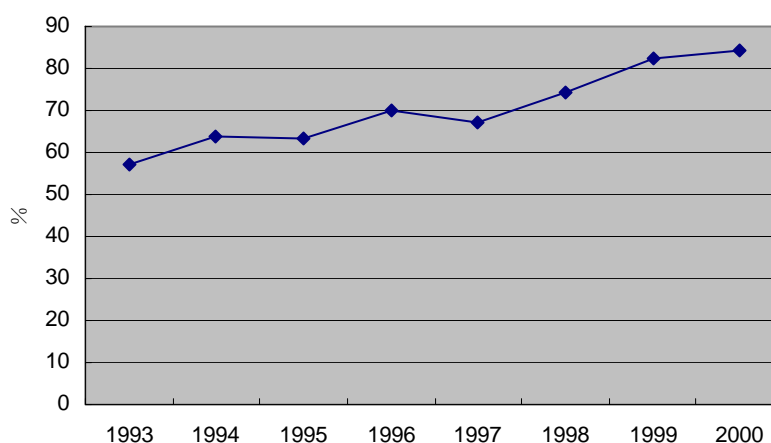


Figure 2.11 Percent of industrial wastewater treated prior to discharge

73. A number of projects targeting improved wastewater management in the province have been designed and some already executed. These typically combine action taken by the industry as well investments by the State and municipalities. In March 2003, the State Council endorsed the Tenth Five Year Plan for Pollution Treatment and Prevention in Lake Dianchi. By the end of 2003, 15 engineering and research projects had started (or 57.7% of a total 26 projects envisaged in the Plan), and 11 projects began preparatory work. In addition, 147 projects were planned under “Contracts on Target Responsibility System for Environmental Protection (2003-2005)” focusing on Lakes Erhai, Fuxian, Xingyun, Qilu, Yangzonghai, Yilong, Chenghai and Lugu county. Of these, 6 (or 4.1 per cent) have been completed, and 64 (43.5%) have started. A further 77 (52.4%) projects have entered a preparatory phase.

74. In 2003, investments in pollution treatment of the nine large plateau lakes reached 557 million RMB, of which 104 million RMB was allocated for Lake Dianchi. The total investment to date in treatment and prevention of pollution of the nine lakes was 4,865 million RMB, of which 3,536 million RMB was for Lake Dianchi.

Table 2.6 Expenditure on industrial wastewater treatment

Year	Expenditure on Industrial Wastewater Treatment (10,000 RMB)
2003	14276.1
2002	9465.2
2001	7191.0

**Suggested Rating:** Average and consistent

**Justification:** Efforts by the government and enterprises resulted in a significant increase in the percentage of industrial wastewater treated prior to discharge and in greater water re-use.

#### 2.4.5 Conclusions

75. In Yunnan, rivers and lakes in close vicinity of population centers have traditionally suffered from high levels of pollution and eutrophication in the case of lakes. The Tenth Five-Year Plan for Pollution Treatment and Prevention in Lake Dianchi's marked a turning point. By 2003, 15 of the 26 planned wastewater management projects had been implemented. Combined with enterprise-level investments in wastewater treatment, most rivers registered notable improvements. Large investments were also made to improve water quality in 9 principal lakes of the Province but the results are believed to be much more modest. Government expenditure in wastewater management is on the rise.

**Suggested Rating: 2 STARS**

**Justification:** Water quality of major rivers in Yunnan stabilizing and has begun to improve. Water pollution control measures by municipalities and the industry have multiplied and have had a positive impact. The quality of Yunnan's major lakes is believed to be cause for concern even if is not evaluated in this EPA.



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## 2.5 Inadequate Waste Management

### 2.5.1 The Context

76. The rapid growth of population and urbanization has led to increased waste generation in Yunnan. Waste management occupies an important place in The Tenth Five-Year Plan for Ecological Rehabilitation and Environmental Protection (2001) of Yunnan.

### 2.5.2 The State

#### 1<sup>st</sup> Indicator –Percentage of Non-Recycled Industrial Waste 1989 – 2004

77. This indicator presents the trend in the volume of industrial solid waste directly discharged into the environment as a percentage of the total volume of industrial waste generated.

78. The growth in Yunnan's economy over the past 15 years has resulted in greater levels of solid waste generated by the industry. As shown in Figure 2.12, the volume in 2004 was nearly 2.5 times that of 1989. The volumes of waste discharged (i.e. not re-cycled) changed little in 1990s but began to decrease rapidly thereafter. As a result, the percentage of non-recycled waste fell even more rapidly.

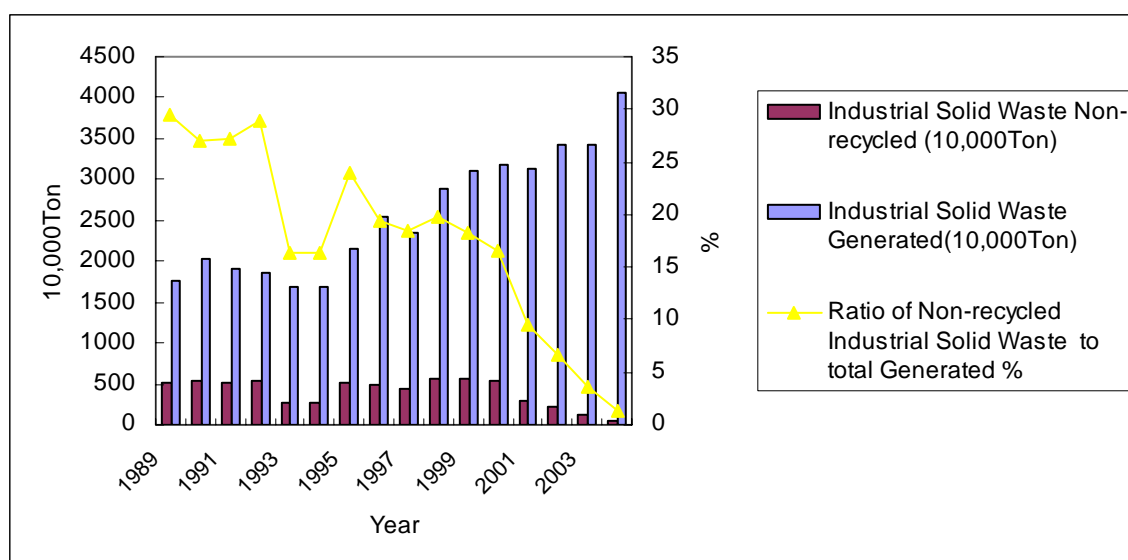


Figure2.12. Percent of non-recycled industrial solid waste in the total generated, 1989-2004

79. The turning point appears to have been the period1993-1998 and especially the promulgation of the Law on the Prevention and Control of Environmental

**Suggested Rating:** Unknown State and improving

**Justification:** The volume of industrial solid waste directly discharged into environment has been decreasing over the past 15 years in part thanks to legislative efforts of the government.

Pollution by Solid Waste in 1996.

**2<sup>nd</sup> Indicator –Percent of Municipal Solid Waste Safely Disposed of in the Total Municipal Solid Waste Generated 2000 – 2004**

80. This indicator (see Figure 2.13) measures the amount of municipal solid waste collected and deposited in designated facilities (“treated”) expressed as a percentage of the the total amount of waste generated. The indicator does not capture the environmental adequacy of these facilities and the term “safe disposal”, when used in this context, refers merely to the “right” destination of the waste.

81. Although the period for which data are available is relatively short, it is reasonable to describe performance as a stagnating one in recent years following a promising improvement in 2001. The total volume of municipal solid waste kept increasing while the volume of solid waste properly disposed of remained largely unchanged.

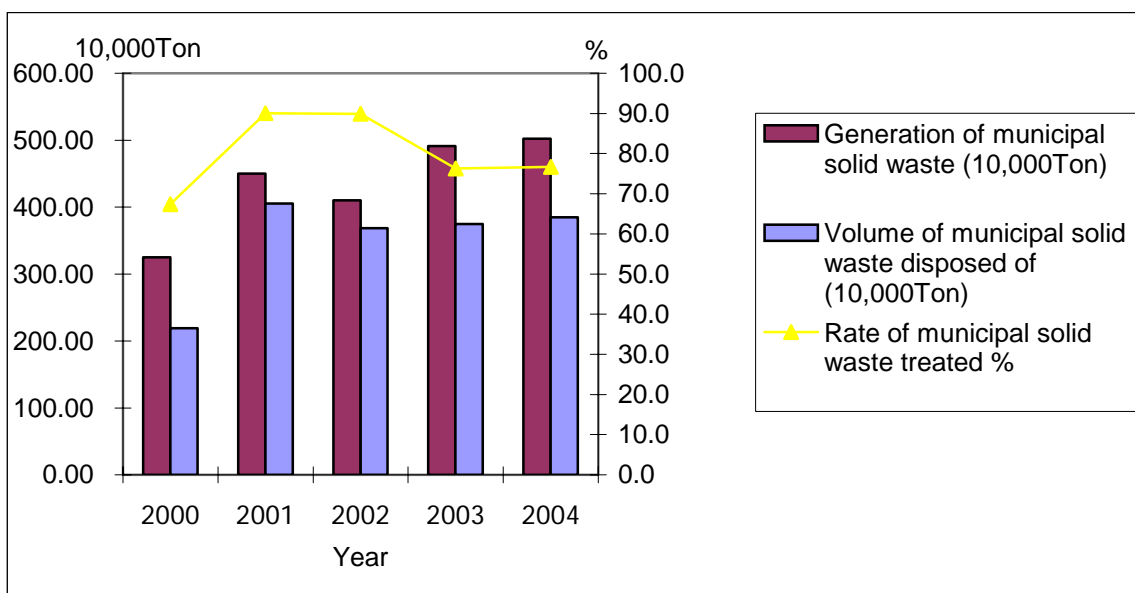


Figure 2.13 Percent of municipal solid waste safely disposed of in the total municipal solid waste generated, 2000-2004

82. By 2005, the percentage of municipal waste safely disposed of should be over 65% in the Province's top-tier cities according to The Tenth-Five Year Plan for Ecological Rehabilitation and Environmental Protection of Yunnan (2001). The data suggest that the target is almost being met but the margin for comfort is very small and the target itself appears to be soft by international comparisons..

**Suggested Rating:** Unknown state and deteriorating

**Justification:** While the industry has significantly improved its waste disposal performance, the same cannot be said of the municipalities. The percentage of municipal solid waste properly disposed of remains low with no signs of improvement.

### 2.5.3 The Pressure

**1<sup>st</sup> Indicator –Volume of Municipal Waste 2000 - 2004**

**2<sup>nd</sup> Indicator –Volume of Industrial Solid Waste Generated 1989 - 2004**

(Note: The values of two above indicators are contained in a single factsheet)

83. Total volumes of municipal and industrial solid waste generated are logical indicators of pressure in this context. In the former case, available estimates largely reflect the growth of population and increasing incomes both of which result in greater volumes of municipal waste (as well as changes in its composition). The latter mirror the expansion of industry. The trends in the value of both indicators are plotted in Figures 2.14 and 2.15 below. Although the data for municipal solid waste are available for 5 years, both of the indicators show a slowly increasing trend.

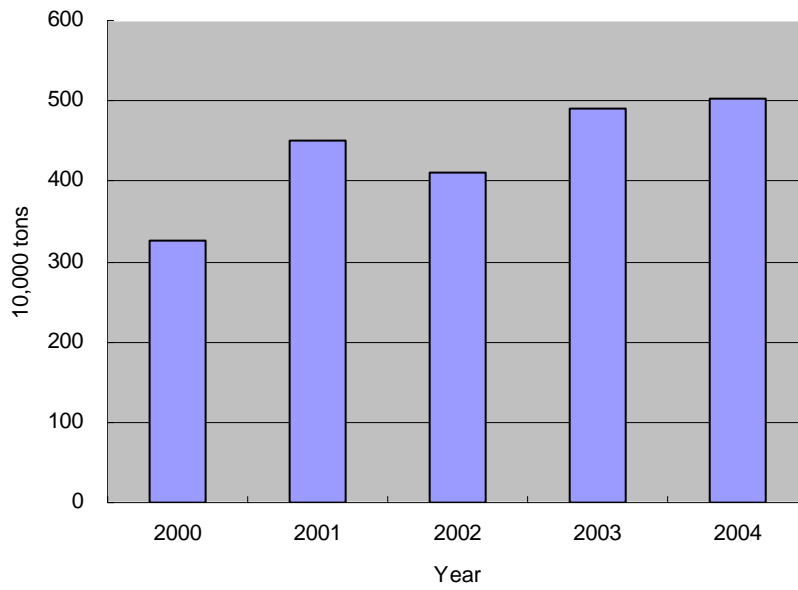


Figure 2.14 Volume of municipal solid waste generated, 2000-2004

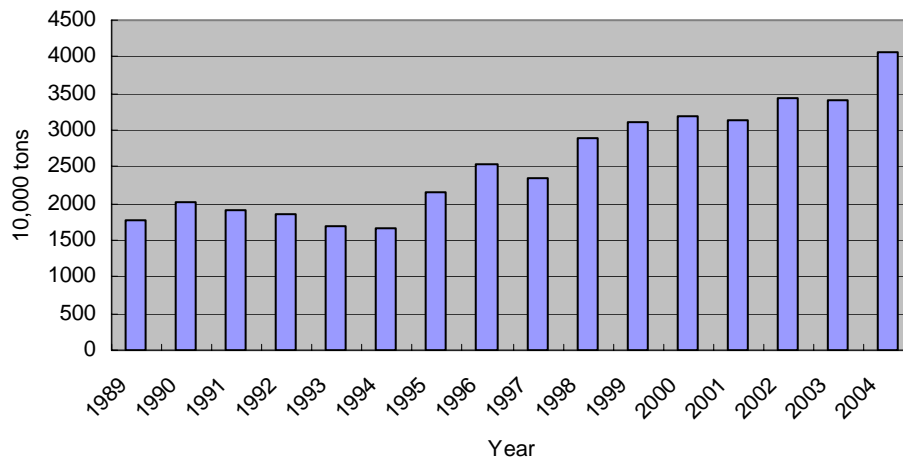


Figure 2.15 Volume of industrial solid waste generated, 1989-2004

**Suggested Rating:** Medium and increasing

**Justification:** The volume of solid waste generated in Yunnan broadly matched the rate of economic growth but was proportionately faster for the municipal than the industrial category.

## 2.5.4 The Response

### Indicator –Percent of Industrial Solid Waste Re-Cycled 1989 - 2004

84. This indicator tracks the efforts to re-cycle industrial solid waste. As shown in Figure 2.16, the percentage of recycled industrial solid waste increased steadily from approximately 20% in the early 1990's to 40% in 2004.

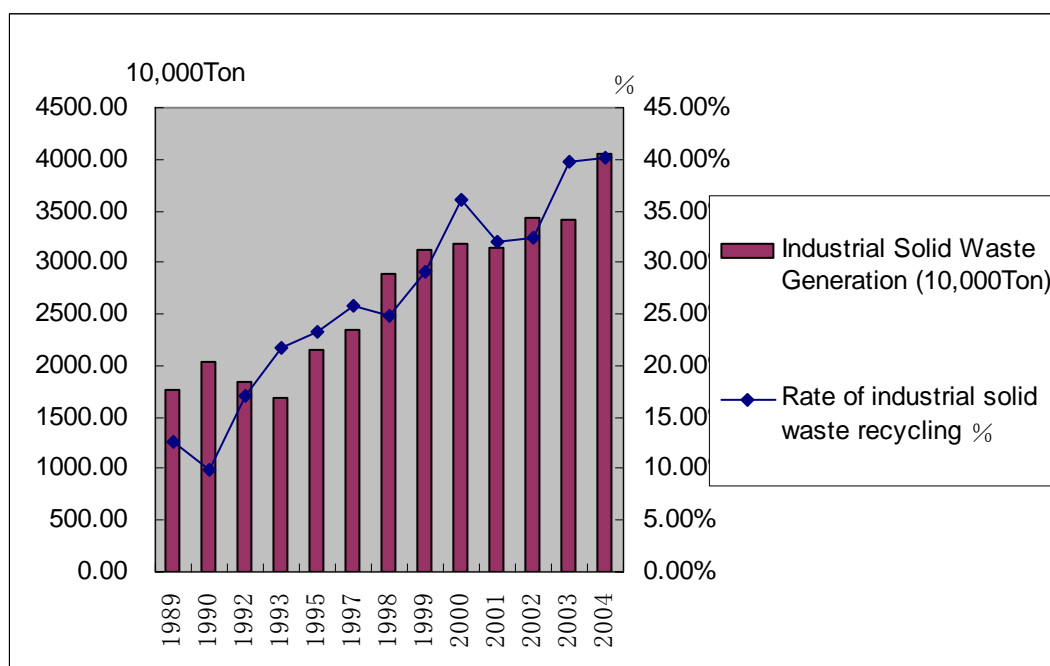


Figure 2.16 Percent of industrial solid waste recycled, 1989-2004

85. The Government efforts to encourage waste recycling by enterprises saw the adoption of the Law of the Prevention and Control of Environmental Pollution by Solid Waste in 1996 that requires enterprises to reduce the production of solid waste. The central government has also urged the use of economic incentives and improved management to foster greater recycling and reuse of solid waste. Nevertheless a coherent approach to recycling of waste, in line with the “3R” spirit—reduce, reuse, recycle—is yet to be formulated.

86. According to The Tenth Five-Year Plan for Environmental Protection of Yunnan province, 2003, 40% of industrial solid wastes should be recycled and reused by 2005. As can be seen, the target for 2005 has been achieved.

**Suggested Rating:** Non-comparable and consistent

**Justification:** The measures and projects on recycling industrial solid waste have had their intended effect and the 2005 targets were met already in 2004.

### 2.5.5 Conclusions

87. The volume of industrial and municipal waste generated has been growing in Yunnan due to increasing urbanization and further growth of the industry. While the solid waste discharge performance of the industry improved significantly during the last decade, no such improvement has been achieved in dealing with municipal waste. The poor performance by the municipal segment may be due to the difficulties and high cost of developing safe landfills.

**Suggested Rating:** 2 STARS for the industry and 1 STAR for the municipal sector

**Justification:** The response by the industry to the waste discharge problem has been strong and positive. By contrast, the management of municipal solid waste remained poor.

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## 2.6 Forest Resources

### 2.6.1 The Context

88. Forest resources are crucial to maintaining the natural environment and biodiversity in Yunnan and are a significant complement of economic growth. Forest resources are threatened by over-cutting and by high local energy demand that is met in part by firewood. Steps are being taken by the government towards conserving forests. A large number of forest conservation and afforestation projects have been implemented during the past decade.

### 2.6.2 The State

<b>1<sup>st</sup> Indicator – Percentage of Forest Cover 1960 – 2002</b>
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89. Forest cover of Yunnan province has steadily increased since the 1990's. The Yunnan Forest Inventory and Planning Institute has been monitoring forest cover since 1960. Complete inventories were conducted in 1975 and 1979. Since 1987, the Institute has conducted forest cover inventories every five years. Figure 2.17 shows the changes in forest cover from 1960 to 2002. In 2002, the total forest area in Yunnan was 15.0 million hectares. This included 12.5 million hectares of natural forest, 1.1 million hectares of plantation forest area and 1.4 million hectares of other forest. Including shrub-land, forests covered 50.2% of the total land area of the province in 2002. The comparison of forest areas with the estimates of the standing volume (see Factsheet 5.1) shows that the growth of standing stock lagged behind that of the area. There were more forests in Yunnan with, however, a low average standing volume. This may not be serious if the principal function of the forests in Yunnan is shifting from production to environmental protection.

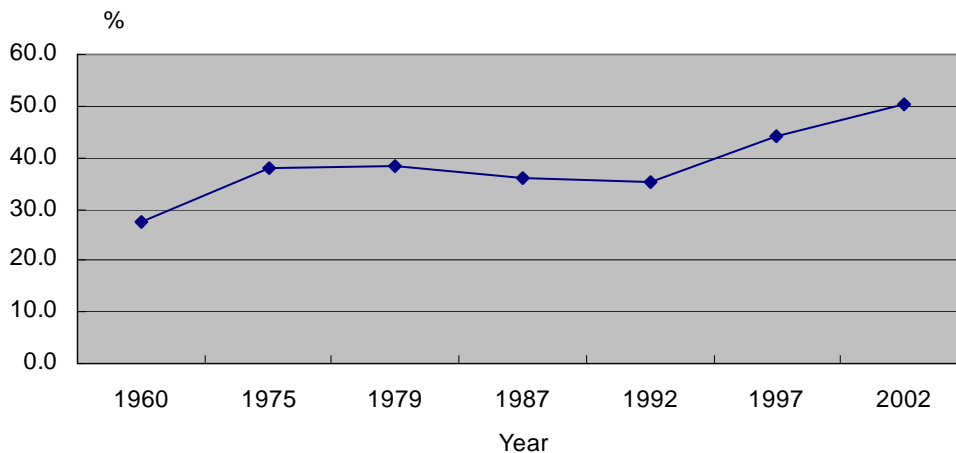


Figure 2.17 Percentage of forest cover, 1960-2002

90. The big floods in Eastern China in 1998 resulted in PRC's government taking resolute steps towards forests conservation. From 1999, many environmental rehabilitation ("ecological construction") projects were started and the positive outcomes of these projects began to be noticeable. These included natural forest conservation projects and conversion of inappropriately cultivated land to forest. Natural forest conservation projects began in 1999. All natural forests are subject to a logging ban. Protection of biodiversity and associated ecological functions of these forests is the principal management objective. Projects supporting conversion of "wrong" farmlands –usually steep slopes- to forestry (afforestation) started in 1999 with the objective of reducing soil erosion.

91. The target of 48% forest cover contained in the Tenth Five-Year Plan for Ecological Rehabilitation and Environmental Protection of Yunnan was exceeded in 2002. Investment in forest protection also increased in the the last 6 years (1998-2004) to a cumulative 6,700 million RMB.

**Suggested Rating:** Average and improving

**Justification:** The environmental rehabilitation projects are effective and the percentage of forest cover has been steadily increasing in Yunnan. The increase in forest area has been faster than the increase in the forest's standing volume.

### 2.6.3 The Pressure

**Indicator – Ratio of Wood Consumption to Forest Standing Stock Increment  
1960 – 2002**

92. This indicator is developed to describe the sustainability of forest management by comparing the volume of wood removed with the annual increment of the standing forest stock. Values of the indicator in excess of 1 indicate depletion of the forest and vice versa.

93. Figure 2.18 plots the value of this ratio since 1960 suggesting that depletion, very serious in the early part of the studied period not least because of the policies of the Cultural Revolution, was reversed around the middle of the 1990s. The improvements since then can be attributed to various forest conservation and afforestation projects undertaken by the state and provincial government, as well as increased availability of modern (non-fuelwood) sources of energy in some locations as described earlier.

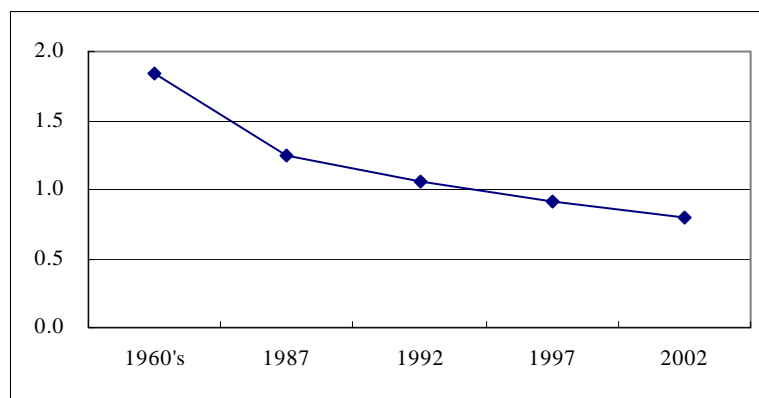


Figure 2.18 Ratio of wood consumption to forest standing stock increment, 1960-2002

**Suggested Rating:** Average and improving

**Justification:** By the middle of the 1990s, a variety of forest conservation and afforestation projects implemented by the government contributed to the reversal of the trend towards forest depletion. The improvements have continued since then.

#### 2.6.4 The Response

### 1<sup>st</sup> Indicator –Afforested Area 1999 – 2004

94. This indicator gives the area of land unsuitable for farming that was converted to forests over the period 1999 to 2003. The indicator does not capture the quality of the afforested areas and parameters such as seedling survival.

95. Cultivation of unsuitable lands (typically, steep slopes) quickly degrades the land and causes serious water and soil losses. Converting inappropriately cultivated land to forest can improve the ecological functions of the lands in question, slow down the rate of soil erosion and avoid off-site losses (siltation etc.) 1999 (Figure 2.19). Environmental rehabilitation projects began in 1999 and the lands afforested each year have increased substantially since then.

96. The 1998 Provincial Afforestation Plan called for a total of 346,700 hectares afforested by 2003, consisting of 166,700 hectares of inappropriately cultivated land and 180,000 hectares of abandoned and mountainous areas. By 2003, a total of 345,500 hectares had been forested, broadly in line with the expectations. The Plan is largely implemented by local communities supported in cash and kind by the Government. Some 117 tons of grain, 74 million Yuan in cash and 233 million Yuan for seedlings were distributed to the local communities during the period 1999 to 2003. Despite this achievement, it is important to bear in mind that the 345,000 ha afforested during the period 1999 to 2003 represented no more than 2 percent of the total forest area of the province albeit the environmentally essential 2 percent.

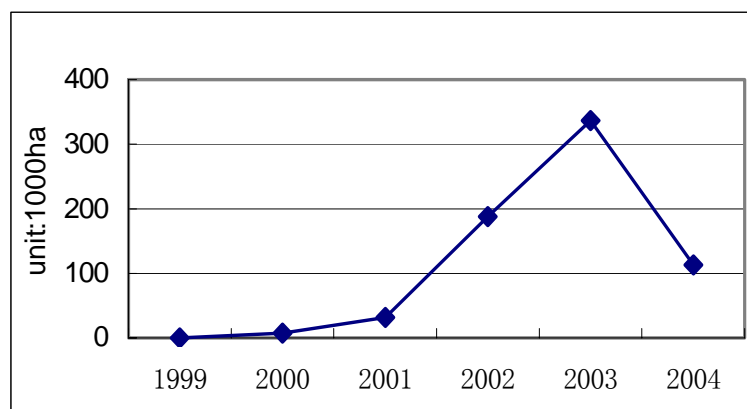


Figure 2.19 Afforested area, 1999-2004

**Suggested Rating:** Significant and intermittent

**Justification:** A steady progress has been made in re-claiming inappropriately farmed lands to forest.

## **2<sup>nd</sup> Indicator – Area under Forest Conservation Programs 2000-2004**

97. This indicator tracks the cumulative area under forest conservation programs in the province. There are currently two types of forest conservation programs in Yunnan, each with own targets and implementation mechanisms. The first is the protection and management of natural forest. The second is the establishment of artificial woodlands for public usage, referred to in Yunnan as public welfare forestry.

98. As shown in Figure 2.20, the total area under both programs increased from approximately 12 million hectares in 2000 to almost 13 million hectares in 2004. The bulk was accounted for by natural forests where the 2005 target of 12.0 million hectares (set out in The Tenth Five-Year Plan for Ecological Rehabilitation and Environmental Protection of Yunnan) was met right from the outset of the program in 2000 (raising questions about how the target was set in the first place). The 2010 target set out in Yunnan Natural Forest Conservation Project remains pegged at 12.0 million ha.

99. The area under public welfare forests is a relatively small percentage of the total forest under conservation (Figure 2.20). The 2010 target of the Yunnan Natural Forest Conservation Project for this type of forest is 1.8 million hectares. Based on the progress so far, the 2005 target of 810,000 hectares (featuring in the Tenth Five Year Ecological Rehabilitation and Environment Protection Plan of Yunnan(2001)) appears to be achievable.

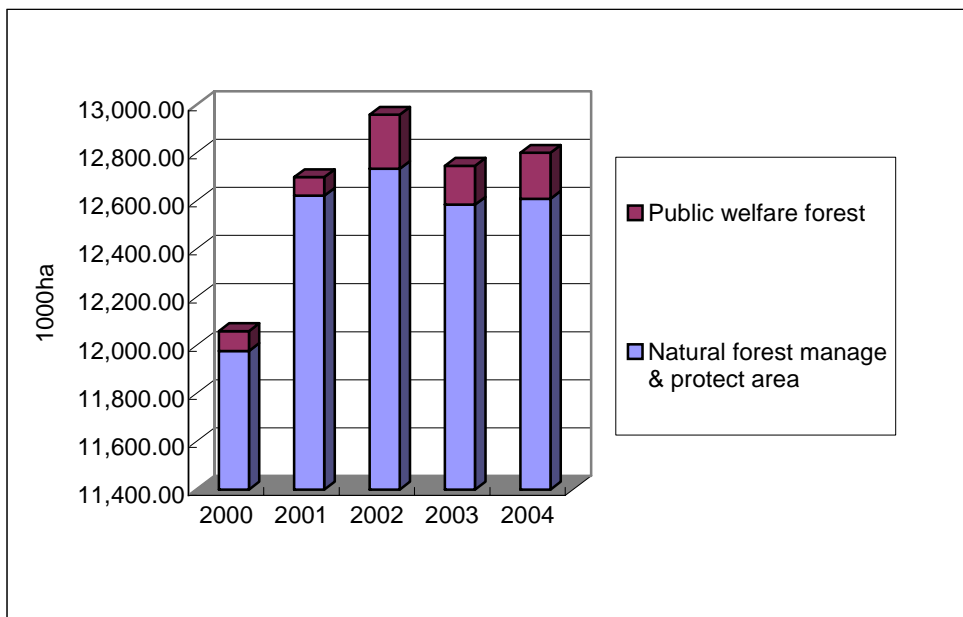


Figure 2.20 Areas under forest conservation programs, 2000-2004

**Suggested Rating:** Average and consistent

**Justification:** Efforts by government and participating communities have resulted in consistent progress in expanding the protection given to natural forest and establishment of people welfare forests.

## 2.6.5 Conclusions

100. Forest resources are essential for the maintenance of environmental functions of the Yunnan province besides their direct economic contribution. A large number of natural forest conservation, afforestation, forest rehabilitation and reforestation projects have been implemented in the province over the past decade. The areas of afforestation, natural forest, and public welfare forests have been steadily increasing as has the overall forest cover.

**Suggested Rating: 3 STARS**

**Justification:** A decisive turnaround appears to have been achieved in Yunnan in the management of forest resources. The area under forest continues to increase and the depletion of the resource, overall, has been arrested and reversed. Some doubts exist concerning the quality of the forest.

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## 2.7 Natural Disasters

### 2.7.1 The Context

101. Because of its location and geography, Yunnan is prone to natural disasters. Various forms of natural calamities affect the province including climatological disasters (heavy winds, hailstone, snow-related disasters, floods, droughts); and geological disasters (earthquakes, mud- and rock slides, etc). Although the bulk of disasters is truly natural, there is a varying man-made element affecting the scale and severity of some categories of disasters. This includes activities such as unsuitable and unauthorized location of housing, poor quality of housing and infrastructure, removal of protective vegetative cover exacerbating the impact of landslides, unsafe storage of hazardous waste, etc. Managing natural disasters including its man-made component and mitigating the economic losses associated with them is a major challenge for Yunnan's authorities and population.

### 2.7.2 The State

#### 1<sup>st</sup> Indicator –Population Affected by Natural Disasters 1992 – 2003

102. This indicator (Figure 2.21) presents the population affected by natural disasters. "Affected population" is defined by the provincial authorities as those who receive compensation for disaster.

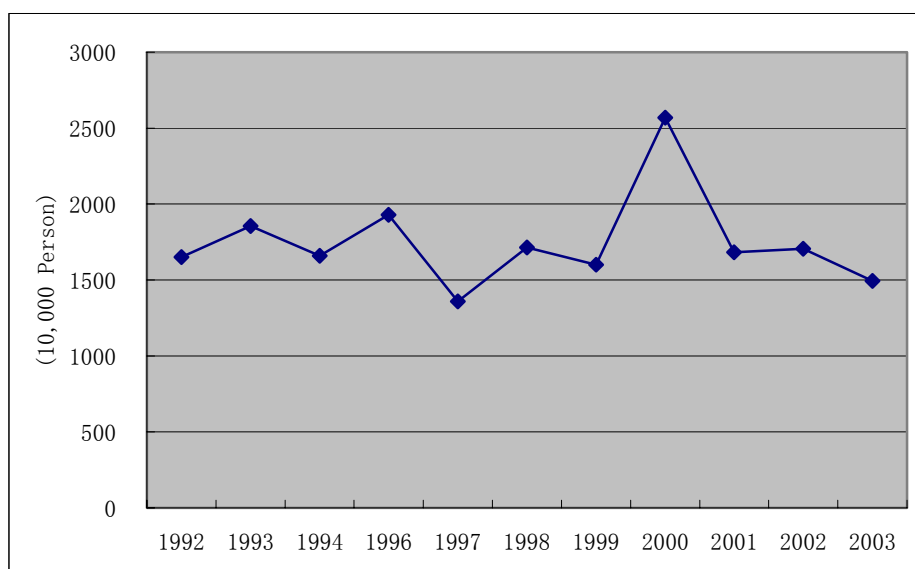


Figure 2.21 Population affected by natural disasters, 1992-2003

103. The population affected by natural disasters in Yunnan province averaged around 16 million each year. In 2000, this number exceeded 25 million. This was



due to a severe frost and snow disaster event that occurred that year in the province followed by four very strong and destructive earthquakes which attacked Yaoan, Qiubei, Mile, Wuding, Longchuan County.

**Suggested Rating:** Relatively poor and undetermined

**Justification:** The percentage of population affected by natural disasters in Yunnan remained relatively stable during a period witnessing wide variations in the frequency and severity of natural disasters.

**2<sup>nd</sup> Indicator –Economic Losses Caused by Natural Disasters as Percentage of Provincial GDP 1992 – 2003**

104. This indicator tracks the economic losses caused by natural disasters between 1992 to 2003 as percentage of the provincial GDP. If plotted over a sufficiently long period, a declining trend of the value of this indicator would suggest greater success of local authorities in preventing and mitigating the impact of natural disasters, including their man-made component (and vice versa) through measures such as improved warning systems, land stabilization measures and others.

105. As shown in Figure 2.22, the percentage values fluctuated with no clear trend. The high values between 1996 and 2000 can be explained by well defined natural phenomena. On 3 February 1996, Lijiang was affected by an earthquake of grade 7.0. 11 counties in Lijiang prefecture, Dali prefecture, Diqing prefecture, Nujiang prefecture were affected. In January 1997, an earthquake of grade 5.1 and 5.5 struck Mengla-Jinghong and Jinghong-Jiangcheng. In October of the same year, an earthquake of intensity 5.3 struck the barely recovering Lijiang. Between October and December 1998, there were 5 earthquakes measuring more than 5.0 in Yunnan. Another earthquake of grade 5.2 struck Chengjiang in 1999. In January 2000, a series earthquakes of intensity 5.9 and above hit Yaoan-Dayao, 13 counties were affected.

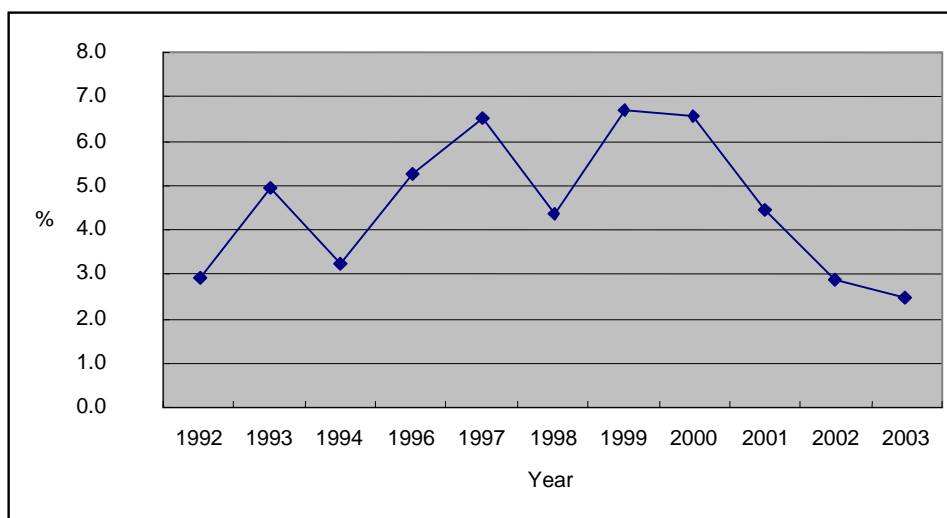


Figure 2.22 Economic losses caused by natural disasters as percentage of provincial GDP, 1992-2003

**Suggested Rating:** Unknown state and undetermined trend

**Justification:** Economic losses caused by natural disasters are affected by the frequency and magnitude of such disasters but also the size of the economy. The available series of data is probably too short to allow us to say whether the decline in natural disaster-associated damage expressed as a percentage of the provincial GDP observed since 1999 is a reflection of greater disaster preparedness in Yunnan or mainly the result of a temporary reduction in the intensity of the disasters themselves.

### Indicator– Provincial GDP at Constant Prices 1991 – 2003

#### 2.7.3 The Pressure

106. The true natural disasters are defined by their near-unpredictability and there would be little point in constructing indicators attempting to capture the disasters' intensity over time. Instead, we have used the data of provincial GDP at constant prices as a proxy for the value of assets that are at risk from natural disasters. The higher the GDP, the greater is likely to be the damage caused by a natural disaster of a given intensity. Since (at least in the un sentimental world of economics) the value of human life and economic cost of injuries tend to be positively correlated with GDP per capita, the indicator may not be as flawed as it may at first appear though it will not capture other non-monetary values such as damage to scenic areas.

107. GDP of Yunnan Province kept increasing from 1991 to 2003. The Tenth Five-Year Plan for Social and Economic Development of Yunnan expects the GDP to

reach RMB 290 billion (at 2003 prices) in 2005.

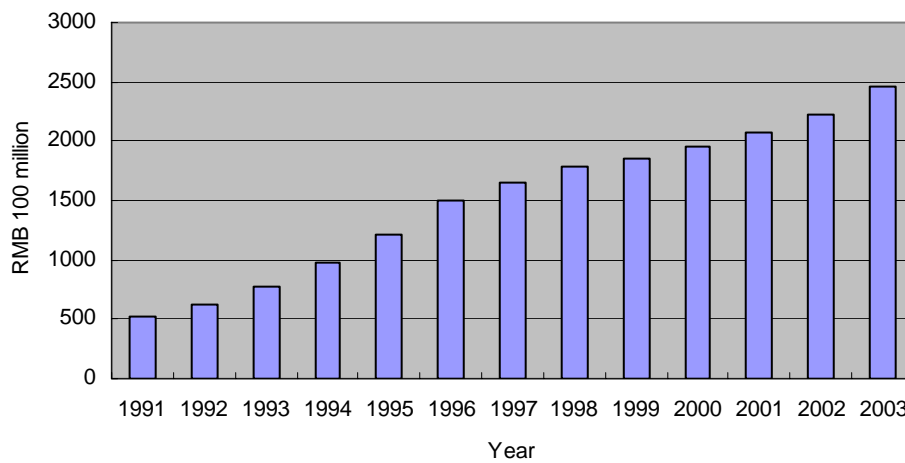


Figure 2.23 Provincial GDP at constant prices

**Suggested Rating:** Average and increasing

**Justification:** The rapidly increasing GDP increasing the risk of damage associated with natural disasters of a given magnitude and frequency.

#### 2.7.4 The Response

**Indicator –Expenditure on Disaster Relief and Preparedness 1992 – 2003**

108. This indicator measures the expenditure on disaster management.

109. The Figure 2.24 shows that after 1994, the expenditure on disaster relief increased rapidly. This was the year that Yunnan experienced several disasters including floods, drought, earthquakes, mud flow, and land slides.

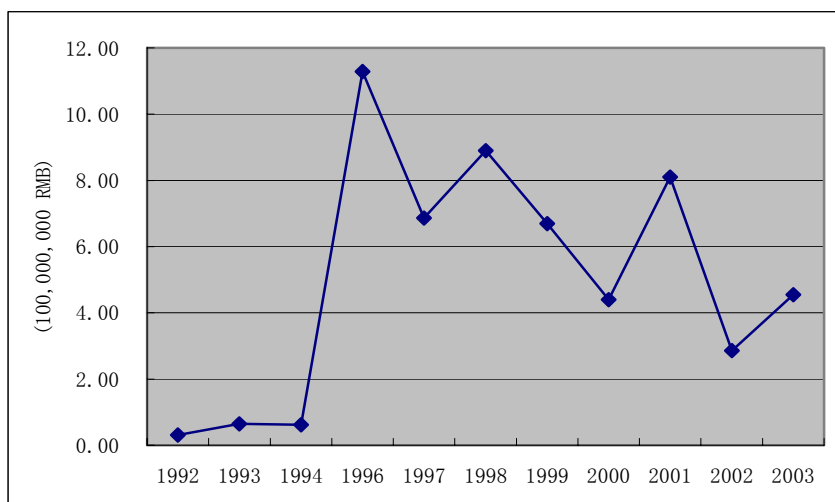


Figure 2.24 Expenditure on disaster relief and preparedness, 1992-2003

110. The results point to a poor match between the economic losses sustained and the expenditure on relief. Part of the explanation may lie in the combined nature of the expenditure with its preparedness component remaining relatively steady while the relief component fluctuates according to perceived needs. There may well be further links and lags between expenditure on disaster preparedness and the expenditure on relief but they are not explored here.

111. Climatological disasters tend to be more frequent in Yunnan than the geological disasters and the expenditure on disaster relief and preparedness reflects this. Part of the expenditure captured in the indicator goes to improving the Geological Disaster Forecasting and the Disaster Prevention and Relief Service. A new network of geological disaster prevention and forecasting for the whole province has been in operation since 2003. In 2003, 209 disasters were successfully anticipated resulting in a successful evacuation of about 7,500 people and an economic loss avoided of 130 million Yuan.

**Suggested Rating:** Non-Comparable and Consistent

**Justification:** Expenditure on disaster relief is affected by the frequencies and risks of natural disaster.

## 2.7.5 Conclusions

112. Natural disasters caused large economic losses in Yunnan during the period under review. Given the Province's vulnerability to natural disasters, Yunnan's rapid economic growth and infrastructural development are likely to result in higher absolute value of such losses in future. The Government's objective must be to reduce the long-term average of such losses as a percentage of the Province's

economic wealth. This can be achieved through better designed and executed disaster preparedness measures.

**Suggested Rating: 2 STARS**

**Justification:** Yunnan has traditionally suffered from disaster-related losses. The magnitude of such losses reflected not only the frequency and intensity of natural disaster phenomena but also the size and the economic assets under threat and the scale and quality of disaster preparedness efforts of the Government. No evidence exists to suggest that the vulnerability of Yunnan's citizens to natural phenomena has diminished during the last decade or so.

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## 2.8 Climate Change

### 2.8.1 The Context

113. Industry is an important economic sector in Yunnan. The key industries include beer, cement, cigarettes, phosphates, jade ornaments, garments, tin, and machine tools. They are located mostly in Kunming and the industrial towns of Yuxi and Qujing. Collectively, they are a significant source of greenhouse gas (GHG) emissions. Other GHG sources include domestic users of coal and fuelwood and segments of the livestock and rice-growing sectors.

114. China is formulating the National Strategy for Climate Change in which the low energy efficiency will feature importantly.

### 2.8.2 The State

115. The state of the global climate is determined in complex ways through the interplay of national and local GHG emissions. No attempt is made here to engage in the sophisticated work required to construct indicators of the state of the global climate.

### 2.8.3 The Pressure

<b>Indicator – Coal Consumption for Energy Generation 1991 – 2003</b>
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116. Worldwide, increased energy consumption resulting in greater burning of hydrocarbons is a key factor contributing to global climate change. Besides hydro power, coal consumption is a main source of primary energy in Yunnan and was considered a suitable pressure indicator for our purposes.

117. Yunnan is among the coal-rich provinces of South China. There are an estimated 70 billion tons of coal reserves in Yunnan with proven reserves of 34.4 billion tons. 63 percent of the reserves is lignite, suitable for generating electricity but high in pollution content.

118. During the past 15 years, coal accounted for 60 percent of primary fossil energy consumption in the province (Figure 2.25). With the growth in the economy, coal consumption grew until 1997 (see Figure 2.26) and has stabilized since. Its share in the Province's output of primary energy total began to decline at about that time. The 2003 decision of Yunnan's Provincial Government to accelerate the development of small and medium hydropower as the main thrust of future energy development in Yunnan is indicative of likely future trends. By 2002, hydropower accounted for one third of electricity generation in Yunnan Province, supplying

power to 64% of rural population in the province.

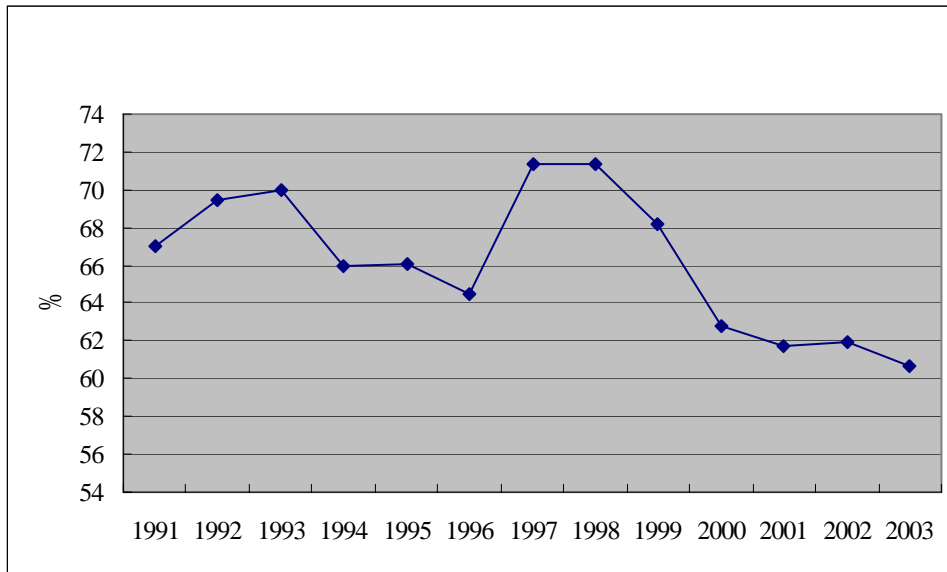


Figure 2.25 Percentage of coal in primary fossil energy consumption in Yunnan, 1991-2003

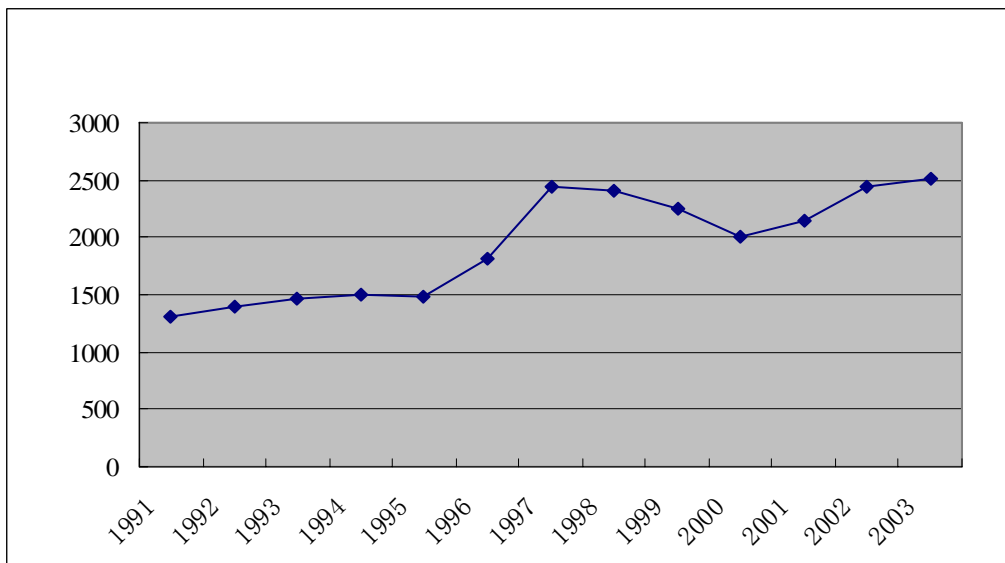


Figure 2.26 Coal consumption, 1991-2003 (10,000 tons)

**Suggested Rating:** High and steady

**Justification:** Coal remains a major source of energy in Yunnan. There are signs, however, of a gradual decline in coal's relative importance.



## 2.8.4 The Response

### Indicator – Energy Intensity 1991 – 2003

119. Energy intensity (or energy consumption per unit of Yunnan’s gross domestic product) is used here as an indicator of provincial efforts to control GHG emissions.

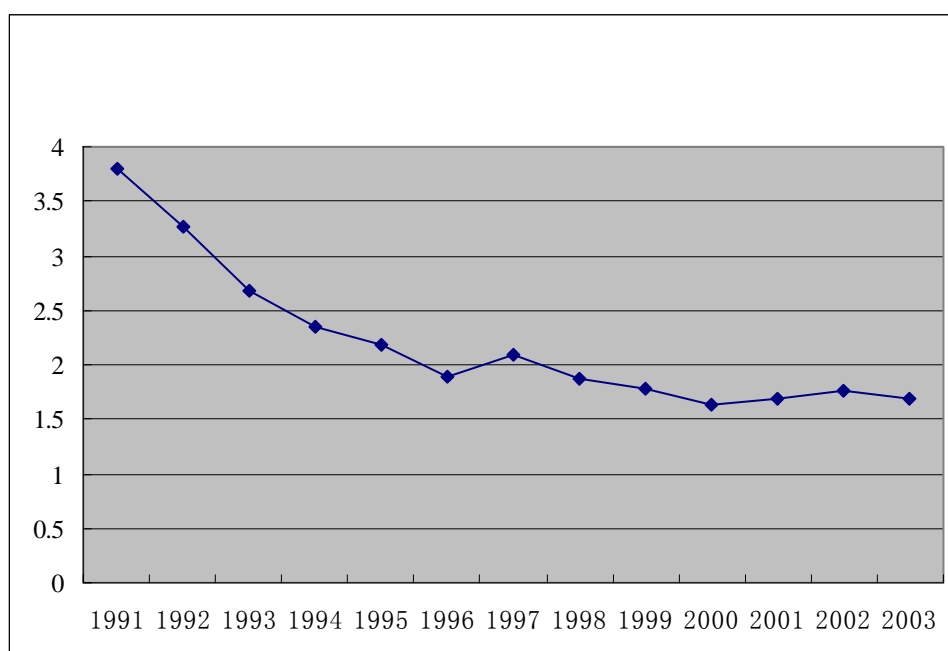


Figure 2.27 Energy Intensity, 1991-2003 (tons of coal equivalent/10,000 Yuan)

120. The energy intensity of Yunnan declined rapidly in the first half of the 1990s but remained largely unchanged since 1996. The policies and actions implemented to reduce or more effectively manage the energy consumption had a major positive effect, not surprising given the general energy inefficiency characterizing China (including Yunnan) until then. However, the improvements were only modest in Yunnan in the latter part of the 1990s and initial years of the current decade. The easiest options associated with the early phase of industrial modernization clearly had been fully used and progress became more difficult to achieve since then.

121. Apart from the support for hydropower development mentioned earlier on that address GHG emissions indirectly, direct initiatives of the Provincial Government include provincial pilot applications of the Clean Development Mechanism (CDM). For now, all of these are at a design stage (e.g. Lijiang Dianximingzhu applications of solar energy or Maguan Hydro Project). The total estimated emission reductions under CDM pilot projects are 37,100 tons of CO<sub>2</sub> during the first phase (2004-2010).

122. Yunnan Provincial Economic Committee is set to support technology innovation projects for industrial enterprises during 2005-2007 under which “clean”

natural gas, and renewable forms of energy such as solar will be promoted. Research on cleaner energy development, energy saving and promoting production efficiency in metallurgy and chemistry industries is also being carried out.

**Suggested Rating:** Average and consistent

**Justification:** Declining energy intensity in a province that continues to depend on coal for the bulk of its primary energy speaks of the positive impact of several government initiatives undertaken to bring about a reduction in air emissions, including those of GHGs.

## 2.8.5 Conclusions

123. With the development of the industry and rising demand for energy, coal consumption in Yunnan shows no sign of losing its traditional position of prominence. It remained largely the same in volume terms since the late 1990s even if its share in the total consumption of primary energy declined slightly. At a time of rapidly growing provincial GDP, this translated into improved energy intensity rapid at first (until 1996) and continuing to decline albeit at a much slower rate since then. For now, Yunnan has no specific targets of GHG reduction. Nonetheless, the government's efforts to improve energy efficiency had both an air-quality and GHG-reduction dimensions.

**Suggested Rating: 2 STARS**

**Justification:** There has been a significant improvement in Yunnan in the efficiency with which coal is used to generate electricity. The consumption of coal has remained largely unchanged since 1997. Energy intensity declined rapidly until 1996 and the emissions of GHGs, though not estimated directly in this EPA, can be presumed to have declined in line with this improvement.

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### **III CROSS CUTTING ISSUES IN EPA**

#### **3.1. Integration of environmental concerns in economic decisions**

124. With the rapid development of China's economy during the past two decades, the demand for natural resources, energy and environmental "sinks" has been on the rise. This has been true of Yunnan as much as of the rest of the country. How best to promote economic growth without threatening the resource base and environmental services is an important concern of the central and provincial governments.

##### **3.1.1 Policy and Institutional Integration**

###### **3.1.1.1 Institutional structure for environmental protection in PRC and Yunnan**

125. The institutional structure of environmental management in PRC was sketched in Section 1.2.4 above. Important to note is that while at the central level, SEPA is a body independent of the executive branch (State Council), provincial environmental protection bureaux (PEPB) though guided technically by SEPA are agencies of provincial governments. Environmental management in China is a provincial matter, within a PRC-wide framework of environmental laws. Whether the non-independent standing of PEPBs has affected Yunnan's environmental performance is difficult to say. Over the years, the Yunnan Provincial Environment Protection Bureau (YNPEPB) has had a much greater say in matters pertaining to economic development, the center of gravity in provincial decision making, but its ability to place environmental safeguards on all the economic decisions in the province may have been compromised somewhat.

###### **3.1.1.2 Institutional strengthening and capacity building**

126. In Yunnan, YNPEPB acts through a network of local environmental protection bureaux in 16 prefectures and 90 counties established in the course of the past two decades. They implement national policies and those of YNPEPB to which they are subordinated. In 2002, the local bureaux had a combined total of over 3,000 staff responsible for EIA-related work, environmental planning, monitoring and enforcement. 1,700 of them were technical specialists.

127. By the end of 2004, there were 55 staff in YNPEPB, including 10 with master's degrees and 36 with bachelor degrees. There were about 350 staff working at the Yunnan Environmental Monitoring Center Station, Yunnan Environmental Information Center, Yunnan Institute of Environmental Science and other agencies directly under the YNPEPB.

128. Yunnan Environmental Monitoring Center Station (YNEMCS) was established in

1994, and is technically guided by China National Environmental Monitoring Station. YNEMCS is responsible for the monitoring of environmental quality and pollution accidents in the province, drafting of the Provincial Environmental Quality Report and the environmental monitoring yearbook and other specialized reports, and for staff training and scientific research. YNEMCS's network covers 16 cities and regions. There are 89 staff in YNEMCS including 76 technical personnel, of which 18 are senior engineers. The staff of 16 local environmental monitoring stations comprises 419 persons, including 63 senior engineers and 174 engineers.

129. In general, the environmental monitoring system of Yunnan boasts strong technical capacity and has the makings of a good quality assurance system. Nevertheless the experience of this EPA suggests that the approach to monitoring and collection, analysis and dissemination of data does not always focus on the most important objectives of policy and the demands of keeping the public informed. Gaps remain in the coverage and quality of data that make it difficult or even impossible to assess performance in some domains.

130. Yunnan Institute of Environmental Science (YIES), founded in 1976 and located in Kunming City, is one of leading research institutes in China, with 7 research centers, 2 laboratories and 3 environmental consulting, engineering and management divisions specializing in ecology, environment protection, and plateau lake research (rivers and wetlands). YIES is also involved in regional environment planning, environmental impact assessment, clean production and ISO14000 certification. It is strong in hazardous waste management and technology research, environmental engineering design and construction, environmental protection technology development and applications. YIES has 168 staff, of which 7 are professors, 43 are senior engineers and 47 are engineers.

131. By now, YIES has completed a number of key national and international cooperation projects, and over 1000 specialized assignments including basin- and city environmental planning, wetland ecology assessments, development of air pollution information system and so on. YIES can offer consultancy services in engineering design, EIA, and other fields. At the same time YIES involvement in policy development and assessment has been relatively modest.

132. Yunnan has substantially enhanced the capacity of its institutions to respond to existing environmental challenges but room for further improvement exists, in particular in environmental monitoring and policy analysis and development.

### **3.1.1.3 Legislative and policy development**

133. This EPA is not intended to provide an extensive review of the development of environmental legislation and policy in PRC. This has been done on numerous occasions (e. g in SEF1, Volume II). Briefly, starting with the 1979 Environment

Protection Law (EPL) and the 1983 decision of the State Council to make environmental protection a basic national policy in China, a period of intense legislative activity ensued during which the bulk of natural resource protection legislation was developed. EPL itself was amended in 1989.

134. More legislative development promulgated by SCPC followed in 1990s [City planning 1989, Water and soil conservation 1991, Agriculture 1993, Foreign trade 1994, Township enterprises 1996, Coal industry 1996, Noise 1996, Energy utilization 1997, Construction 1997, Land resource administration 1998, Meteorology 1999, Promotion of clean production 2002, Environmental impact assessment 2002, Radioactive pollution and control 2003] that clearly illustrates an awareness of the links environmental protection has with the economy as a whole. For its part, the State Council (the Executive) passed a key resolution on environment protection (1996), and adopted regulations on environment protection in construction (1988), on phasing out the use of leaded gasoline (1999), urban water supply, water saving and water pollution control (2000), disposal of domestic waste (2000), management of medical waste (2003), and hazardous waste permitting (2004). SEPA formulated regulations on environmental monitoring systems (1996), administrative penalties for environmental offences (1999), administration of environmental standards (1999), pollution prevention and control in the livestock and poultry sectors (2001), and environmental management of new chemical substances (2004). (see SEF1, Volume II and <http://www.zhb.gov.cn/english/index.php3>). Taken together this amounted to a formidable leap in the quantity and complexity of the regulatory instruments over a relatively short period of a decade and a half. As in most countries of the world, the pace of legislative activity ran well ahead of the administrative capacity to implement the legislation fully. Important to note is that the existing legislation gives individual provinces the power to set own environmental standards provided these are stricter than the national ones.

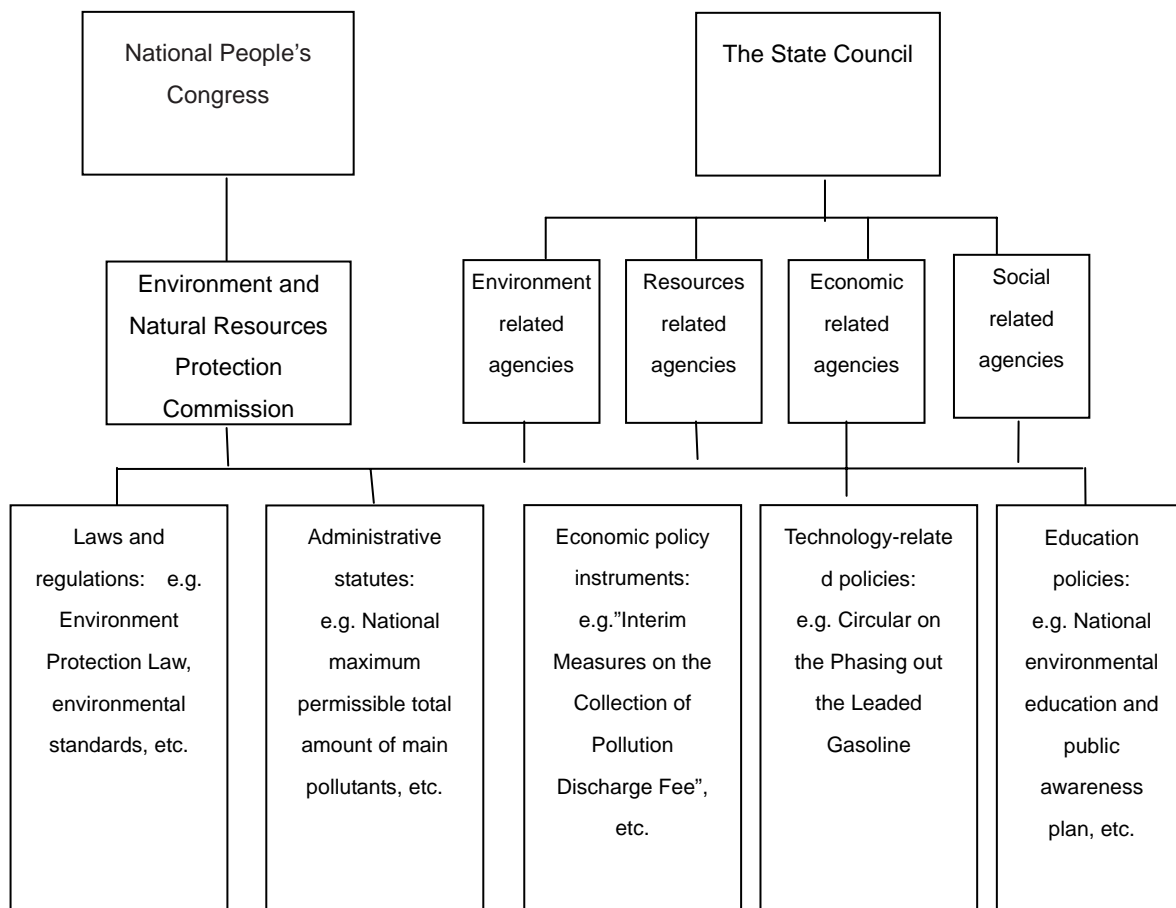


Figure 3.1 China's environmental protection policy structure

135. Several other provincial or local regulations and statutes have been formulated, namely the Environmental Protection Statute of Yunnan, the Agricultural Environment Protection Statute of Yunnan, Rules for Scientific and Technical Planning of Environmental Protection Projects and statutes regulating the environmental management of key water bodies or related structures (e.g. Xingyun Lake, Dianchi Lake, Yangzong Hai Lake, Dumu Reservoir in Qujing City and others) to mention only the most important.

136. In terms of policy development, in all of China and its provinces, five-year plans for ecological rehabilitation and environmental protection (FYPEREP) supplement five-year plans of socio-economic development (5YPSD). The latest FYPEREPs were formulated in 2001 to match the 10<sup>th</sup> 5YPSD. In Yunnan, YNPEPB and Yunnan Provincial Government are at present guided by The Tenth Five-Year Plan for Ecological Rehabilitation and Environmental Protection of Yunnan.

### 3.1.2 Environmental expenditure and financing

137. Understood much more broadly as activities that extend beyond those managed

by YNPEPB, environmental performance is crucially (though not solely) dependent on the amount of financing. Among the departments with large budgets a portion of which affects environmental outcomes in Yunnan are (1) Forestry, (2) Agriculture, (3) Water Resources, (4) Land Resources, (5) Health (6) Earthquake Bureau, and (7) Meteorological Bureau. The volume of funds available for environmental management in Yunnan is furthermore supplemented by the financing by the Central Government of activities that are national in scope but implemented by local authorities.

138. The 10<sup>th</sup> FYPEREP has a projected expenditure of 7.8 billion Yuan to be invested in 26 projects. The budget is dominated by Dianchi Lake, one of the severely polluted lakes in China, and pollution control in general that, together, account for about 4 billion Yuan of the projected expenditure. This represents almost 4 per cent of the total provincial budget during the corresponding period (see Table 9 for the overall provincial budget).

Table 3.1 Yunnan Province government budget, 1998 - 2003, (current RMB mil)

Category	1998	1999	2000	2002	2003
Yunnan Province total Government expenditure	31,320.1	37,804.7	41,410.7	52,689.1	58,734.7

139. The size of the budget alone is clearly insufficient to explain some of the disappointments in the achievement of stated objectives (e.g. the conditions of the plateau lakes, or municipal solid waste disposal) just as it cannot, on its own, explain the successes. It seems clear nevertheless that in an increasingly diversified economy of Yunnan, the ability of the Government to influence environmental outcomes through its own expenditures and own activities is significantly smaller than it was a decade or two ago. A diversified economy with a growing private sector demands a fine mix of regulatory and incentive instruments to achieve the environmental objectives, in addition to adequate funding.

## 3.2 Implementation issues

### 3.2.1 Regulatory and economic instruments

140. The traditional approach to environmental management in China has been one of “command and control”. Command and control remains an important component of policy and practice to this day. At the same time, the limitations of a near-total reliance on command and control in a more complex economy with a strong market based element and a far greater diversity of entities to be monitored became clear early in the 1990s. Formal adoption of the Polluter-Pays-Principle (PPP) early in the 1990s ushered in a broader mix of policy instruments that embraced economic tools such as resource pricing, taxes, pollution charges, subsidies, supervised trading of pollution



entitlements and others. (SEPA 1997b). In contrast to quantitative regulation of damaging by-products of economic activities (such as harmful emissions) these instruments often operate indirectly giving the polluters more flexibility in selecting damage-reducing strategies that minimise their costs and the society's overall cost of achieving compliance with standards. Besides, some of the economic instruments generate substantial amount of revenue that in principle can be re-invested in further environmental improvements. The introduction of the pollution levy system in particular has been extensively described and studied in China.

141. In Yunnan, too, the pollution levy has become an important tool of policy. Initially applied only to large industrial enterprises, its coverage was extended in 1996 to the increasingly important township & village enterprises (TVEs) and its application to wastewater discharged was further extended. From 1998, the sulfur dioxide levy was imposed in the acid rain control region, mainly the overwhelmingly coal-dependent north and center of the country (i.e. not in Yunnan). The proceeds of the pollution levy from 1995 to 2003 in Yunnan are shown in Figure 3.2.

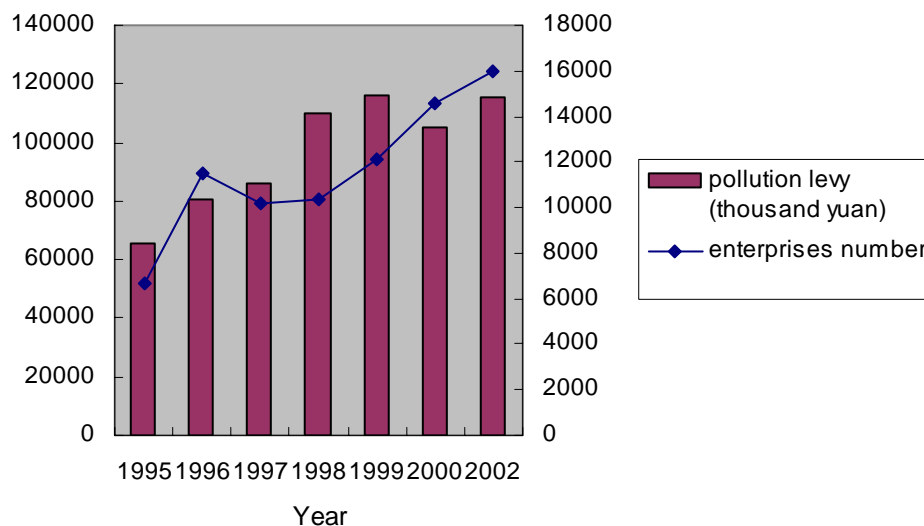


Figure 3.2 Proceeds of the pollution levy , 1995-2002

142. The 120 million RMB collected annually in Yunnan is a significant sum, about 7 per cent of the annual environment budget of the provincial government in recent years. In principle the sum collected is reinvested in pollution reduction activities via subsidies to industrial enterprises for pollution-reducing investments.

143. The application of the system in Yunnan has contributed to improved pollution abatement performance by enterprises and to improvements registered in areas such as the quality of river waters or energy intensity described in Part II of this EPA. However, the reach and application of the system was not enough to improve the

quality of most badly polluted lakes in the Province. Polluters (especially the enterprises but some households also) continue to pay only a portion of the environmental cost they impose on the society at large.

144. Water pricing is another important indirect tool of environmental policy and some of the achievements of the provincial Government in reducing wastewater discharges and improving river water quality have their origin here. Higher water tariffs promote water saving, wastewater treatment and water re-use. The latest increases in water tariffs adopted in 2002 brought household tariffs to 1.8 Yuan per cubic meter (including a wastewater treatment surcharge of 0.5 Yuan), industrial tariffs to 2.5 Yuan, and commercial tariffs to 2.3 Yuan (inclusive a wastewater surcharge of 0.6 Yuan in the last two cases). A new block structure of tariffs is to be adopted in 2008 to combine the demands of protecting the weakest in the society with the imperatives of efficient use of scarce water. In this way the Provincial Government has been shifting the cost of pollution abatement (especially the construction of centralized WWT plants) onto the polluters.

145. Sensibly, in most areas of environmental management, the Provincial Government has opted for a mix of policies. In its approach to land degradation, for instance, the Provincial Government has used –with partial success– policies combining command (enforcement of zoning provisions) with economic incentives (e.g. subsidies to local population to compensate them for abandoning farming on steep slopes).

### **3.2.2 Enforcement**

146. Enforcement of regulations is a necessary (though not always sufficient) condition of improved environmental management. In Yunnan, some of the key regulations serving as a basis for enforcement (The Yunnan Nature Reserve Management Rules, Yunnan Agriculture Pollution Regulations, logging ban in Jinsha river basin and in Xishuangbanna, and others) were adopted during the Ninth Five-Year Plan of Socio-Economic Development (1995-2000). The results have been mixed and difficult to judge simply by reported numbers of environmental offences investigated and the amounts of penalty fees collected.

#### **3.2.2.1 Environmental management system**

147. Environmental impact assessment (EIA), attention to pollution control throughout the life of enterprises (“three simultaneities” system), and pollution permitting are three pillars of the environmental management in China. In Yunnan, all three have played a role.

148. From 1995 to 2003, the coverage of EIA has been extended to practically all new or reconstruction projects in the province (see Figure 3.3).

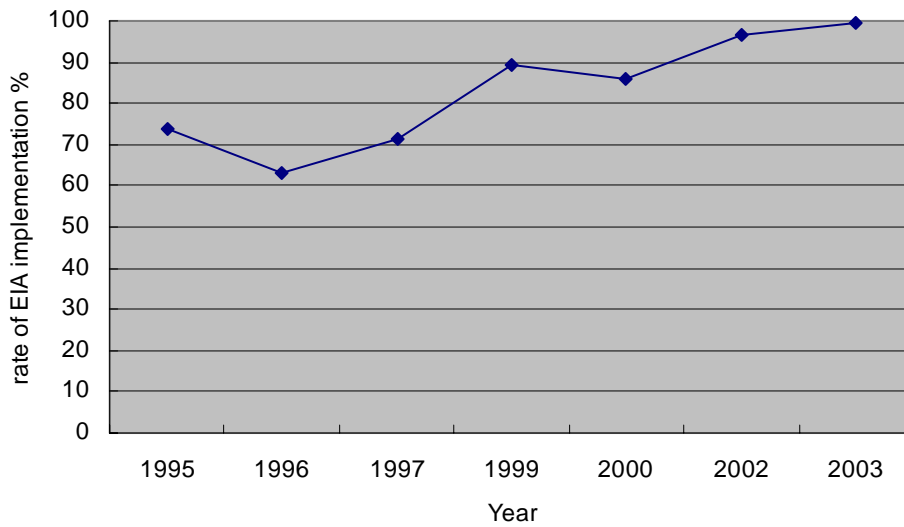


Figure 3.3 EIA compliance 1995-2003

149. The "three simulteneities" system requires that pollution control measures be taken into consideration by enterprises at the design, construction and operation stages rather than opportunistically grafted later on. As shown in Figure 3.4, from 1995 to 2003, the compliance with the system fluctuated around 90%.

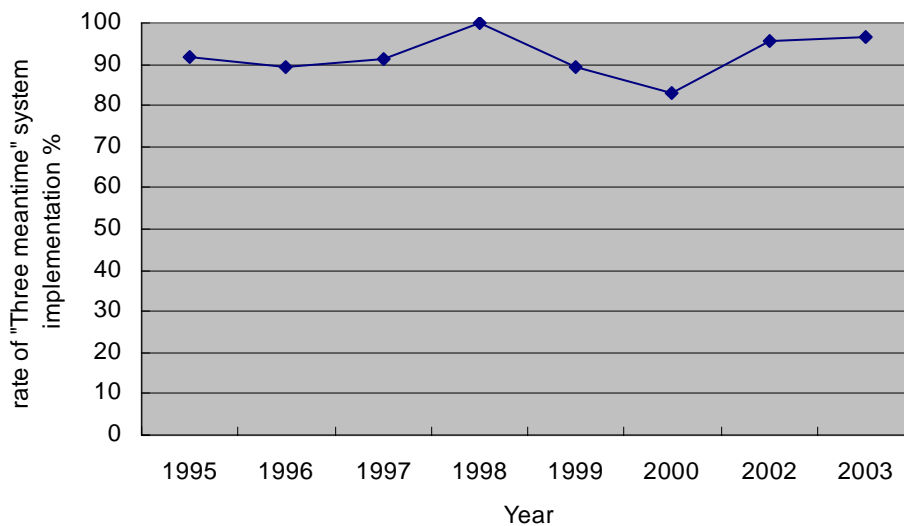


Figure 3.4 Rate of compliance with the "Three Simultaneities" system, 1995-2003

150. The pollution permit system in China is anchored in the policy of capping the total quantities of pollution in a given area (and gradually lowering the cap). Target totals of permissible pollution for selected management areas are then allocated to

enterprises. This in principle opens the way for (future) trading in emission entitlements among the enterprises. In Yunnan, the majority of emission permits are wastewater related. As shown in Figure 3.5, from 1999, the number of enterprises holding an emission permit increased significantly after 1997.

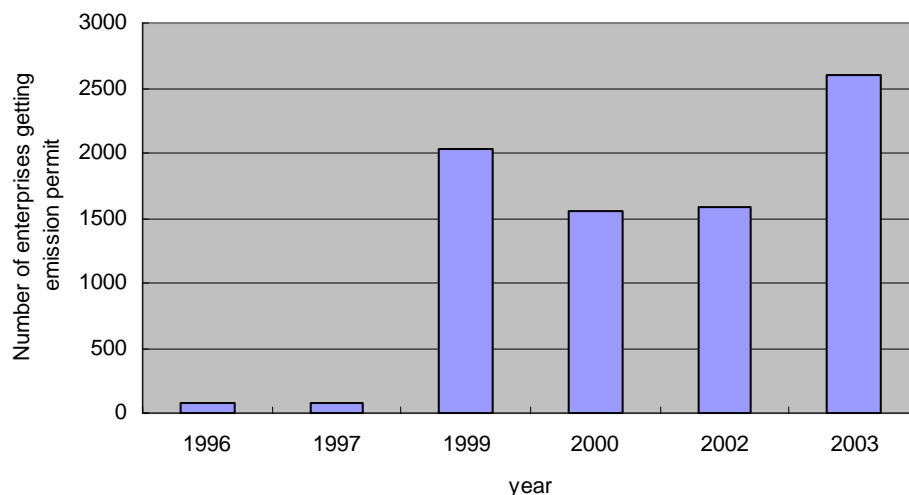


Figure 3.5 Number of enterprises with an emission permit, 1996-2003

### 3.2.2.2 Special pollution control actions

151. Some specific actions were taken in Yunnan to control pollution, especially industrial pollution control.

152. Fifteen kinds of the most polluting small enterprises (coking plants, small paper mill, tanneries, and others), without room for efficient pollution control, were closed starting in 1996. By 2000, 98.2% of such enterprises had been closed (and some relocated to new industrial parks with centralized treatment facilities) with a major positive impact on water resources.

Table 3.2 Rate of compliance with the decision to close and ban 15 kinds of small enterprises

Year	Percentage of compliance
1996	55.10%
1997	81.40%
1998	87.25%
1999	93.40%
2000	98.20%

153. The policy of targeting 100 principal industrial pollution sources for special

attention started in 1997. It introduced a number of tasks for adoption by the enterprises. The campaign ended in 2000 when the majority of the required steps had been adopted. In 1999, Yunnan Province selected 1,042 enterprises for an environmental audit. In the first year, only 24.4% of them had met existing environmental standards and 62 were ordered closed. By January 2001, 1038 enterprises (99.6% of the selected sample) had met the standard and four had been ordered closed.

154. In 2001, 186 additional enterprises were included in a program designed to bring them up to existing environmental standards. By the end of 2002, 98 of them had complied and 48 were ordered closed, transformed or moved.

155. These resolute actions were a strong complement to the pollution levy system and together, they have lessened the pollution load on the Province's water bodies.

### **3.3 Environment and civil society**

#### **3.3.1 Environment, health and safety**

156. Environmental conditions and health are closely related. Good health influences productivity and welfare of a person. The major environmental causes of poor health are unsafe water and sanitation, exposure to disease carriers and to toxic substances; dirty air inside the home and in urban areas. These account for 19% of illnesses and deaths in the developing world. From 1999, the respiratory disease ranked fifth among the cause of mortality in China.

157. In the past eight years, the public health and medical conditions improved in Yunnan. All principal health indicators show improvement. This does not mean that improvements were evenly distributed across the province but it does suggest that the Government succeeded in maintaining or improving the overall quality of environment at a time of rapid economic growth and that, therefore, the positive impact of higher incomes on health (via better nutrition, for instance) was not negated by deteriorating conditions of the environment.

#### **3.3.2 Access to information and public accountability**

158. YNPEPB is the principal source of environment-related data in the province. Yunnan Environmental Information Center (YEIC) was established in 2002 as YNPEPB's information management and technical support department. Its major responsibilities include drafting the environmental information development plan and technical criteria for environmental information; managing and updating the provincial environmental information network; information and data collecting, processing, transmission, storage and sharing data about the provincial environmental protection system; building and managing provincial environmental databases and developing

related software; monitoring via the geographical information system (GIS), remote sensing (RS) and other technical applications. It is also responsible for environmental information sharing for cooperation.

159. Despite the ambitious mandate of YEIC, the data available to YNPEPB in Kunming (let alone to others) falls well short of the standards of advanced (as well as some other) countries as the experience of drafting this EPA demonstrated. The situation is not fundamentally different at other provincial departments whose activities have a bearing on environmental outcomes. Most of these departments may have developed own websites for the purpose of disseminating information about their own activities but the information available electronically is too sketchy to facilitate analysis. Unpredictable newspaper reports or personal notebooks of key staff of government agencies continue to serve the function of unsystematic, out-of-context and incomplete updating of vital environmental information.

160. Information is not exchanged easily and often not without payment even among government agencies. Complex procedures necessary to obtain information from other government agencies add to the already strong incentives *not* to exchange and improve information within the Government. Information is guarded to extract influence and money. As to the degree of public access to environmental information this has improved considerably during the last decade but from a very low base. Still, documents such as the publicly available Yunnan State of the Environment 2003 Report constitute the first general review of the environmental situation in Yunnan for the non-specialized reader. The vastly improved Internet access in China has also created an opportunity for a growing section of the public to access some documents dealing with environmental conditions in Yunnan and PRC and related subjects.

161. The tradition of taking a longer view of environmental outcomes is surprisingly weak in Yunnan as reflected in an apparent inability of most Provincial Government agencies to generate long enough and compatible time series of some key environmental variables. It is hoped that this EPA will help change this situation by creating demand for a different style of working.

### **3.3.3 Environmental awareness and education**

162. The importance of public participation in environmental protection is recognized in China. Chinese people's immense efforts country-wide to undo some of the legacy of environmental neglect or mismanagement of the earlier days speak for themselves. Over time, and building on the provisions of the Environmental Protection Law 1898 and Decision of the State Council on Several Issues Concerning Environmental Protection (1996), SEPA has broadened its approach to environmental management by going beyond the activities of the State and enterprises and reaching out to the public to participate in various environmental management activities. Environmental NGOs and individuals have begun to play a role. The pollution-related legislation of

the late 1990s includes provisions authorizing and even demanding consultation with the residents of prospective locations of evaluated projects.

163. By 2004, there were several dozens environmental NGOs in Yunnan, such as Center for Biodiversity and Indigenous Knowledge (CBIK), Kunming EarthWatch, Institute for Sustainable Development of Natural Resources, Yunnan Participatory Rural Association (YNPRA), Yunnan Econetwork (YEN), etc. World Wildlife Fund (WWF), The Nature Conservancy (TNC), and Oxfam Hong Kong have divisions or project office in Yunnan.

164. WWF developed the Integrated Conservation and Development project in Baima Jokul in Yunnan in 2000.

165. The Nature Conservancy has been working in Yunnan Province to protect some of the Province's unique natural and cultural diversity. In collaboration with Chinese local and state government agencies, the Conservancy established the Yunnan Great Rivers Project, which protects an area about the size of Switzerland. The Conservancy is now assisting with one of the most ambitious projects—a nationwide assessment of China's biodiversity that will result in a plan protect the country's most important natural resources for future generations.

166. CBIK is a participatory learning organization, dedicated to biodiversity conservation and community livelihood development, as well as documentation of indigenous knowledge and technical innovations related to resource governance at community and watershed levels, which is supplementary to government activities. The organization was established in 1995 as a membership non-profit organization. It has finished several reports focusing on Sustainable Agriculture for Livelihood Development in Uplands of Yunnan, Enhancing the Livelihoods of Agro-pastoralists in NW Yunnan, Value of Forest Resources in a Miao community, etc. These outputs arouse people's interest in biodiversity and traditional culture.

167. Kunming EarthWatch Institute for Sustainable Development of Natural Resources was established in 1995 as a NGO. It focuses on the natural resources and environmental protection, cares for the aboriginals' survival and development. Its priority fields are the renewable energy utilization, the development and environment of West of China, sustainable use of forest, and others.

168. The environmental education in youth and pupils is important part of environmental education in Yunnan.

169. The Yunnan Youth League developed the "Protect Mother River — Ecological monitoring and protection in 9 lake basins " Project in 2003. By now, 2000 youth volunteers and 6000 pupils in primary and middle school have participated in this project. 17 ecological monitoring stations in Chenggong Country (Dianchi Lake),

Jiangchuan Country (Xingyun Lake), Yuxi City (Fuxian Lake, Xingyun Lake) and other counties have been set up. More than 400 environmental protection information sessions were organized and nearly 2 million inhabitants in lake basins were influenced and began change their attitudes and working practices. Furthermore, this project gifted schools handbooks on environmental protection to enhance the environmental awareness of pupils.

170. In 2003, Building Green Schools Project was developed in Yunnan. By 2003, 66 schools were conferred a “Green School” label.

171. Every year, various publicity activities are conducted on World Environment Day and Earth Day, and after new environmental laws and regulations have been promulgated.

172. For a long time limited, the participation by non-governmental and individual stakeholders in environmental policy-making and implementation is on the rise. The participation of Oxfam Hong Kong in the drafting of this EPA is an encouraging development. There are many similar examples. As a result, environmental awareness especially among the young generation of Yunnan has grown and this has had a positive effect on the overall performance.

173. On the part of the industry, the late 1990s saw a growing interest among industrial enterprises in voluntary environmental compliance schemes such as the ISO 14000 Environment Management standard and in clean production initiatives. By 2003, 30 enterprises were designated “Clean Production Audit Pilot Enterprises”. Many enterprises in Yunnan have applied for the Environmental (“green”) Label. Simao Hongta Timber Industry Ltd. and Yunnan Jinggu Forestry Industry Ltd. Are two of the enterprises that were “green-certified” in 2004.



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## **IV. CONCLUSIONS AND RECOMMENDATIONS**

174. Over the last decade or so, a period of rapid economic growth, the environmental quality of Yunnan remained stable with a somewhat uneven performance in different environmental concern areas. The main improvements were registered in forest cover, water quality in rivers and pollution abatement performance by the industry. The disappointments were a stagnating municipal solid waste management and the water quality in the Province's principal lakes. The Province largely succeeded in countering the loss of farmland and had some success in fighting soil erosion. Improvements in energy efficiency and urban air quality became much harder to sustain after a period of rapid improvement in the early 1990s. The quality of environment-related information and access to data remain inadequate.

175. The following sections make recommendations. These are of two kinds. The first, relating mainly to data, are suggestions for way of improving future assessments of environmental performance. The second target the management itself of priority concerns. To this are added several recommendations that are cross-cutting in nature.

### **4.1 Management of Environmental Concerns**

#### **4.1.1 Land management**

Recommendation No. 1: Set up a task force consisting of YNPEPB and Agriculture Department specialists to reconcile and organize existing information regarding the changes in the area of farmland of different quality in order to obtain a more reliable picture of land scarcity in the Province;

Recommendation No. 2: Review the efficiency and cost effectiveness of past province-wide measures targeting soil erosion and publish the results of such an evaluation. Encourage all public agencies concerned to adopt a cost-benefit approach to land rehabilitation and land conservation investments; and

Recommendation No.3: Prepare a database on land degradation including provincial soil erosion risk maps and assign institutional responsibility for these activities. Improve the Province's institutional capacity to carry out assessments of land degradation.

#### **4.1.2 Biodiversity conservation**

Recommendation No. 1: Generate estimates of the areas of all principal ecosystems in the Province, not only forest ecosystems, to establish suitable benchmarks for future monitoring. Support the steps recommended in 4.2.2. to improve the authorities' and the public's knowledge of the conditions of Yunnan's natural forest.

Recommendation No. 2: Support measures aiming to modify the boundaries of some of the existing natural reserves in keeping with an ecosystem-based approach to biodiversity conservation. Explain to the public the ecosystem-based approach to biodiversity management and promote it.

Recommendation No. 3: Continue to strive for a closer integration of biodiversity conservation into sectoral planning activities.

Recommendation No. 4: Prepare or review provincial action plans for forestry, grasslands, and river and wetland management.

Recommendation No. 5: Promote local technical skills in biodiversity assessments and conservation management and formulate a research framework that allows the results of government and NGO-administered research to be combined. Use these skills to establish how effective the existing system of protected areas has been in actually protecting the underlying biodiversity.

Recommendation No. 6: Introduce a systematic and multi year budgeting for biodiversity conservation. Accompany this by the formulation of suitable targets for protected and threatened species to facilitate the monitoring of cost effectiveness of biodiversity conservation programs.

#### **4.1.3 Water resource management**

Recommendation No. 1: Generate, consolidate, improve and publicize information on the percentages and volume of municipal wastewater that is treated and publish the data on (1) the performance of centralized wastewater treatment plants, (2) plans of connections of households to the WWT network and achievements under that plan, and (3) the revenues and expenditures for WWT by individual municipalities.

Recommendation No. 2: Prepare, consolidate, improve and disseminate information on the status of water quality in all major lakes of Yunnan.

Recommendation No. 3: Make the promotion of clean production technologies in industrial enterprises a tool of wastewater management.

#### **4.1.4 Waste management**

Recommendation No. 1: Summarize information on existing landfills in Yunnan including their number, location, capacity, estimated lifetime and principal technical parameters.

Recommendation No. 2: Improve the knowledge of the sources, quantities disposed,

and stock of hazardous substances in the province and formulate a provincial hazardous waste action plan. Formulate a legal framework to deal with imports and exports of hazardous waste.

Recommendation No. 3: Consider additional economic incentives to encourage pre-sorting and re-cycling of waste with the aim of moderating the growth in demand on landfill establishment. Estimate likely future demand for new landfills or incineration facilities in second- and third-tier cities of the Province.

Recommendation No. 4: Use media and schools to increase public awareness of waste disposal issues to encourage pro-environment changes in values and lifestyles.

#### **4.1.5 Forest management**

Recommendation No. 1: Improve and update information about the role of fuelwood consumption in the Province.

Recommendation No. 2: Ensure that more complete information is available to Government agencies and the public about the quality of the existing forest resources in addition to information about the area of forest cover.

Recommendation No. 3: Formulate a program of monitoring of the effectiveness of the logging ban in the Province's natural forest and the flows of illegally harvested timber allowing for participation by the civil society in such a program.

#### **4.1.6 Natural disasters**

Recommendation No. 1: Encourage a shift of attention and expenditure from post-disaster assistance towards greater disaster preparedness. Educate the public about the many ways in which the impact of natural disasters can be minimized, including investments in certain types of public works, modifications of infrastructure design, management of hazardous substances and others.

Recommendation No. 2: Increase expenditure for key elements of disaster preparedness such as risk assessment, improvement of emergency procedures, enforcement of building- and similar codes, and others

Recommendation No. 3: Improve the public knowledge of disasters and their impacts including the financial aspects of disaster preparedness and management.

Recommendation No. 4: Strengthen the legislative aspects of disaster preparedness to discourage activities that unnecessary increase the cost of natural disasters.

#### **4.1.7 Climate change**

Recommendation No. 1: Replicate the PRC's initial communication to UNFCCC to produce an estimate of GHG emissions by the Province as a basis for future monitoring.

Recommendation No. 2: Based on the provincial GHG inventory and other elements, formulate a provincial medium-term GHG reduction strategy.

Recommendation No. 3: Develop renewable means of energy, such as solar energy, wind energy

#### **4.2 Cross cutting recommendations**

Recommendation No. 1: YNEPB should commission a cross-agency review of legislative and regulatory overlaps and redundancies adversely affecting environmental management in the Province with a view to eliminating them.

Recommendation No. 2: Provincial Government should formulate a systematic approach toward eliminating the disincentives to sharing of environment-related information among different agencies of the government, government technical institutes and between the Government and the public. Such approach should have a legal, human-resource-development, and technical components.

Recommendation No. 3: In its role as communicator of policy, the government needs to adapt to the growing diversity of the civil society, individual opinions and the changes in communication technology. YNEPB should formulate a communication strategy targeting a number of different media and different target audience.