

**ADB, GEF, UNEP**  
in collaboration with IGES and NIES

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

ADB T.A. No. 6069-REG

**MYANMAR**  
**NATIONAL ENVIRONMENTAL PERFORMANCE**  
**ASSESSMENT (EPA) REPORT**

Prepared by  
National Commission for Environmental Affairs, Myanmar  
*and*  
Project Secretariat UNEP Regional Resource Center  
For Asia and the Pacific



March 2006

## List of abbreviations

AAC	annual allowable cut
ADB	Asian Development Bank
ALGAS	Asia Least Cost Greenhouse Gas Abatement Strategy
ARI	acute respiratory infection
ASEAN	Association of South-East Asian Nations
CDM	Clean Development Mechanism
CEU	car equivalent unit
CFI	Community Forestry Instruction
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CNG	compressed natural gas
CSO	Central Statistical organization
DAP	Department of Agriculture Planning
DDA	Department for Development Affairs
DHSHD	Department of Human Settlement and Housing Development
DISI	Directorate of Industry Supervision and Inspection
DMH	Department of Meteorology and Hydrology
DNP	Department of National Planning
DOF	Department of Fishery
DOH	Department of Health
DOP	Department of Population
DWIR	Directorate of Water Resources and Improvement of River Systems
DZGD	Dry Zone Greening Department
EE	Environmental education
EIA	environmental impact assessment
EPA	environmental performance assessment
EPD	Energy Planning Department
EPF	Environmental Partnership Fund
EPP	Environmental Partnership Program
ERC	Environmental Resource Center
FAO	Food and Agricultural Organization of the United Nations
FD	Forest Department
FREDA	Forest Resource Environment Development Association
FWP	forest working plan
GAD	Government Affairs Department
GDP	gross domestic product
GEF	Global Environment Facility
Gg	gigagram
GHG	greenhouse gases
GIS	geographic information system
GMS	Greater Mekong Subregion
GWP	Global warming potential
HSD	high speed diesel
ID	Irrigation Department
IGES	Institute of Global Environmental Strategies
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPTG	Inter Panel Technical Group
ISO	International Standard Organization

IUCN	International Union for the Conservation of Nature
JICA	Japan International Cooperation Agency
MCDC	Mandalay City Development Committee
MCM	million cubic meters
MDG	Millennium Development Goals
MOAI	Ministry of Agriculture and Irrigation
MOF	Ministry of Forestry
MOFA	Ministry of Foreign Affairs
MOH	Ministry of Public Health
MOI	Ministry of Information
MOST	Ministry of Science and Technology
MPBND	Ministry of Progress of Border Area Development and National Races and Development Affairs
MS	motor spirit
MSS	Myanmar Selection System
NCC	National Coordination Committee
NCCE	National Coordination Committee for Environment
NCEA	National Commission for Environmental Affairs
NCHRD	National Center for Human Resource Development
NGO	Non Governmental Organization
NIES	National Institute for Environmental Studies (of Japan)
NWFP/NTFP	Non-Wood/Timber Forest Products
ODA	official development assistance
OECD	Organization for Economic Co-operation and Development
OWA	other woodland area
PAS	Protected Area System
PCCD	Pollution Control and Cleansing Department
PFE	permanent forest estate
PPP	polluter pays principle
RS	remote sensing
RTAD	Road Transport Administration Department
UNEP	United Nations Environment Program
RRCAP	Regional Resource Center for Asia and the Pacific
SALT	sloping agriculture land technology
SEF	Strategic Environmental Framework
SLRD	Settlements and Land Records Department
SOE	state of the environment
SPM	suspended particulate matter
TSP	total suspended particulate
UNCBD	United Nations Convention on Biological Diversity
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
UNEP	United Nations Environmental Program
UNFCCC	United Nations Framework Convention on Climate Change
UNICEF	United Nations Children Fund
VFMP	village-forest-management-plan
WHO	World Health Organization
WRUD	Water Resource Utilization Department
WWF	World Wildlife Fund
YCDC	Yangon City Development Committee

Exchange rate (December 2005)

1 US dollar = 6.42 Myanmar Kyat

## Executive Summary

1. Like its Greater Mekong Subregion neighbors, Myanmar has been trying to reconcile the demands of economic growth with the integrity of its physical environment and the long-term health of its citizens. This Environmental Performance Assessment (EPA) report evaluates the degree of success that national stakeholders have had in achieving this objective, expressed in a number of different ways in official policy documents. The assessment is confined to seven key environmental concerns, viz., forest resources, biodiversity, land degradation, management of water resources, waste management, air pollution from mobile source and climate change. The assessment uses a structure of performance indicators and is supported by detailed statistical information.

2. Reinforced by policy and institutional support, progress has been made towards safeguarding the forest resources despite evidence of increased pressure on them during the last three decades. Following a period of rapid loss between 1975 and 1995, the forest cover stabilized around 51 per cent at the turn of the last decade. The expansion of the Permanent Forest Estate is a strongly positive feature. It is too early to say what the effect of recent re-orientation of forest management towards community management and greater attention to reducing fuelwood consumption has been.

3. Myanmar's exceptionally rich biodiversity could not escape the effect of the pressure on habitats during the last two decades, in particular the rapid loss of natural forest in the 1980s (and its continuation to this day), and loss of mangroves. The authorities' response has been to expand the protected area system to about 6.5 per cent of the total land area by 2004.

4. Although the country is well endowed with land suitable for agriculture, it is not immune to different forms of land degradation. Soil erosion is serious in the uplands on about 10 per cent of the country's cultivated areas. The authorities' land rehabilitation schemes have not kept pace with new cultivation by the upland farmers, the trend sustained by high rates of population growth.

5. Myanmar is perceived as a low water stress country. Nonetheless, the dominant role of rice in the cropping systems and several other factors have made irrigation a priority concern. The volume of irrigation water storage capacity has increased 27 times since 1988s. Given the continued policy and strategic preference for more paddy, the pressure on supplying more water for irrigated farming is set to remain high in the foreseeable future. Sustained funding of the irrigation water storage capacity and irrigation management has made it possible to improve the percentage of total lands effectively irrigated.

6. The country has achieved substantial progress in providing its population with safe drinking water and Myanmar scores well in comparison to other GMS countries. In rural areas, access increased from 50% in 1995 to 74% in 2003. In urban areas the increase was from 78% in 1995 to 92% in 2003.

7. Solid waste management in Myanmar presents a mixed picture of clear improvements in the country's two premier cities (Yangon and Mandalay) combined with stagnating or deteriorating collection and disposal in other States and Divisions. In Yangon, reduced volume of waste per capita has resulted in an overall decline in the volume of waste generated. The authorities' greater efforts at collecting the waste disposal fees are believed to be largely responsible for this outcome.

8. Unsystematic and insufficient information on air quality in Myanmar limits the authorities' and the public's knowledge about the principal trends and the contributions that vehicles make to atmospheric pollution in the principal cities. What can be said with greater degree of confidence is that the "vehicle density" has been on the rise in Yangon and Mandalay. At the same time, it appears that the fuel consumed per vehicle has been declining.

9. The National Commission for Environmental Affairs (NCEA) is the central body tasked to manage the environment in concert with sectoral agencies such as the Ministry of Forestry. Since its establishment, NCEA has achieved some progress in integrating environmental concerns into the economic development mainstream. This included the formulation of the national environmental policy (1994), and drafting of 'Myanmar Agenda 21' as a framework for a multi-pronged approach to sustainable development. However, NCEA requires more administrative and financial support to further increase its effectiveness. The enactment of the draft national environment protection law might be a key step in that direction.

## TABLE OF CONTENTS

I. INTRODUCTION .....	1
II . MANAGEMENT OF PRINCIPAL ENVIRONMENTAL CONCERNS .....	9
1. Forest Resources .....	9
2. Threats to Biodiversity .....	21
3. Land Degradation .....	30
4. Water Resources.....	37
5. Solid Waste Management .....	47
6. Mobile Source Air Pollution .....	53
7. Climate Change .....	60
III. ENVIRONMENT AND ECONOMIC DEVELOPMENT: CROSS CUTTING ISSUES IN EPA .....	66
3.1. Integration of Environmental Concerns into Economic Decision Making .....	66
3.1.1 Policy and Institutional Integration .....	67
3.1.2 Inter-Agency Coordination .....	68
3.1.3 EIA Process and other Tools.....	69
3.1.4. Environmental Expenditure and Financing.....	69
3.1.5 Conduct of future EPAs .....	71
3.2. Implementation Issues.....	71
3.2.1. Regulatory and Economic Instruments .....	71
3.2.2 Enforcement.....	73
3.3 Environment and Civil Society .....	73
3.3.1 Environment, Health and Safety .....	74
3.3.2 Information Access and Stake Holder Participation .....	74
3.3.3 Environmental Awareness and Education.....	75
IV. CONCLUSIONS AND RECOMMENDATIONS .....	77
 APPENDIX: Indicator Factsheets	

## I. INTRODUCTION

1. Myanmar's "National Environmental Policy" of 1994 elevated the profile of environmental considerations in the country's policy. This was followed by the preparation of the country's Agenda 21 in 1997. Internationally also, Myanmar's contacts have increased and by now, the country has signed some 30 international environmental treaties and conventions.

2. That this large body of policies and commitments calls for periodic assessments of actual performance is recognized. Among others, Chapter 18 of Myanmar's Agenda 21 recommends a national review of existing policies, plans and programs and their effects on environment (NCEA, 1997, pp:187). It is against this background that the National Commission for Environmental Affairs (NCEA) has been collaborating with ADB, GEF, UNEP, IGES and NIES in the National Performance Assessment and Strategic Environment Framework of Greater Mekong Sub-region ("SEF II"). The prime purpose of the SEF II project, initiated in 2003, is to promote sustainable development in the GMS through the creation of national and sub-regional environmental performance assessment system and development of national and sub-regional capacities for implementing such assessment. (Project Secretariat 2003, pp:1-2)

3. Environmental performance assessment (EPA) is a systematic evaluation of the effectiveness of environmental management in a defined administrative area (country, region, project, etc.) over a specified period of time. Supported by a detailed and transparent data base an EPA report draws a picture of principal environmental trends, assesses the degree of environmental managers' success in achieving set environmental targets (i.e. performance) and makes recommendations. In this way, EPA assists the process of policy adjustment and becomes a tool of public accountability. Furthermore, in the Greater Mekong Subregion (GMS) sub-regional context, the preparation of EPA reports by each GMS member contributes to a shared understanding of environmental challenges and a greater comparability of underlying data. These, in turn, facilitate assessments of sub-regional environmental performance or performance related to global environmental concerns.

4. This report, a *national* EPA, was prepared under the guidance of a national coordination committee (NCC) specifically set up for the task. Three national workshops were held during EPA's preparation and extensive consultation and comment characterized the process. Altogether, 21 Government agencies and departments participated in Myanmar's EPA. The composition of NCC is given below.

### Members of the National Coordination Committee for National Environmental Performance Assessment

<b>No.</b>	<b>Name of Organization</b>	<b>Position</b>
1.	National Commission for Environmental Affairs (NCEA)	National Focal Point, SEF II Project
2.	Department of National Planning (DNP), Ministry of National Planning and Economic Development	Member Organization
3.	Central Statistical Organization (CSO), Ministry of National Planning and Economic Development	Member Organization
4.	Department of Population (DOP), Ministry of Immigration	Member Organization

5.	and Population Department of Forestry (FD), Ministry of Forestry	Member Organization
6.	Department of Agriculture Planning (DAP), Ministry of Agriculture and Irrigation	Member Organization
7.	Settlements and Land Records Department (SLRD), Ministry of Agriculture and Irrigation	Member Organization
8.	Irrigation Department (ID), Ministry of Agriculture and Irrigation	Member Organization
9.	Water Resource Utilization Department (WRUD), Ministry of Agriculture and Irrigation	Member Organization
10.	Department of Fishery (DOF), Ministry of Livestock and Fisheries	Member Organization
11.	Directorate of Water Resources & Improvement of River Systems (DWIR), Ministry of Transport	Member Organization
12.	Department of Meteorology and Hydrology (DMH), Ministry of Transport	Member Organization
13.	Road Transport Administration Department (RTAD), Ministry of Transport	Member Organization
14.	Department of Health (DOH), Ministry of Health	Member Organization
15.	Department of Mines (DOM), Ministry of Mining	Member Organization
16.	Energy Planning Department (EPD), Ministry of Energy	Member Organization
17.	Department of Human Settlement and Housing Development (DHSHD), Ministry of Construction	Member Organization
18.	Department of Development Affairs (DDA), Ministry of Progress of Border Areas and National Races and Development Affairs	Member Organization
19.	Directorate of Industry Supervision and Inspection (DISI), Ministry of Industry (1)	Member Organization
20.	Yangon City Development Committee (YCDC)	Member Organization
21.	Yangon University	Member Organization

An EPA technical review team was also created consisting of

Daw Yin Yin Lay	Joint Secretary, National Commission for Environmental Affairs (NCEA)
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U Htun Lwin	Deputy Director General, Department of Meteorology and Hydrology, Ministry of Transport



Dr Htun Than Htun	Head of Department, Yangon City Development Committee
U Zaw Win	Director, Irrigation Department, Ministry of Agriculture and Irrigation
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The report was reviewed by the subregional expert group and international consultants and edited by Messrs. Mike Comeau, Mohit Kumar and Ivan Ruzicka.

5. The report is organized in four parts, in addition to this Introduction. Part II is an assessment of performance under principal environmental concerns, such concerns selected by the National Coordination Committee after an extensive internal discussion. In Myanmar's case, these include (1) depletion or degradation of forest resources, (2) threats to biodiversity, (3) land degradation (4) air pollution from mobile sources, (5) inadequate solid waste management, (6) threats to sustainable use of water resources and (7) climate change. Part III of the report deals with factors (such as institutional strength, environmental education etc.) that affect performance while cutting across individual concerns. Part IV draws conclusions and contains recommendations.

### **The assessment method used**

6. Like all assessments of performance, assessment of environmental performance demands a retrospective look at what has happened, not what might happen in future. To make that judgment, suitable indicators need to be selected and their values established. Also, in order to learn from the assessment, the indicators should be logically inter-related. Here, the present EPA draws on the "P-S-R" model pioneered by OECD (see Figure 1 below). In that model, indicators are chosen to capture the "state" (S) of the concern being studied, the underlying "pressures" (P), and the responses (R) intended to counter the pressures and lead to an improvement of the situation (the state).

7. The P, S and R indicators' values are the raw material of the EPA. The statistical background of each indicator is summarized in indicator "factsheets" and these are attached to the report to give the reader an opportunity to judge the underlying basis of the assessment. The assessment itself is a matter of rating (a) individual indicators and (b) the overall performance –an interplay of all indicators--under the concern being studied. A rating structure has been developed for this purpose.

8. 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) is omitted. The descriptions applied to each class of indicators are contained in Table 1 and the rating applied to each concerns is given in Table 2.

Figure 1. Simplified representation of a P-S-R model (hypothetical example of air quality management with four indicators of performance, marked in yellow)

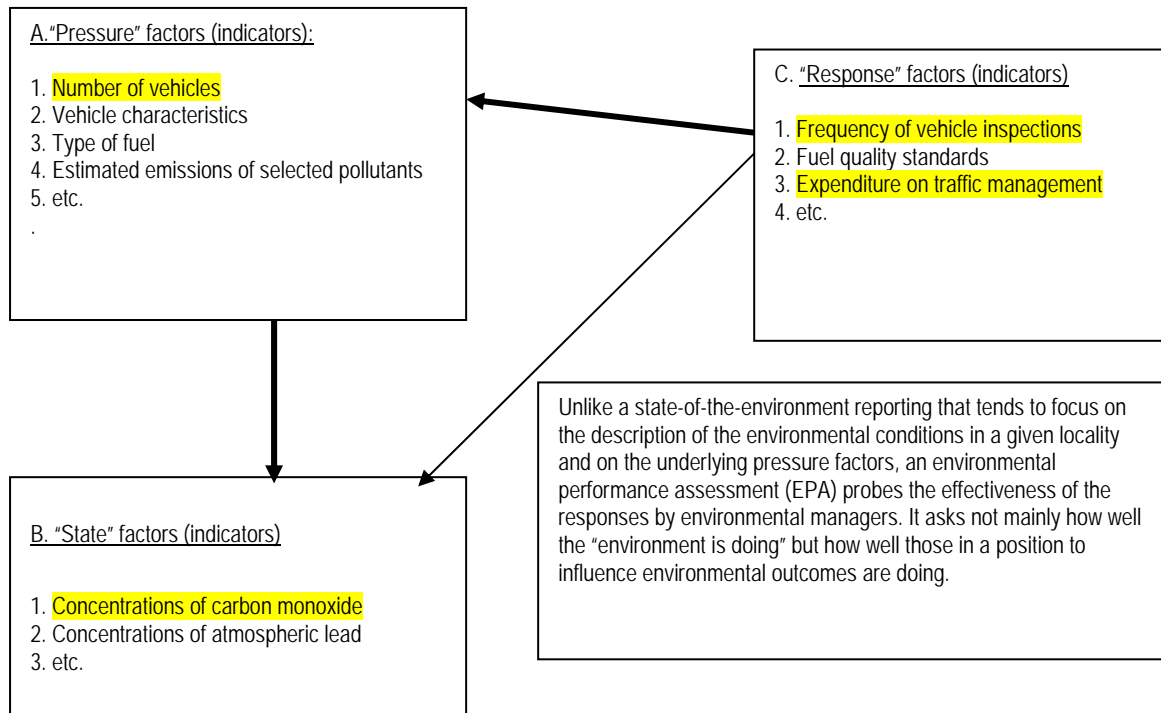


Table 1: Rating used to assess selected indicators

<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 and ....</b>	<b>Average and ...</b>	<b>Relatively Good and ....</b>	<b>Unknown State and ....</b>
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	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	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	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
<b>Deteriorating</b>	<b>Stabilizing</b>	<b>Improving</b>	<b>Undetermined Trend</b>
As evidenced by a steady long-term deteriorating trend and with no immediate signs of improvement.	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.	As evidenced by a long-term deteriorating trend but with sure signs of improvement based on more than one observation in the positive trend.	This rating is used if the selected indicator in inconclusive in terms of long or short-term trends or if the indicator is based on a single observation over time.

<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>
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	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.	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.	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.

<b>Increasing</b>	<b>Steady</b>	<b>Decreasing</b>	<b>(blank)</b>
As evidenced by a long-term trend of increasing pressure, with very little sign of relief or stabilization.	As evidenced by a long-term steady or near-constant pressure that shows no sign of increase or decrease in the past or future.	As evidenced by a long-term trend of declining pressure, with perhaps fluctuating short-term oscillations.	The keyword is left blank if there is only one observation, or if there is no observed trend over time in the indicator value.
<b>RESPONSE INDICATOR</b>			
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.			
<b>Low and</b>	<b>Average and</b>	<b>Significant and</b>	<b>Non-Comparable</b>
If the magnitude of the response is significantly below the national target or below the average in other GMS countries or other comparable regions.	If the magnitude of the response is in line with national targets or the average responses of other GMS countries or comparable regions.	If the magnitude of the response exceeds national targets of the average of other GMS countries or comparable regions.	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.
<b>Sporadic</b>	<b>Intermittent</b>	<b>Consistent</b>	<b>(blank)</b>
If the response has been irregularly applied over time with no set program or budgets to continue the response in the future.	If the response has not been consistently applied but there are programs and budgets to continue the application of the response in future.	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	The keyword is left blank if there is only one observation, or if there is no observed trend over time in the indicator value.

The description used to rate overall performance under each concern is given in Table 2 below.

*Table 2: Rating used to evaluate performance under a selected environmental concern*

<b>ENVIRONMENTAL CONCERN</b>			
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.			
<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 institutional role and responsibilities for</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> </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</li> </ol>	<p>If the trend in the state indicator cannot be explained by the pressures or the responses.</p> <p>The label “un-rated” 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>

<p>environmental management of environmental concerns have been assigned or where they have been, no tangible progress has been achieved suggesting an appropriate response and non-achievement of the target.</p>	<p>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.</p>	<p>targeted roles and responsibilities assigned. 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 environmental management matters etc.</p>	
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## The target audience

The target audience for the report are

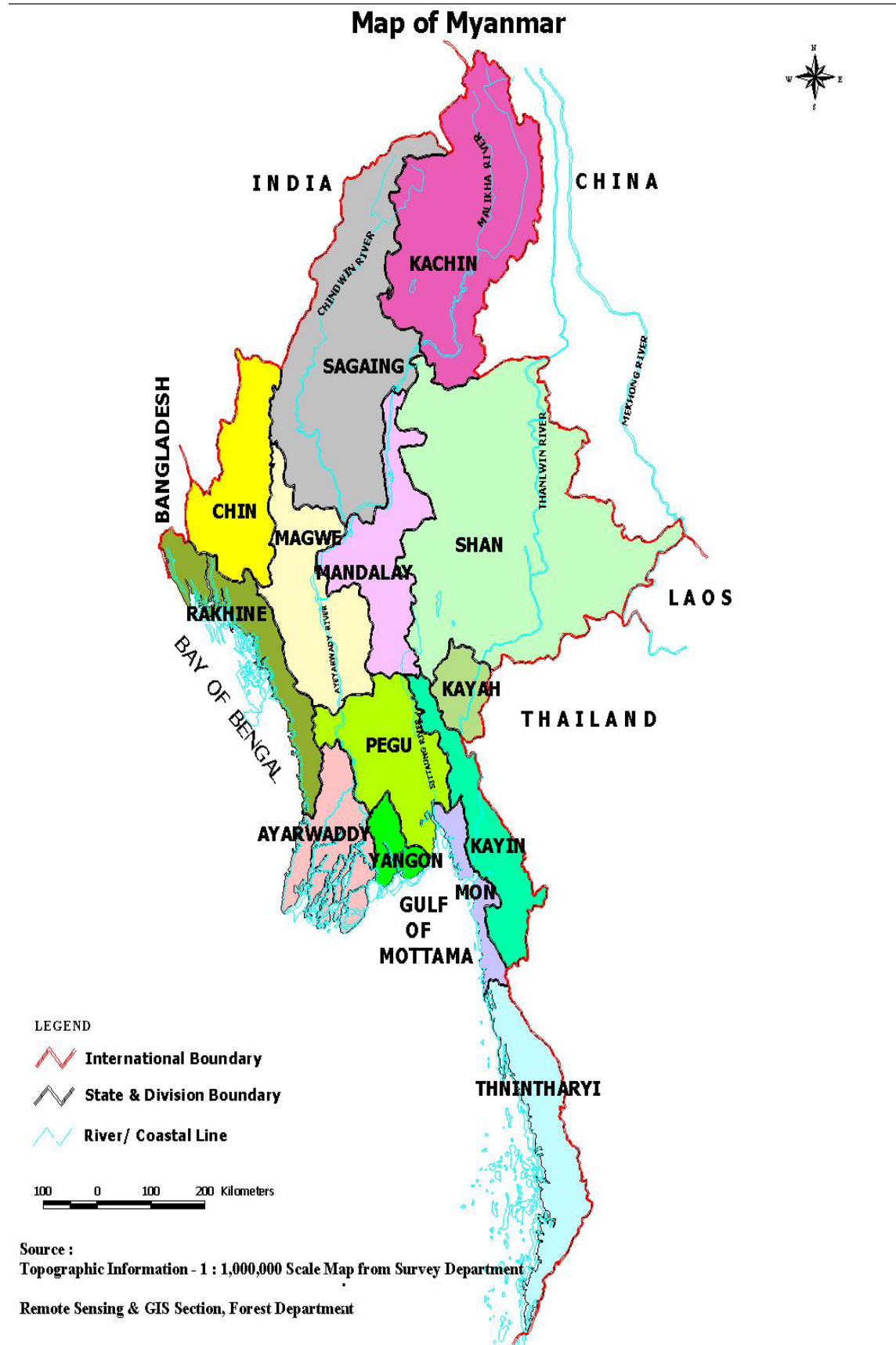
- National-level decision and policy makers
- National Commission for Environmental Affairs (NCEA)
- Government departments, institutions and agencies related to environmental management in Myanmar
- Universities and research institutes
- National non-governmental organizations active in socioeconomic development and environmental conservation such as FREDA, Myanmar Woman Association, etc.
- Non-for-profit professional and private organizations such as Myanmar Engineering Society, Chamber of Industry and Commerce, and etc.
- Collaborating international and regional organizations such as GEF, ADB, UNEP, IGES and NIES.
- Local authorities, implementers and communities in selected case study areas

## References

NCEA (1997), *Myanmar Agenda 21*, National Commission for Environmental Affairs, Government of the Union of Myanmar, Yangon.

Project Secretariat (2003), "*Implementation Plan: National Performance Assessment and Sub-regional Environment Strategic Framework for the Greater Mekong Sub-region – ADB/TA.No.6069-REG*", Prepared by Project Secretariat, UNEP Regional Resource Center for Asia and the Pacific, Bangkok, 2003, pp: 1-2

MAP 1: Administrative Map of Myanmar



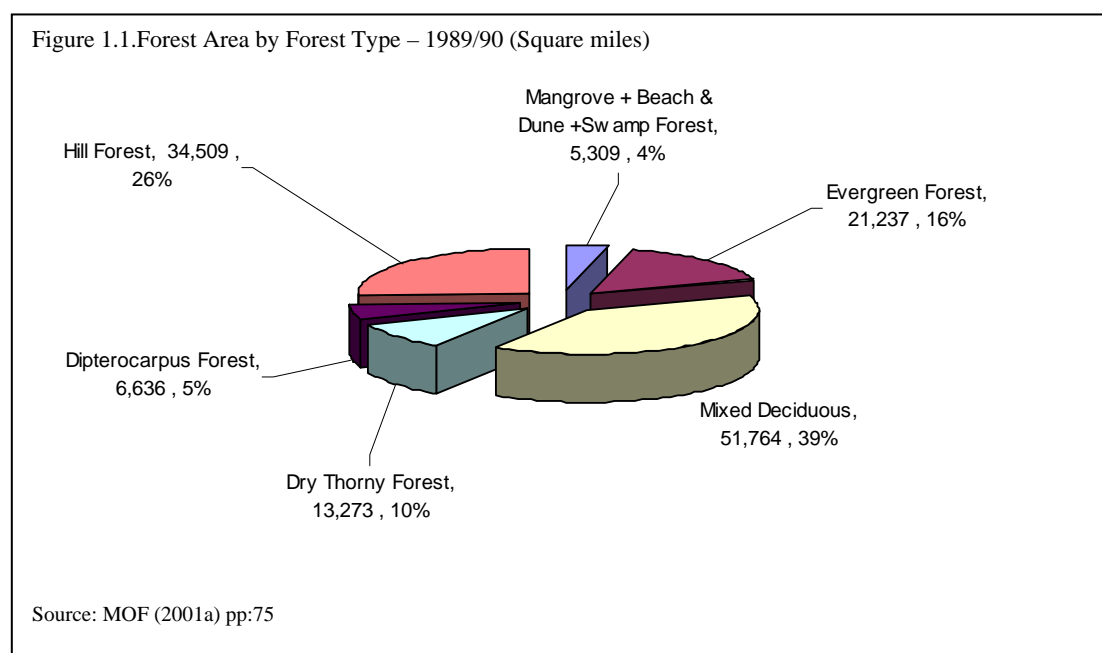
Source: Forest Department 2005

## II . MANAGEMENT OF PRINCIPAL ENVIRONMENTAL CONCERNS

### 1. Forest Resources

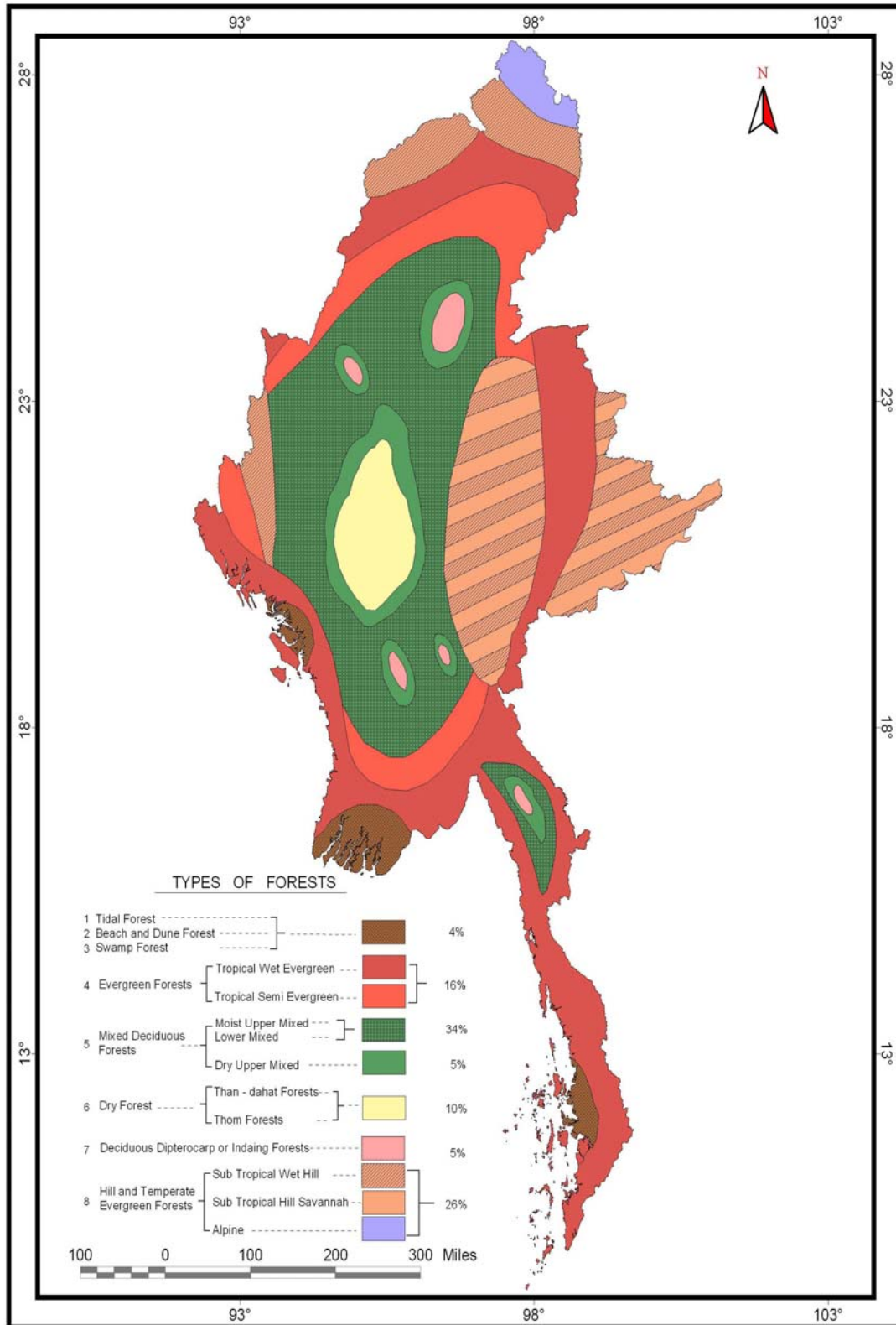
#### 1.1. Context

9. The richness of Myanmar's forest reflects the diversity of the country's climatic and topographic conditions and a wide range of latitude. The forests are of eight broad types; namely (1) mangrove tidal forests, (2) beach and dune forests, (3) swamp forests, (4) evergreen forests, (5) mixed deciduous forests, (6) dry thorny forests, (7) dipterocarp (*Dipterocarpus*) forests and (8) Hill and Temperate Evergreen Forest. Besides the above classification, the forest flora can be divided into 48 ecological sub-divisions based on climatic, edaphic and other factors. Among the principal categories, the (1) mixed deciduous teak and hardwood forests and (2) dipterocarp forests are the most important commercially. The mangrove forests in the coastal areas and Ayeyarwaddy delta are vital for the ecological stability of these areas. (Forest Department 1989, pp: 3-4)



10. These diverse forests have been providing a wide range of goods and environmental services. Forty-five commercial timber species are extracted, the teak, ironwood and rosewood the most valuable and best known among them (Forest Department 1994, pp:14). Non-wood forest products (NWFP) such as charcoal, bamboo, cane, resin, latex, honey, beeswax, edible bird nests, bat's guano, turpentine and orchids support local livelihoods. The forests continue to provide wood energy to rural households and local cottage industries. Although the forestry sector accounted for only 0.6 per cent of total GDP in 2001/02, it generated over 10% of total export earnings, second only to agriculture and petroleum sectors (CSO, 2002). In these circumstances, the state of forest resources is of major significance for livelihoods and the environmental stability of the nation.

**Map 2 DOMINANT TYPES OF FORESTS**



Source: Forest Department 2005, (based on Forest Inventory Data)



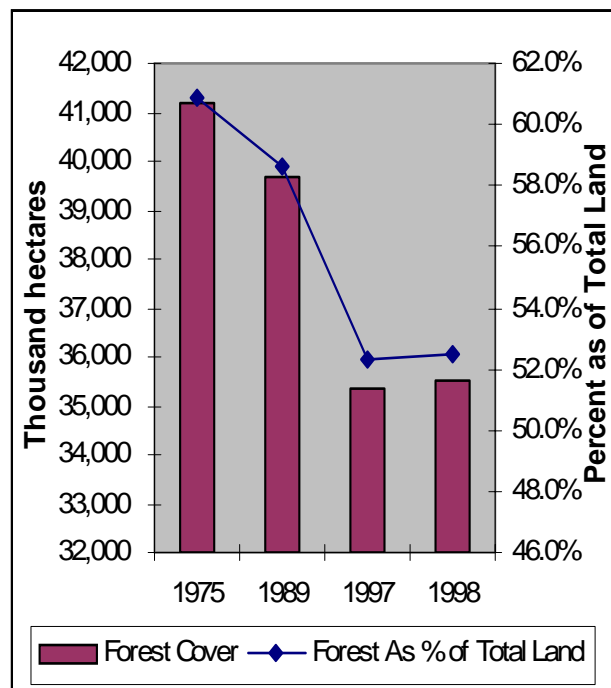
## 1.2. State

Indicator: Per cent Forest Cover in Total Land Area 1975 to 1998

11. Following globally accepted indicators of the state of forests as used, for instance, by the Food and Agriculture Organization of the United Nations (FAO) in ongoing global monitoring of tropical forests, forest cover, expressed as a percentage of the total land area, was selected as the state indicator.

12. At present, half of the country is still covered with natural forests. Based on Forest Department estimates, total forest area was 41.2, 39.7 and 35.5 million hectares in 1975, 1989 and 1998 respectively, corresponding to 61, 59 and 52 per cent of the whole country (see Figure 1.2.). The loss of forest cover accelerated over time from a 2 per cent loss between 1975 and 1989 to 7 per cent during the period 1989 to 1998. According to Forest Policy and Master Plan, 30 per cent of total land is to be a Permanent Forest Estate (Reserved Forest and Public Protected Forest) while another 10 per cent is to be under Protected Area System. Additional 10 per cent of total land is to be managed for multiple land use containing agroforestry and community forests. (MOF, 2001a)

Figure (1.2). Forest Cover As Percent of Total Land



Source: Forest Department 2005

13. The spatial pattern of deforestation is presented in detail in the corresponding factsheet. Out of 14 States and Divisions, the most serious deforestation (measured by the forest area lost between 1989 and 1998) occurred in the Sagaing Division, Shan State and Magwe Division. The Mandalay Division, Kachin State and Rakhine State followed. When measured by the excess of the local annual deforestation rate over the national average (1.18%) between 1989 to 1998, the fastest deforestation was found in

- a. *Ayeyarwaddy Division* – Annual deforestation rate was 5.6 % per annum as total forest cover declined from 24 per cent of the total area in 1989 to 12 per cent in 1998. Major threats in this region were over-exploitation of mangroves for fuelwood supply to major urban areas (especially Yangon) and expansion of shrimp farming in recent years.
- b. *Mandalay Division* – Annual deforestation rate was 5.0% per annum as the forest area decreased from 35% to 19% of total land between 1989 and 1999, fuelled by rapid urbanization in the central part of the country and commercial exploitation of forest products in the north and south of the region.

- c. *Yangon Division* – Annual deforestation rate was 5.0% per annum. Forest cover declined from 15% of the total land area in 1989 to 9% in 1998 affected by the closeness to Yangon, the timber export capital. Forests in the far north of the Division were opened up for commercial timber extraction and for fuelwood supply to the capital. Increased accessibility due to infrastructure development in recent years contributed to accelerated forest exploitation.
- d. *Magwe Division* – Annual deforestation rate was 4.2% per annum. Unlike in other regions, deforestation took place predominantly in the open forest while a net increase of forest cover was recorded in the closed forest after 1989. This was due mainly to better forest protection in the Shwe Setaw National Park and Forest Plantation contrasting with open access elsewhere. Within 9 years, a 38% forest cover (both open and close forest) in 1989 declined to 23% in 1998.
- e. *Bago Division* – The teak bearing forests of the Division were being lost at a rate of 2.8% per annum during the decade 1989-1998. Forest cover declined from 45% to 33% during that period. The teak forest was under the pressure of lucrative teak exports.
- f. *Rakhine State* – Annual deforestation rate was 2.6% per annum. This coastal area in the western part of the country is less densely populated and had a high forest cover of 62% in 1989. The coastal mangrove forests were being encroached for paddy cultivation and shrimp farming. The forest cover declined to 50 % by 1998.
- g. *Kachin State and Sagaing Division* are the northern regions of the country with large areas of commercially valuable species. Many of them disappeared after 1989 as commercially driven production took hold. Expansion of mining and illegal timber exports to China contributed to deforestation. However, given the initially large forest cover, the average deforestation rate during the studied decade was only 1.8% in Kachin State and 1.3% in Sagaing Division. These regions contain the Ayeyarwaddy and Chindwin watersheds and deforestation here poses the threat of complex socioeconomic and environmental repercussions downstream.

14. From the above it is clear that deforestation has been positively correlated with each region's commercial forest potential and the state of the local economy. From two periodical assessments on forest cover of Myanmar, it emerges that each year, 107,910 hectares of natural forests were lost during the period 1975 to 1989 while the forest area lost in later years from 1989 to 1998 was 466,420 hectares per annum. The major acceleration after 1989 coincided with the opening of the forestry sector to the private sector in the aftermath of the economic reforms of 1988.

15. The 2000 FAO Forest Resource Assessment (FAO, 2000) put the forest cover of other GMS countries at 54.4% in Lao, 52.8% in Cambodia, 30% in Vietnam, and 28.9% in Thailand. The forest cover of Yunnan was 32.4%. Thus Myanmar's forest cover (52.5%) is second highest among them after Laos. It is important to add, however, that the methods of classifying forest as such continue to differ among GMS countries (especially in terms of canopy cover percentage) and the cross-country comparisons should be treated with caution.

**Suggested Rating:** Relatively good but deteriorating

**Justification:** Forest cover in Myanmar declined from 61% in 1975 to 52% in 1998. Since 1989, about 460,000 hectares of natural forest were lost on average each year. This represented a major acceleration in forest cover loss compared with the situation prevailing until then. However, compared with other GMS countries, Myanmar's forests are still abundant despite recent deteriorating trends.

### 1.3 Pressure

Indicator: Ratio of Wood Removal over Thousand Hectares of Forest Cover 1975 to 2001

16. The description of forest cover and its changes over time in the previous section identified land use change and forest exploitation as principal causes of deforestation in Myanmar. The former has been related to conversion of forest to agriculture, particularly by slash and burn farmers but also by commercial agriculture, most notably for tree crops (rubber, palm oil and fruit). The net sown area (including a relatively small area of tree crops like rubber and palm oil) increased from 19.9 million acres in 1988/89 to 25 million acres in 1999/2000. This compares with a net loss of forest cover of 4.2 million acres during the period of 1989 to 1998 (consisting of 6 million acres of closed forest lost and 1.8 million acres of open forest gained). As timber elephants are used in official timber extraction, legal logging did not cause deforestation, merely a change from closed forest to open (logged-over) forest. Commercial logging accounted for the bulk of the 4.2 million acres of closed forest lost but some loss due to clearance for agriculture cannot be excluded. If, on the other hand, agriculture expansion is confined to "cultivable waste land"<sup>1</sup> (as it should be in theory), the principal factors for the loss of forest would be illegal forest exploitation given that slash and burn areas during 1990 to 1999 remained stable at around half a million acres<sup>2</sup>. It is possible that under-reported slash and burn cultivation is also contributing to forest loss.

17. The influence of commercial logging is not easy to analyze. Available data do not support the notion that commercial logging operations systematically violated existing annual allowable cut (AAC) regulations<sup>3</sup>. Key to satisfactory explanation seems to lie in illegal logging taking place in remote and difficult-to-monitor areas.

18. While the pattern of deforestation is clearly complex, there is little doubt about the expansion of the commercial forestry segment (including commercial logging, fuelwood extraction and commercial harvesting of non-timber forest products)<sup>4</sup>

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<sup>1</sup> The Settlement and Land Record Department (SLRD) considers "cultivable waste land" to be neither permanent farmland nor permanent forest estate (or PFE, defined as reserve forest and protected public forest under the management of the Forest Department) but land available for agriculture expansion. Such land may contain trees but is not considered as forestland by the Forest Department yet. This category is often confused with "other woodland area" (OWA), which may not be used for agriculture cropping. OWA is not given the same legal protection as PFE.

<sup>2</sup> According to data compiled by NCEA for ASEAN's SOE Report, annually reported shifting cultivation areas were 235, 228, 221, 228, 232, 230, 209, 201, 180 and 150 thousand hectares respectively for the period 1990-1999. (NCEA 1999).

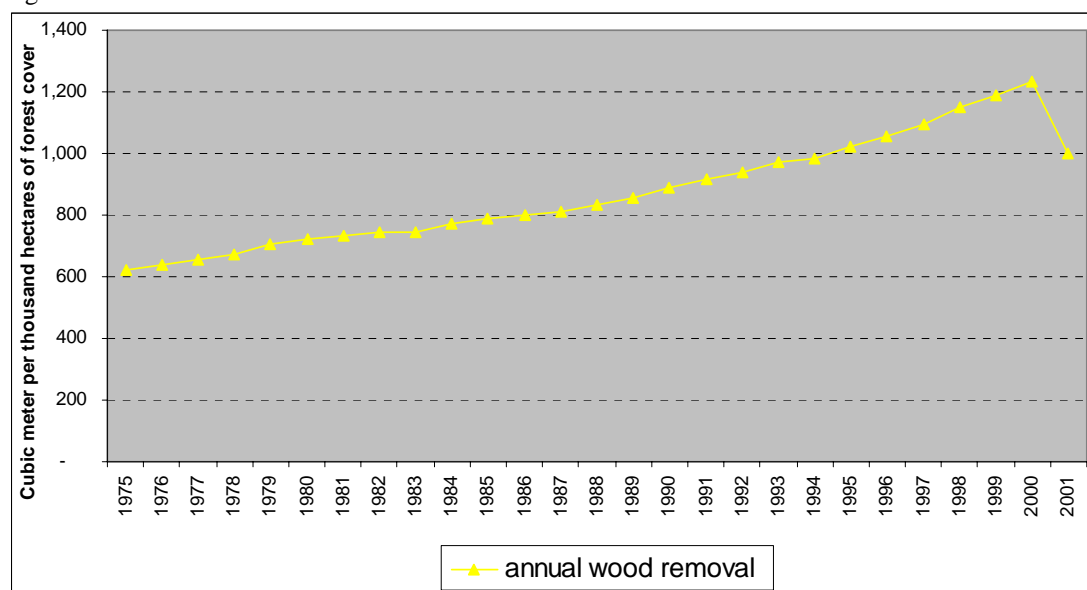
<sup>3</sup> Under the Myanmar Selection System, the volumes of wood that can be sustainably removed each year is fixed. Adherence to this limit in practice has varied. For instance, AAC for teak was 350,000 and 226,954 hoppus tons respectively before and after 1996 periods but annual extraction of teak during 1975 to 2001 ranged from 203,122 to 489,019 hoppus tons p.a. In case of hardwood species, AAC fixed for before and after 1996 were 1.3 and 1.8 million hoppus tons respectively and actual felling has never exceeded the AAC limits. (Ohn, 1999), (Forest Department 1991), and MOF (2001b)

<sup>5</sup>The growth of export-led timber industry coincided with the official adoption of market economy in 1988.

during the last decade<sup>5</sup>. As can be seen the pressures on forest resources in Myanmar have been many and a single indicator is unlikely to capture this complexity.

19. In this EPA, the indicator “Ratio of Wood Removal to 1000 Hectares of Forest Area” has been developed to describe the pressure on the forest resource exerted by forest exploitation. Wood removal combines the figures of commercial round wood production with those of fuelwood production derived from estimated consumption of firewood and charcoal in both rural and urban areas.

Figure 1.3. Ratio of Annual Wood Removal Over Thousand Hectares of Forest Land



Source: Forest Department 2005

20. The figures illustrate the near doubling of the pressure on average forest area between 1975 and 2000 from 624 cubic meters per 1000 ha of forest to 1232 cubic meters. The indicator also shows an acceleration of pressure during the last decade coinciding with a rapid loss of forest cover during the same period (as brought out in the “state” section). Broadly speaking, the rate of forest loss was twice as fast as the rate of pressure increase.

21. The data presented here also suggest that extraction of fuelwood has had a far greater impact on the state of Myanmar’s forest than round-wood removals. Firewood and charcoal constituted around 92 per cent of total wood removal at the turn of the decade and dominate the values of our indicator. The dominance of fuelwood in total wood production is hardly surprising given that more than 80% of total primary energy in Myanmar is still supplied by fuelwood (ADB et al, 1998, pp: 54). Coupled with a population increase of 2% per annum and a slow pace of alternative energy introduction, the demand for fuelwood continues to rise (from 24.5 million cubic meters in 1975 to 40.4 million cubic meters in 2000). Furthermore, the actual extraction of fuelwood might be higher still than the figures generated here. This is because official estimates of per capita fuelwood consumption (used here) date back to 30 years ago and may underestimate the current average use. Also, fuelwood consumption by small enterprises and cottage industries, a rapidly growing sector in recent years, is not fully taken into account in our estimates. No up to date

<sup>5</sup> As of CSO (2002), annual growth rate of forestry sector gross domestic product were 8.3 % (1990/91), -4.5% (1995/96), 2.1% (1996/97), 2.8% (1997/98), 3.2% (1998/99), 4.6% (1999/2000), 3.3% (2000/01) and 10% (2001/02).

figures for other GMS countries are readily available to make comparisons with although such comparisons could be made with additional effort.

**Suggested Rating :** High and increasing

**Justification:** The pressure on the forest has been increasing in Myanmar. Wood removal per thousand hectares of forest cover nearly doubled from 624 m<sup>3</sup> in 1975 to 1,232 m<sup>3</sup> in 2000.

#### 1.4 Response

22. Attempts to respond to the threat of forest depletion and loss in Myanmar have a long history going back to 1856 (Saw El Dah, 2004) and the development of sustainable management regimes for the teak forests of Bago and the Myanmar Selection System (MSS) built around the concepts of allowable cut, forest-working plans (FWP), decentralized management and “local supply working circles”<sup>6</sup>. Under MSS, teak forests of Myanmar sustained their production over three felling cycles, i.e. almost a century.

23. With the abundance in natural forests during the colonial period, establishment of forest plantations was not a priority (Slebbing E.P 1962). It remained a low priority during the early years of independence. The decentralized forest management was replaced by a centralized national planning system between 1962-1988. The basic planning unit shifted from forest ecosystem to an administration unit disrupting operations within the same ecological unit. The ecological stability of the forest became harder to establish and enforce. The quality and execution of forest working plans declined.

24. In the meantime the profile of plantation forestry, especially teak, increased. From modest compensatory planting during the 1960s it progressed to an annual average of around 80,000 acres (MOI 2000) in the late 1990s (see Table 1.1 below). Among others, World Bank and Asian Development Bank supported forest plantation establishment during the period 1979 to 1987 through East Pegu Yoma Project (Ohn U, 1999).

Table 1.1: Establishment of forest plantations (acres)

Type of Plantation	1968 to 1988	1989 to 2000	Total as of 2000
<i>Commercial timber plantations</i>	402,910	514,017	916,927
<i>Village supply (fuelwood) -</i>	185,575	280,709	466,284
<i>Industrial supply</i>	50,796	73,633	124,429
<i>Catchment protection</i>	65,439	96,683	162,122
<b>Total -</b>	<b>704,720</b>	<b>965,042</b>	<b>1,669,762</b>

Source: Forest Department (1989) and MOF (2001a), pp: 121

25. A major change took place in 1988, when the state-run timber industry was opened to private sector participation. Efforts were made to accompany this by reinforcing forest management: Forest Law was revised in 1992, national forest policy formulated in 1995, community forestry given a legislative basis (1995) and Dry Zone Greening Department (DZGD) created in 1997.

<sup>6</sup> “Local supply working circles”, designed to ensure supply of forest products to the population living in the vicinity of forest, pre-date the current discussion about bufferzone management by almost hundred years.

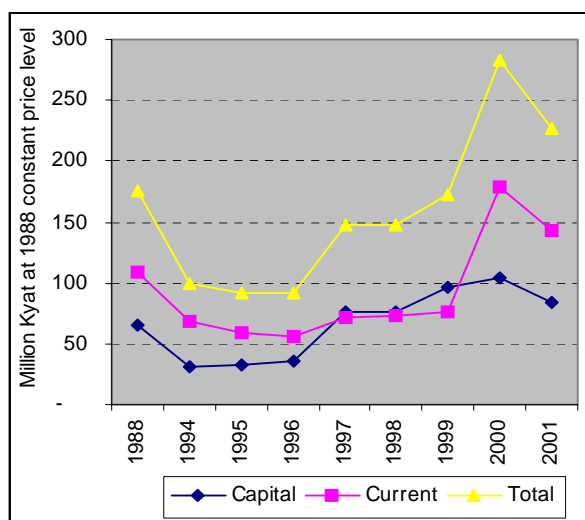
26. The 1995 Forest Policy set the target of expanding the reserve forest to 30% of the total land area and setting aside no less than 5% of total land as protected area system (10% for the long term). Annual reforestation target of 20,000 hectares (approximately, 50,000 acres) was also announced to restore degraded lands and meet rural needs. (MOF, 1996, pp: 4-5). Forest conservation and reforestation for environmental protection and for rural development have become the centerpiece of forest management in recent years while MSS was retained to regulate the exploitation of non-plantation forest. Through the activities of DZGD, reforestation work and law enforcement intensified in the most needy areas like the heavily deforested parts of Magwe, Mandalay and Sagaing Divisions. Community forestry legislation is also providing for the right of local people to manage nearby forests for own use. A comprehensive Forestry Master Plan for 2001 – 2031 reinforced the policy support for sustainable forest management. Overall, the management of forest resources has been receiving policy-, legal and institutional support during the last decade.

27. Real expenditure on forest conservation has been developed in this EPA as an indicator of response based on information provided by the Forest Department and Dry Zone Greening Department, under Ministry of Forestry.

1<sup>st</sup> Indicator: Expenditure on Forest Conservation 1988 to 2001

28. Annual expenditure for forest conservation rose 15 times in nominal terms over the period 1988 to 2001. Adjusted for price inflation, the picture is mixed. The total annual expenditures at constant prices of both Forest Department and DZGD during the period of 1994 to 1999 were lower than in 1988. The increase in total real expenditure after 1999 was due largely to a sharp increase in current expenditure (mainly salaries of government employees).

Figure (1.4). Expenditure on Forest Conservation at 1988 Constant Price



Source: Forest Department (2005), Dry Zone Greening Department quoted in NCEA (2004)

29. The real capital expenditure on forest plantations, natural forest management and related conservation activities also increased slightly during the same period. Most of the expenditure was incurred to establish forest plantations. Expenditure on other forest management operations was minimal. For instance, 22 to 34% of Forest Department's expenditure was spent on forest plantations and only 1.5% on forest conservation and natural forest management. Expenditure for wood energy saving was virtually non-existent in the Forest Department though there might have been some expenditure by the Dry Zone Greening Department<sup>7</sup>. Current expenditure, i.e. spending on personnel and

<sup>7</sup> One of the main functions of Dry Zone Greening Department is to promote wood saving. Energy-efficient cooking stoves were purchased and distributed to dry zone rural villages. The expenditure incurred for this activity was included in "Capital Cost" and could not be separately reported. Energy saving activity outside dry zone is carried out by Forest Department and there is no separate budget line for this activity.

administration, took almost 63% of total budget in 2001 and this contributed to a weakening of forest conservation work in the field. The allocation for 2000 and 2001 increased somewhat but overall, the period 1988 to 2001 saw a fluctuating trend. Therefore, expenditure on forest conservation is considered “intermittent”. It is not comparable with other GMS’s countries the majority of which used different indicators to assess the response.

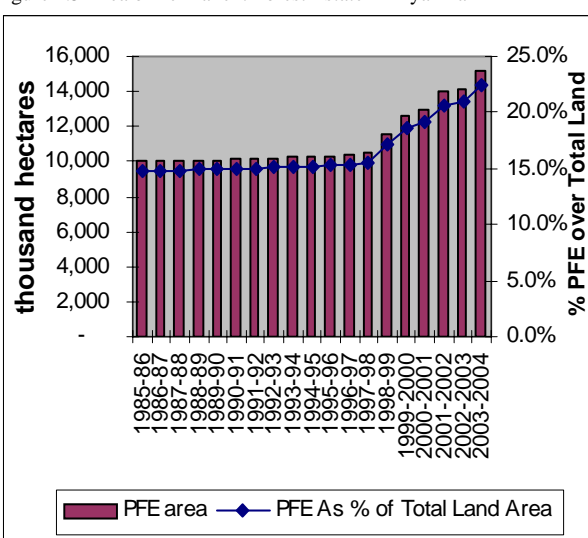
**Suggested Rating :** Average and intermittent

**Justification:** The inflation-adjusted expenditures available for forest conservation have been fluctuating during the period 1988 to 2001. The response is considered intermittent. In general, the expenditures averaged 200 Million Kyat p.a. The largest share was used to finance administration and personnel with the rest divided between forest plantations and natural forest management including wildlife conservation.

2<sup>nd</sup> Indicator: Permanent Forest Estate As Per cent of Total Land 1985 - Expenditure on Forest Conservation 1988 to 2003

30. In Myanmar, different typologies of forest and differences in their legal status are found. Forest Reserve is the best known category fully protected by existing forestry related laws. Establishing a Forest Reserve is normally a lengthy official process during which potential conflicts of interest and tenurial claims of different parties and the State need to be reconciled. Notification of an area as a Protected Public Forest is a simpler alternative to giving legal protection to trees and placing limits on the type of activities allowed. Other forested areas are normally in the category of either (1) public forest (“other woodland area” – OWA) where forest cover might be still good and access to trees and land is open to local communities or (2) “wasteland” where natural vegetation is sparse or very poor. The former two categories, i.e. the Forest Reserve and Protected Public Forest, are termed Permanent Forest Estate (PFE) and 1995’s Forest Policy has been targeting 30% of total land to be managed under PFE. Therefore, PFE as percentage of total land was developed as an indicator here to assess the current level of response.

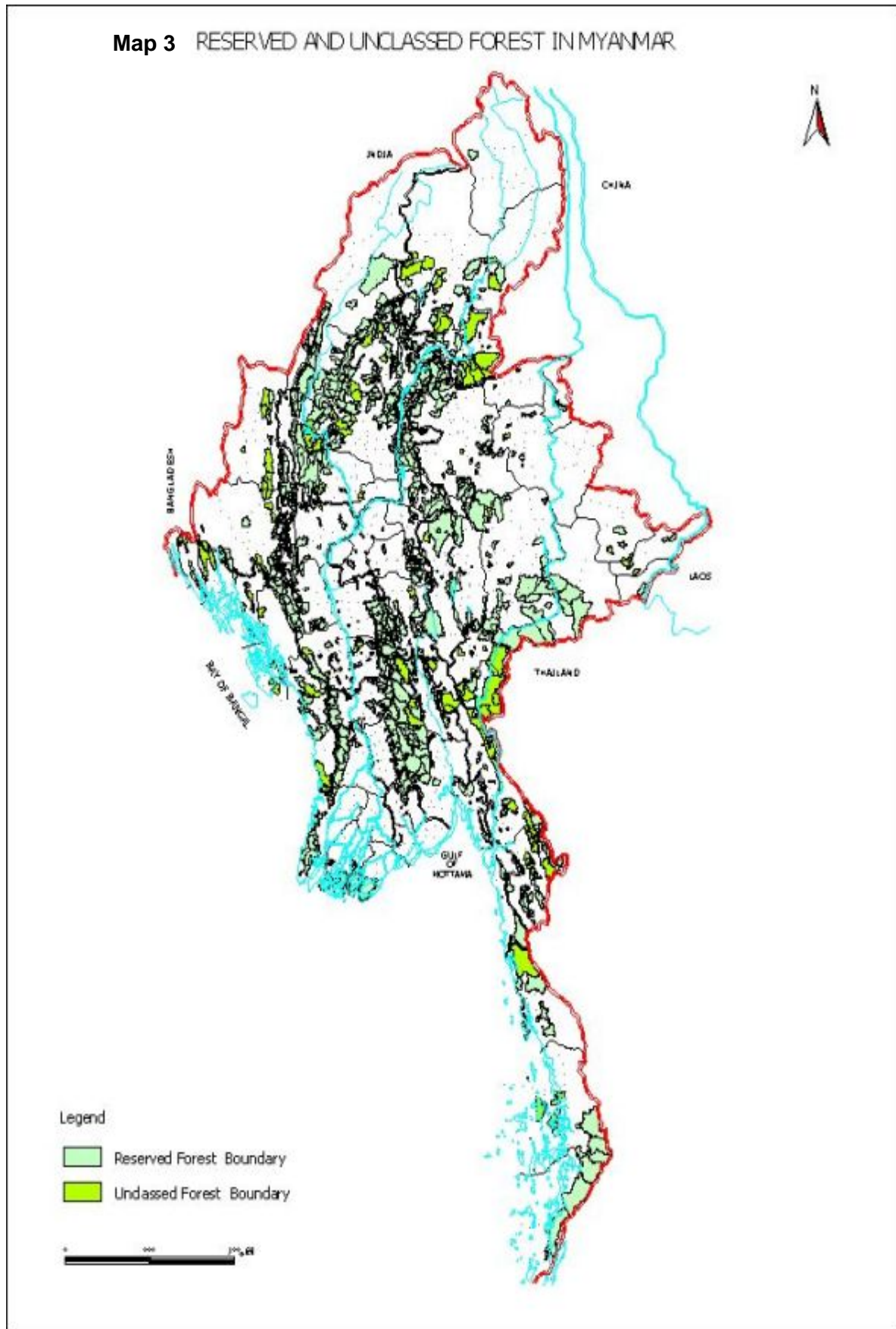
Figure 1.5 Area of Permanent Forest Estate in Myanmar



Source: Forest Department (2005)

31. Before the policy target was announced, the total percentage of PFE was about 15%. The Forest Department data show no or very little change from 1985 to 1997 (Figure 1.5). Between 1998 and 2003, the total area of PFE increased to 22% of the total land area. The additional 7% of total land placed under PFE is about half of the projected increase and the official target therefore looks to be within the authorities’ reach.

**Map 3** RESERVED AND UNCLASSED FOREST IN MYANMAR



Source: Forest Department 2005



**Suggested Rating:** Average and consistent

**Justification:** Annually, an average of about 1% of total land area was added to Myanmar's Permanent Forest Estate during the period 1998 to 2003. In 2003, the total PFE amounted to 22 per cent of the country's total land area. Over a decade and a half, the response was average with a consistent improvement, however.

## 1.5 Conclusions

32. Average wood removals in Myanmar (measured in average volume extracted from a unit of forest area) approximately doubled since 1975 and annual losses of forest area accelerated notably since 1989. In spite of these developments, Myanmar's forest cover continues to compare favorably with other GMS countries even if more work is needed to achieve true comparability of forest cover data in the GMS. Without consistent and increasing response to the pressures on the resource the loss of forest cover is set to continue. The resources devoted to forest conservation have fluctuated in recent years showing no clear trend.

33. The response has been more telling in a related domain: The Forest Department was able to increase the Permanent Forest Estate from 15.3 % of the total land area in 1995 to 22.4% in 2003. This is almost half of the policy target established in the 1995 Forest Policy.

34. Forest management has also been strengthened by several sound policy and institutional measures. In particular, a forestry master plan has been formulated for a 30-year period starting from the budget year 2001/2002. It addresses principal shortcomings currently observed in forest management, and gives greater attention to elements such as forestry extension, community forestry, agro forestry, wood energy saving and human resource development. A shift towards people-oriented forestry is underway. Thus, overall performance in managing forest resource is fair with signs of a greater momentum.

**Suggested Rating: 2 STARS**

**Justification:** Reinforced by policy and institutional support in recent years, progress has been made towards safeguarding the forest resource despite evidence of increased pressure during the last decade and a half. The expansion of the Permanent Forest Estate is a strongly positive feature. It is too early to say what the effect of recent re-orientation of forest management towards community management and greater attention to reducing fuelwood consumption has been.

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## **2. Threats to Biodiversity**

### **2.1. Context**

35. Myanmar is a country of exceptional ecological biodiversity featuring lowland wet evergreen forests in the southern part of the country, deciduous *Dipterocarp* forests and thorn scrub in the central part and sub-alpine forests in the north. Large, slow-flowing rivers and large lakes support freshwater ecosystems and the extensive seacoast with tidal mangroves supports marine ecosystems. (UNDP/FAO, 1983, pp:1)

36. The wildlife of Myanmar is equally diverse. It includes, among others, most of the larger Indo-Malayan mammals. The Taninthari Division in the south is characteristic of Malaysian rain forests. By contrast, in the mountainous area of Kachin State in the extreme north, the fauna is typically Himalayan. Based on a World Wildlife Fund (WWF) definition, Myanmar includes all or part of seven Global-200 eco-regions (Olson and Dinerstein 1988, Dinerstein et al, 1999).

37. The Indo-Myanmar “hotspot” is known as one of the most threatened areas globally and is one of the eight hotspots likely to lose most plants and vertebrates as a result of continued forest cover loss (Brooks et al, 2002, pp:909-923). Throughout the hotspot, a combination of economic development and human population growth is placing increasing pressure on natural habitats and species populations. While these trends are currently not as pronounced in Myanmar, the country is becoming increasingly exposed to external economic forces, including demand for timber and wildlife products. (CI, 2004, pp: 43).

38. As the designated agency for biodiversity conservation in Myanmar, the Ministry of Forestry through its 30-year Master Plan (MOF, 2001, pp: 254-255) has identified the following major threats to biodiversity:

- a. Conversion of closed forests for other land uses.
- b. Shifting cultivation by hill tribes.
- c. Importing and introduction of invasive species without proper supervision and monitoring.
- d. Lack of modern and appropriate fishing gear and equipment and uncontrolled use of chemicals in ocean and fresh waters causing pollution.
- e. Weak regulation and control of commercial exploitation and trade in endangered flora and fauna.
- f. Lack of Environmental Impact Assessment and integration of biodiversity concerns in development activities affecting land use change.

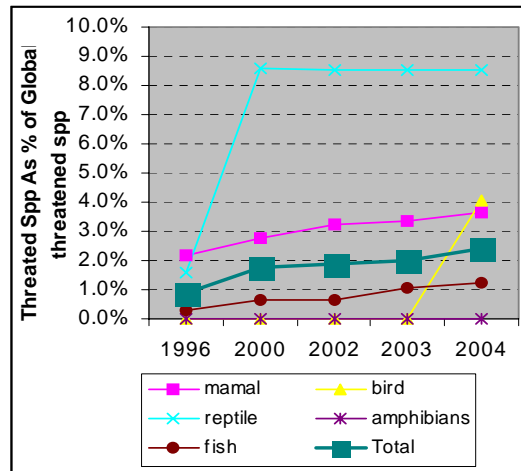
### **2.2. State**

39. Myanmar is far from having completed an inventory of its biological resources and there are many conflicting figures on the number of existing species of both fauna and flora in the literature. Therefore, a state indicator, which is sensitive to both nationally threatened and globally threatened species, is not feasible at this time.

Indicator: Threatened Species as Per cent of Globally Threatened Species - 1996 to 2004

40. The selected indicator tracks the number of threatened species over time and is expressed as the percentage of the number of threatened species at the national level over the number of threatened species at the global level. Threatened species are those defined by the International Union for the Conservation of Nature (IUCN) (World Conservation Union) as vulnerable, endangered or critically endangered in the “Red List of Threatened Species”. Extinct or lower risk (conservation dependent, near threatened or least concern) do not form part of the indicator. Species under consideration include mammals, birds, reptiles, amphibians and fish; plant and insect species, for which the process of evaluation has only just begun, are excluded from the indicator figures.

**Figure 2.1. Threatened Species as Percent of Globally Threatened Species (1996 to 2004)**



Source: IUCN Red List 2004

41. As can be observed from the final 2004 results in Figure 2.1, Myanmar is a tentative sanctuary to approximately 2.4% of the globally threatened species. This standing includes approximately 3.6% of globally threatened mammals, 4% of globally threatened birds, 8.5% globally threatened reptiles, and 1.3% of globally threatened fish. As of 2004 there were no globally threatened amphibians, which have sanctuary in Myanmar.

42. It is highlighted here that the rise in the share of globally threatened species from 0.91% in 1996 to 2.41% in 2004 is largely attributed to the progress of the evaluation work of IUCN and is not necessarily indicative of a trend of loss of biodiversity in Myanmar during the period 1996 to 2004. The 0.91% value in 1996 is based on the first version of the IUCN Red Book, when most relevant mammals, some reptiles and some fish species had been evaluated but at which time amphibians and birds were not yet part of the equation. The bulk of the relevant reptiles were not evaluated until year 2000 and relevant amphibians and birds were not evaluated until year 2004. Therefore the indicator value and the trend before 2004 have very little meaning.

43. Subsequent to 2004 and now that the indicator value is inclusive of all threatened species tracked by this indicator, the future value of the indicator will be more indicative of the trend in the loss of biodiversity in Myanmar. It is not expected to vary dramatically from the 2004 figures. It may artificially rise if new globally threatened species also have sanctuary in Myanmar; it may artificially fall if new globally threatened species have sanctuary outside of Myanmar. Some of this artificial oscillation can already be observed in the reptile species since year 2000. While the indicator serves well to measure Myanmar’s share of the global priority, only changes in the status of individual species (as detailed in the relevant factsheet) can be utilized to measure progress at the national level. Any future decrease in the level of endangerment of the listed species, or the removal of the species from the list, is indicative of progress in conserving biodiversity; any future increase in the level of endangerment will be a negative indication of progress.

44. With regards to the degree of vulnerability of these threatened species, as of 2004, 75 species were listed as vulnerable, 34 as endangered and 16 as critically

endangered. It is also observed that not all of Myanmar's share of the globally threatened species is endemic to Myanmar and therefore Myanmar alone is not solely responsible for its 2.4% share of globally threatened species. However, 8 of the threatened species, including 5 reptile species, are endemic to Myanmar and for another 5 threatened species, Myanmar and one of its GMS neighbors share the responsibility. It was also observed that 15 of Myanmar's current 125 threatened species are endemic within GMS countries.

**Suggested Rating :** Average with no observable trend

**Justification:** In comparison with other GMS's countries, Myanmar's 2.4% of globally threatened species is slightly below the average of all GMS countries combined. Reptiles are the largest contributors to Myanmar's share of the threatened species and as noted above Myanmar is currently void of amphibian species on its threatened list. The number of threatened reptile species (26) is above average in Myanmar but only 5 of these threatened reptile species are endemic to Myanmar. However Myanmar alone is not accountable for all of these threatened reptile species. But at the same time, Myanmar could provide safe heaven to a relatively high proportion of globally threatened reptiles. Based on this comparison it is concluded that the current state of biodiversity in Myanmar is on average with other GMS countries, with no observable past trends and an expectation that the global share of Myanmar's threatened species will remain constant in the very near future.

### 2.3 Pressure

45. The state indicator analysis has also provided some insight as the habitats of the threatened species in Myanmar and the major threats to those threatened species. Forests were identified as the dominant habitat for approximately 36% of the threatened mammals and birds but loss of wetlands and grasslands were equally important to threatened bird species. Therefore pressure indicators which attempt to track the loss of habitat are an appropriate choice.

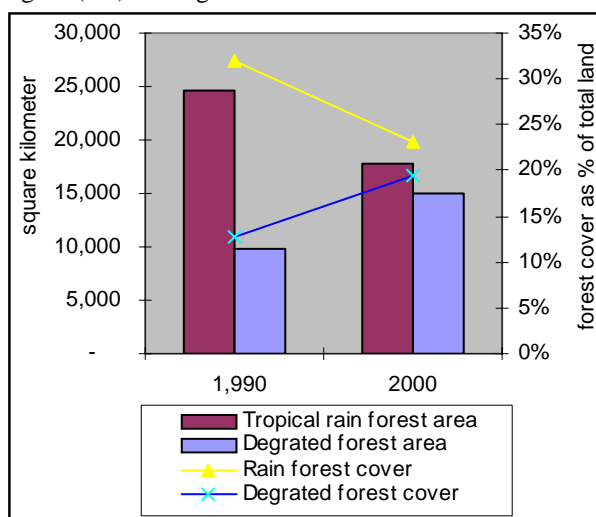
46. Loss of forest cover has already been addressed under the forest resources concern and there is no need to repeat such indicator here. Instead, the loss of tropical rain forest was selected as one pressure indicator and the loss of mangroves as another. Loss of tropical rain forest is based on existing land use studies in Taninthari Division where most tropical rain forests are found in Myanmar. Loss of mangroves is based on the results of historical land use monitoring in the Delta Forest Reserve. This forest reserve is by no means inclusive of all mangrove forests in Myanmar but the trends observed there may well be representative of the loss of mangroves throughout the country.

1<sup>st</sup> Indicator: Loss of Tropical Rainforest in Taninthari Division from 1990 to 2000

47. As can be observed from Figure 2.2, the area of rainforests (closed forest) in Taninthari Division declined from 24603 km<sup>2</sup> or 31.9% of the division area to 17,820 km<sup>2</sup> or 23.1% of the division area by year 2000. This translates to a 28% loss of tropical rain forest over the 10-year period and there was very little observed loss, if not a gain, in the period prior to 1990. The accelerated rate of deforestation, including the decline of tropical rain forests, substantially coincides with the 1988 open market economy and the competition from competing land uses.

48. The loss of 6,783 km<sup>2</sup> of tropical rain forest is counter-balanced by a 4,772 km<sup>2</sup> increase in the area of degraded forest which increased from 9,820 km<sup>2</sup> in 1990 to 14,592 km<sup>2</sup> in year 2000. The transition from tropical rain forest to degraded forest is even higher than this in the land use change matrix and in fact 6,350 km<sup>2</sup> were lost from closed forest to degraded forest. Given the closure of all forest concessions along the Thai-Myanmar border in 1992/93, the loss of tropical forests in Taninthari Division strongly points to existence of illegal logging. Palm oil plantations may also be a contributing factor.

Figure (2.2). Change of Rainforest in Taninthari Area



Source: Forest Department & Food & Agriculture Organization (2005)

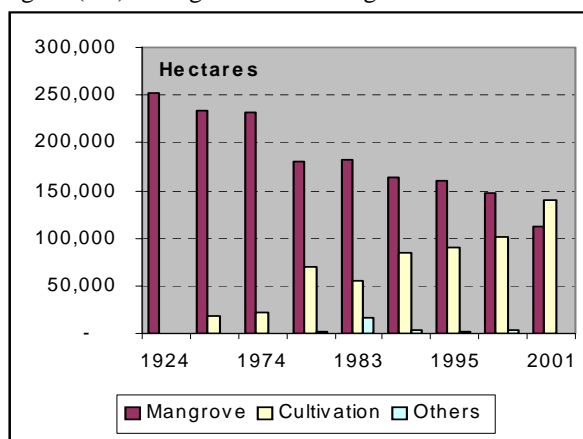
**Suggested Rating :** High and increasing

**Justification:** When compared with the national deforestation rate of 1.2% for the same period, the deforestation rate of 2.8% in the tropical rain forest of Taninthari Division is high. Given the continued pressures from illegal activities and competing land uses, there does not appear to be any immediate sign that the pressures will be reduced.

2<sup>nd</sup> Indicator: Loss of Mangroves in Delta Forest Reserve -1924 to 2001

49. As can be observed from Figure 2.3, mangrove forests in the Delta Forest Reserve declined at an alarming rate from 253,018 hectares in 1924 to 111,939 hectares in 2001. Only 44% of the original mangroves remain. The increase in the area of rice cultivation during the past 25 years is likely the main contributing factor. The cultivated area is now more than half the total reserve area. Fuelwood extraction for charcoal production was also a contributing factor in the 1980s but was banned in 1990. Shrimp farming is now the main contributor to the loss of mangrove forest in the delta area.

Figure (2.3) Change of Delta Mangrove Area



Source: Forest Department 2005

**Suggested Rating:** High and increasing

**Justification:** Despite a decade-long ban on the use of mangroves for charcoal, the pressure on the remaining mangrove forest from competing land uses (rice cultivation and shrimp farming) remains high. Unless drastic measures are taken, there will be a continued decline of mangrove forests in the delta.

## 2.4 Response

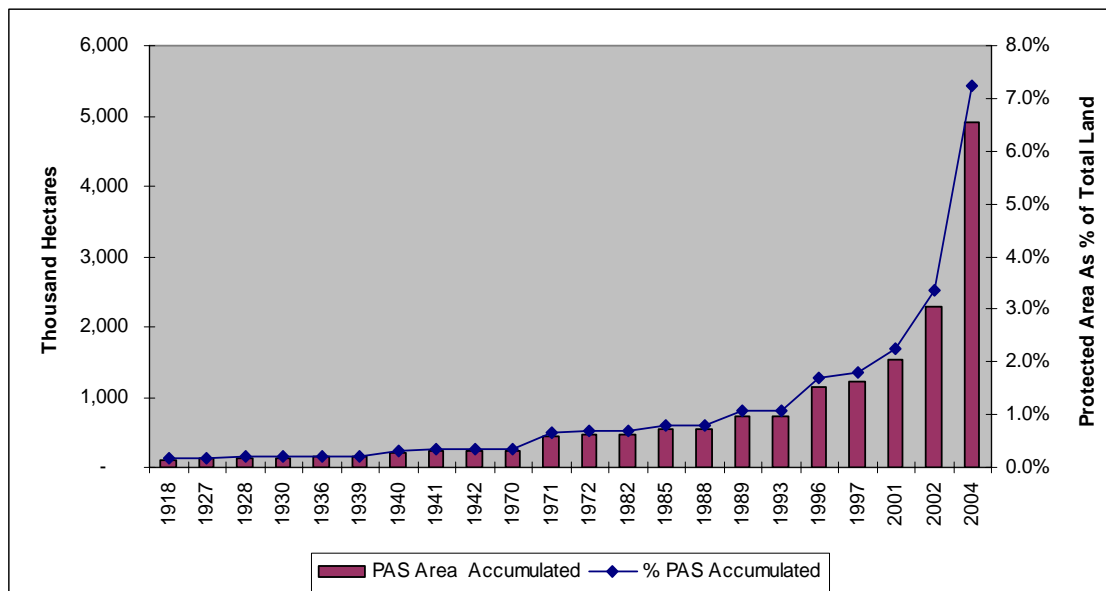
50. In the past, the most effective means of protecting threatened species was to enact laws which had the aim to ensure the species' future existence. Myanmar has a long history of this starting with the Elephant Preservation Act of 1897, the Wild Bird and Animals Protection Acts of 1912 and 1936 and the Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law proclaimed in 1994 (Forest Department 1991. pp: 10-11, NCHRD 2002.pp:274-275). The development of an indicator, which attempts to track the number of globally threatened species locally protected by law was considered and remains a valid response indicator for the future. However for the present exercise and for compatibility with other GMS countries, an indicator which tracks protected areas was opted for instead.

51. Protected areas also have a long history in Myanmar. The Pidaung Wildlife Sanctuary and the Pyin-O-Lwin Bird Sanctuary date back to 1918. A substantial number of other wildlife and bird sanctuaries were added throughout the 1920's, 1930's and 1940's. A formal PAS has existed since the late 1980, however, the management of protected area was not clarified in the Wild life Protected and Protected Area Law until 1994.

Indicator: Per cent of Protected Area over Total Land Area 1918-2004

52. The area under the national Protected Area System was selected as the response indicator; the result is expressed as a percentage over total land area. The trend of the indicator to year 2004 is illustrated in Figure 2.4.

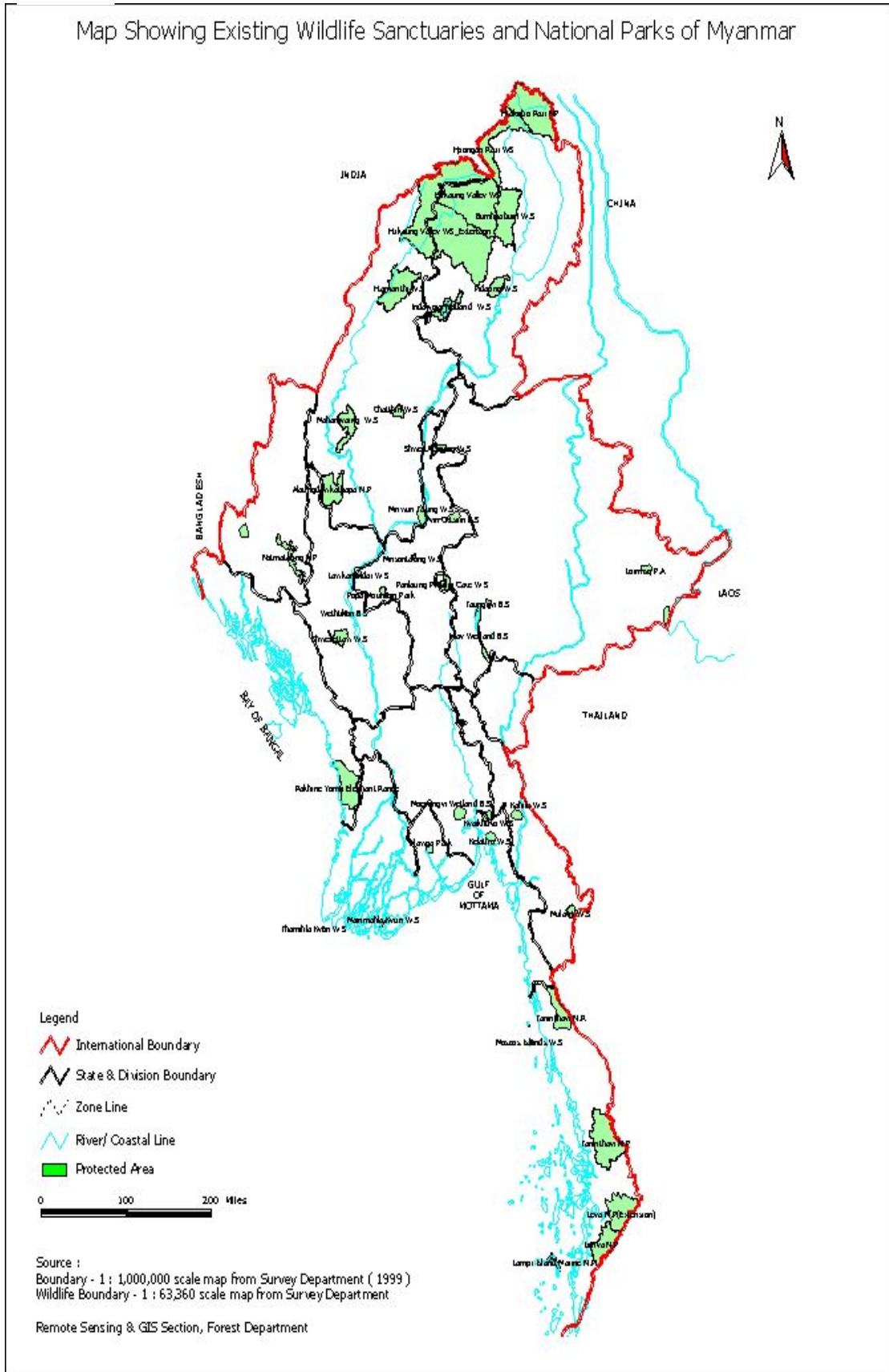
Figure 2.4. Protected Area As Per cent of Total Land 1918 to 2004



Source: Forest Department (2005)

**Map 4**

Map Showing Existing Wildlife Sanctuaries and National Parks of Myanmar



Source: Forest Department 2005



53. As illustrated in Figure 2.4 and detailed in the corresponding factsheet, the area of PAS defined in the Wildlife Law of 1994 was about 1% of the total land area of Myanmar. Six additional protected areas were added in 1996/97 bringing the total to 1.8% of total land area. Another 9 were added in 2001/2002 bringing the total to 3.4 % of total land area.

54. In 2004 notifications were issued to add another three protected areas, including the Taninthari Nature Reserve and Hu-kaung Valley Wildlife Sanctuary (extension) in the northern forest complex area where biodiversity is extremely rich. This will extend the system to 38 protected areas equivalent to 7.2% of total land area, or approximately 4.9 million hectares.

55. Although currently no targets directly associated with protected areas have been made, The National Forest Policy, which was proclaimed in 1995, has set an indirect target of having a forest area equivalent to 5% of the total land area under the system of protected areas (MOF, 1996, pp: 22). Forestry Master Plan (2001/2002 – 2030/31) adjusted this target to 10 % in the long term (MOF, 2001, pp: 21), while keeping the 5% for short-term implementation. These short term and long-term targets are to be achieved by the budget year 2005/2006 and 2017/2017 respectively (MOF, 2001, pp: 264). Therefore, present coverage of protected area has already met the short-term target. However, notable is the focus on conserving forest-based habitats (96%). There are only a few areas for protecting wetlands (0.8%) and marine habitats (3.2%). In the meantime, it is found that protected area as percentage of total land is higher in other GMS countries; e.g. 32% in Cambodia (2002)<sup>8</sup>, 27.5% in Thailand (2004)<sup>9</sup> and 14% in Lao (1999)<sup>10</sup>. Here, too, it is important to keep in mind the limitations of cross-country comparisons based on area figures only without supplementary indicators about the effectiveness of protection.

**Suggested Rating:** Low but consistent

**Justification:** While there has been a good and consistent effort to expand the PAS over the recent years, the magnitude of the response and the end result is considered low in comparison with other GMS's countries.

## 2.5 Conclusions

56. Although there is currently no observable or measurable trend in the biodiversity state indicator, it is widely accepted that biodiversity has been diminishing throughout Myanmar and throughout the GMS sub-region. Myanmar's 2.4% share of globally threatened species, which is average by GMS standards, already highlights the need for added conservation measures, both in terms of species protection and habitat protection.

57. In terms of species protection, a preliminary analysis revealed that only 66 of Myanmar's 125 globally threatened species are protected by law. However this law is under review and the revision aims to take into account these recently identified species that are threatened at the global level.

58. Loss of habitat is no doubt the largest threat to biodiversity in Myanmar. Overall forest cover and forest habitats are on the decline and immediate plans to reduce the loss of forest cover are urgently needed. Tropical rain forests, mainly concentrated in Taninthari Division, which provide habitat to a wide range of threatened species, seem to be under pressure for other land uses. Mangrove

<sup>8</sup> EPA's Fact Sheet on Protected Area, SEF II Project, Cambodia (2005)

<sup>9</sup> EPA's Fact Sheet on Protected Area, SEF II Project, Thailand (2005)

<sup>10</sup> ASEAN's Secretariat (2001), "ASEAN State of the Environment Report 2000, pp:96

forests throughout Myanmar and especially in the Delta Forest Reserve are being lost to competing land uses.

59. On the response side, there has been good progress in expanding the system of protected areas. The current 7.2% of total land area could be regarded as a realization of short-term targets. However, this target is primarily derived from forest conservation objectives and there is a need to accommodate the holistic strategies and approaches of biodiversity conservation such as bio-corridor conservation and community-based nature conservation.

**Suggested Rating: 2 STARS**

**Justification:** A 2-Star rating of environmental performance is suggested, mainly based on the recent achievements in expanding the PAS. While the added protected areas will not have an immediate impact on lowering the pressures and improving the state, there is hope that this will occur in the future. Although not the main driving force, short-term and long-term targets for forest protection have been set and the short-term target can be said to having been met. Also consistent with a 2-Star rating, international conventions have been ratified and most reporting requirements have been met. Ongoing monitoring and databases exist for tracking forest habitat; databases also exist to monitor mangrove forests in representative parts of the country. Institutional responsibilities for the conservation of biodiversity are mainly concentrated in the Nature and Wildlife Conservation Division of the Forestry Department.

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### 3. Land Degradation

#### 3.1. Context

60. With a total area of 167 million acres, Myanmar is rich in land resources, with adequate land available for agriculture use and socioeconomic development. About 21 million acres or 13% of total land area is under cultivation. There is about 16 million acres of cultivable “wasteland” that can still be utilized for cropping and animal husbandry. From 1991 to 2001, the area under agriculture grew by an average of 0.48% p.a. while agricultural workforce grew by 1.17% p.a. (MOAI, 2003, pp:70).

61. There is a broad consensus in Myanmar concerning the existence of untapped land resources for further agricultural growth despite signs of land degradation in some areas.

62. Official data indicate that problem soils occupy an area of about 2.4 million acres, accounting for about 5.3 per cent of the total cultivable land area of 44.5 million acres. Of this about 0.74 million acres are acid sulphate soils, degraded soils, peat soils and swampy soils while saline and alkaline soils accounted for the remaining 1.63 million acres (Kyi Win & Tin Hla, 1999). Key factors characterizing land degradation have been summarized as: (NCEA 1997, pp:131-132)

1. Soil erosion and degradation in the hilly region and dry zone,
2. Salinity problems occurring in delta and coastal areas,
3. Alkalinity problems especially in dry zones
4. Acidity problems in some laterite soil areas
5. Seasonal flooding in low-lying agriculture land

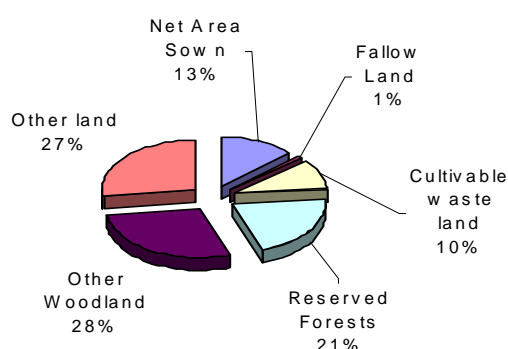
63. Within the constraints of time and data availability soil erosion has been adopted as the major land degradation issue for evaluation under this EPA.

#### 3.2. State

Indicator: Vulnerable Farm Area as Per cent of Total Cultivated Area 1998

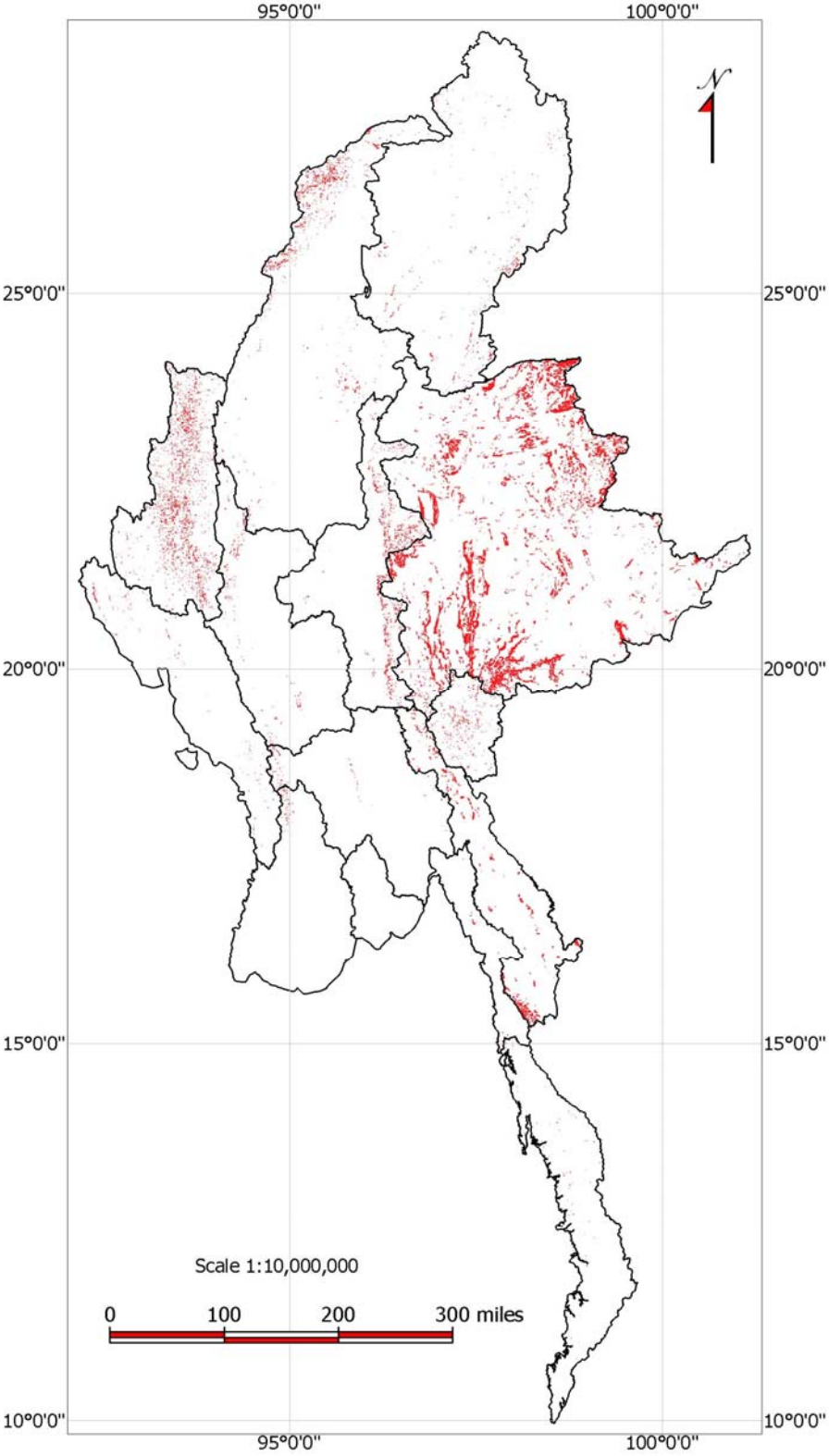
64. This is a commonly used indicator for assessing state of land degradation; and for tracking the total extent of vulnerable farming area in the sub-administrative areas of the country i.e., State and Division. It is expressed in acres. Vulnerable farming area is defined as the area of cultivated land susceptible to soil erosion, located at altitudes of 1000 feet and above with the slopes of 10 degrees and above.

Figure 3.1.Land Use in Myanmar



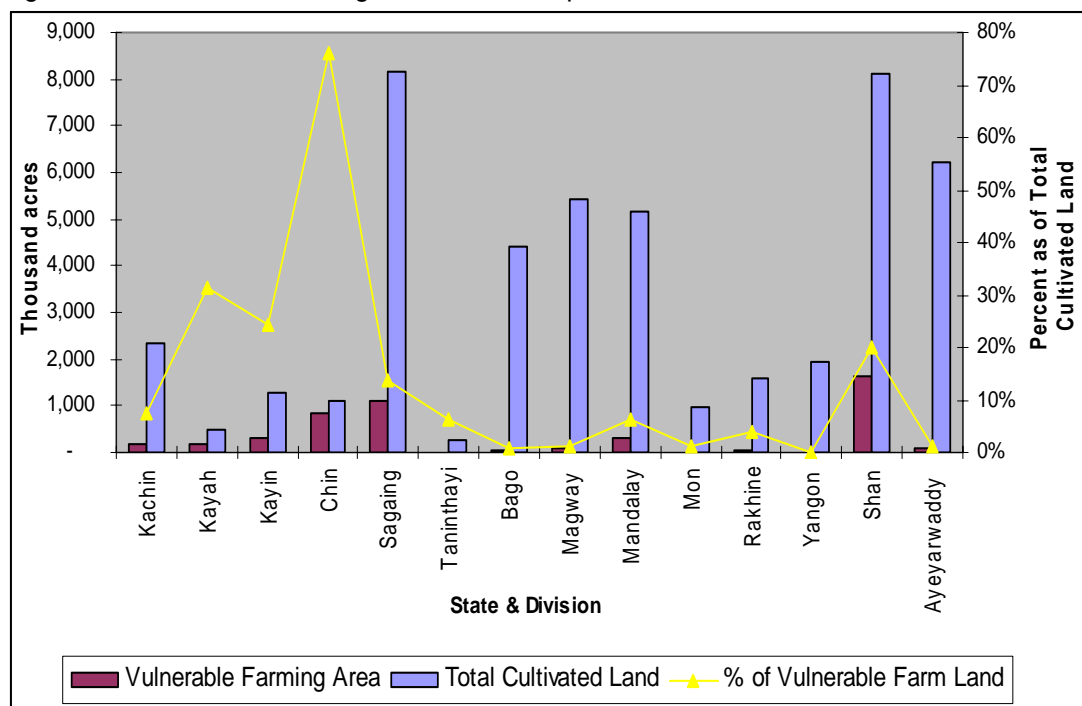
Source: Statistical Yearbook, CSO 2003

**Map 5 Distribution of Shifting Cultivation Above 10% Slope in Myanmar**



Source: Forest Department 2005

Figure 3.2. Vulnerable Farming Areas within respective Sub Administrative Areas 1998



Source: Remote Sensing and Geographical Information System Section, Forest Department 2005

65. Two hundred and thirteen townships accounting for 66 per cent of total administrative townships in Myanmar are located in the upland area of the country. The degree of risk associated with soil erosion in these areas is relatively high. The 1998 Forests Department RS/GIS data indicate that total vulnerable farming area with slopes of 10 degrees and more in these upland townships was estimated to be 4.8 million acres. Prominent amongst them were the Shan State (1.6 million acres), Sagaing Division (1.1 million acres) and Chin State (0.8 million acres) followed by Mandalay Division, Kayin State, Kachin State and Kayah States with smaller areas affected at 0.32, 0.31, 0.18 and 0.16 million acres respectively. In comparing vulnerable farming area with total cultivated area, the highest percentages of vulnerable farming area were found in Chin State (76%), Kayah State (31%), Kayin State (24%) and Shan State (20%). On the whole, the data reveal that 10 per cent of total cultivated land throughout the country is vulnerable to higher risk in soil erosion.

66. Soil conservation schemes and projects have been implemented in Shan and Chin States. The figures quoted above would suggest that similar programs are also needed in Kayah, Kayin, Kachin and Sagaing. Findings of the study "Soil Loss in Chindwin Watershed" (Nilar Aye, 2004) for Kachin, Sagaing and Chin found that total area subject to severe soil erosion had increased from 4,799 square kilometers in 1990 to 36,429 square kilometers in 2002 primarily due to rapid deterioration of vegetation cover. Soil susceptibility to erosion appears to have been the single largest factor in land degradation. However, due to data deficiencies more work is required to produce a more secure assessment of vulnerable farming area across the country.

**Suggested Rating :** Average with undetermined trend

**Justification:** Soil erosion is a key factor in making agricultural land vulnerable to land degradation in Myanmar. About 10 per cent of total cultivated land in the country is estimated to be vulnerable to severe soil erosion. Severely affected areas include Shan State, Sagaing Division and Chin State. Soil erosion in the upland regions of Myanmar is primarily a result of farming on steep lands (10 degrees or above). As data were only available for a single year (1998) the trend is undetermined. As percentage of total cultivated land, the existing vulnerable farming area is considered to be average.

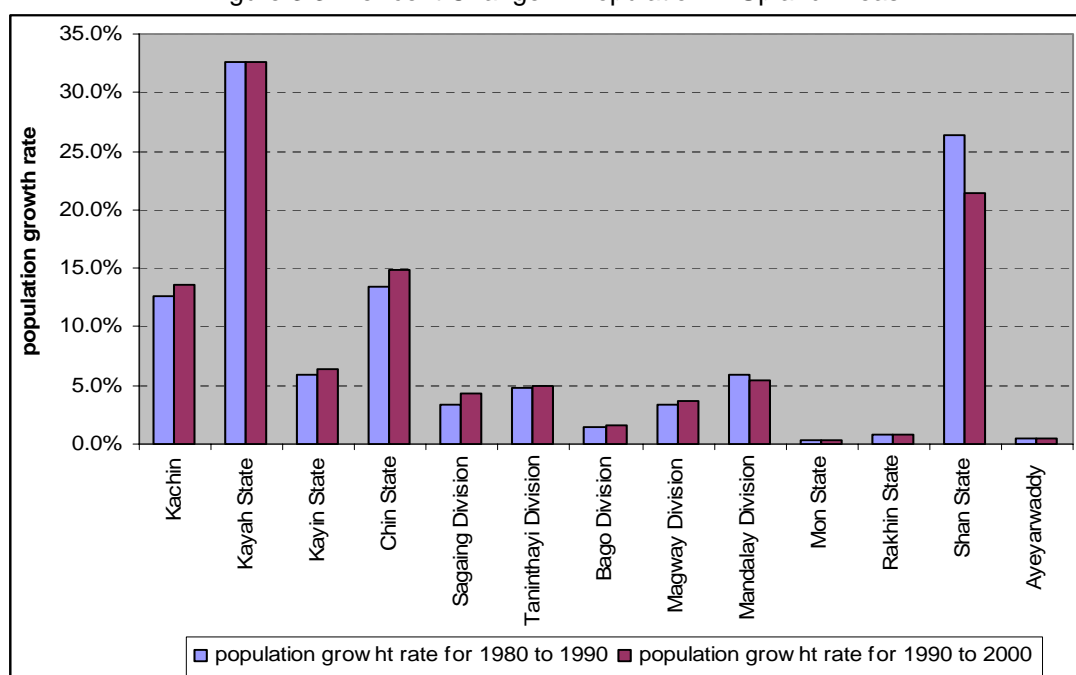
### 3.3 Pressure

Indicator: Growth in Upland Population 1980 to 2000

67. This indicator tracks the rate of change in the population of those townships within states or divisions that are either partially or fully located in upland areas. Population data are amongst the most comprehensively collected in GMS and changes in population are agreed to be an important driver of land use –and, indirectly, land productivity-- change, especially in upland areas; hence the choice of population as a pressure. Uplands areas are defined here as areas with altitudes of 1000 feet or more above sea level. Without recent occupation surveys for upland areas it is assumed that the majority of the population residing in upland areas are engaged in agriculture and other land related activities.

68. As of 2000, the upland population of 21 million accounted for almost 42 per cent of national population. The population growth rates were 3 % per annum in Kayah State, 2.1% per annum in Shan State, 1.4 % per annum in Chin State and 1.3 % per annum in Kachin State against the national average of 2% per annum. Except in Shan State, the general trend of population growth rates has been up between the period 1980-1990 and 1990-2000.

Figure 3.3. Per cent Change in Population in Upland Areas



Source: Adapted from Department of Population, DOP 2004 by authors of the report

69. Population increase in the upland areas has led to increased farming including the use of unsustainable farming practices. The relationship between farming vulnerability and population growth rates, however, is not clear cut with areas of high vulnerability including both areas of above-average and below-average population growth rates.

**Suggested Rating :** Medium and Steady

**Justification:** From 1980 to 2000, the population of upland areas grew by 6.8 million reaching 21 million, accounting for 42% of the national population. On the whole, population growth in upland areas is not significantly different from the national average although important differences exist among different upland areas. The pressure resulting from this growth is deemed to be medium and steady.

### 3.4 Response

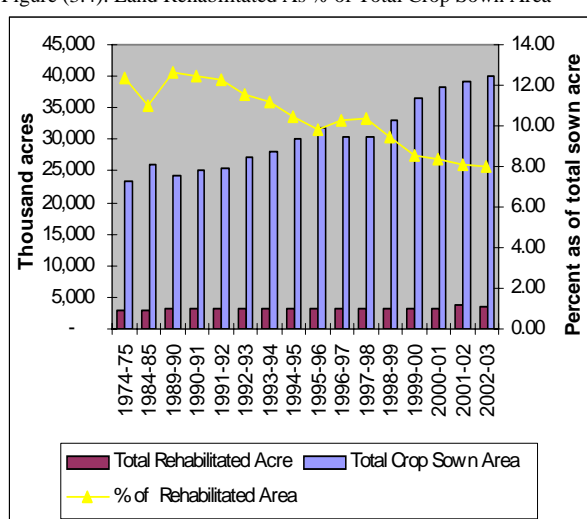
Indicator: Land Rehabilitated as Per cent of Area Sown to Crops 1974 to 2002

70. This indicator tracks the area of agricultural land under various conservation and rehabilitation programs (here, for simplicity referred to as rehabilitation programs) as a percentage of total area sown to crops, nation-wide. Details of different rehabilitation programs are given in the relevant factsheet. Area of rehabilitated land is among response indicators suggested by OECD.

71. Ministry of Agriculture and Irrigation is responsible for undertaking land rehabilitation including the promotion of terracing, contour bund making, SALT, agriculture extension activities including the use of organic fertilizers as well as flood management and prevention of saline water intrusion.

72. In 2003, the total area under land rehabilitation was 3.4 million acres which was 0.3 million acres or 10 per cent more than in 1989. Most of the area included multipurpose irrigation management schemes. Other land conservation and rehabilitation activities such as flood control, organic farming, erosion control, soil improvement measures and agricultural extension in general have been receiving increasing levels of official attention.

Figure (3.4). Land Rehabilitated As % of Total Crop Sown Area



Source: Department of Agriculture Planning, DAP 2005, and Statistical Yearbooks, CSO 1980, 1991, 1997, 2003

73. However, as Figure 3.4 shows, the percentage of rehabilitated area has averaged around 10% and seen a decline since 1989/90. The total area of sown crops has simply grown faster than the rate of land rehabilitation. The growing population of upland areas is largely responsible for the former. In addition, multiple cropping has become more common and conservation programs have not kept pace. The data can be interpreted in several different ways, either as suggesting that



farming is become more sustainable and fewer conservation and rehabilitation measures are needed than before, or that the proportionately lower level of conservation measures observed in recent years merely stokes up the problem of land degradation that will eventually show up in the value of the state indicator. A re-estimation of the 1998 figures of the percentage of vulnerable lands might help throw more light on the nature of the relationship. No information is available to assess the progress under MOAI's land rehabilitation targets.

**Suggested Rating :** Low and intermittent

**Justification:** On average, 3 million acres of agriculture land have been included each year in some form of land conservation and rehabilitation program of the Ministry of Agriculture and Irrigation. However, the growth of areas under crops has outpaced these rehabilitation efforts. Not enough information is available for now to assess of the effectiveness of land rehabilitation programs.

### 3.5 Conclusions

74. Several factors contribute to agricultural land degradation in Myanmar. Key amongst those factors is soil erosion. Around 42 per cent of Myanmar's population resided in upland areas (areas located at 1000 feet and more above the sea level), at the turn of the decade resulting in increased level of human activity in particular agriculture. Growth in agriculture has outpaced the rehabilitation efforts by the government. However, government has been taking steps to stem the impact of soil erosion and other associated impacts. Some of the key initiatives and programs being implemented by the government include:

- a. *National Action Plan to Combat Desertification*, United Nations Convention to Combat Desertification (NCEA, 2002)
- b. *Watershed Management Plan*, for conserving 52 catchments of newly constructed dams, Forest Department, (MOF, 2002)
- c. *Management of Development Activities in the Highland of Border Areas*, to reducing slash and burn cultivation on sloping lands by hill tribe people, Department for Progress of Border Area and National Race (MOI 2003, pp:227-232)
- d. *Planning Highland Reclamation for Period 2003 to 2007*, Ministry of Agriculture and Irrigation (MOI 2003)
- e. *Implementation of community based natural resource management activities*, International and Local Non-Governmental Organizations (NCEA, 2000)

75. In spite of the above initiatives more work is needed to safeguard the productivity of the upland farms in conditions of growing upland population. The Ministry of Agriculture and Irrigation has taken the lead in implementing the programs for land management. It has set targets for reclaiming 111,900 acres of permanent sloping agriculture land; 223,816 acres of slash and burn area in the period from 2003 to 2007 in Eastern and Northern Shan State and Chin State.

**Suggested Rating: 2 STAR**

**Justification:** The growth in upland population has led to an increase in the area under crops in vulnerable areas. The data are not sufficient to establish with confidence whether there has been an overall deterioration or improvement in the productivity of land in recent years. Our knowledge of the scale of the problem has improved but the monitoring of the state of land resources needs to be sustained in order to derive robust enough conclusions. Targets have been set for rehabilitating the land affected by soil erosion, slash and burn etc. In addition, Myanmar is undertaking its obligations under UNCCD.

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## 4. Water Resources

### 4.1. Context

76. Due to favorable climatic conditions and large river basins that cover 90% of the country's area, Myanmar is perceived as a low water stress country. In terms of available water resources, Myanmar stands at 14<sup>th</sup> position globally and 5<sup>th</sup> position in the Asian region. There are altogether eight major river basins and it is estimated that the surface and groundwater potential of Myanmar is 876 and 400 million acre feet per annum respectively (Zaw Win, 2004).

Table 4.1. Average Annual Water Resource Potential by River Basin

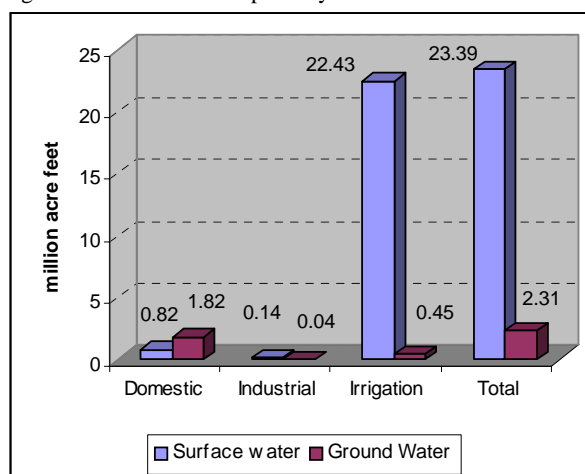
River Basin No	Name of River Basin	Drainage area (Square mile)	Surface Water (Million Acre Feet)	Ground Water (Million Acre Feet)
I	Chindwin	44,500	114.5	46.6
II	Upper Ayeyarwady	74,600	184.7	75.0
III	Lower Ayeyarwady	36,900	69.5	124.1
IV	Sittoung	18,600	65.8	23.0
V	Rakhine State	22,500	112.8	33.8
VI	Taninthari Division	15,700	106.1	31.8
VII	Thanlwin	61,000	209.0	60.6
VIII	Mekong	11,000	14.3	5.7
Total		284,800	876.7	400.6

Source: Irrigation Department, 2005

77. However, making this abundant water resource available for human use requires investment and currently that remains a challenge for the country's planners and decision makers. According to a 2000/2001 assessment by the Irrigation and Water Utilization Departments, total annual water consumption was roughly 25.7 million acre feet, about 2% of the total water potential annually available. By sectors, 89 % of annual water consumption was for agriculture use, whereas water for domestic and industry uses accounted for 10% and 1% respectively.

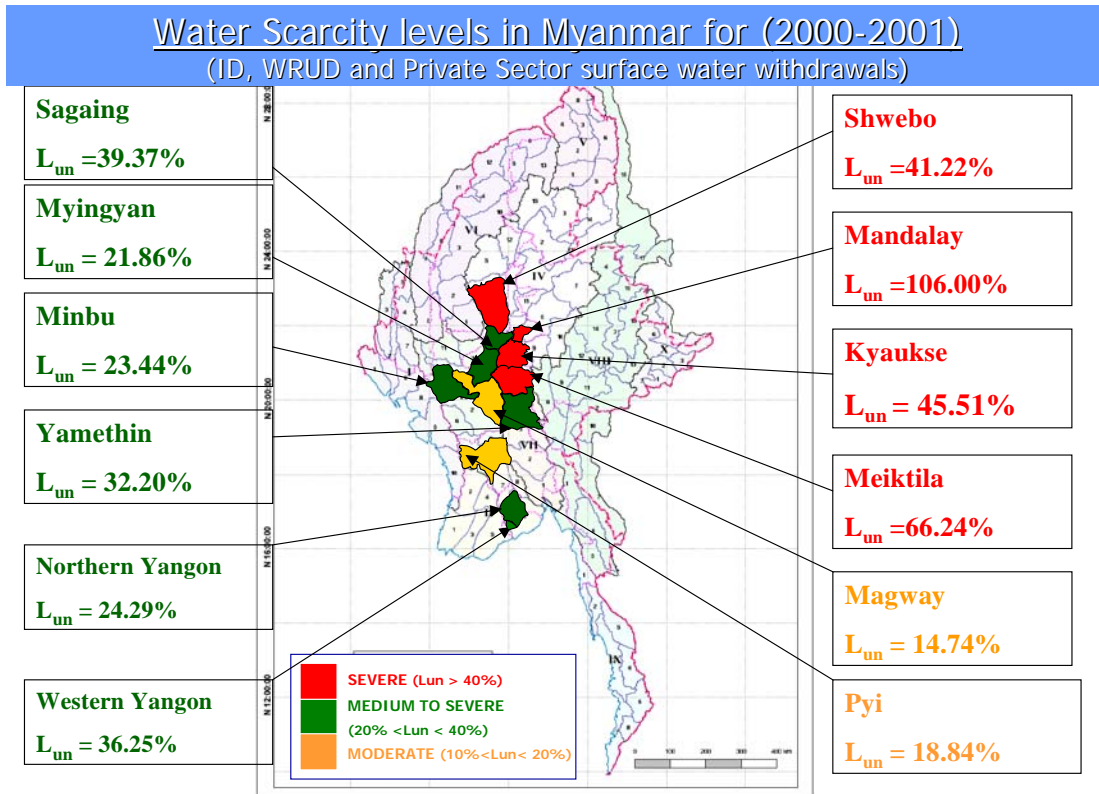
78. The inability to translate abundant water resources into reliable water supply results in seasonal water shortage in some regions of the country, particularly in the dry zone of central Myanmar and the rain shadow areas. Out of 63 districts throughout the country, 12 districts were classified as water shortage areas (see Map 6 and Map 7). In this EPA, management of water resource is assessed with respect to drinking water and water for agriculture use.

Figure 4.1. Water Consumption by Sector -Year 2000-2001



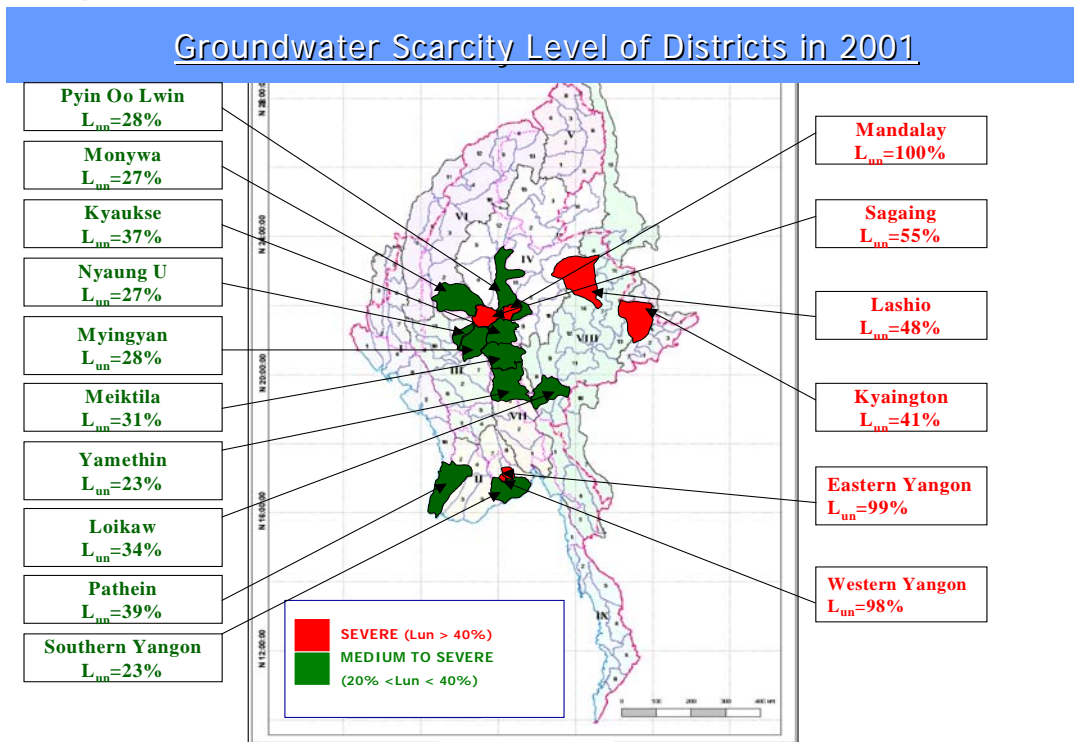
Source: Irrigation Department, 2005

**Map 6**



**Source:** Myanmar Academy of Agriculture, Forestry and Livestock and Fisheries Science (2003). Agricultural water resource study in Myanmar (water scarcity variations in Myanmar), Yangon, December 2003

**Map 7**



**Source:** Myanmar Academy of Agriculture, Forestry and Livestock and Fisheries Science (2003). Agricultural water resource study in Myanmar (water scarcity variations in Myanmar), Yangon, December 2003

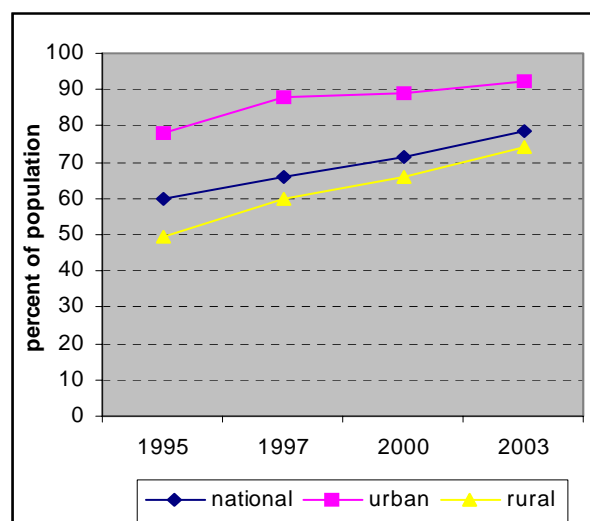
## 4.2 State (Drinking Water)

Indicator: Per cent Population with Access to Safe Drinking Water 1995 to 2003

79. This indicator measures the percentage of national population (urban and rural) with access to safe drinking water. Halving the percentage of people without access to safe potable water by 2010 is one Millennium Development Goals (MDGs).

80. As observed in Figure 4.2, the share of population with access to safe drinking water in Myanmar has been growing. In 1995, 60 per cent of national population had access to safe drinking water and this increased to 80% in 2003. This improvement was observed in both rural and urban areas. In rural areas, access increased from 50% in 1995 to 74% in 2003. In urban areas the increase was from 78% in 1995 to 92% in 2003.

Figure 4.2. Percent of Population Access To Safe Drinking Water



Source: Multiple Indicator Cluster Survey, Ministry of Health 2003

81. Among the various sources of safe drinking water, the use of protected open dug wells and ponds has been the highest (34%) followed by the use of tube wells (22%). Piped water supply to households has also increased and by 2003, 15.4% of total population was estimated to have access to piped water supply. Population with water supply from a public standpipe source declined from 8.8% to 7.3% during this period confirming the move to piped water supply.

82. The official target for safe drinking water is to have full access for all people by 2010. At present, approximately 80% of the population enjoys such access.

**Suggested Rating:** Average and improving

**Justification:** For the country as a whole, access to safe drinking water increased by almost 20 per cent between 1995 and 2003 to a total of 80 percent. The rates in rural and urban areas were 74% and 92%, respectively. As of 2000, the corresponding figures for GMS countries ranged from 30% to 80% and Myanmar's figures were therefore at the high end of the range.<sup>11</sup>

## 4.3. Pressure (Drinking Water)

Indicator: Population Growth - 1985 to 2015

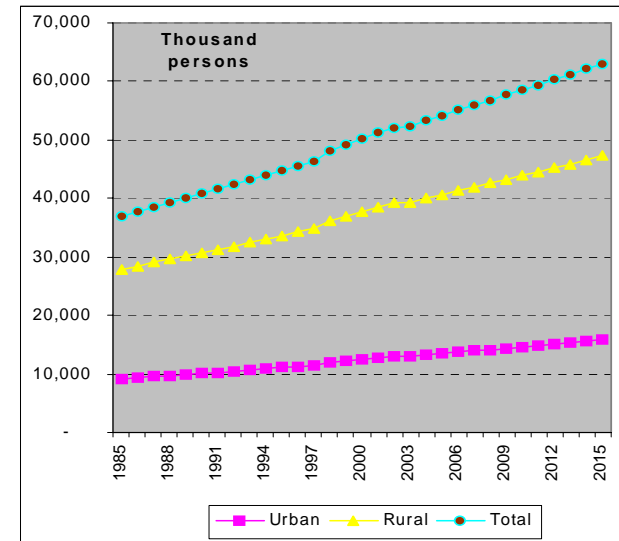
83. This indicator presents the growth in national population, projected to the year 2015 (beyond 2010 the year for MDG target for safe drinking water). It is estimated

<sup>11</sup> Asian Development Bank (2004), "Greater Mekong Region – Atlas of the Environment", Manila, pp:193

that total population in year 2015 will be 62 million, an increase of about 16% of in the next decade. As discussed per cent of population with the access to safe drinking water was 80% up to 2003, equivalent to 42 million persons approximately.

84. In order to meet the target of drinking water to all by 2010, 20 millions people (or 4 million people per annum) will need to be provided access to improved water supply. In the last eight years from 1995 to 2003, an average of 2.5 million people annually acquired access. This is a considerable achievement. However, unless the pace of the activity is considerably stepped up the 2010 target will not be achieved (although the relevant MDG already has been).

Figure 4.3. Rural and Urban Population 1985 to 2015



Source: Statistical Yearbooks, CSO 1992 & 2003

**Rating:** High and Increasing

**Justification:** An additional 20 million people need to be provided access to safe drinking water if the target of water to all has to be met by 2010. Whereas the current rate of safe water access approx. 80% is commendable, additional work is required to meet the targets set of 2010 and 2015. Projected growth of rural population is higher than that of urban population and the effort will need to take this into account.

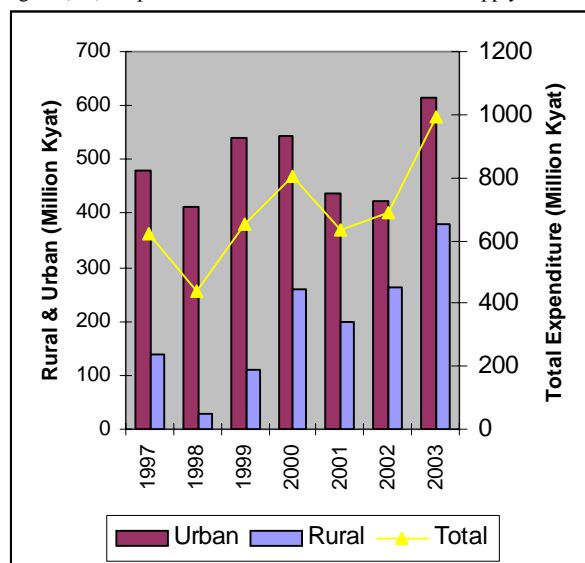
#### 4.4 Response (Drinking Water)

Indicator: Expenditure on Drinking Water Supply 1997 to 2003

85. This indicator tracks the inflation-adjusted expenditure by concerned government departments on improved access to safe drinking water supply throughout the country.

86. There are several organizations involved in improving water supply in Myanmar. Department of Development Affairs is the key agency responsible for both town and rural water supply. Water supply in the capital cities like Yangon and Mandalay, are the responsibility of municipal authorities (Yangon City

Figure (4.4). Expenditure for Rural and Urban Water Supply



Source: WRUD (2005), YCDC (2005), DDA (2005) & MCDC 2005.

Development Committee – YCDC and Mandalay City Development Committee – MCDC). Housing Department under the Ministry of Construction is also involved in developing water supply for the housing estates in these cities.

87. In addition, rural water schemes have been supported by the Environmental Sanitation Department under Ministry of Health, Water Resource Utilization Department (WRUD) and the Irrigation Department. International organizations like UNDP, UNICEF and international NGOs are also implementing community development activities related to rural water supply in their project areas. Private sector has contributed to the establishment of water supply infrastructure especially in the dry zone areas. For the purposes of this indicator expenditure data from WRUD, DDA, YCDC and MCDC have been used.

88. Total investment for rural and urban water supply expressed at constant prices of 1997 reached 994 million kyat in 2003, 60 per cent more than in 1997 (Figure 4.4.).

**Suggested Rating :** Significant and consistent  
**Justification:** Expenditure on the provision of safe drinking water has been increasing since 1998. The expenditure has been consistent and instrumental in helping reach a figure of 80% country-wide access by 2003. More work is still required to meet the goal of safe potable water for all by 2010.

#### 4.5 Conclusions (Drinking Water)

89. Significant progress has been made in providing safe drinking water access in Myanmar. While the population of Myanmar increased steadily, at around 2 per cent per annum, the rate of access to safe potable water was faster than that, around 2.5 per cent per annum. Nonetheless if the 2010 policy target of full access to drinking water is to be achieved, provision of access will need to be accelerated and grow by about 5 per cent per annum.

**Suggested Rating: 2 STARS**  
**Justification:** Notable progress has been made and Myanmar scores well in comparison to other GMS countries. Also, Myanmar seems to be making progress towards the objective of providing safe drinking water access for its entire population. Institutional responsibilities are being discharged by appropriate government authorities though the tempo needs to be stepped up to keep pace with the growing population.

## 4.6 State (Water Resource for Agriculture)

Indicator: Irrigated Area as Percentage of Irrigable Area 1997 to 2002

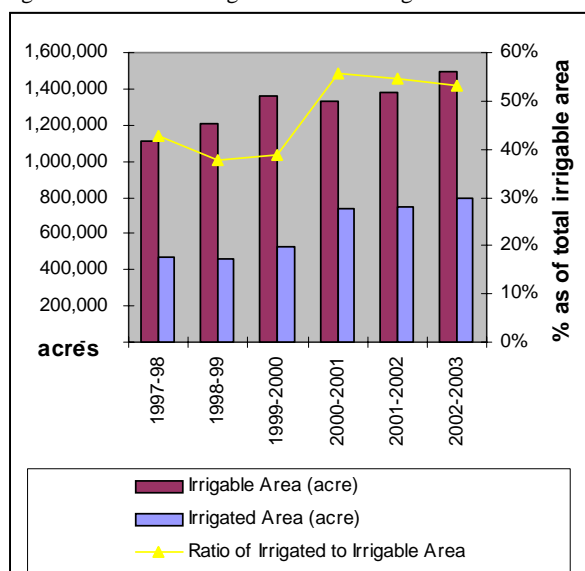
90. This indicator tracks the capacity of irrigation storage facilities to serve potential command areas. It is expressed as a share of agricultural land actually irrigated in the total irrigable area served by the facilities constructed by Government's Irrigation Department.

91. Figure 4.5 plots the values of the indicator. The ratio rose steadily, approximately doubling during the period 1997 to 2002 to approximately 50%.

92. This was the result of a strong official support since 1989 for the policy of increasing the irrigation storage capacity. By the end of the budget year 2001/02, the water storage capacity reached almost 10 million acre feet, or 27 times more than in 1989.

93. The indicator points to a significant improvement in the overall capacity of the system to deliver water to the fields. There is a number of reasons why the percentage falls well short of 100 per cent: Factors such as the pattern of annual precipitation, maintenance of canal systems and off-take structures, conveyance losses and others reduce the percentage of water effectively delivered (see FAO 2004, pp:10-11) and all of these have played some role in Myanmar. The government's policy since the launching of pro-market reforms of 1988 has been to utilize fully the water resource potential for agricultural development although no official target value of the indicator has been formulated.

Figure 4.5. Ratio of Irrigated Area To Irrigable Area



Source: Irrigation Department, 2005

**Suggested Rating :** Average and improving

**Justification:** The volume of irrigation water storage capacity has increased 27 times since 1988, following the construction of more reservoirs and irrigation facilities. The target is to maximize the percentage of potentially irrigable areas that actually receive irrigation supplies. That percentage stands at about 50% at present and this is considered average. The trend has been improving but still has a long way to go to meet the potential.

## 4.7. Pressure (Water Resource for Agriculture)

Indicator: Irrigated Crop Sown Area 1985 to 2002

94. This indicator tracks the growth in the total demand for irrigation water. It is measured by the total area effectively irrigated allowance made for multiple cropping.



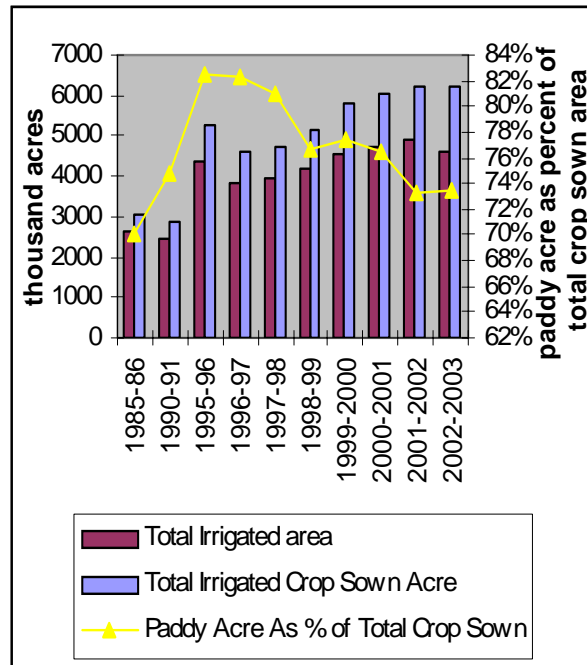
95. As observed in Figure 4.6, the value of the indicator rose to 6.2 million acres between 1985 and 2002, a nearly two-fold increase. Total area served by irrigation showed a similar increase reflecting the expansion of the irrigation water storage capacity described in the previous section of this EPA

96. In 2002, the area sown of irrigated crops was 134% of the total irrigated area in 2002 pointing to a significant extent of multiple cropping. Paddy played a major role in this as the policy of self-sufficiency in rice production led to a greater share of paddy in the prevailing cropping patterns, such increase particularly marked from mid-1980s to the mid 1990s (Figure 4.6)

97. Water requirements for paddy cultivation under double cropping can be as high as 5 acre feet per acre. The 4.5 million acres planted to paddy in Myanmar in 2002-2003 thus created a potential demand for up to 22.5 million acre feet of irrigation water. This compares with the capacity of irrigation water storage in the Irrigation Department's reservoirs of about 10 million acre feet at present.

98. The current acreage of irrigated paddy sown area is therefore already exercising pressure on irrigation water supplies and the capacity of the storage and conveyance system. The promotion of multiple cropping of paddy in line with the policy of achieving self-sufficiency in rice promises to further add to this pressure.

Figure 4.6. Irrigated Crop Sown Area and % of Paddy



Source: Statistical Yearbook, CSO 2003

**Suggested Rating:** High and steady

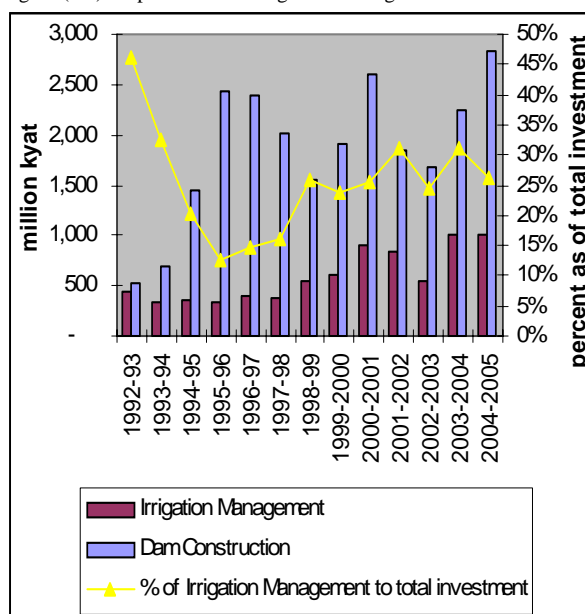
**Justification:** Irrigated sown area approximately doubled from 3 to 6 million acres during the period 1985 to 2002. More than 70 per cent of this growth was the result of a greater share of paddy in the cropping patterns. Given the continued policy and strategic preference for more paddy, the pressure on supplying more water for irrigated farming is set to remain high in the foreseeable future.

## 4.8 Response (Water Resource for Agriculture)

Indicator: Expenditure on Irrigation Management 1992 to 2004

99. This indicator tracks the expenditure on irrigation management by the Irrigation Department, expressed in millions kyat per annum. Figure 4.7 plots the values of the indicator as well as expenditures on dam (reservoir) construction, and expenditure on irrigation management as a percentage of the overall investment by the Irrigation Department. A rising trend in all forms of irrigation expenditure can be observed. The 2004-05 level of budget spending is twice as high in real terms as the 1992 levels. The increased spending during the studied was directed at improved irrigation management, alongside a sharp increase in investments in reservoir construction.

Figure (4.7). Expenditure on Irrigation Management



Source: Irrigation Department – ID 2005

100. During the period 1992 to 2004, expenditure on irrigation management as a percentage of total investment of the Irrigation Department ranged from 12 to 45 percent.

101. As noted earlier, the ratio of irrigated to irrigable area was approximately 50 per cent in 2000. The increase in expenditure on irrigation management in the last few years has made it possible to stabilize the trend at around 50 per cent. However, more work is still required to capture the potential to further increase this percentage.

**Suggested Rating:** Average and consistent

**Justification:** The real value of expenditure on irrigation management has been increasing in real terms and its value now is about the double of what it was in 1992. Sustained funding of the irrigation water storage capacity and irrigation management has made it possible to improve, over time, the percentage of total lands effectively irrigated. .

## 4.9 Conclusions (Water Resource for Agriculture)

102. Efforts have been made since 1989 to increase irrigation water storage and improve irrigation infrastructure to boost water supply to the agricultural sector. The storage capacity has increased spectacularly since 1989 and with it, the area irrigated (and area sown). The conveyance and other losses have been reduced during the last decade to allow a greater percentage of the area potentially irrigable to actually receive water but more can be done.

103. The demands on irrigation supplies and corresponding infrastructure are closely linked to the pattern of cropping. Here, the official preference for self-sufficiency in paddy and for greater use of multiple cropping have significantly increased the demand for irrigation water. Irrigation management including canal maintenance, better monitoring and mobilization of local farmers for participatory water distribution and management, have been strengthened through greater government budgetary allocations. More effort is still required to realize the full potential of the irrigation storage facilities.

**Suggested Rating: 2 STARS**

**Justification:** Government efforts to utilize more fully the irrigation water storage capacity have yielded tangible results with almost 50% of the total irrigable area receiving irrigation supplies. Still more can be achieved. The Government has significantly and consistently increased its funding for the sub sector.

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## **5. Solid Waste Management**

### **5.1. Context**

104. Since Myanmar jettisoned the socialist economy in 1988, the pace of urbanization quickened with the mainly urban-based private sector leading the way. Many cities and townships throughout the country have expanded their boundaries and new settlements have been created. Many urban squatters have been relocated to the new settlements. Between 1988 and 2001, 18 industrial zones were established most of them are located at Yangon and Mandalay. The number of factories increased from 39,802 to 55,227 in the same period (MOI, 2002, pp:67). The population of Yangon City grew from 2.5 million in 1983 to 4.1 million in 2003/2004 and Mandalay from 532,949 in 1983 and to 856,264 in 2003 (Department of Population, DOP 2005).

105. The industrial and urban expansion, while clearly positive for employment and incomes, has brought with it the challenge of wastewater and solid waste management. Throughout the studied period, the volume of each of the principal categories of solid waste, i.e. household, commercial and industrial, increased though –as shown later- increased much less than might have been expected, especially in Yangon.

106. Traditionally, waste collection and disposal in Myanmar have been the responsibility of local municipal authorities, without any private sector involvement. In Yangon (lower Myanmar) and Mandalay (upper Myanmar), autonomous City Development Committees and their Pollution Control and Cleansing Departments (PCCDs) with a network of branches and sub-units are tasked with solid waste management within their municipal areas. In other parts of the country Township Development Committees under the Department for Development Affairs (DDA), Ministry of Progress of Border Area Development and National Races and Development Affairs (MPBND), manage municipal waste collection and disposal. This makes DDA responsible for 323 out of the total of 325 townships in Myanmar.

107. The assignment of institutional responsibility for waste management is clear but there are financial and other hurdles to effective performance by these bodies. [Khin Maung, 1997, pp:301 and Yamauchi and Sato (2001)]. Traditionally, urban centers have claimed most of the attention of the agencies responsible for waste collection while sub-urban areas continue to rely on burning of waste or dumping it into in unauthorized low-lying areas (Yu L.S, 1998, pp: 23). In some townships, solid waste has been used to raise the level of streets and lanes prone to flooding. (Khin Maung, 1997, pp: 298-299).

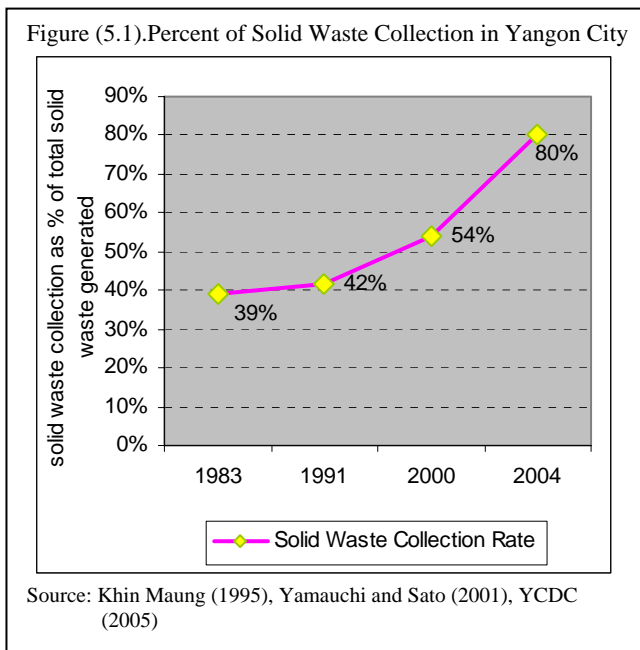
### **5.2. State**

Indicator: Per cent Solid Waste Collected in Yangon City 1983 to 2004
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108. This indicator measures the volume of solid waste collected by official means from the point of production, expressed as a percentage of total estimated municipal solid waste generated. Municipal solid waste is defined as the “non gaseous and non-liquid waste” that results from the daily activities of community’s residential and commercial sector within a given administrative urban area.

109. The indicator was based on the data for Yangon City. It was confirmed by PCCD/YCDC that most of municipal waste collected in Yangon is disposed at designated dumping sites.

110. The values of the indicator (Figure 5.1) show that the total volume of solid waste collected in Yangon capital grew from 400 tons/day in 1983 to 1150 tons/day in 2003/04. The percentage of solid waste collected increased from 39% in 1983 to 80% in 2003. Solid waste management in Yangon has clearly been improving even if the figure of 80% is still low in comparison with, for instance, Bangkok.



111. At present all waste collected by the municipality is hauled to designated dumping sites which also accommodate any other waste. PCCD/YCDC data suggest that 99.96 % of the total amount of transported waste in 2004 was treated by land filling and about half a ton (0.04% of the total) of medical waste was incinerated. Approximately 10% of total solid waste generated was collected by private collectors and used as raw materials for cottage industries in Yangon.

112. With respect to the volume of waste collected and disposed in other States and Divisions (except Yangon & Mandalay), it was found that 9 out of 14 States and Divisions had lower rates of collection in 2003 than in 1998. Improvement in solid waste disposal was observed only in Magwe Division, Mon Division, Shan State and Ayeyarwady Division (see the relevant factsheet for details). On a national basis, the per cent of solid waste disposed of in 2003 decreased to 28% from 24% in 1998. (see Figure 2 of the relevant factsheet)

113. It seems safe to conclude that solid waste management in Myanmar presents a mixed picture of clear improvements in the country's two premier cities combined with stagnating or even deteriorating collection and disposal in other States and Divisions. Although no quantitative target has been formulated to which the indicator could be related, the "Green and Garbage Free City" campaign embodies the official desire to improve collection and disposal. While medical waste is recognized as a separate category deserving (and getting) a special disposal regime the same has not yet happened with other types of hazardous waste much of which is mixed in with the solid waste.

**Suggested Rating :** Relatively poor and stabilizing

**Justification:** The percentage of solid waste collected in Yangon City increased from about 40% at the beginning of the 1990s to 80% in 2004 whereas it declined from 28% in 1998 to 24% in 2003 for all other urban areas taken together. No quantified national targets have been established for solid waste management but the Government has launched the “Green and Clean City” campaign. The percentage of waste collected in Yangon has improved and is comparable to, for instance, Hanoi but it lags significantly behind Bangkok.

### 5.3 Pressure

Indicator: Municipal Solid Waste Generated in Yangon City 1983 to 2004

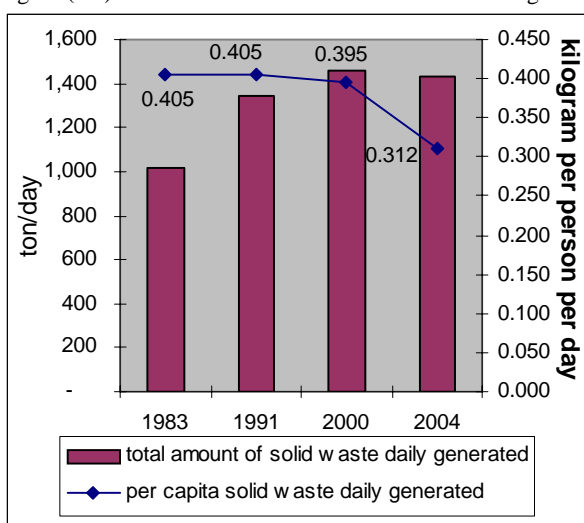
114. This indicator tracks the amount of solid waste generated per person per day in Yangon municipal area. As before, municipal solid waste is defined as the “non gaseous and non-liquid” waste generated by the community in the residential and commercial sector in an urban administrative area. It is expressed in kg per day.

115. It can be seen from Figure 5.2, that the volume of waste generated decreased in the period 1983 to 2004, on a per capita basis. This is unexpected given the rising real GDP per capita during the last decade. International evidence almost invariably finds a strong positive correlation between disposable incomes and the volume of solid waste. If recent efforts of PCCD to collect fees for waste disposal are responsible for the declining trend (as has been suggested) this would provide a nice illustration of an economic instrument that appears to work the way it was intended to.

116. In general, solid waste in Yangon is characterized by high proportion of biodegradable materials. A study by YCDC in 2003 found that on average, solid waste contained 77% food refuse, 7% paper and textile, 13% plastics and 3% other substances. This largely confirmed World Bank’s earlier estimate (World Bank, 1999) that put the percentage of biodegradable waste at 80%. The modest increase in the share of paper and plastic waste observed for year 2003 indicates a growing importance of waste from commercial sources.

117. Despite a significant fall in solid waste per capita in Yangon, the total amount of MSW generated in Yangon has remained steady due to urbanization and population growth. World Bank’s 1999 study contains a comparison among selected GMS capitals. Yangon’s daily amount of solid waste of about 1,400 ton falls well within the range of about 100 tons/day in Vientiane/Lao PDR to 6000 tons in Bangkok.

Figure (5.2). Amount of Solid Waste Generated in Yangon



Source: Khin Maung (1995), Yamauchi, Hisashi. and Sato, Shinsuke. (2001), YCDC (2005), Immigration & Manpower Dept (1986), DOP 2005

**Rating :** Medium and steady

**Justification:** The total volume of waste generated by Yangon City has remained fairly steady during the last decade despite the growth of the city's population. Reduced volume of waste per capita is largely responsible for this outcome and it seems that the authorities' greater efforts at collecting the waste disposal fees have played a role in this outcome.

#### 5.4 Response (Inadequate Solid Waste Management)

Indicator: Expenditure on Solid Waste Management in Yangon City 1994 -2004

118. The indicator tracks the annual expenditure on solid waste management by Yangon City Development Committee. It is expressed in million kyat at constant prices of 1994. Consumer Price Index of the Central Statistical Organization was used to convert current to constant prices.

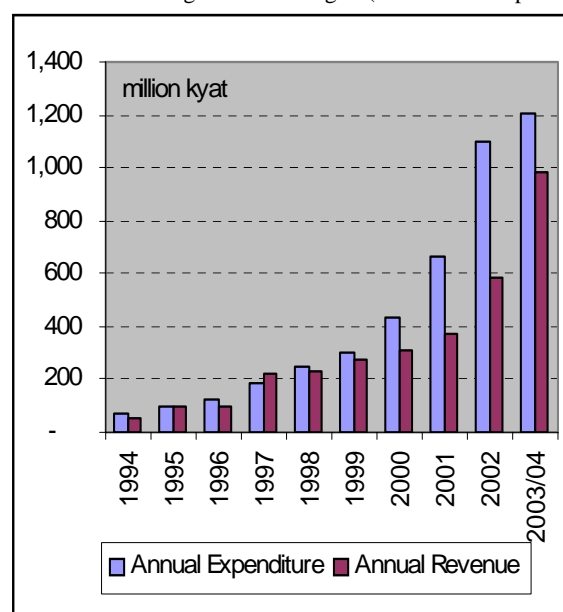
119. As observed in Figure 5.3, the inflation-adjusted expenditure on solid waste management increased steadily from the 1994 level of 69 million kyat to 300 million kyat in 2003, an almost four and half fold increase. The increase was particularly steep during the last four years (2000 to 2004), demonstrating a clear commitment on the part of government.

120. The revenues generated by PCCD/YCDC also increased and this helped reduce waste disposal subsidies from 376 kyat per ton in 2000 to 134 kyat per ton in 2003. The more aggressive cost recovery policy of PCCD/YCDC clearly had both an incentive effect referred to earlier on and a healthy financial effect.

121. The largest components of the expenditure were labor and waste handling. A total of 4,469 workers were employed by PCCD/YCDC in waste collection and disposal in 2003/04 compared to 1700 in 1983. There was some capital expenditure for waste-treatment infrastructure such as establishment of West Final Disposal Site in Hlaing Tharyar during the last three years of the observed period. Collection and disposal continue to dominate for the time being and waste treatment (re-cycling) plays a minimal role.

122. In summary, real expenditure on solid waste management has increased and financial viability (and, hence, sustainability) of waste collection and disposal has improved within Yangon municipal area.

Figure (5.3). Expenditure and Revenue in Solid Waste Management in Yangon (1994 constant price)



Source: CSO (1997), CSO (2002), & YCDC (2005)



**Suggested Rating :** Average and consistent

**Justification:** Financial resources made available for solid waste management in Yangon steadily increased from 1994 to 2004. Total expenditure in 2003/04 was four and a half times higher than that of 1994. The financial viability of waste collection and disposal in Yangon has improved.

## 5.5 Conclusions

123. Solid waste collection and disposal improved considerably in Myanmar's two principal cities during the last decade but remain unsatisfactory in the majority of small towns and settlements. Somewhat surprisingly, in Yangon, the total volume of solid waste generated remained steady at a time of strong population growth and this was achieved through a reduction in waste generation per capita. About 80 per cent of waste generated in Yangon is now collected and deposited at designated landfills. The performance in second-tier towns has stagnated or even deteriorated slightly. The achievements in Myanmar and Mandalay reflected a significant increase in budget support for solid waste management and sustained efforts to improve cost recovery. The Government's vision has been articulated in the 'Green & Clean City' campaign without, however, being accompanied by specific quantified targets for the activity.

124. Until now, the focus in Myanmar's cities has been on collection and disposal of waste to the detriment of waste treatment and re-cycling. Also, with the exception of medical waste, the question of hazardous waste has not featured significantly in the discussion of performance and its monitoring. Quantified targets that would make monitoring of performance easier have not been formulated or sufficiently publicized.

**Suggested Rating: 2 STARS**

**Justification:** Progress has not been consistent in collection and disposal of solid waste in Myanmar during the last decade and a half. Improvements are noticeable in the two largest cities but performance remains poor elsewhere. Also, little information exists in disposal methods. No quantified targets exist; however budgets for solid waste management have been increased and steps taken to improve the financial performance of the entities charged with solid waste management.

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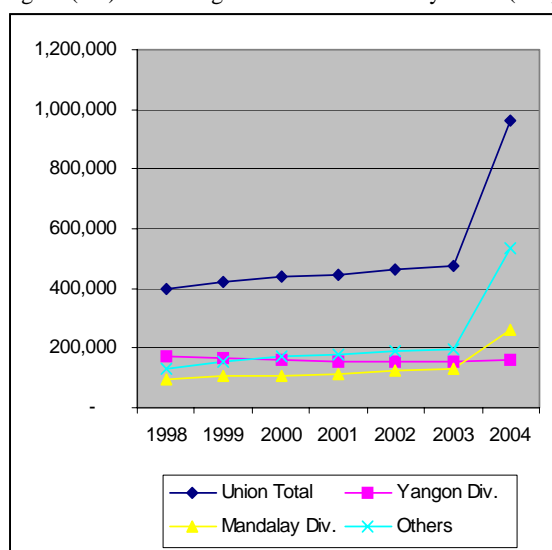
## 6. Mobile Source Air Pollution

### 6.1 Context

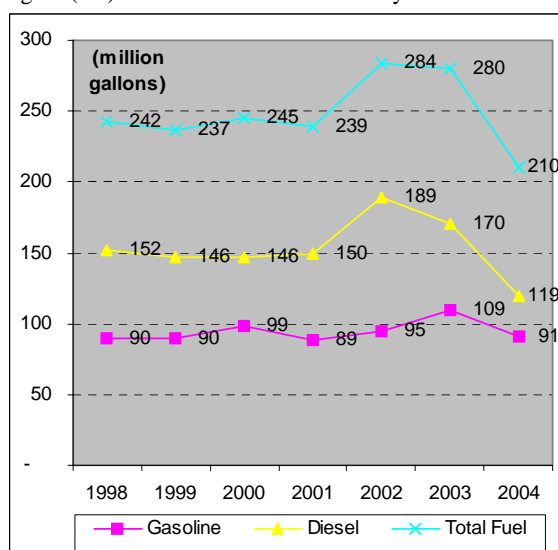
125. Since 1993, Myanmar has recorded annual GDP growth rates ranging from 5.7% to 10.9% resulting in a gradual improvement in the standard of living of the middle classes in urban areas. Growth of vehicle ownership has been a sign of that modest prosperity. Vehicle import rules were relaxed at the beginning of the 1990s. The growth in the total number of registered vehicles in Yangon and other urban centers of Myanmar, rapid in the last two years, is shown in Figure 6.1.

126. Increases in vehicular density and in automotive fuel consumption (see Figure 6.2), have inevitably led to a rise in air pollution levels in the cities, particularly Yangon and Mandalay. Although –somewhat surprisingly-- there is no national standard on ambient air quality, WHO standards for air quality are an appropriate alternative standard for assessing the performance of mobile source pollution for the purposes of this EPA. A 1996 UNEP/WHO study undertaken with the Occupational Health Unit of the Department of Health spoke of a worsening air pollution in Yangon linked to the use of low octane number petrol containing lead and other additives (National Environmental Engineering Research Institute, 1996, pp:20).

Figure (6.1). Total Registered Vehicles in Myanmar (No.) Figure (6.2). Automotive Fuel Sold in Myanmar



Source: Energy Planning Department- EPD, 2005



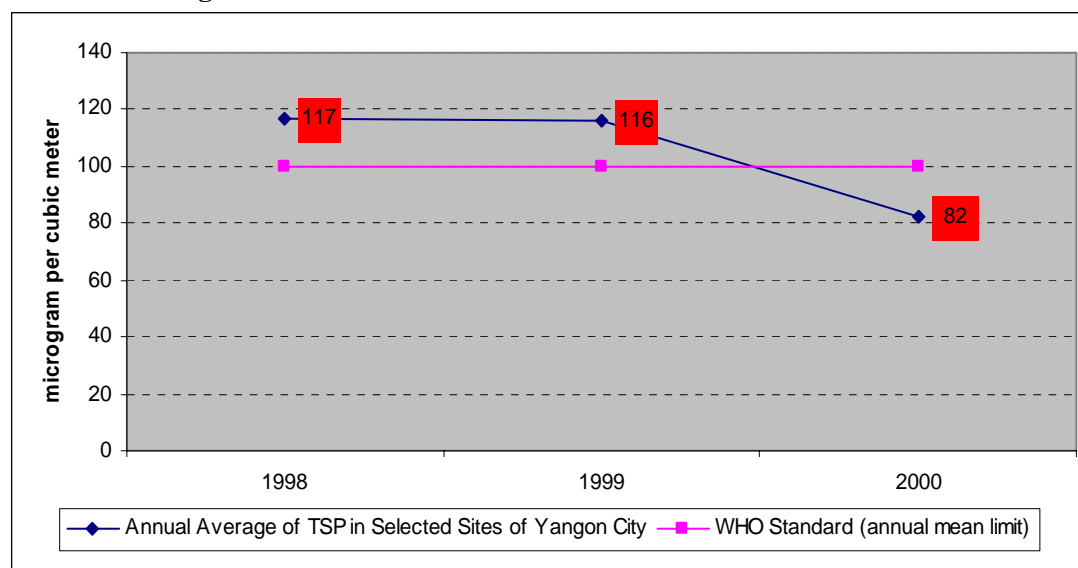
Source: Energy Planning Department- EPD, 2005

### 6.2. State

127. The concentrations of suspended particulate matter (SPM) in Yangon City have been chosen as indicator of air quality. TSP concentrations capture reasonably well the spectrum of fine solid and liquid particles associated with mobile source emissions though, clearly, the nature and chemistry of such pollution is very complex and the number of pollutants large. However, data on many other types of air pollution are simply not available in Myanmar for the time being or not available for a meaningfully long period.

Indicator: Total Suspended Particulate (TSP) Concentration in Yangon City 1998 to 2000

**Figure 6.3. Annual Average of Total Suspended Particulate (TSP) matter in Capital Yangon**



Source: Adapted from Wai Zin Oo, Department of Atomic Energy, Ministry of Science and Technology, 2001

128. Figure 6.3 shows the concentrations of TSP (annual averages for selected sampling sites in Yangon city) during the period 1998 – 2000. The annual average of TSP concentrations exceeded the WHO standard of  $100 \mu\text{m}^3$  in two out of the three years of the studied period. Not surprisingly, seasonal variations were observed (please refer to the relevant factsheet), the concentrations being higher during summer (April and May) and early winter months (November and December) than during other parts of the year. To be expected also, TSP concentrations were higher in areas with a high density of vehicles viz., Theinphyu Road, Shwe Gon Daing Junction, Kanber Aye road, Yankin and Thamine junction.

129. Data on additional parameters viz., aerosol concentrations,  $\text{SO}_2$  concentrations are also presented in the relevant factsheet. The annual average of lead concentration in 1997, 1998 and 1999 ranged from  $0.3$  to  $0.5 \mu\text{m}^3$ . This was close to but below WHO's standard of  $0.5$  to  $1 \mu\text{m}^3$  (National Environmental Engineering Research Institute, 1996, pp:7).

130. Data on  $\text{SO}_2$  concentrations in residential areas around Bayint Naung Road, Hlaing Township were obtained from Yangon University for the period 1999-2000. As in the case of TSP, dry season concentrations of  $\text{SO}_2$  were well above those of the wet season (Saw Kalayar, 2000). In 1999, the annual average was  $54.4$  micrograms/cubic meter exceeding the WHO standard of  $50 \mu\text{g}/\text{m}^3$  (or)  $0.02$  ppm (ASEAN Secretariat 2001, pp:109).

131. No information is available on the impact of TSP,  $\text{SO}_2$  and other pollutants on public health in Myanmar and/or other harmful impacts of these pollutants on the environment. A link between air pollution and associated health risks was highlighted by a recent study by the Health Department on "Causes of Death in Under Five Year

*Old Children*<sup>12</sup>, Acute respiratory infection (ARI) ranked as the highest cause of mortality for the under 5 in Myanmar (UNICEF, 2003, pp:40) and air pollution was among the likely contributors.<sup>13</sup> More work, however, needs to be done to establish more securely the pattern of these impacts in Myanmar.

132. The data used here were available only for the period 1998-2000. This is because monitoring was discontinued at the end of the project under which these data were generated. Regular monitoring of air pollutants has not been kept up by any of the government agencies and for now, it remains impossible to establish long-term trends of relevant air pollutant concentrations.

**Suggested Rating :** Relatively poor with undetermined trend

**Justification:** Annual average TSP concentrations in Yangon exceeded WHO standards in two out of three years for which data are available. The rapid rise in vehicle registrations in the last two years suggests that the situation may have worsened although the lack of regular pollutant monitoring since 2000 makes this only an educated guess.

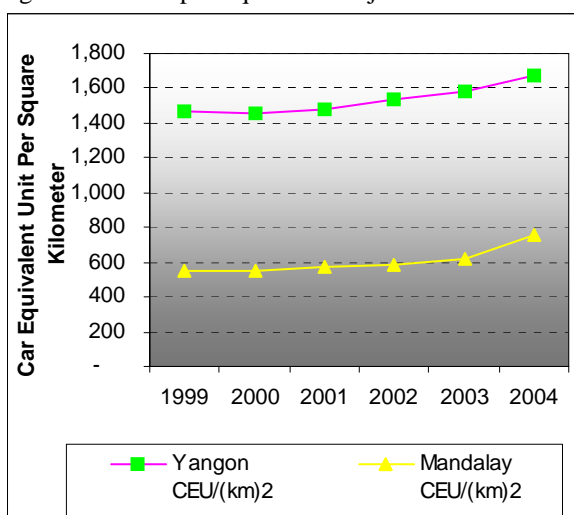
### 6.3 Pressure

Indicator: Car Equivalent Unit per km<sup>2</sup> in Major Cities 1999 to 2004

133. For the purpose of this EPA, a Car Equivalent Unit (CEU) was developed for all types of registered vehicle based on the level and type of fuel consumption (please refer to the relevant factsheet). The indicator tracks the number of Car Equivalent Units per square kilometer of principal urban area in Yangon and Mandalay cities.

134. Total CEU/sq km values in Yangon and Mandalay rose only very slowly until 2003 with signs of a faster increase after that. The rapid increase of CEU in Mandalay is linked to a large-scale licensing of motorcycles imported from a neighboring country. As would be expected, the total CEU/sq km was higher in Yangon than in Mandalay. The potential for air pollution increased in line with the values of the indicator.

Figure 6.4. CEU per Sq-Km of Major Cities



Source: RTAD 2005, YCDC 2003, & GAD 2004

135. The total volume of high-speed diesel and motor spirit sold in 1998 was 242 millions gallons. The volume reached a peak of 284 million gallons in 2002. By 2004,

<sup>12</sup> First survey was carried out during 1994 – 1996 and second study called “Overall and Cause Specific Under Five Mortality Survey was done during March 2002 to March 2003.

<sup>13</sup> Air pollution that affect on ARI might be sourced from either mobile vehicle or household cooking with poor ventilation in the house (indoor pollution)

total automotive fuel sold (MS & HSD) had fallen back to 210 millions gallons or an average of 1 gallon per vehicle per day for a total of 960,341 vehicles. Total consumption of automotive fuels is higher in Yangon than in Mandalay. The higher consumption in Yangon is reinforced by the differences in the ceiling on the amount of automotive fuel per car that can be purchased at government petrol stations that is higher (60 gallons per month per car) in Yangon than in Mandalay (40 gallons).

136. The rising vehicle density in the two largest cities of Myanmar coincided with falling total amounts of automotive fuels sold. The decline in fuel sales reflects a likely increase in fuel efficiency associated with newer vehicle vintages imported into the country and possibly lower distance traveled per vehicle, and higher fuel prices. The first mentioned, if true, is clearly a positive development that offsets some or all of the increase in the values of CEU/sq km.

**Suggested Rating:** Medium and increasing

**Justification:** During the last few years, there has been a steady rise in the vehicular density in Yangon and Mandalay. The values of CEU per square kilometer increased by 13% and 39%, respectively, between 1999 and 2004. At the same time fuel consumption per CEU has been declining. Without additional information, the direction of pressure is impossible to establish with confidence.

#### 6.4 Response

Indicator: Percentage of Vehicles Inspected 1998 -2004

137. This indicator measures the numbers of vehicles inspected as a percentage of total numbers of vehicle registered in Myanmar. As mentioned earlier, national ambient air quality standards have not yet been established in Myanmar. Air quality standard is drafted under the Yangon City's Pollution and Cleansing Rules, which was issued in 1999, but awaiting for final approval. According to this rule, PCCD under YCDC is an authority for handling all air and water pollution matters in Yangon City's Municipal area. Institutional capacity is another constraint to monitor ambient air quality and air pollution on regular basis. Studies were undertaken in the past but none of them has generated a comprehensive picture of air pollution in major cities of Myanmar. At national level, committees on pollution control exist under the Ministry of Science and Technology (MOST) and National Commission for Environmental Affairs but they have no clear-cut control powers or ambient air quality standards to refer to in the event they were to pursue a particular policy. The most relevant of the legislation are the Myanmar Motor Vehicle Rules under the Motor Vehicle Law of 1964 (NCEA, 2000). The Law requires all vehicles to be technically inspected by the Road Transport Administration Department (RTAD) for roadworthiness prior to registration.

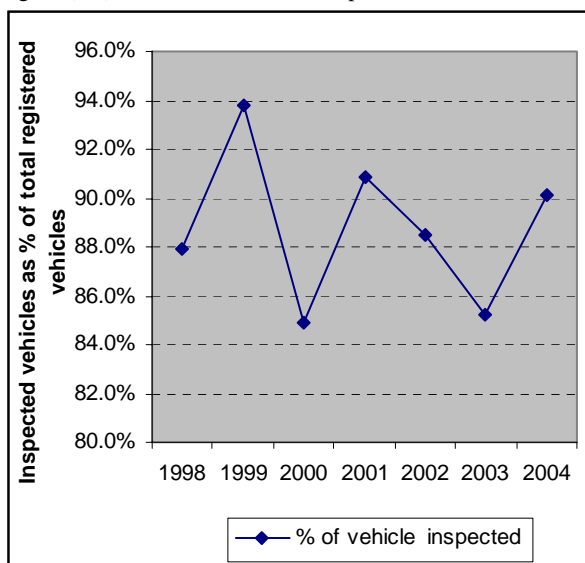
138. Both vehicle emissions and noise pollution feature in the RTAD test. The test is formally based on ASEAN standards on emission levels. However, no monitoring equipment is used to inspect the actual emission performance (see the relevant factsheet). Equipping gasoline-fuelled cars with catalytic converters remains voluntary. On the plus side, restrictions imposed by the Trade Council on the age and model of imported cars has prevented an accumulation of old cars in Myanmar.

139. The data on the number of vehicles inspected shows no particular trend. The percentage of registered cars annually inspected for renewal of license is relatively high at above 80%. In the absence of clear pollution performance guidelines, these inspections do little more than eliminate the worst of mechanical defects.

140. RTAD has begun to equip their inspection facilities with improved inspection devices but these steps are too new to assess their effectiveness. The Government has begun to promote compressed natural gas (CNG) vehicles with the objective

of converting one fifth of the total vehicle stock (i.e. about 200,000 out of 1 million) to CNG in order to control the level of air pollution in major cities.

Figure (6.5). Percent of Vehicles Inspected



Source: Road Transport Administration Department, RTAD 2005

**Suggested Rating:** Low and intermittent

**Justification:** Lack of appropriate emission standards and a weak vehicle inspection regime limit the effectiveness of the official response to the threat of worsening air pollution in Myanmar's principal cities. As it is, most of the credit for containing such pollution goes to the manufacturers of vehicles who have improved the pollution performance of their new vehicle models.

## 6.5 Conclusions

141. Unsystematic and insufficient information on air quality in Myanmar limits the authorities' and the public's knowledge about the principal trends and the contributions that vehicles make to atmospheric pollution in the principal cities. What can be said with greater degree of confidence is that the "vehicle density" has been on the rise in Yangon and Mandalay. At the same time, it appears that the fuel consumed per vehicle has been declining. A complex interplay of technical and non-technical factors such as improved pollution performance of newer vehicles (versus the older vintages), increasing proportion of motorcycles in the stock of vehicles, fuel composition, traffic management and several others would deserve to be studied more systematically to present a rounded picture of the current situation and principal trends.

142. Absence of national air quality standards makes it harder for the authorities to implement pollution control measures. The responses have been relatively low-key. The inspections of vehicle emission, relatively ineffective in mitigating pollutant discharges need to become more meaningful. The policy regulating imports of second-hand vehicles has been tightened. Overall, however, the performance in dealing with the prospect of worsening vehicular pollution has been poor.

143. More work is required to develop a credible database of pollution levels and the development of national air quality standards should begin.

**Suggested Rating: 1 STAR**

**Justification:** The prospect of adding to air pollution created by increasing vehicle registrations in Myanmar's principal cities is undeniable. However, available data are insufficient to confirm whether the apprehensions are justified or not. Improving pollution performance of vehicles imported into Myanmar may have largely neutralized the impact of the growing vehicle density although this, too, needs to be supported by evidence. It has not attached enough importance to generating better data and enforcement for inspecting vehicle emission level has been weak.

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## **7. Climate Change**

### **7.1 Context**

144. Climate Change and Ozone Layer Depletion were not identified as major concerns during the initial selection and prioritization of national environmental concerns. The downstream effects of climate change might be a national concern but emissions of Greenhouse Gases (GHGs) were not seen as a priority for the time being. Lively discussion has been going on domestically about the figures compiled by Department of Meteorology and Hydrology and the extent to which they could be interpreted as indicating the effect of global warming. A variety of parameters features in these discussions such as frequency of depressions and cyclones, average temperatures and others (Tun Lwin, 2002).

145. All GMS countries are parties to the United Nations Framework Convention on Climate Change (UNFCCC) and the related Kyoto Protocol. Myanmar ratified this convention on November 25th, 1994 and the Kyoto Protocol on August 13th, 2003 (NCEA, 2005). Assessment of Myanmar's response under UNFCCC has therefore been considered a suitable addition to this EPA. Myanmar is also party to the Vienna Convention for the Protection of the Ozone Layer but unlike GHG emissions, this convention and its related protocols are not addressed in this assessment.

### **7.2 State**

146. Under the P-S-R model utilized in this assessment of environmental performance, it is not feasible to develop an indicator of the state of climate change at the national level. An appropriate state indicator would have to be developed at the global level and this is beyond the scope of this assessment. Therefore only a pressure and a response indicators have been developed in this assessment

### **7.3 Pressure**

Indicator: GHG Emissions in CO <sub>2</sub> Equivalent 1990 to 2005
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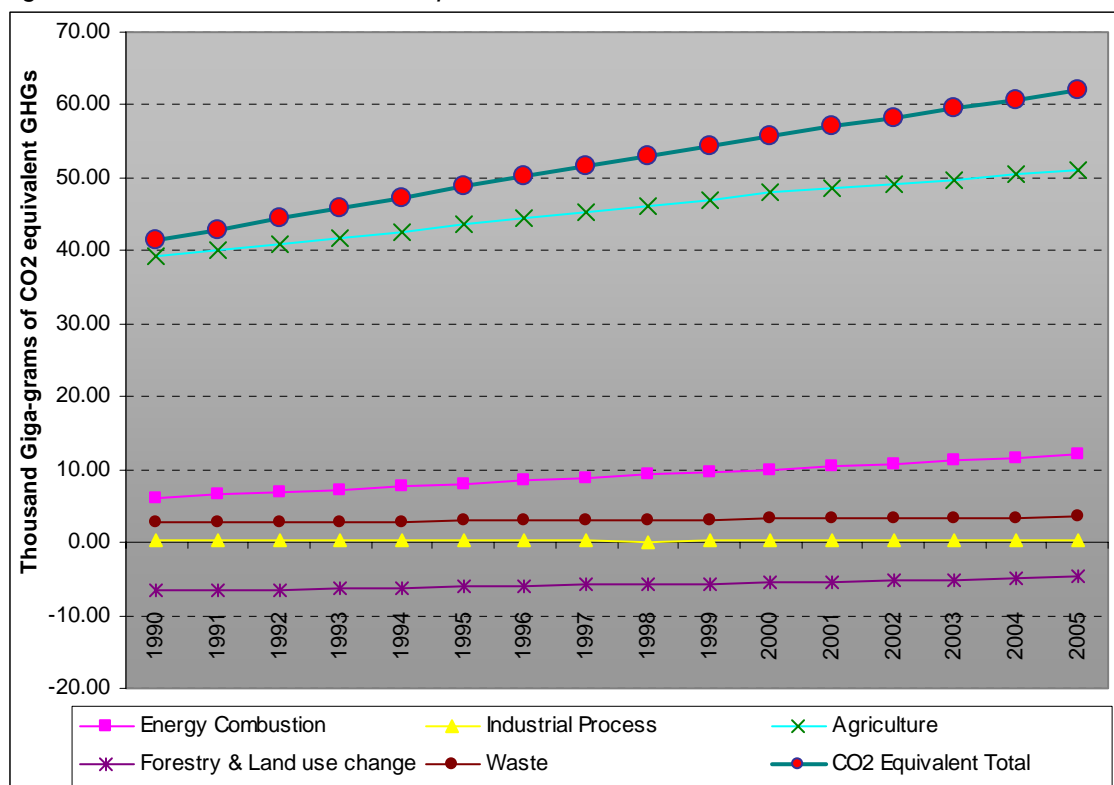
147. As required by all parties to the UNFCCC, Myanmar conducted its first GHG inventory with the assistance of ADB in 1997 under the Asia Least Cost Greenhouse Gas Abatement Strategy (ALGAS) project. The inventory is for base year 1990 and includes annual projections of GHG emissions through to year 2020. The selected pressure indicator is based on these estimates and projections and the result is expressed in terms of CO<sub>2</sub> equivalent.

148. The baseline inventory featured a relatively complex methodology and a set of rules used to estimate GHG emissions originating in the energy sector, industrial processes, agriculture, land use change and forestry, and production of waste. While in advanced economies (and this now probably includes Thailand, at least from a GHG point of view), the energy and industrial sectors are the largest GHG sources, in less industrialized countries (and this includes Myanmar), agriculture and land use changes dominate. Forest cover and the conditions of the forest are an important part of the equation since forests absorb some of the gases and are considered a "GHG sink"

149. In a simulation analysis the baseline inventory can be combined with a number of key parameters (population growth, land use, GDP, etc) to generate projections of GHG emissions. For Myanmar, these estimates were generated up to 2020. The principal point here is that while the 1990 figures are based on an actual inventory of GHG sources and sinks the later values are projections only, their reliability naturally declining with the length of the projection period.

150. As can be seen in Figure 7.1 and the corresponding factsheet, net GHG emissions in CO<sub>2</sub> equivalent were estimated at approximately 41,500 Giga-grams (Ggs) in the 1990 base year. These were projected to climb to 55,900 Ggs in year 2000, 68,200 Ggs in 2010 and 82,900 Ggs by 2020. The agriculture sector, mainly rice cultivation, was by far the largest emitter of GHGs in Myanmar. It accounted for 94% of the overall emissions in 1990 and is expected to dominate throughout 2020, at a somewhat reduced rate. The energy sector was the second largest source but the magnitude of its emissions was dwarfed by that of the agriculture sector. The burning of fuelwood was the major contributing factor in the energy sector. Emissions from industrial processes and waste, both existing and projected, were minimal.

Figure 7.1. GHG Emissions in CO<sub>2</sub> Equivalent – 1990 to 2005



Source: ALGAS Study (ADB & et al, 1998), CSO 1989, 1993, 1997 & 2003

151. It can also be observed from Figure 7.1 that forestry and land use change were a net sink of GHGs. In the base year, the net removal was 6,655 Ggs but this figure was estimated to decline to 2,400 Ggs by 2020. This projection was based on a deforestation rate of 218,800 hectares per year, through to 2020. The actual deforestation rate in the 1990s was closer to 400,000 hectares per annum and it is possible that the sequestration effect may have disappeared by the turn of the new millennium.

152. In terms of pure CO<sub>2</sub> emissions, Myanmar was a net sequester, i.e. the country absorbed more CO<sub>2</sub> gases that it generated. The growing forest stock and

the abandonment of marginal lands compensated for all the CO<sub>2</sub> emissions of all the other sectors. The amounts are also significant here. Approximately 67,100 Ggs of CO<sub>2</sub> were emitted; approximately 73,000 Ggs were removed. The balance of 5,900 Ggs was subtracted from the other gases in the CO<sub>2</sub>-equivalent equation.

153. Most of the other CO<sub>2</sub>-equivalent emissions were the result of rice cultivation. In the 1990 base year, approximately 1,327 Ggs of methane or 27,900 Ggs of CO<sub>2</sub>-equivalent originated in rice cultivation. The overall contribution of rice farming is unlike that of any of the other GMS countries. For Myanmar, the rate applied in calculating methane emissions was based on actual field measurements that were approximately three times higher than the magnitude recommended by UNFCCC as a default value. The large difference is partially explained by the use of organic manure applied to the rice crop in Myanmar.

154. The UNFCCC's early estimate on the excess pressure on the planet is in the order of 37 million Ggs. That figure is based on a tentative estimate of what the planet can withstand without undergoing climate change. Obviously Myanmar's 41,500 Gg's share of the excess 37-million Gg's problem is miniscule. On a per capita basis and using year 2005 estimates and for emissions and population, the ratio is approximately 1.1 metric ton CO<sub>2</sub> per person.

**Suggested Rating:** Low but increasing

**Justification:** The current estimated emission level (1.1 metric ton of CO<sub>2</sub> per person) is relatively low comparing to other GMS countries like Thailand, Yunnan (China) and Vietnam; the per capita rate is also low by international standards. However the trend and the pressure are expected to increase as methane gases from rice cultivation continue to rise and as the sequestration of CO<sub>2</sub> by growing biomass diminishes.

## 7.4 Response

Indicator: GHG Emissions Over Per Unit Value of GDP - 1990 to 2001

155. GHG Emissions Over Per Unit Value of Gross Domestic Product (GDP) – termed here “GHG intensity”-- was selected as the response indicator. This indicator attempts to track the increase or decrease of GHG emissions for every additional unit of GDP. It is expressed in kilograms of CO<sub>2</sub> per Kyat (Kg CO<sub>2</sub>/Kyat).

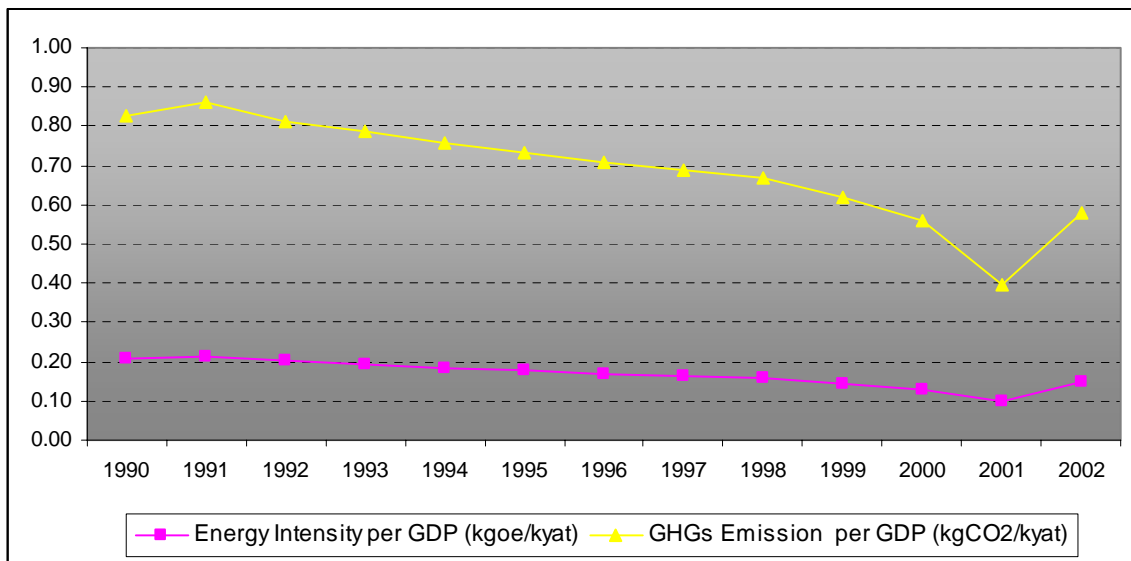
156. While GDP growth will normally result in an increase in GHG emissions, the increase will be less than proportional if existing policies and economic environment encourage emissions reduction. Greater efficiency of combustion processes, brought about by industrial competition and environmental regulation that penalizes GHG emissions, is among the chief forces that will lead to a “de-coupling” of GDP growth and GHG emissions growth. The declining values of the indicator will be an indirect indicator of the effectiveness of national responses that normally combine measures adopted by the Government to promote emissions reduction and the steps taken by the GHG emitters themselves.

157. In Myanmar's case it is important to remember, once more, that the only true estimate of GHG emissions is that made in 1997 using the data of 1990. All subsequent GHG emissions values are projections only, “educated” as they may be. GDP data, on the other hand, are available up to 2002. The values of the indicator will therefore combine a true estimate (for 1990) with “best-guess” estimates (from

1991 to 2002) and projections from 2002 onwards when both GHG emissions and GDP values are assumed rather than actual.

158. Figure 7.2 illustrates the trend under the conditions described above. Assuming GHG emission values during the post-1990 period to be reliable, the results suggest a positive development i.e. declining values of GHG emissions per unit of GDP. The rapid decrease in the value of the indicator in the year 2001 appears to reflect an unexpected jump in the value of GDP in that year (the ALGAS model assumed a growth rate of 6.8% for 2000 whereas in reality the GDP growth rate was nearly double of this amount at 13.7%) rather than necessarily demonstrating a suddenly improving performance by GHG emitters. This jump illustrates one of the pitfalls of relying on assumed rather than actual values of indicators in assessing performance.

Figure 7.2. GHG Emissions Per Gross Domestic Product



Source: ALGAS Study and Statistical Yearbooks, CSO 1989, 1993, 1997 & 2003

159. In general, a declining value of the indicator is desirable as it suggests – especially in industrializing economies-- that energy supporting GDP growth but also resulting in GHG emissions is being produced with increasing efficiency. In the case of Myanmar, there are signs that the indicator values may be declining but the absence of fresh estimates (post-1990) of GHG emissions makes it impossible to say with confidence what the recent trend has been.

**Suggested Rating:** Non comparable and undetermined trend

**Justification:** GHGs emission per unit of GDP probably declined during the 1990s. Absence of up-to-date GHG emission inventory makes it impossible to establish a trend and provide a reliable assessment.

## 7.5 Conclusions

160. Myanmar commitments to the UNFCCC include the following tasks. (ADB & et al, 1998, pp:4-5.

- a. developing national inventories on sources and sinks of all greenhouse gases (GHGs);
- b. formulating, implementing, and publishing national and regional programs to mitigate climate change;

- c. promoting and cooperating in the development, application, and transfer of technologies, practices, and processes that control, reduce, or prevent GHGs emissions;
- d. promoting sustainable forest management practices by conserving and enhancing sinks and reservoirs of GHGs;
- e. cooperating in the development of programs of adaptation to potential impacts of climate change
- f. taking climate change considerations into account in relevant social, economic, and environmental policies;
- g. promoting and cooperating in research and data development to help understand and reduce the potential impacts of climate change
- h. promoting and cooperating in the exchange of technical, scientific, socioeconomic, and legal information related to the climate system and climate change;
- i. promoting and cooperating in education, training, and public awareness campaign related to climate change and
- j. communicating to the Conference of the Parties information related to implementation of the Convention commitments

161. As a non-annex I country of UNFCCC, there is no obligation for Myanmar to reduce its GHG emissions. However, as mentioned above, there are monitoring and reporting requirements for all parties to the convention. Although Myanmar has completed its baseline inventory through the ALGAS project, there is currently no program in place to monitor current emissions (item a. above). There is still a need to establish a national-level communication committee to raise citizen's awareness and the most effective adaptation measures formulated.

162. The state of climate change was not assessed under this EPA since it is a global rather than mainly a national concern. The pressure indicator developed for this assessment highlights the importance of natural GHG sinks. These natural sinks are being diminished through deforestation. Energy saving programs, which are important for reducing GHG emissions, are underway but mostly through sectoral efforts rather than through integrated approaches within the climate change context.

**Suggested Rating: 1 STAR**

**Justification:** One star rating is given for overall performance in climate change because Myanmar still needs to fulfill certain obligations stipulated under UNFCCC.

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### III. ENVIRONMENT AND ECONOMIC DEVELOPMENT: CROSS CUTTING ISSUES IN EPA

163. The purpose of Part III is not to comprehensively review the existing institutional and legislative basis of environmental management in Myanmar. Several summaries exist including the Institutional Analysis prepared as part of the SEF II Project (SEFII 2005) and the reader is referred to them for details. Rather, the purpose is to identify those elements of the existing institutional framework that affect the national environmental management performance.

#### 3.1. Integration of Environmental Concerns into Economic Decision Making

164. Myanmar continues to be an agriculture-based country and environmental concerns chosen for assessment under EPA, dominated by resourced-related concerns, are indeed of key importance for national economic development. As shown in Table III.1 below the combined share of agriculture, livestock, fisheries and forestry sectors in 1998-99 GDP was 68.2%. The Third Five Year Short-Term National Economic Plan (from 2001/02 to 2005/06) has set six objectives, i.e. to (a) expand agro-based industries, (b) develop hydro-electrical power generation, (c) expand agriculture, livestock and fishery sector for domestic sufficiency and export promotion, (d) strive for all round development of other sectors, (e) expand the education and health sectors for developing human resource, and (f) develop rural areas.

**Table III.1 GDP Composition (1998 -99)**

Sector	Share %
Agriculture	59.7%
Livestock and Fishery	7.5%
Forestry	1.0%
Mining	1.4%
Processing & Manufacturing	9.1%
Energy	1.0%
Communication	1.9%
Construction	4.9%
Transportation	4.3%
Financial Institutions	2.1%
Social and Admin Services	6.7%
Rental and Other Services	4.2%
Trade	21.1%

Source: National Planning Dept. 2005

165. Increased agriculture and other development activities have complex impacts on the natural resource environment and/or public health. Growth of fishery sector may lead to a decline in mangroves; hydropower development may be associated with sedimentation in conditions of rapid deforestation, and rapid urbanization tends to go hand in hand with increased air and water pollution and waste disposal problems, all of them impacting public health.

166. Integration of environmental concerns into economic decision-making then becomes crucial if the natural resources and environmental "sinks" are to benefit the population in a lasting manner. As the 1994 national environmental policy puts it (Yin Yin Lay, 1997):

..... *The wealth of the nation is its people, its cultural heritage, its environment and its natural resources. The objective of Myanmar's environmental policy is aimed at achieving harmony and balance between these through the integration of environmental considerations into the development process to enhance the quality of the life of all its citizens. Every nation has the sovereign right to utilize its natural resources in accordance with its environmental policies; but great care must be taken not to exceed its jurisdiction or infringe upon the interests of other nations. It is the responsibility of the State and every citizen to preserve its natural resources in the interests of present and future generations. Environmental protection should always be the primary objective in seeking development.*"



### 3.1.1 Policy and Institutional Integration

167. In Myanmar, environmental management has been traditionally undertaken by line agencies within their respective mandates. In the most obvious example, the Ministry of Agriculture and Ministry of Forestry are largely responsible for the management of “their” natural resources under agriculture and forestry development projects/programs. The mandates are sometimes combined: For instance, the Irrigation Department, Water Resource Utilization Department, Yangon/Mandalay City Development Committees, the Department of Development Affairs, and Environmental Sanitation Division under Department of Health share the responsibility for improving water supply in rural and urban areas. For the management of urban environment, the responsibilities have been allocated mainly to City/township Development Committees, Government Affairs Department, Department of Human Settlement and Housing Development, Department of Health, and Directorate of Industrial Supervision, and Inspection. Among the omissions is the assignment of responsibility for national air and water quality management.

168. Until 1989, no governmental agency existed to oversee environmental matters. In 1989, the Ministry of Foreign Affairs (MOFA) began to assume authority over domestic environmental protection, while the Cabinet retained responsibility for international environmental matters. In 1990, the National Commission for Environmental Affairs (NCEA) was created by MOFA to act as a central agency for environmental management. In 2005, NCEA was transferred under the stewardship of the Ministry of Forestry, with Minister of Forests assuming the NCEA chairperson role.

169. NCEA has a Chairman, a Secretary and a Joint Secretary as shown in the chart below, with the chairman and secretary being officials of MOFA.

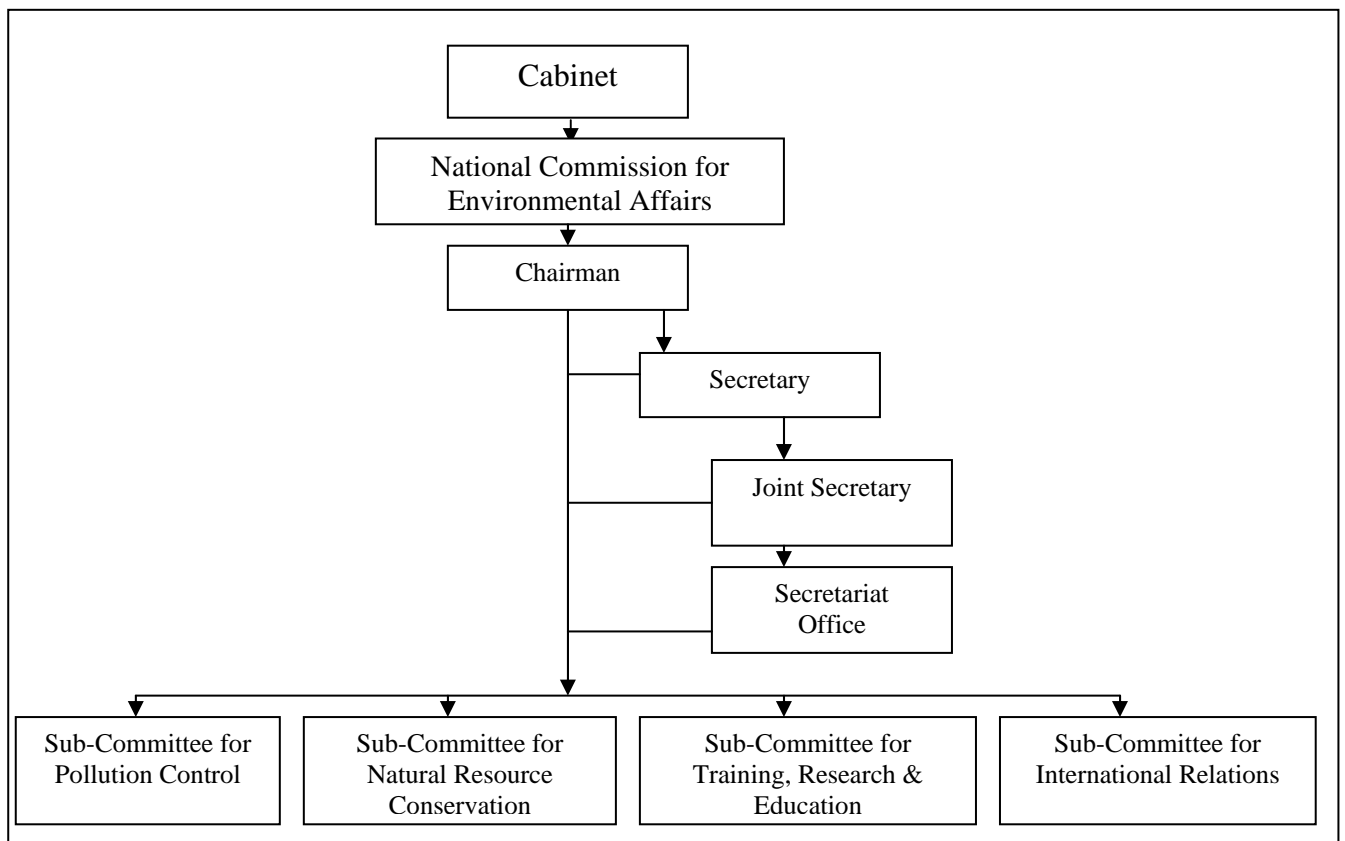


Chart III.1. Organization Structure of NCEA , NCEA (2000)

170. Creation of NCEA was a significant step in the integration of environmental considerations into Myanmar's development planning process. NCEA's main mission is to ensure sustainable use of environmental resources and to promote environmentally sound practices in industry and in other economic activities. Its key functions are to:

- a. Formulate policies on natural resource management,
- b. Prepare environmental legislation (standards and regulations) for pollution control, monitoring and enforcement,
- c. Promote environmental awareness through public education and to liaise as necessary with international organizations in environmental matters.

171. NCEA is supported by sub-committees that oversee the management of several environment and related concerns viz., (a) pollution control, (b) natural resource conservation (c) research, information and education, and (d) international cooperation.

172. Since its inception, NCEA has been able to accomplish a series of initiatives required for integration of environmental concerns into economic development. These included formulation of national environmental policy (1994) and development of 'Myanmar Agenda 21' as a framework for adopting multi-sectoral approaches to sustainable development. It also drafted the National Environmental Protection Law that is awaiting approval. All of these initiatives were taken in collaboration with other government and non-government organizations.

### **3.1.2 Inter-Agency Coordination**

173. Inter-ministerial and departmental committees are set up as the need arises to address cross-sectoral environmental issues. The National Committee for Combating Land Degradation under UNCCD is one such example. National Water Committee has also been formed to better address conflicts in water management and related institutional issues. The Committee is tasked to establish a 'national water council' in future to implement Myanmar's Water Vision. In parallel to NCEA and PCCD/YCDC, another pollution control committee was formed under Ministry of Science and Technology Development to monitor and regulate industrial pollution in urban environment at the operational level.

174. As many institutions are involved in different or same aspects of environmental management, there are some overlaps, resource conflicts and instances of inconsistent approaches. Although NCEA has been playing a coordinating role, the process has not always been smooth. In the absence of the national environmental law, coordination among stakeholders tends to be ad hoc and informal rather than structured and systematic. This also affects environmental information and data management.

175. The way it is set up, NCEA does not have the authority to enforce coordination. It can facilitate and ensure that the concerned agencies are kept informed about each other's activities. There are the sub-committees that play a key role in achieving coordination at the central level. However, they are not very active and effective for the operations at the provincial and local levels. Local committees created until 2004 to coordinate natural resource management and land use have had no direct relationship to NCEA. The formation of the National Coordination

Committee for Environment (NCCE) in 2004 with a structure of sub-committees<sup>14</sup> was a step in the direction of achieving both horizontal and vertical coordination. Ministerial agencies and local authorities are represented in the Committee.

176. Conducting future EPAs through NCCE sub-committees might be an effective mechanism of supporting this integration given NCEA's likely responsibility for future EPAs. Nevertheless, there is still a need for a legislative mandate to mainstream EPA more securely.

### **3.1.3 EIA Process and other tools**

177. The above discussion highlights the need for better integration between environmental management and economic development planning. Some of the approaches that could reinforce this integration are:

- d. Integrated land use planning – land zoning for commercial, agricultural, industrial and institutional uses could be a simple form of land use demarcation that prevents long term land use conflicts. Industrial estates should be planned and all industries should be located within these estates preferably at some distance from settlements;
- e. EIA Process – EIA of large development projects as a means of identifying adverse environmental impacts will allow for a better understanding of a project or program and the necessary mitigation measures.
- f. Integrated watershed management –Myanmar's forests, agricultural lands and rivers are interlinked. Integrated catchments and watershed planning allows to formulate an approach to these areas' development that does take these linkages into account.

178. However, turning these ideas into more telling and regular components of NCEA's and other agencies' activities requires a legislative mandate. Without it, the existing ad hoc approach to environmental management is likely to persist. Such a legislative support would furthermore need to be accompanied by easing of the budgetary constraints on NCEA and other resource management agencies.

179. International organizations and non-governmental organizations like UNEP, ESCAP and Hans Seidel Foundation have been helping NCEA to lay the foundations of a more integrated approach to environmental management typified by Myanmar Agenda 21. Previous ADB-supported environmental projects under the GMS umbrella have also contributed. However, more work is required to keep the momentum generated by these activities. Steps need to be taken that make it possible to institute the culture of collaboration between economic decision-makers, environmental specialists and civil society.

### **3.1.4. Environmental Expenditure and Financing**

180. The current national accounting system does not separately report environmental expenditure. Financial resources for environmental management are apportioned to sectoral ministries or agencies. Table III.2 below gives an indication of the budget's sectoral breakdown in 1999/2000. Of the total expenditure, only 11.8%

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<sup>14</sup> NCCE sub-committees have been set up based on the eco-region, including Northern Forest Region, Eastern Forest Region, Western Forest Region, Southern Forest Region, Ayeyarwaddy River Region, Chindwin River Region, Sittoung River Region, Thanlwin River Region, Central Plain Zone and Coastal Zone.

was allocated to the agencies most closely linked to the management of natural resources (i.e. agriculture, livestock, fisheries, forestry) whilst –not unlike in the other GMS countries-- a greater proportion of the funds were allocated to defense, administration and social services. The level of resources available to development committees, the key local bodies for managing solid waste, pollution control, and rural and urban water supply, was insignificant within the overall national budget.

181. Needless to say such budgetary patterns do not bode well for enhancing the environmental management tasks not to mention EPAs in the future.

*Table III.2. Financial Expenditure of Government Administrative Organization in Year 1999-2000*

No.	Sector	Current		Capital		Both Current & Capital	
		Amount	%	Amount	%	Amount	%
1	<b>Union Total</b>	84,646.6	100.0	60,404.7	100.0	145,051.3	100.0
2	Agriculture	6,638.4	7.9	8,519.2	14.1	15,157.6	10.4
3.	Livestock & Fishery	406.0	0.5	93.2	0.2	499.2	0.3
4.	Forestry	790.1	0.9	868.5	1.4	1,658.6	1.1
5.	Industry	443.8	0.5	1,659.7	2.8	2,103.5	1.5
6.	Energy	18.5	*	7.1	*	25.6	*
7.	Social Services	24,272.9	28.7	6,390.6	10.6	30,663.5	21.1
8.	Defense	19,279.5	22.8	18,758.0	31.1	38,037.5	26.2
9.	Administration	25,151.6	29.7	3,070.0	5.1	28,221.6	19.5
10.	Development Committee	23.2	*	8.6	*	31.8	*
11.	Others	7,622.0	9.0	21,029.8	34.8	28,651.8	19.8

Source: Statistical Yearbook 2002; Note: (a) Value in million kyats, (b) \* for in-significant data value.

182. Table III.3 gives the annual expenditure of NCEA during the period 2001/01 to 2004/05, showing a significant increase. However even the 2004/05 amounts are barely enough to meet the administrative and office operational costs. If NCEA is to assume a more active coordinating and integrating role as advocated in this report the annual budget for NCEA needs to be increased further. Such an increase should make suitable provisions for financing future monitoring and evaluation activities such as future EPAs and the improved financing secured through a suitable legal provision.

*Table III.3. Annual Expenditure of NCEA (Kyats)*

Year	Admin	Personnel	Operation & Maintenance	Others	Total
2000/01	346,970	2,577,750	788,490	1,915,480	5,628,690
2001/02	296,030	2,290,500	810,730	2,566,700	5,963,960
2002/03	953,820	2,771,330	1,053,920	2,880,530	7,659,600
2003/04	1,524,940	3,018,070	1,092,680	2,241,040	7,876,730
2004/05	975,000	8,380,000	651,000	2,254,000	12,260,000

Source: NCEA (2005)

183. International donor assistance is severely limited in Myanmar. Access to loans or grants from the international financial institutions in support of environmental initiatives is minimal or none, the GMS program a partial exception. At present, official development assistance (ODA) to Myanmar is channeled almost exclusively toward humanitarian assistance. Non-availability of financial and technical resources is a key constraint to improving environmental management capacity in the country.

### 3.1.5 Conduct of future EPAs

184. Based on the experience gained in the current SEFII project, NCEA is most likely to be responsible for future EPAs. It should discharge this role in collaboration with the National Coordination Committee for Environment (NCCE). NCCE's sub-committees may want to utilize EPA as a tool of improving local environmental performance.

## 3.2. Implementation Issues

185. Given the cross-sectoral nature of environment management, collaboration among government agencies is essential if objectives are to be reached. Myanmar is taking small steps towards achieving that collaboration but it still has a long way to go. The following are three examples of how inter-agency collaboration is being promoted

- g. In the water resources sector the catchments of irrigation dams built by the Ministry of Agriculture & Irrigation for agriculture needs also serve as a source of water supply for domestic purposes and the storage reservoirs are co-managed.
- h. Ministry of Agriculture and Irrigation, and Ministry of Forestry have jointly made the efforts to curtail shifting cultivation and to halt deforestation and land degradation.
- i. Normally, nature conservation is the responsibility of the Wildlife Division under Forest Department. However, the Fisheries Department has been also making efforts in establishing marine parks and protecting fishery biodiversity and pristine island ecosystem in Myeik Archipelago.

186. At the local level, local authorities (State & Division, District, Township and Village Tract Peace and Development Councils) are responsible for the implementation of environmental programs and initiatives within the territory they administer. Under the "*Re-Greening Program*", local authorities have been active in mobilizing local people to take part in the program in collaboration with departments technically responsible. This coordination is carried out through committees formed at the local level. The Inle Watershed Conservation Committee is one such committee addressing the issues of land degradation, deforestation and species biodiversity in Southern Shan and Kayah States.

### 3.2.1. Regulatory and Economic Instruments

187. Regulatory instruments are the backbone of environmental management, more recently supplemented worldwide by economic (incentive) instruments. Below, examples are given of each group of instruments in today's Myanmar practice.

- *Tree Cutting Restrictions*: According to Forest Law, cutting of trees without permission is prohibited in Forest Reserves and Protected Public Forest, which are termed as *Permanent Forest Estate (PFE)*. Generally, there is no legal prohibiting of tree cutting in areas outside of PFE. However, local authorities impose restriction on tree cutting outside PFE area for better conservation. Cutting of trees is a serious offence in *Dry Zone* areas and legal action can be taken against the offender.

- *Restricting Shifting Cultivation:* There are still many forest areas outside PFE in Myanmar and these are subject to pressures from the community. To regulate such practices, prior permission is required from the concerned local authority before any forest area outside of PFE can be used for shifting cultivation.
- *Zoning Rules for Shrimp Farming:* To prevent the depletion of mangroves, Fishery Department is preparing zoning rules for shrimp farming. No farming is allowed in the restricted segments of the mangrove area.
- *Vehicle Emission Standard:* Road Transport Administration Department (RTAD) has established a vehicle emission standard to control air pollution from mobile sources.
- *Regulation on Disposal of Healthcare Waste:* Medical and healthcare waste pose hazards to public health; City Development Committees have issued special regulation for systematic collection and disposal of these wastes and for their incineration as appropriate.

Elements of economic instruments are present in several areas:

- *Sustainable Forest Management Criteria:* The Ministry of Forestry has developed criteria for sustainable forest management in order to issue '*Green Certificates*' to producers of timber products originating in forests certified as sustainably managed. '*Code of Practice for Logging and Timber Harvesting*' is also being developed to minimize environmental damage associated with timber harvesting. These measures are an attempt to reinforce the AAC principle. The command tools are still present: *export licenses* are issued to private sector for valued added forest products. *Quota system* on log sale is also being applied for supplying round wood to private wood-based industry.
- *Privatization of Forest Plantation:* Forest law (1992) promotes private investment in commercial forest plantations. Recently Government opened teak plantations to private investors. The '*Community Forestry Instruction*', which was legislated in 1995, encourages local community to manage forests. It grants 30-year leases to communities and depending on their performance, the lease can be extended for an additional period.
- *Credit facility for CNG Vehicles:* The Government is encouraging the use of CNG in public transport. Preferential loans are given to vehicle owners for conversion to CNG. It is planned to convert one fifth of all registered vehicles in Myanmar to CNG.

188. The National Environmental Law has been drafted and is awaiting approval. This will allow NCEA to proceed with developing national ambient standards on air and water quality. A regulation on the conduct of EIA is also expected to be prepared.

189. Apart from government measures, initiatives have also been taken by the private sector. Several industrial establishments have been certified compliant with the International Standard Organization (ISO) 14000-series voluntary standards. For the most part, however, local industries lack the capacity and resources to adopt measures required for ISO certification. On a related front, some large international companies have undertaken community based conservation programs. For instance, Total, the international oil company, has financed several biodiversity conservation studies.

190. Financing of municipal environmental infrastructure is a complex mix of government funding with varying elements of cost recovery. While the Government and City Development Committees bear the cost of infrastructure investment, its subsequent use is partly or wholly financed by the urban users. Part II described the effect of waste disposal charges on restraining the generation of waste in Yangon. With regard to land degradation, small-farmer loans provided by Myanmar Agriculture Development and Cooperative Bank is utilized for application of soil conservation measures such as terraces and contour bunds.

### **3.2.2 Enforcement**

191. Enforcement of the “rules of the game” is agreed to be a major determinant of performance. The degree of enforcement varies in Myanmar’s environmental management. Strong when it comes to cutting of individual trees within commercial forestry, for instance, it is less than effective when addressing shifting cultivation. In some cases, enforcement is adversely affected by overlapping mandates: In regulating shrimp farming to protect mangroves, for instance, the authority to manage mangrove forest assigned to Forest Department conflicts with that assigned to the Fisheries Department to regulate shrimp farming.

192. For the control of air pollution from vehicles, RTAD is manually inspecting vehicles in accordance with the vehicle emission standards. RTAD also plans to secure smoke detectors for better inspection. Eight task forces have been deployed throughout Yangon City for regular checking of emission levels. Yangon City Development Committee has developed a surveillance system for monitoring waste disposal by the local residents and commercial enterprises. Fines are levied on those who breach the established disposal restrictions.

## **3.3 Environment and Civil Society**

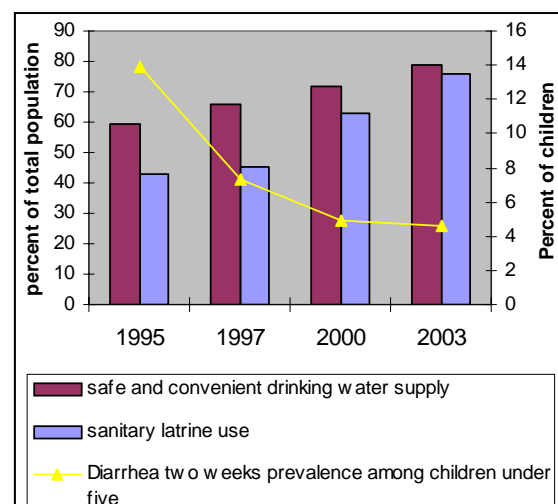
193. Traditionally, civil society has played an active role in Myanmar in improving social welfare at the local level. Collectively tackling tasks and contributing labor and other resources are common in activities such as improving community water supply, maintenance of village infrastructure (schools, roads) and improving village sanitation. The youth, women and religious groups are active in such collective activities. In the hilly areas of the country, hill tribe people have traditional customs that encourage sustainable use of water and other land resources e.g. managing water springs, mini-watersheds and community forests. Religious groups and monasteries play an important role in nature conservation around religious monuments.

194. In urban areas, neighborhood groups are active in organizing sports, festival, religious ceremonies and social welfare activities. They sometimes campaign with local residents for drainage clearance, solid waste collection and disposal, and children health immunization. NGO presence is increasing in Myanmar. Local NGOs such as ‘Union of Solidarity and Development Association’ and ‘Myanmar Women Association’ are active in community based environmental and natural resource management programs. Emerging local NGOs in environmental sector are “*Friends of Rainforest Myanmar (FORM)*”; “*Forest Resource Environmental Development Association (FREDA)*”; “*Renewable Energy Association of Myanmar (REAM)*” and “*Biodiversity and Nature Conservation Association (BANCA)*” to name a few. However, these local NGOs are working primarily in rural areas and are less involved in urban environmental issues like air pollution and solid waste management. That role is in part performed by Myanmar Women Association, especially in relation to solid waste management.

### 3.3.1 Environment, Health and Safety

195. Surveys on the causes of mortality among children under the age of five single out acute respiratory infections (ARI), and diarrhea and dysentery as the principal causes (UNICEF, 2003). This finding is a wake up call for those in charge of air quality and sanitary condition in urban areas. Government has been making efforts to improve access to safe drinking water and provide better sanitation. Figure 1 indicates some decline in cases of 2 weeks prevalence of diarrhea among children under age five alongside the improvements in safe water supply and sanitary latrine use

Figure III.1. Prevalence of Diarrhea among the children under five Versus Improved Water Supply and Sanitation



Source: Ministry of Health, (2003)

196. National health policy, formulated in 1993, highlighted the concern about environmental health risks and targets were set to intensify and expand environmental health activities including prevention and control of air and water pollution. An environmental health component was included in the national health plan for implementation. Pilot scale activities were launched to measure air and industrial wastewater discharges for toxicity. ARI Control Project was implemented to enhance the awareness of environmental health risks posed by air pollution (Win Lwin Nyunt, 1997). National Poison Control Center was established and methods of dealing with poison and toxic contamination are being disseminated in hospitals and public health care centers.

### 3.3.2 Information Access and Stake Holder Participation

197. Newspapers, journals, radio and television are key sources of information pertaining to the management of environment. Popular opinions on environmental issues are often voiced in "People's voice" sections of local newspapers and journals. The government often takes note of these especially in cases involving industrial pollution. There is no law restricting access to information on environmental issues by the public. Practice, however, requires a prior approval from heads of the agencies to release information.

198. In general, government agencies seek public participation in implementing the activities sanctioned in national planning documents. National Tree Planting Campaign is a case of an activity with a conservation focus attracting substantial participation. Local NGOs participate in national workshops and working committees. The committee set up to facilitate the implementation of UNCCD in Myanmar is a good illustration of such participation. Among significant steps in institutionalizing stakeholder participation in decision-making is the '*Community Forestry Instruction (CFI)*'. The Instruction recognizes local customary rights to trees and customary land tenure and allows communities to form forest user groups in their neighborhoods. The forest user groups draw up a village-forest-management-plan (VFMP) with the assistance of local Forest Department. Among others, the plans specify the pattern of benefit sharing. The scheme stimulates community-based natural conservation and



gives local communities a direct stake in sustainable forest management. Since CFI was legislated in 1995, Forest Department has been handing over forestland to local community for self-management. Japanese International Cooperation Agency (JICA) has assisted the Forest Department in training of forestry staff in extension and participatory forest management activities. The CFI may well become a model for other environment-related activities in promoting local people's role not only in implementation but also in decision-making and resource sharing.

### 3.3.3 Environmental Awareness and Education

199. Attempts have been made by various government agencies to raise environmental awareness and improve environmental education in Myanmar. The Ministry of Education has developed a life skill-learning curriculum for children for integration with the usual subjects taught in primary schools. It includes basic principles of environmental conservation such as water recycling, relationship between living and non-living things, tree planting, waste disposal, and personal hygiene. Training is also given to Primary School Teachers to improve their environment-related skills. An interdisciplinary curriculum for bachelor and postgraduate degrees in environmental management has recently been developed and introduced. This will greatly assist in building human resource skills in the environmental sector. Post-graduate studies in environmental engineering are now available at the Yangon Technology University.

200. There are regular programs on local television to raise environmental awareness of the public. These programs cover a broad range of topics such as deforestation, household energy saving, pesticide handling, integrated pest management, soil fertility improvement, solid waste disposal, personnel hygiene, sanitation etc. NCEA organizes the national environment day once a year. National tree planting campaign is also an effective tool in relaying the sustainability message to the wider society.

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## IV. CONCLUSIONS AND RECOMMENDATIONS

201. This section contains recommendations based on the material presented in Parts II and III. The recommendations are of two types: those relating to the quality of EPA and those addressing the management of the relevant environmental concern.

### ***Forest Resource***

#### *Recommendations concerning data and EPA*

202. Forest Department should build on the experience of this EPA to collaborate with professional peers in other GMS countries to achieve greater comparability of key parameters describing the conditions of the forest resource. Forest cover is the most obvious example but there are others where inertia and other reasons (in all countries concerned) have perpetuated insufficient comparability.

203. Future EPAs in Myanmar should focus on providing a better understanding of the reasons for the loss of forest cover, in particular the possibility of significant under-reporting of the true extent of slash-and-burn practices and the extent of illegal logging.

204. Forest assessment has already been done twice in the past and the forestry master plan commits the authorities to the continuation of this work. Consistent methodology is required to facilitate future assessments of performance. It is recommended that the question of consistency of method be explicitly addressed in future assessments. Also, future assessments should add information about the condition of forest within forest reserves, by type of eco-system.

205. There is a need to gather better information about the pattern of fuelwood production and use. In particular, new estimates are needed of today's per capita use of fuelwood by selected categories, and the use of fuelwood by rural-based and other industries. The results should be integrated into national energy-saving strategies and communicated also to those in charge of monitoring Myanmar's GHG emissions and be.

206. Now is the good time to put in place an appropriate system of monitoring of the "new" activities in the forestry sector, such as community forestry, to make sure future EPAs can begin to draw lessons about these activities' effectiveness.

#### *Other recommendations*

207. Forest conservation activities have been overshadowed in Myanmar by commercial logging, on the one hand, and state-run forest plantations, on the other. "New" activities such as community forestry are only slowly becoming a telling component of the sector. The notable absentee is the private sector. It is recommended that a study be undertaken of the obstacles to the involvement of the private sector in different forms of forestry (other than logging in the old forest). The study should also address (1) the question whether a greater involvement by the private sector could free the Government resources for more intensive forest conservation and watershed management, and (2) the environmental and other safeguards to accompany private sector involvement.

208. Existing forest policy contains clear policy target regarding the loss of forest cover. But it does not specify any target concerning forest degradation (a change

from closed forest to open forest as well as changes within the category of open forest). The desirability of adding targets specifically related to forest degradation should be considered.

### ***Threat to Biodiversity***

#### *Recommendations concerning data and EPA*

209. The national inventory on flora and fauna should be considered an ongoing activity the completion of which will significantly improve the authorities' ability to monitor the state of biodiversity. In such inventory, the place of globally threatening species should be highlighted to facilitate global comparisons.

210. GIS-based ecosystem assessment is needed to add to the knowledge of changes in habitats within PAS, as partially done in this EPA. Future assessments may want to target critical ecosystems and bio-corridors as a basis for possible expansion of PAS to other non-forested areas and non-terrestrial ecosystems.

#### *Other recommendations*

211. The idea of extending the concept of community management from forestry only to nature conservation for effective biodiversity conservation should be seriously considered.

212. As trafficking is a serious threat to biodiversity not only within Myanmar but also other GMS countries, Myanmar's authorities should work more closely with CITES as well as international NGOs like WWF.

213. In compliance with the UNCBD, the following activities should be implemented:

- a. Preparation and submission of 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup> National Reports (due date for the 3<sup>rd</sup> report was 15 May, 2005). Only one of these reports has been submitted by Myanmar to UNCBD.
- b. Development of the National Biodiversity Strategy and Action Plan.
- c. Preparation and submission of thematic reports on invasive alien species, access to genetic resources and benefit sharing, forest eco-systems, mountain-ecosystems, protected areas, technology transfer and cooperation, and global taxonomy initiatives.

### ***Land Degradation***

#### *Recommendations concerning data and EPA*

214. Land use planning is crucial for not only land rehabilitation but also many other applications. All spatial information now scattered between Ministry of Forestry and Ministry of Agriculture and Irrigation should be pooled and used to develop land capability maps and land suitability classifications, which are key elements in land use planning. The current EPA confirmed the such task is technically possible

215. Not enough is known in Myanmar about the pattern of soil erosion. Regular monitoring of soil erosion backed by establishment of monitoring stations and points and appropriate monitoring design should be designed and implemented.

### *Other recommendations*

216. The analysis of Part II suggests that a strong case exists for expanding land rehabilitation activities in Kayah and Karen States.

217. The role of credit in supporting soil conservation activities should be given greater consideration.

218. A “Farmer-Field School Approach” has been used by agriculture extension agencies. This approach should be extended to soil conservation and sloping agriculture technology development.

219. Greater use should be made of the international experience with the sloping agricultural land technology (SALT) and its applicability in Myanmar.

### **Solid Waste Management**

#### *Recommendations concerning data and EPA*

220. Future EPAs should address the management of hazardous waste as a subcomponent of waste management.

221. An assessment of the condition of existing landfills would add to the quality of the overall assessment of solid waste management in Myanmar.

222. Quantitative targets for solid waste management should be formulated.

#### *Other recommendations*

223. Given a good performance in waste management in Yangon contrasting with poor performance in second-tier towns, efforts should be taken to strengthen the capacity of local authorities in these towns for improved solid waste management.

224. Commission a study on best ways of promoting private sector participation in solid waste management drawing on relevant GMS and other experience.

### **Water Resource**

#### *Recommendations concerning data and EPA*

225. Link future EPAs more closely with information on the efficiency of the irrigation systems, especially parameters such as conveyance losses and on-farm irrigation efficiency.

#### *Other recommendations*

226. A study should be carried out comparing the cost effectiveness – in representative local conditions — of investments in new irrigation water storage vs. improved irrigation management. The environmental repercussions of reservoir construction would deserve a separate attention

## **Mobile Source Air Pollution**

### *Recommendations concerning data and EPA*

227. Monitoring of key air quality parameters (TSP, at a minimum) should be resumed in Yangon and started in Mandalay with adequate attention to the methodology of scientific basis of such monitoring (e.g. particle size, frequency, location of monitoring points, etc).

228. Future EPAs should pay more attention to the approaches used in recent initiatives on vehicular pollution management in Asia, including those funded by ADB. These approaches should be used to further develop the methodology adopted in this EPA.

229. The findings of future EPAs should be more closely related to the topic of GHG emissions.

### *Other recommendations*

230. National air quality standards should be formulated and enacted.

231. Institutional strengthening is required to allow regular monitoring of air quality in urban areas. NCEA, PCCD under YCDC and Occupation Health Unit under Department of Health are probably the most suitable candidates for this task. International technical assistance should be sought to equip these institutions for that task.

232. Promotion of CNG as a policy alternative should be treated with caution given the high cost of creating the CNG distribution infrastructure. Experience of Delhi and Bangkok should be studied and the cost effectiveness of the CNG option should be compared with different models of public transport promotion. If the preference for the CNG option is confirmed, its promotion should be linked also to the topic of GHG emissions a possible financial support under the Clean Development Mechanism (CDM).

## **Climate Change**

### *Recommendations concerning data and EPA*

233. An outside support should be sought for updating the ALGAS inventory of GHG emissions in Myanmar. Such an update should also serve to gain better understanding of the continued validity (or not) of ALGAS-type projections.

234. Information on several important elements of the national response under UNFCCC needs to be more systematically organized. This includes information on fuelwood use, pattern of vehicular emissions and various energy-saving initiatives.

### *Other recommendations*

235. To comply with UNFCCC provisions, a national communication committee should be set up within appropriate agencies. National communication reports should be prepared and submitted to UNFCCC sooner. National adaptation program should be formulated. Meeting the requirements of an international environmental convention should not be considered as an end in itself but a means of improving

domestic environmental performance, supported by sound energy-efficiency and related policies.

### ***Cross-cutting recommendations***

236. The draft National Environmental Law should be approved. To enforce the proposed 'National Environmental Law', strengthening and re-organization of NCEA should be undertaken. The re-organization should be used as an opportunity also to review on the functioning of existing sub-committees under NCEA and reform them. Areas deserving particular attention are air and water quality monitoring and environmental database management within NCEA.

237. Based on the experience gained through current SEFII project, NCEA is the body most likely to be responsible for future EPAs. It should discharge this function in collaboration with the National Coordination Committee for Environment (NCCE). NCCE's sub-committees may want to utilize EPA as a management tool in improving local environmental performance.

238. Greater funding is an essential (though not the only) precondition of improved environmental performance and better future EPAs as well. Funding should involve international partners (international NGOs, foundations, private sector etc.) and contain flexible financial mechanisms. An Environmental Partnership Fund (EPF) under NCEA should be created in conjunction with the development of Environmental Resource Center (see below) A local non-profit organization such as Myanmar Engineers Society could be asked jointly to manage the fund in the interest of transparency and accountability. The search for higher budgets should not detract from the need periodically to review the efficiency with which existing budgets are used, in particular the balance of different budget categories.

239. Establishment of Environmental Resource Center (ERC) is recommended for two reasons. Among other duties (see para. 240) the Center would serve as a clearing house for the now scattered environmental information making it available to stakeholders. Second, the Center would seek to enhance national and international partnerships using the EPF to implement environment-related initiatives such as community based nature conservation, clean technology development, alternative energy development, etc.

240. The proposed structure of ERC and EPF is given in Figure 4.1. The Center's duties and functions would be to:

- a. Archive all environmental information and manage national database to which all stakeholders have access.
- b. Form an Inter-Panel Technical Group (IPTG) with technical resource persons from both government and non-government organization. Conduct regular fora or meetings to share knowledge and information.
- c. Develop training curricula for various environment-related subjects and conduct short course training for partners.
- d. Publish environmental newsletter (bulletin, journal/magazine) to disseminate information and promote environmental awareness
- e. Provide technical backstopping and environmental consultancy service to various organizations, particularly to the private sector.
- f. Develop an "Environmental Partnership Program (EPP)" to raise funds for EPF to support outreach conservation projects and environmental initiatives.

Among other things, the EPP would facilitate administrative and technical clearance for the growing number of potential investors in environment-related projects in waste management, pollution control equipment, CDM projects, community-based conservation and other fields.

Figure IV.1 Proposed Structure and Activities of the Environmental Resource Center

