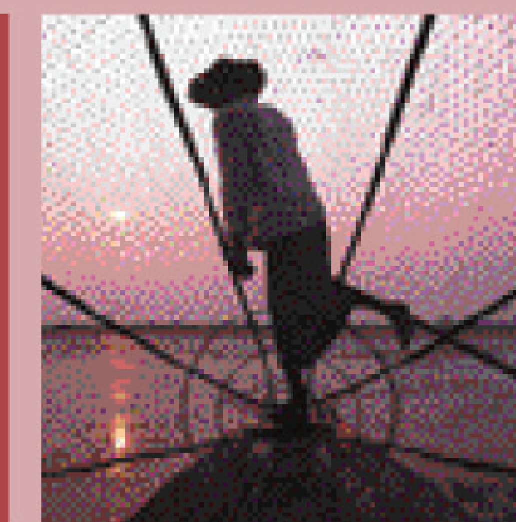
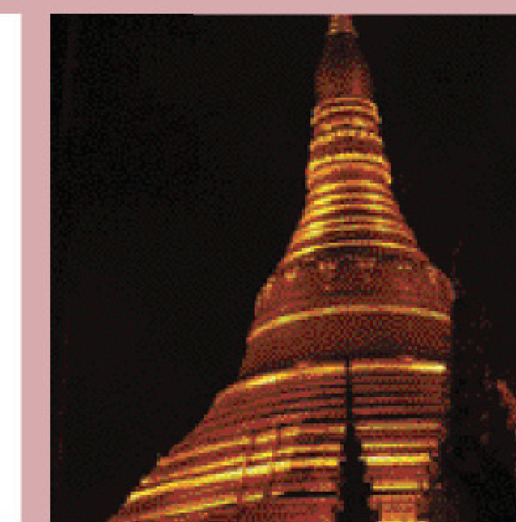
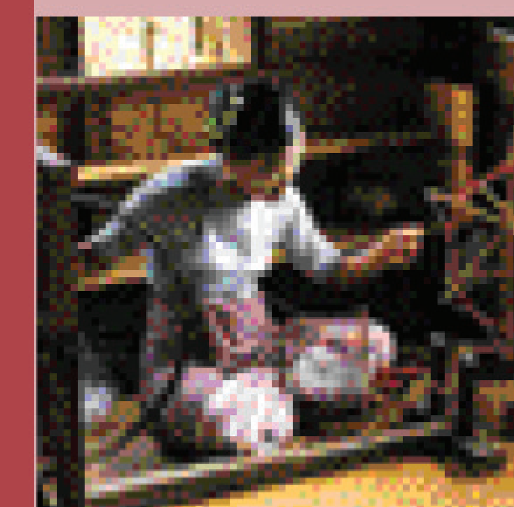
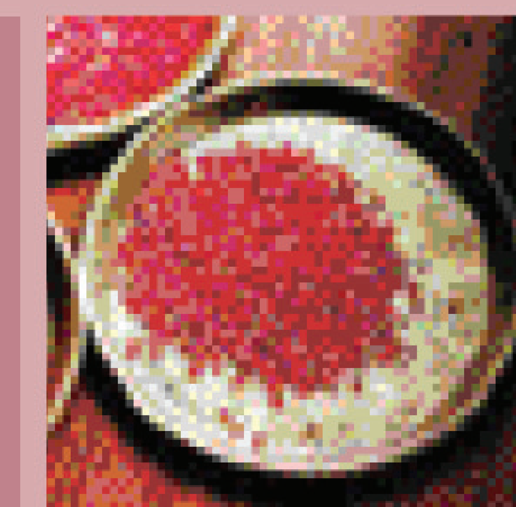
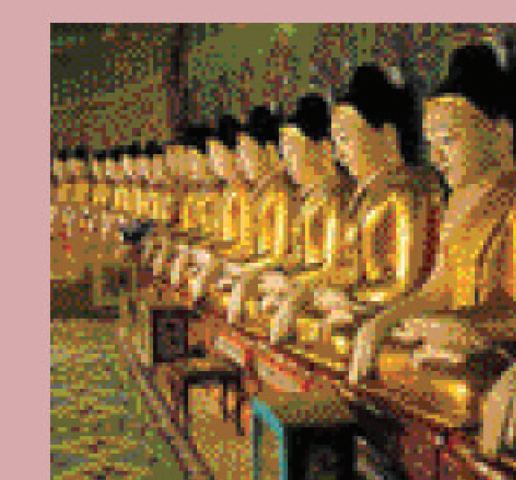

MYANMAR

NATIONAL ENVIRONMENTAL PERFORMANCE ASSESSMENT (EPA) REPORT

ADB UNEP

ADB UNEP
MYANMAR NATIONAL ENVIRONMENTAL PERFORMANCE ASSESSMENT (EPA) REPORT

National Performance Assessment and
Subregional Strategic Environment Framework
for the Greater Mekong Subregion
TA No. 6069

Prepared by
National Commission for Environmental Affairs,
Ministry of Forest, Myanmar and Project
Secretariat UNEP Regional Resources Center
for Asia and the Pacific (RRC.AP)

Technical review completed by UNEP RRC.AP

Collaborative Partners

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Foreword

Like its neighbors in the Greater Mekong Subregion (GMS), Myanmar has been trying to reconcile the demands of economic growth with the integrity of its physical environment. Despite its great natural resources and progress made at reversing some decline in forest cover, there remain many challenges for the country's environmental stability, from soil degradation to water quality. This environmental performance assessment (EPA) encompasses seven key environmental concerns: forest resources, biodiversity, land degradation, management of water resources, waste management, air pollution from mobile sources, and climate change.

The prime purpose of the second Strategic Environmental Framework (SEF II), initiated in 2003, is to promote sustainable development in the GMS through the creation of a national and subregional environmental performance assessment system and the building of capacity to implement such a system. Supported by a detailed and transparent database, the EPA report draws a picture of principal environmental trends, assesses the degree of success in achieving specific targets, and makes key recommendations. In this way, EPA assists the process of policy adjustment and becomes a tool for public accountability, as well as a device for the wider GMS to implement on a subregional picture. This national EPA was prepared under the guidance of a national coordination committee.

Like all assessments of performance, assessment of environmental performance demands a retrospective look at what has happened, not what might happen in the future. Here, the present EPA draws on the "P-S-R" model pioneered by Organization for Economic Cooperation and Development (OECD). In the model, indicators are chosen to capture the state of the concern being studied, the underlying pressures, and the responses, to counter the pressures and improve the state. The report is vital in highlighting gaps and weaknesses in current policy, by illustrating Myanmar's current record, and then showing ways forward. The EPA report is vital not just as a national marker, but also as a tool for the whole GMS to incorporate.

Myanmar was able to carry out SEF II with guidance of the Asian Development Bank (ADB) and United Nations Environment Programme (UNEP) teams.

The report is written in four parts. After an introduction in Part I, Part II is an assessment of performance under principal environmental concerns. Part III of the report deals with the factors that affect performance. Part IV draws conclusions and gives recommendations. As well as in national application, this report will also be of great use for future planning and improvement of environmental management in Myanmar.

Dr. San Win
National Commission for Environmental Affairs
Union of Myanmar

Acknowledgment

The completion of the National Environmental Performance Assessment (EPA) Report for Myanmar would not have been possible without the valuable inputs and assistance of many individuals. A core team of international and national consultants prepared the initial and final draft of the report under the aegis of the National Commission for Environmental Affairs (NCEA). Daw Yin Yin Lay, NCEA Joint Secretary and Daw Htwe Nyo Nyo, NCEA Deputy Director, served as the National Focal Point and National Coordinator, respectively, for the project. We wish to thank international consultants Ivan Ruzicka, Kumar Mohit, and Mike Comeau and national consultants Win Myo Thu and Maung Maung Than for their very significant work on the report.

Acknowledgement is also given to the many people and institutions that participated in the various consultations and workshops organized during the preparation of the report and provided feedback. This includes an EPA technical review team consisting of representatives from NCEA, Ministry of Energy, Ministry of Transport, Yangon City Development Committee, Ministry of Agriculture and Irrigation, and Ministry of Health.

The project was made possible through financial and technical support from the Asian Development Bank (ADB), the Global Environment Facility (GEF), the United Nations Environment Programme (UNEP), Institute for Global Environmental Studies (IGES) of Japan, and the National Institute for Environmental Strategies (NIES) of Japan. A note of thanks is given to Masami Tsuji and Herath Gutanilake, both ADB staffs, who provided valuable insight and support throughout the process of preparing this report. Finally, kudos to the team from UNEP who ably coordinated the management of the entire project on Strategic Environmental Framework for the Greater Mekong Subregion (SEF II): Yuwaree In-na and Tin Aung Moe.Acknowledgment

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

Executive Summary

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 sources and climate change. The assessment uses a structure of performance indicators and is supported by detailed statistical information.

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 strong 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.

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.

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.

Myanmar is perceived as a low water stress country. Nonetheless, the dominant role of rice in the cropping systems and several other factors has made irrigation a priority concern. The volume of irrigation water storage capacity has increased 27 times since 1988. Given the continued policy and strategic preference for more paddies, 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.

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.

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, a 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.

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 a 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.

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 ormulation 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.

Acronyms & Abbreviations

AAC	annual allowable cut
ADB	Asian Development Bank
ALGAS	Asia Least Cost Greenhouse Gas Abatement Strategy
ARI	acute respiratory infection
ASEAN	Association of Southeast 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

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1 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 Subregion ("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 subregional environmental performance assessment system and development of national and subregional 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 database, 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) 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 subregional 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

No.	Name of Organization	Position
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 and Population	Member Organization
5.	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)
U Thein Lwin	Deputy Director General, Energy Planning Department, Ministry of Energy
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
Dr. Than Htut	Deputy Director, Occupational Health Unit, Department of Health, Ministry of Health
Daw Htwe Nyo Nyo	Deputy Director, National Commission for Environmental Affairs (NCEA)

The principal authors of this draft were:

U Win Myo Thu	ADB's Domestic Consultant, Environmental Issues, SEF II Project
U Maung Maung Than	ADB's Domestic Consultant, Environmental Database, SEF II Project

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 "fact sheets" 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.nA 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)

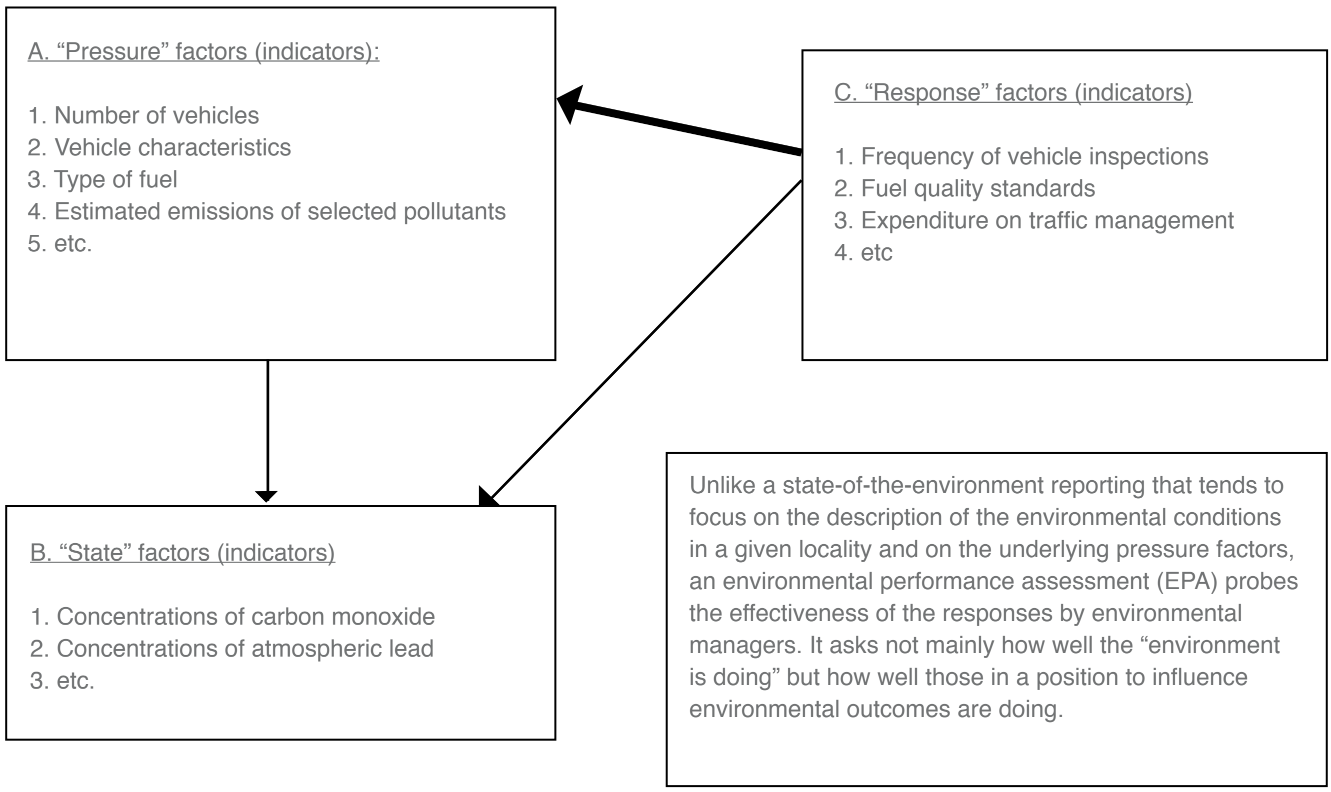


Table 1: Rating Used to Assess Selected Indicators

STATE INDICATOR			
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). 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".			
Relatively Poor and	**Average and ...**	**Relatively Good and ....**	**Unknown State and ....**
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
Deteriorating	**Stabilizing**	**Improving**	**Undetermined Trend**
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.

PRESSURE INDICATOR			
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. 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.			
High and	**Medium and**	**Low and**	**Non-Comparable and**
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.
Increasing	**Steady**	**Decreasing**	**(blank)**
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.

RESPONSE INDICATOR			
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.			
Low and	**Average and**	**Significant and**	**Non-Comparable**
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.
Sporadic	**Intermittent**	**Consistent**	**(blank)**
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.

Table 2: Rating Used to Evaluate Performance Under a Selected Environmental Concern

<table>
<tr><th colspan="4">ENVIRONMENTAL CONCERN</th></tr>
<tr><td colspan="4">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 fact sheets, not on what a consensus view or expectations may be.</td></tr>
<tr><th>1-Star *</th><th>2-Stars **</th><th>3-Stars ***</th><th>Un-Rated</th></tr>
<tr><td>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.
Additional criteria for 1-Star rating:
1) Reasonable targets have not been set or have not been met.
2) International conventions have not been ratified or adhered to.
3) No ongoing monitoring or data collection.
4) No clear institutional role and responsibilities for 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.</td><td>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.
Additional criteria for 2-Star rating:
1) Targets have been set and generally met.
2) International conventions have been or will be ratified and most of the reporting requirements have been met
3) Plans exist for ongoing monitoring and data collection.
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.</td><td>If there is clear evidence that the responses have reduced the pressure and/or there is a clear sign that the state is improving.
Additional criteria for 3-star rating:
1) Effective targets have been set and met.
2) International conventions have been ratified and reporting requirements have been met.
3) Ongoing monitoring and databases exist.
4) Specific institutions with 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.</td><td>If the trend in the state indicator cannot be explained by the pressures or the responses.

The label “un-rated” is a sign that we have failed to identify appropriate indicators backed by fact sheets, and/or have failed to apply the PSR model, and/or have failed to apply the PSR model to performance assessment.</td></tr>
</table>

The Target Audience

The target audiences for the report are:

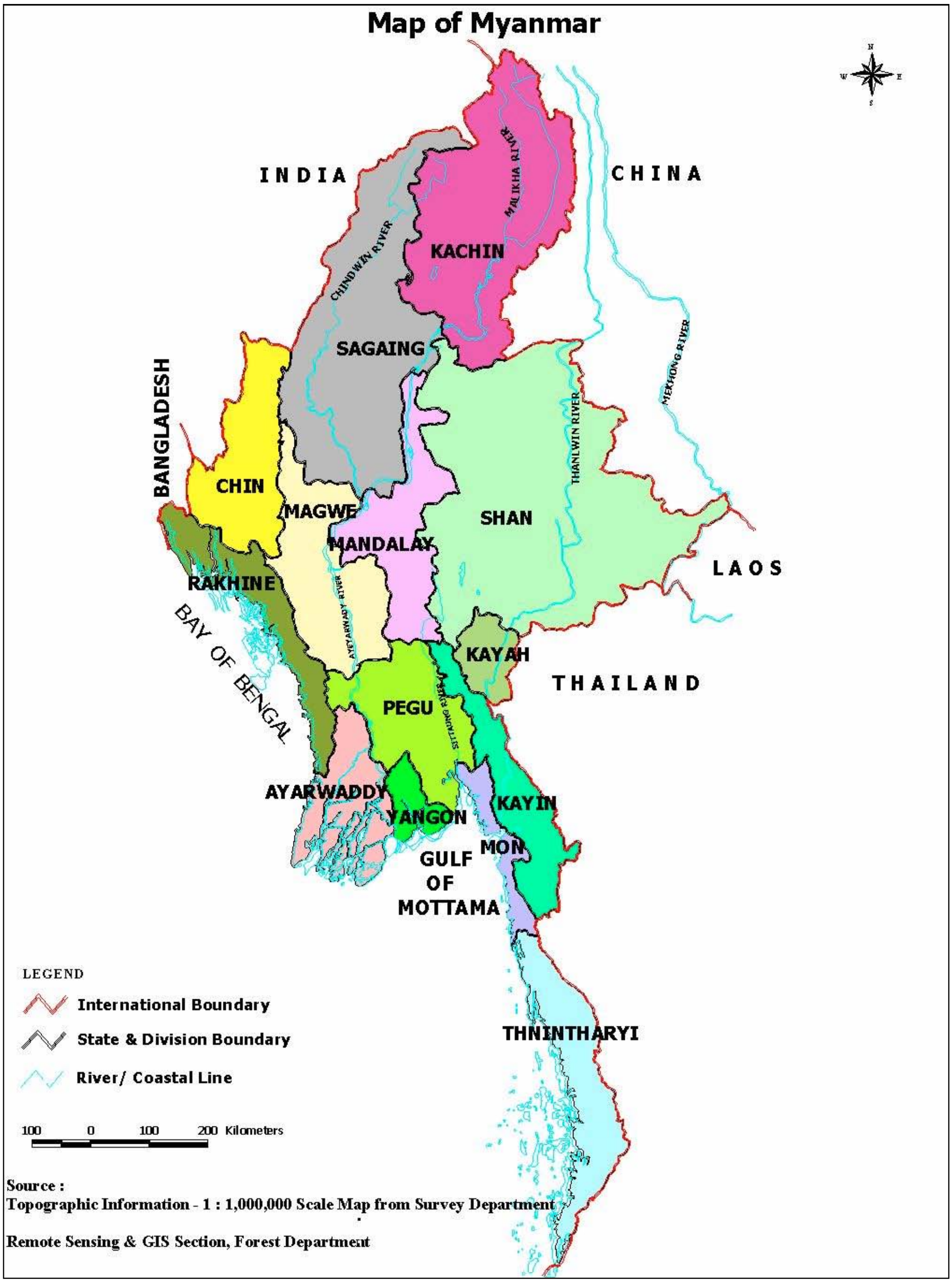
- National-level decision and policy makers
- National Commission for Environmental Affairs (NCEA)
- Government departments, institutions and agencies related to environmental management in Myanmar
- Universities and research institutes
- National non-governmental organizations active in socio-economic 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 Subregional Environment Strategic Framework for the Greater Mekong Subregion – ADB/ TA.No.6069-REG. Prepared by Project Secretariat, UNEP Regional Resource Center for Asia and the Pacific, Bangkok, pp: 1-2.

Map 1: Administrative Map of Myanmar



Source: Forest Department 2005

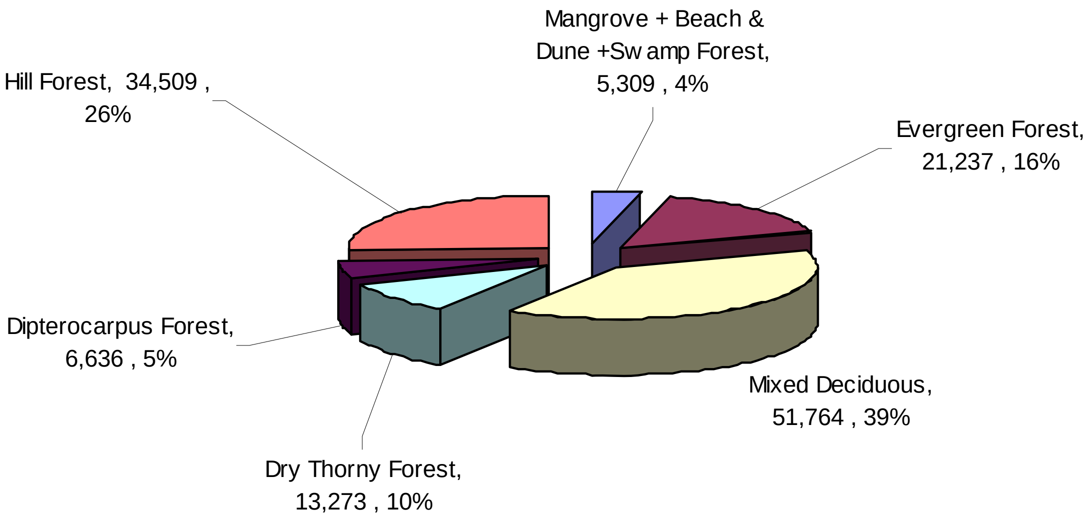
2 MANAGEMENT OF PRINCIPAL ENVIRONMENTAL CONCERNS

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)

Figure 1.1: Forest Area by Forest Type – 1989/90 (Square miles)



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% 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.

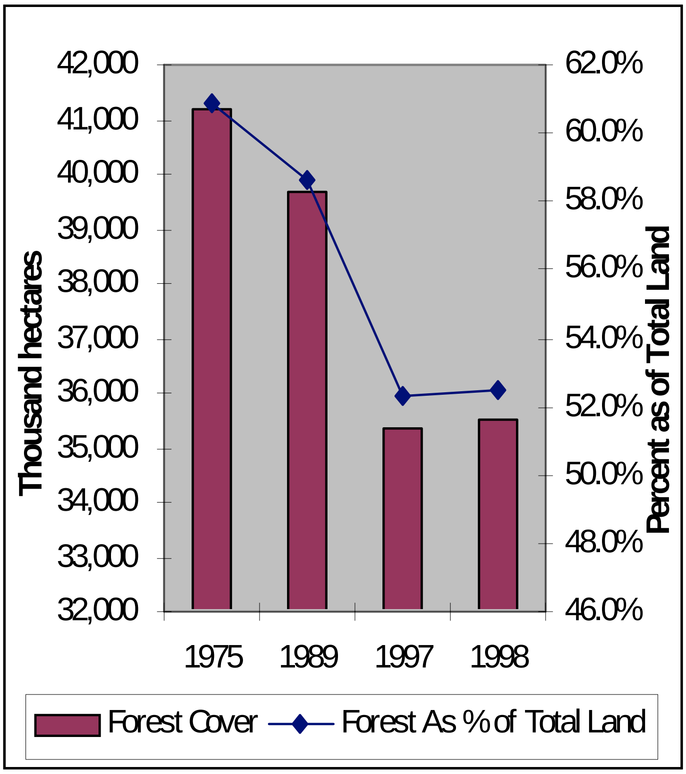
Indicator: Percentage of Forest Cover in Total Land Area 1975-1998

1.2. State

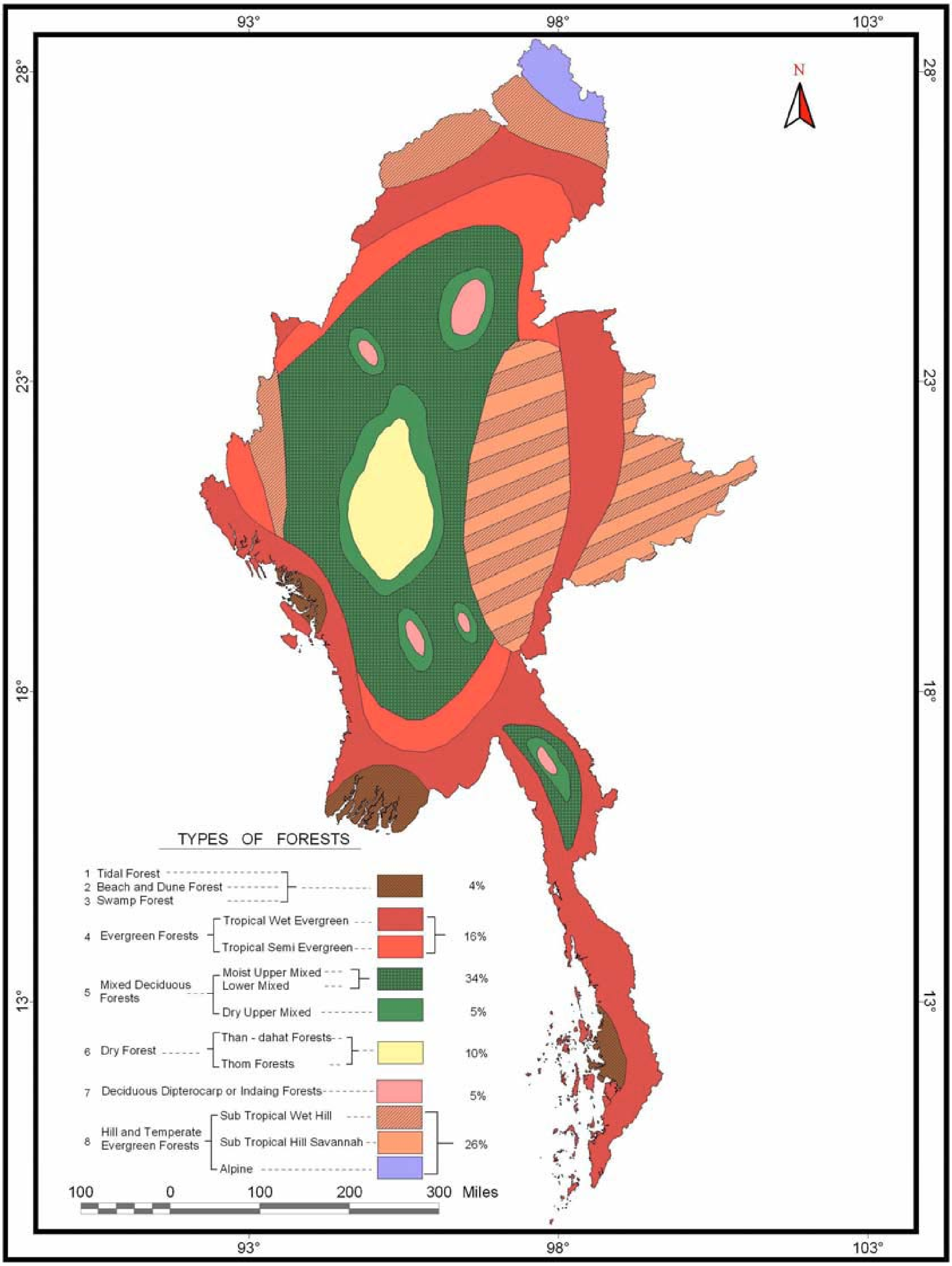
11. Following globally accepted indicators of the state of forests as used, for instance, by the Food and Agriculture Organization of the United Nations (FAO) in ongoing global monitoring of tropical forests, forest cover, expressed as a percentage of the total land area, was selected as the state indicator.

12. In 2005, half of the country is still covered with natural forests. Based on the Forest Department (FD)'s estimates, total forest area was 41.2, 39.7 and 35.5 million ha in 1975, 1989 and 1998, respectively, corresponding to approximately 61%, 59% and 52% of the total land area (see Figure 1.2.). The loss of forest cover accelerated over time from a 2% loss between 1975 and 1989 to 7% during 1989-1998. According to Forest Policy and Master Plan, 30% of total land is to be a Permanent Forest Estate or PFE (Reserved Forest and Public Protected Forest) while another 10% is to be under Protected Area System. An additional 10% of total land is to be managed for multiple land use containing agroforestry and community forests. (MOF, 2001a)

Figure 1.2: Forest Cover as a Percentage of Total Land



Map 2: Dominant Type of Forests



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

13. The spatial pattern of deforestation is presented in detail in the corresponding fact sheet. 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 these following areas:

a. Ayeyarwaddy Division – Annual deforestation rate was 5.6 % per annum as total forest cover declined from 24% of the total area in 1989 to 12% 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 PRC 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 ha 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 ha 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 put the forest cover of other GMS countries at 54.4% in Lao PDR, 52.8% in Cambodia, 30% in Viet Nam, and 28.9% in Thailand (FAO, 2000). The forest cover of Yunnan was 32.4%. Thus Myanmar's forest cover (52.5%) is the second highest among them after Lao PDR. It is

important to add, however, that the methods of classifying forest 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 ha 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- 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"[1] (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[2]. 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[3]. The key to a 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)[4] during the last decade[5]. As can be seen the pressures on forest resources in Myanmar have been many and a single indicator is unlikely to capture this complexity.

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[1]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.

[2]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).

[3]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)

[4]The growth of export-led timber industry coincided with the official adoption of a market economy in 1988.

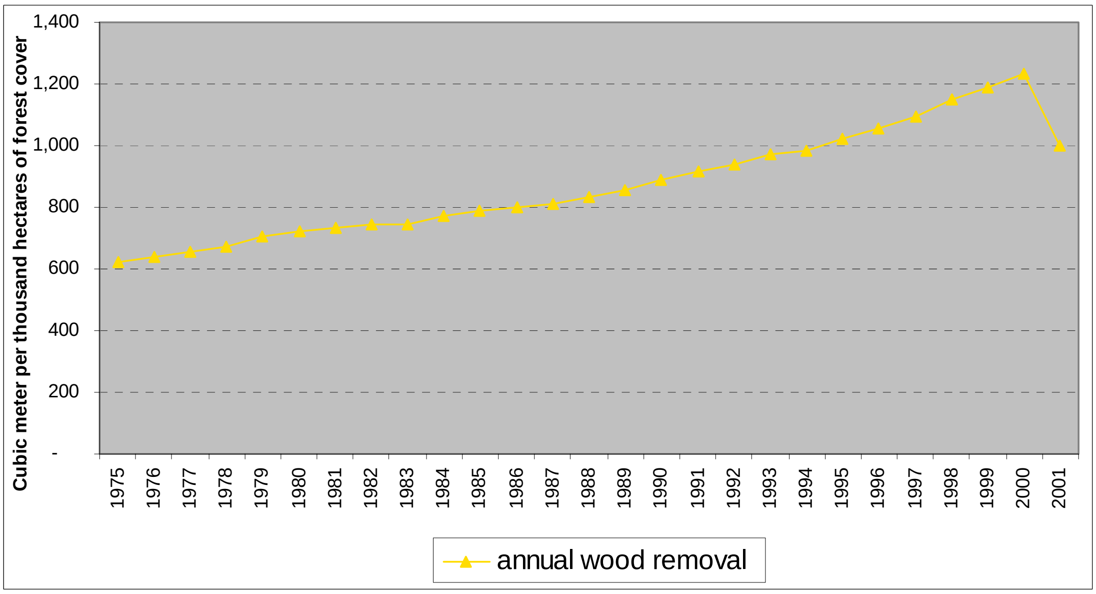
[5]As of CSO (2002), annual growth rate of forestry sector gross domestic product were 8.3 % (1990/91), -4.5% (1995/96), 2.1% (1996/97), 2.8% (1997/98), 3.2% (1998/99), 4.6% (1999/2000), 3.3% (2000/01) and 10% (2001/02).

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.

20. Figure 1.3 illustrates the near doubling of the pressure on average forest area between 1975 and 2000 from 624 m3 of annual wood removal per 1000 ha of forest to 1232 m3 in 2000. 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 in this report 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 approximately 92% 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 m3 in 1975 to 40.4 million m3 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 in this report) 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 figures for other GMS countries are readily available to make comparisons with although such comparisons could be made with additional effort.

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



Source: Forest Department (2005)

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^3 in 1975 to 1,232 ^{3} 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"[6]. 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, the establishment of forest plantations was not a priority (Slebbing, 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, the World Bank (WB) and Asian Development Bank (ADB) supported forest plantation establishment, from 1979 to1987, through the East Pegu Yoma Project (Ohn U, 1999).

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.

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 ha (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 neediest areas like the heavily deforested parts of Magwe,

Table 1.1: Establishment of Forest Plantations (acres)

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

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

6"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 buffer zone management by almost one hundred years.

Mandalay and Sagaing Divisions. Community forestry legislation is also providing for the right of local people to manage nearby forests for their 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.

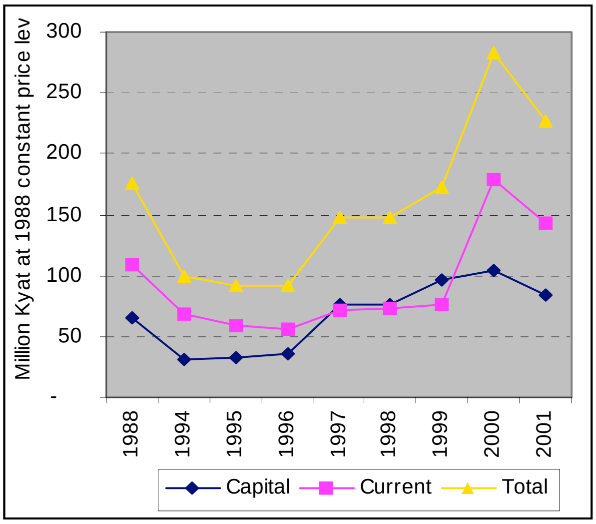
27. Real expenditure on forest conservation has been developed in this EPA as an indicator of response based on information provided by the Forest Department and Dry Zone Greening Department, under Ministry of Forestry.

1st Indicator: Expenditure on Forest Conservation 1988-2001

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 expenditure at constant prices of both Forest Department and DZGD during 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).

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 the FD'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 FD though there might have been some expenditure by the Dry Zone Greening Department[7]. The 2001 expenditure, i.e. spending on personnel and administration, consumed almost 63% of the total budget 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.

Figure 1.4:Expenditure on Forest Conservation at 1988 Constant Price



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

7One 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.

Suggested Rating: Average and Intermittent

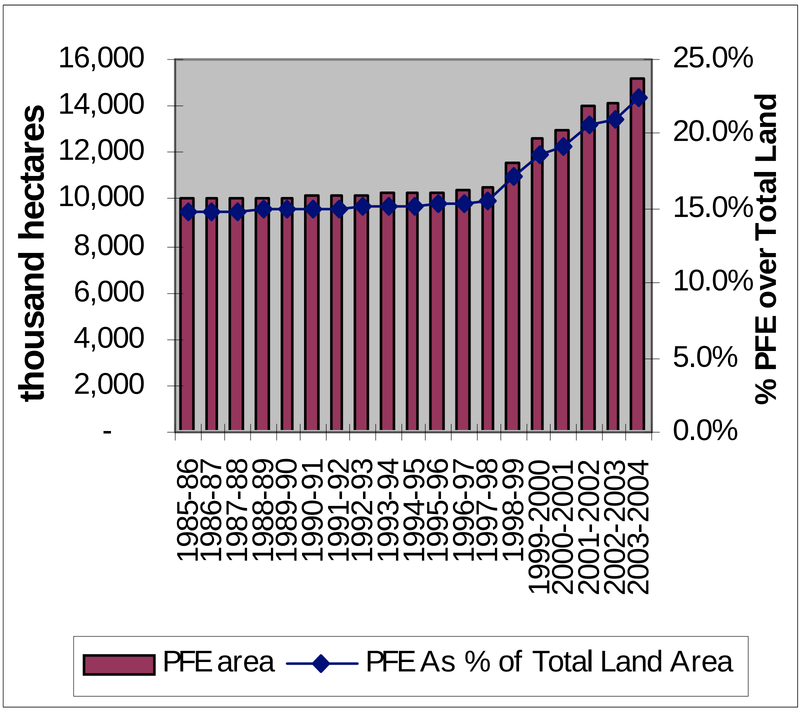
Justification: The inflation-adjusted expenditures available for forest conservation have been fluctuating during the period 1988 to 2001. The response is considered intermittent. In general, the expenditures averaged 200 Million Kyat p.a. The largest share was used to finance administration and personnel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

2nd Indicator: Permanent Forest Estate as a Percentage of Total Land 1985 - Expenditure on Forest Conservation 1988-2003

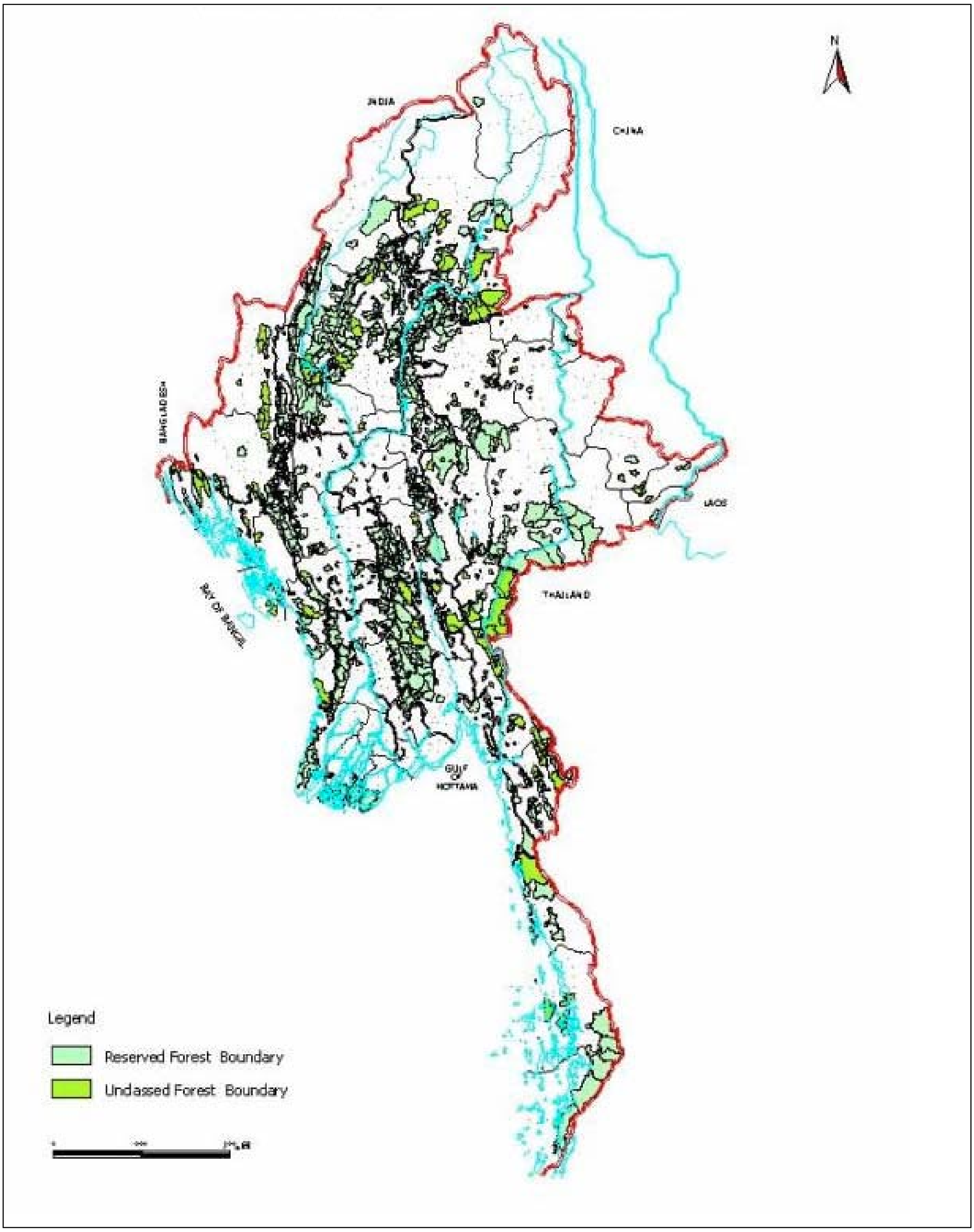
30. In Myanmar, different typologies of forest and differences in their legal status are found. Forest Reserve is the best-known category fully protected by existing forestry related laws. Establishing a Forest Reserve is normally a lengthy official process during which potential conflicts of interest 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.

31. Before the policy target was announced, the total percentage of Permanent Forest Estate (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.

Figure 1.5: Area of Permanent Forest Estate in Myanmar



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 Permanent Forest Estate (PFE) amounted to 22% 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: FD was able to increase PFE 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.

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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).

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 characteristics 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 "hot-spot" 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). 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).

38. As the designated agency for biodiversity conservation in Myanmar, the Ministry of Forestry (MOF) through its 30-year Master Plan (MOF, 2001) 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 un-controlled 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 a Percentage of Globally Threatened Species – 1996-2004

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.

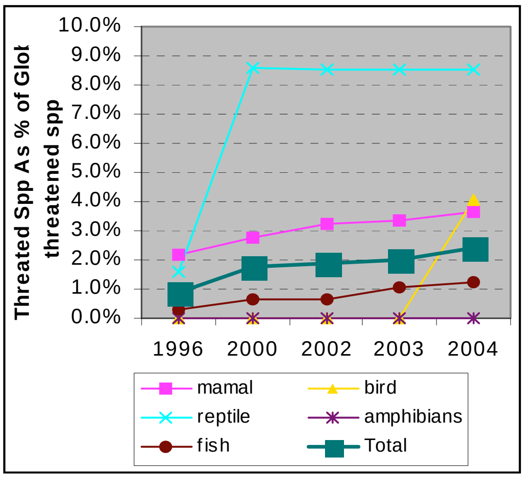
41. As can be observed from the 2004 data in Figure 2.1, Myanmar is a tentative sanctuary to approximately 2.4% of the globally threatened species (mammals, birds, reptiles and fish). This standing includes approximately 3.6% of globally threatened mammals, 4% of birds, 8.6% reptiles, and 1.3% of globally 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 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 threatened species have sanctuary outside of Myanmar. Some of this artificial oscillation can already be observed in the reptile species since 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 fact sheet) 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

Figure 2.1: Threatened Species as a Percentage of Globally Threatened Species (1996 to 2004)



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, 88 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

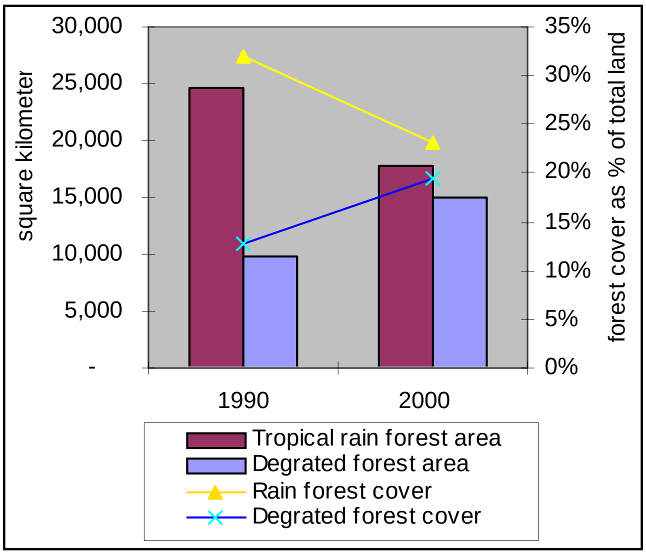
45. The state indicator analysis has also provided some insight as the habitats of the threatened species in Myanmar and the major threats to those threatened species. Forests were identified as the dominant habitat for approximately 36% of the threatened mammals and birds but loss of wetlands and grasslands 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.

1st Indicator: Loss of Tropical Rainforest in Taninthari Division from 1990-2000

47. As can be observed from Figure 2.2, the area of rainforests (closed forest) in Taninthari Division declined from 24603 km^2 (or approximately 32%) of the division area in 1990 to 17,820 km2 (or 23%) of the division area in 2000. This translates to a 9% 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 km2 of tropical rain forest is counter-balanced by a 4,772 km^2 increase in the area of degraded forest which increased from 9,820 km^2 in 1990 to 14,593 km^2 in 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^2 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 Tanintharí Area



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

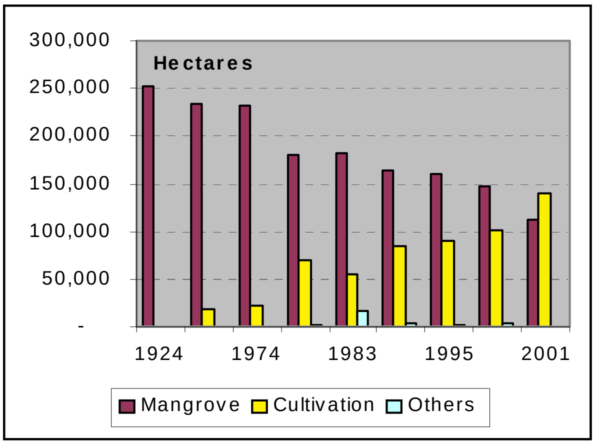
Suggested Rating: High and Increasing

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 Tanintharí 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.

2nd Indicator: Loss of Mangroves in Delta Forest Reserve – 1924-2001

49. As can be observed from Figure 2.3, mangrove forests in the Delta Forest Reserve declined at an alarming rate from 253,018 ha in 1924 to 111,939 ha in 2001. Approximately 44% of the original mangroves remain. The increase in the area of rice cultivation during the past 25 years is probably 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

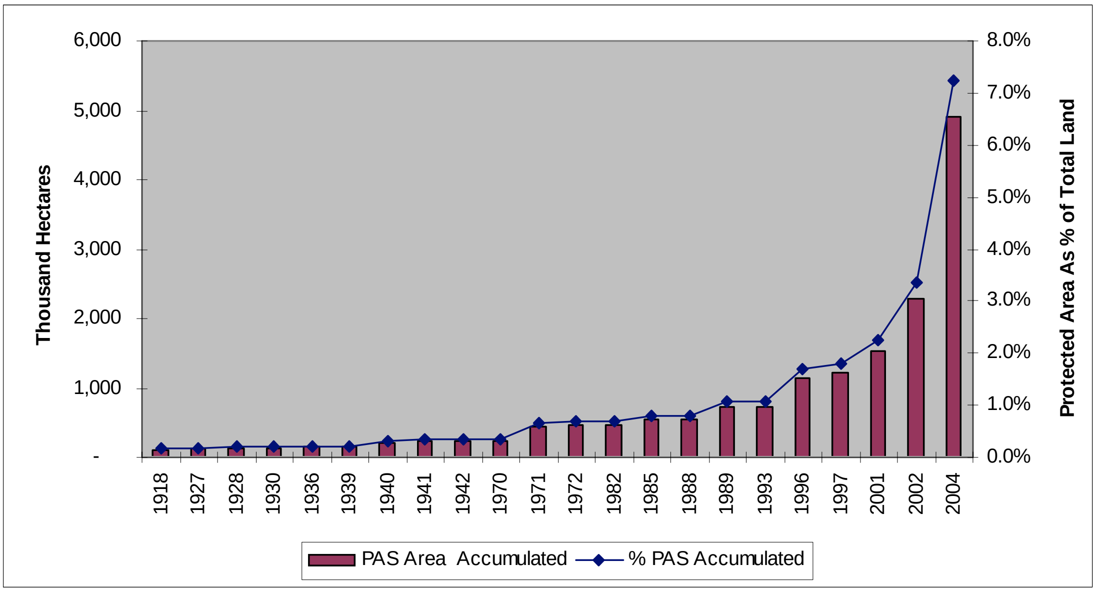
50. In the past, the most effective means of protecting threatened species was to enact laws which had the aim to ensure the species' future existence. Myanmar has a long history of protecting species, starting with the Elephant Preservation Act of 1897, the Wild Bird and Animals Protection Acts of 1912 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: Percentage of Protected Area over Total Land Area 1918-2004

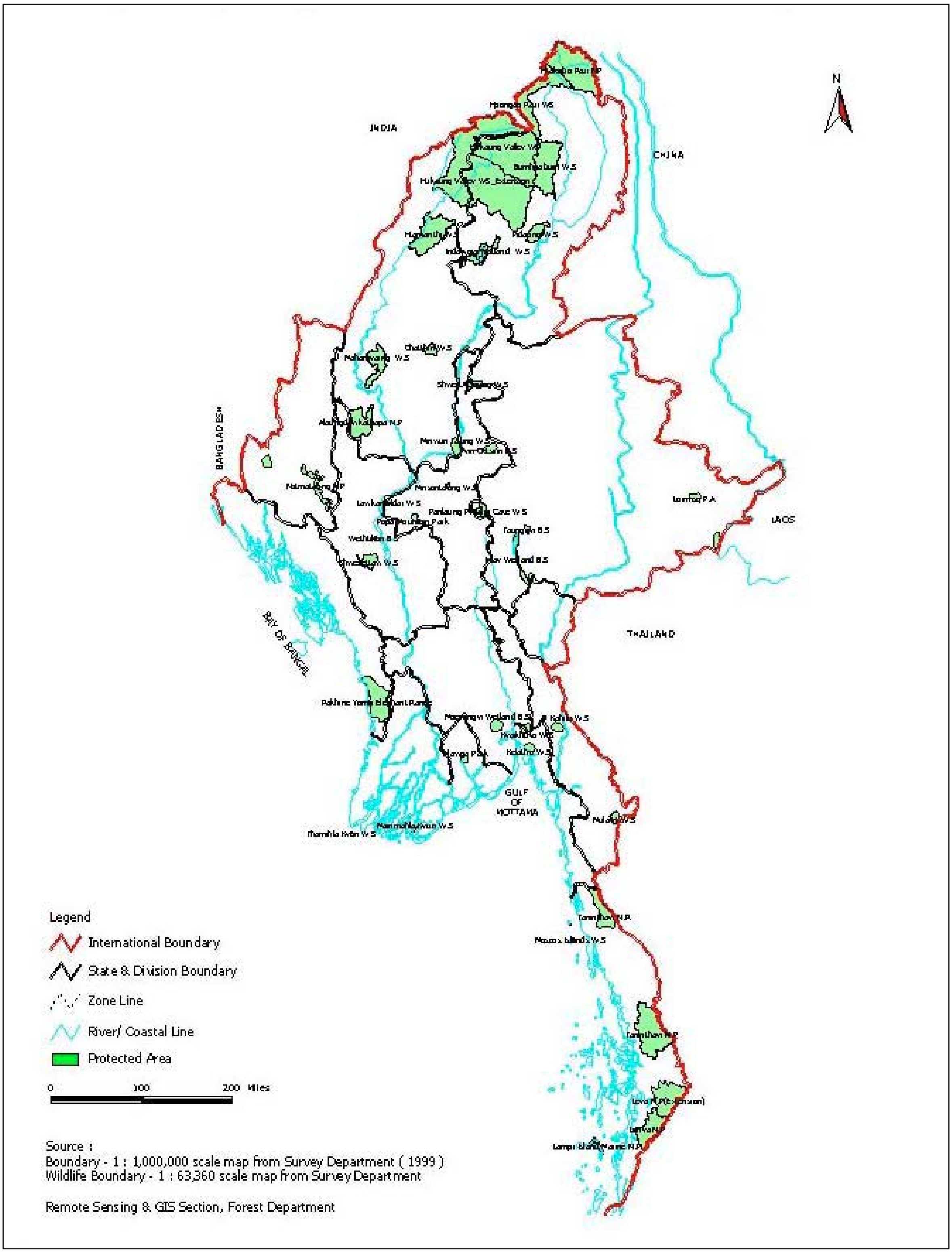
52. The area under the national Protected Area System was selected as the response indicator; the result is expressed as a percentage over total land area. The trend of the indicator to year 2004 is illustrated in Figure 2.4.

Figure 2.4: Protected Area as a Percentage of Total Land 1918-2004



Source: Forest Department (2005)

Map 4: Existing Wildlife Sanctuaries and National Parks of Myanmar



Source: Forest Department 2005

53. As illustrated in Figure 2.4 and detailed in the corresponding fact sheet, 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 39 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)[8], 27.5% in Thailand (2004)[9] and 14% in Lao (1999)[10]. 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. 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 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.

8EPA's Fact Sheet on Protected Area, SEF II Project, Cambodia (2005)
9EPA's Fact Sheet on Protected Area, SEF II Project, Thailand (2005)
10ASEAN's Secretariat (2001), "ASEAN State of the Environment Report 2000, pp:96

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.

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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 socio-economic 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% 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):

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.

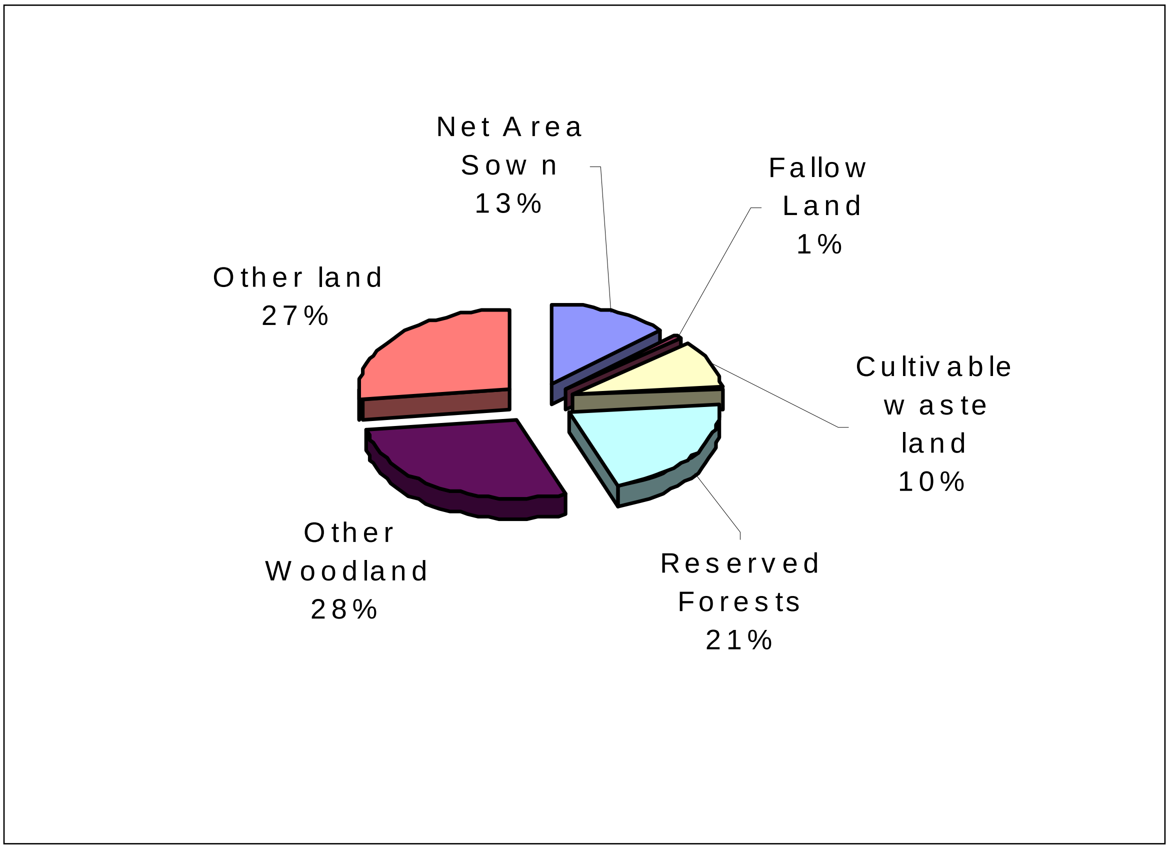
63. Within the constraints of time and data availability soil erosion has been adopted as the major land degradation issue for evaluation under this EPA.

3.2. State

Indicator: Vulnerable Farm Area as a Percentage of Total Cultivated Area 1998

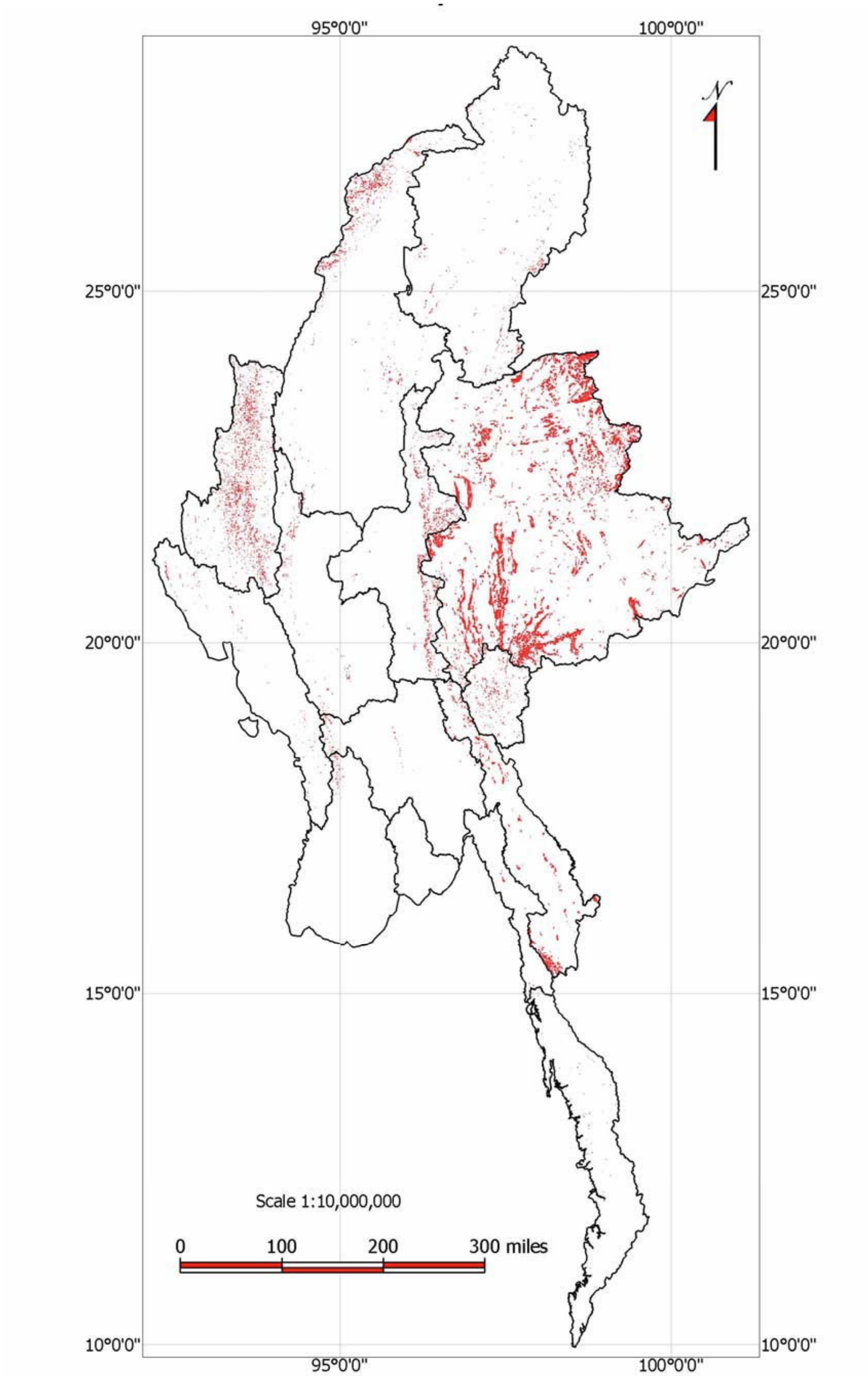
64. This is a commonly used indicator for assessing state of land degradation; and for tracking the total extent of vulnerable farming area in the sub-administrative areas of the country i.e., State and Division. It is expressed in acres. Vulnerable farming area is defined as the area of cultivated land 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



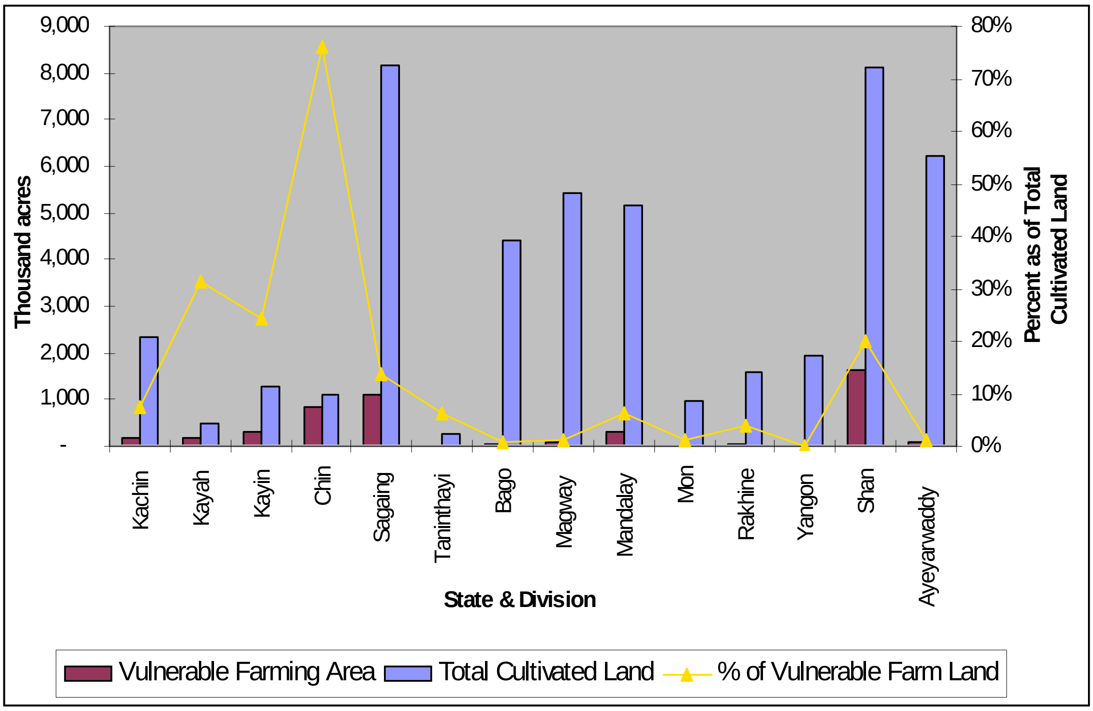
Source: Statistical Yearbook (CSO, 2003)

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



65. Two hundred and thirteen townships accounting for 66% 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° 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% 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 Sagain. Findings of the study "Soil Loss in Chindwin Watershed" (Nilar Aye, 2004) for Kachin, Sagain and Chin found that total area subject to severe soil erosion had increased from 4,799 km2 in 1990 to 36,429 km2 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% 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 a percentage of total cultivated land, the existing vulnerable farming area is considered to be average.

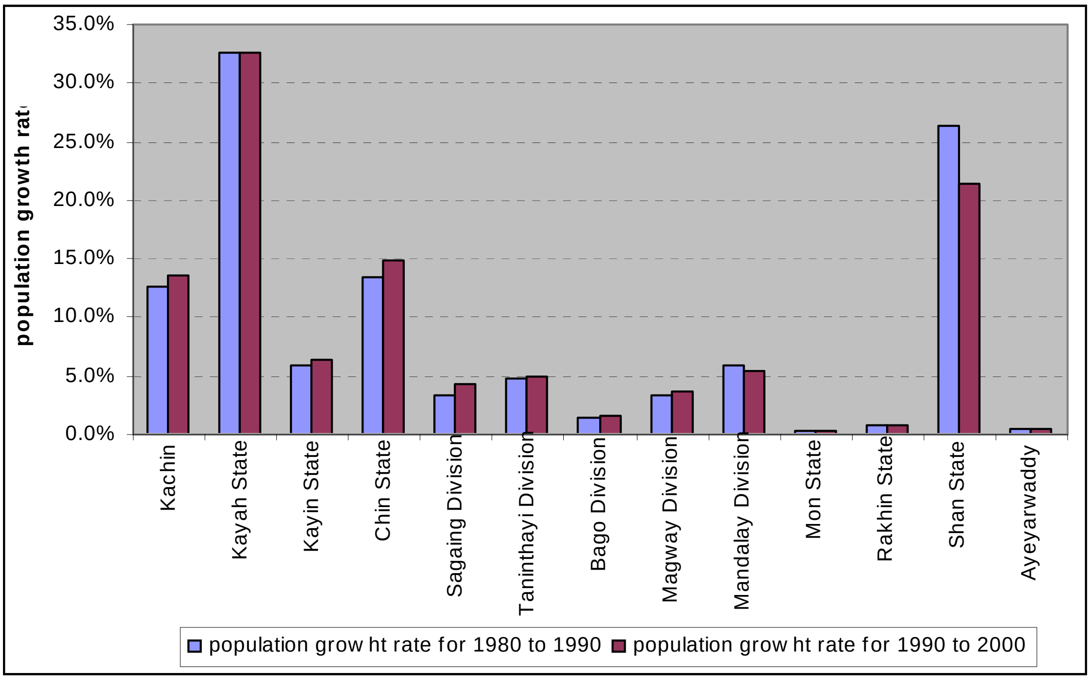
3.3 Pressure

Indicator: Growth in Upland Population 1980-2000

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% of national population. The population growth rates were 3.3% per annum in Kayah State, 2.1% per annum in Shan State, 1.5% per annum in Chin State and 1.4% per annum in Kachin Sate 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: Percentage of 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

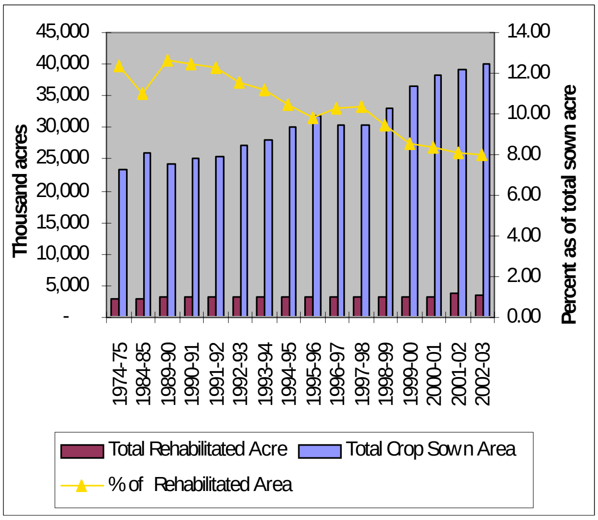
Indicator: Land Rehabilitated as a Percentage of Area Sown to Crops 1974-2002

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 fact sheet. The 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, sloping agriculture land technology (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%) 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.
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 to 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.

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

3.5 Conclusions

74. Several factors contribute to agricultural land degradation in Myanmar. Key amongst those factors is soil erosion. Around 42% 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: 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.

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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 14th position globally and 5th 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

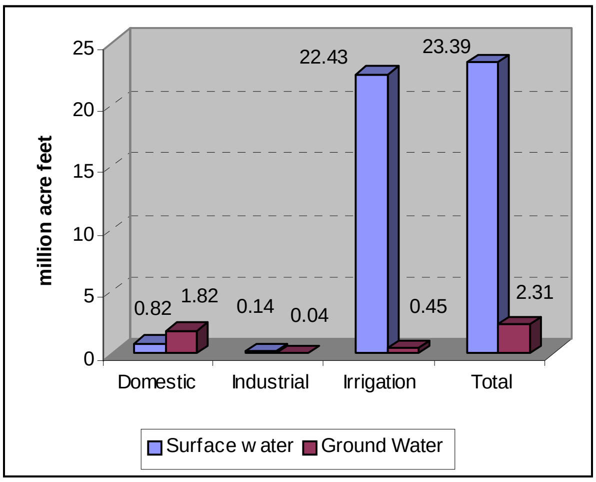
River Basin No	Name of River Basin	Drainage area (Square mile)	Surface Water (Million Acre Feet)	Ground Water (Million Acre Feet)
I	Chindwin	44,500	114.5	46.6
II	Upper Ayeyarwady	74,600	184.7	75.0
III	Lower Ayeyarwady	36,900	69.5	124.1
IV	Sittoung	18,600	65.8	23.0
V	Rakhine State	22,500	112.8	33.8
VI	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, approximately 2% of the total water potential annually available as groundwater. 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 Maps 6 and 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 (2000-2001)



Source: Irrigation Department, 2005

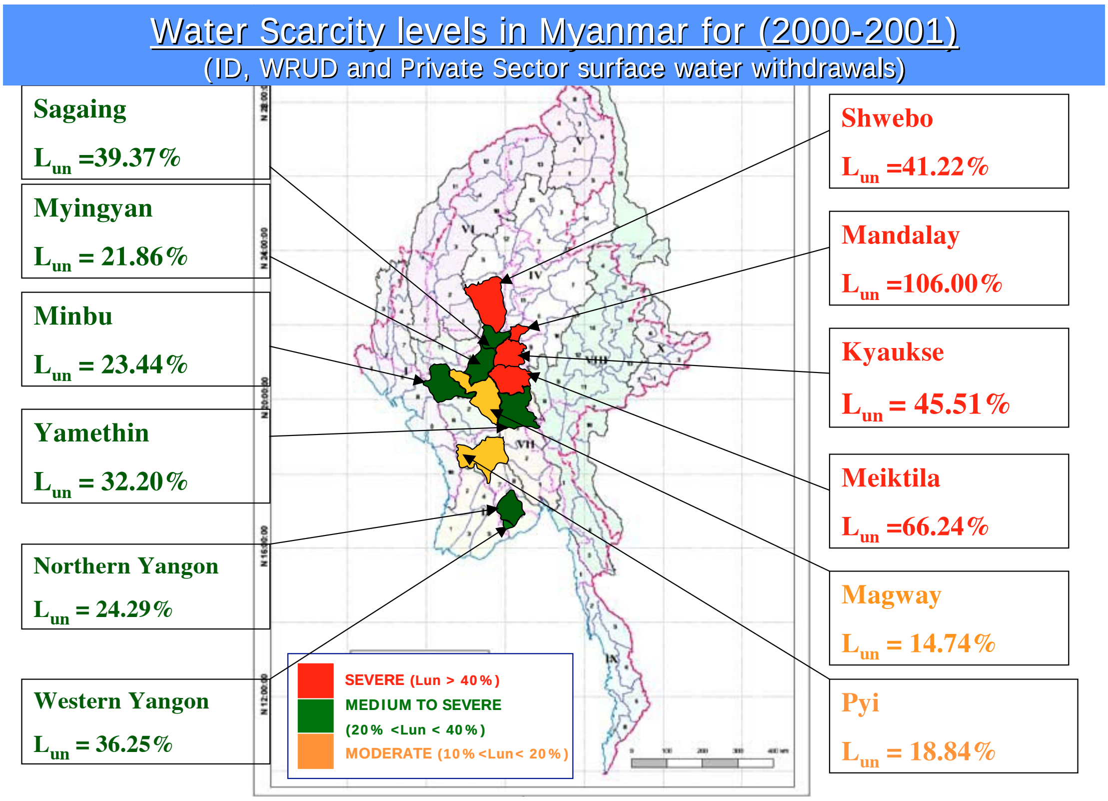


Figure A21

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

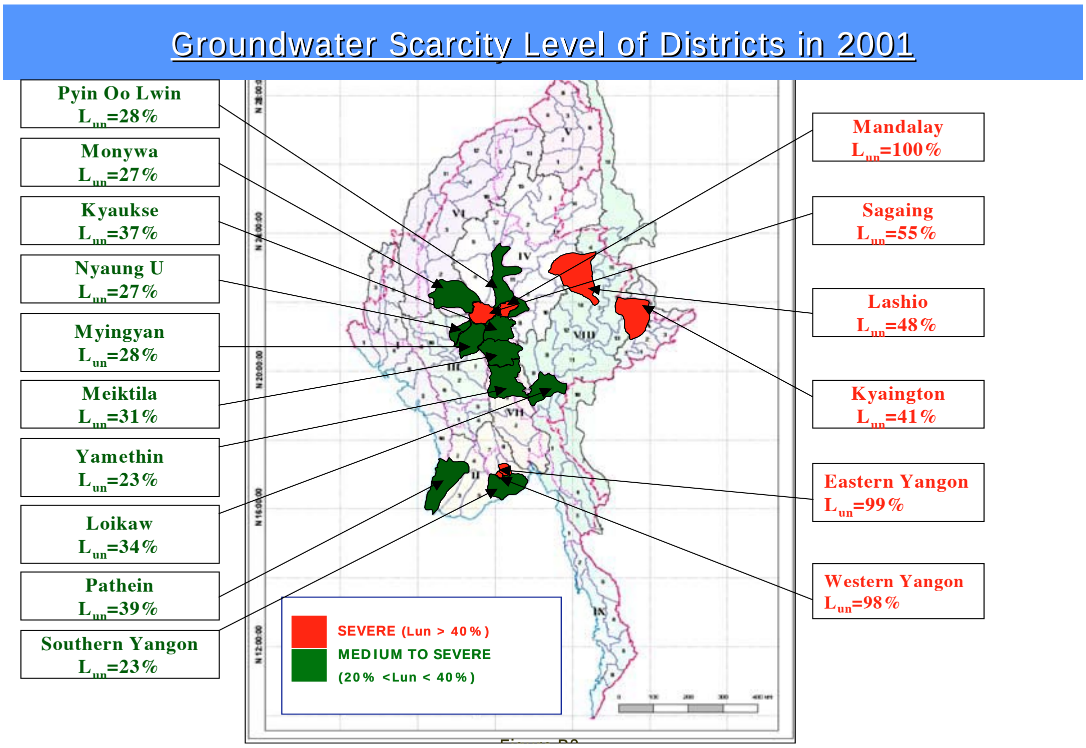


Figure B3

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: Percentage of Population with Access to Safe Drinking Water 1995-2003

79. This indicator measures the percentage of the 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% of the 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.

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 the 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

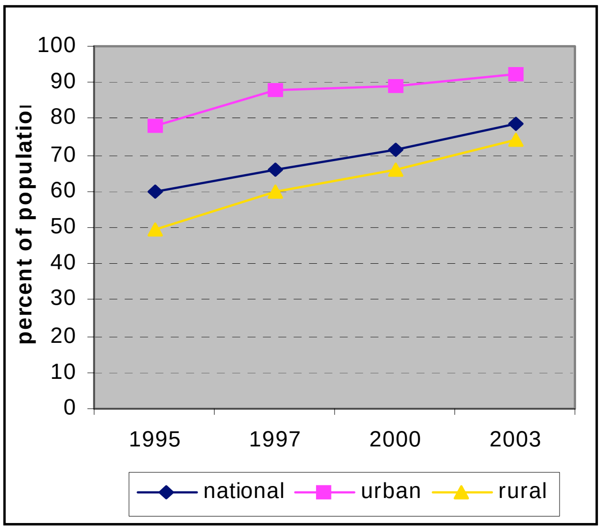
Justification: For the country as a whole, access to safe drinking water increased by almost 20% between 1995 and 2003 to a total of 80%. The rates in rural and urban areas were 74% and 92%, respectively. As of 2000, the corresponding figures for GMS countries ranged from 30% to 80% and Myanmar's figures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

4.3. Pressure (Drinking Water)

Indicator: Population Growth – 1985-2015

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 that the total population in 2015 will be 62 million, an increase of about 16% of in the next decade. As discussed, the percentage of the population with the access

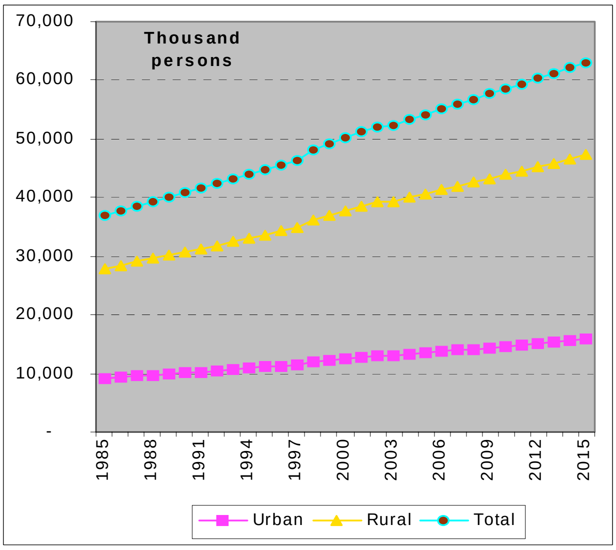
Figure 4.2 Percentage of Population Access to Safe Drinking Water



Source: Multiple Indicator Cluster Survey, Ministry of Health 2003

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

Figure 4.3: Rural and Urban Population 1985-2015



Source: Statistical Yearbooks, CSO 1992 & 2003

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 with 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).

Rating: High and Increasing

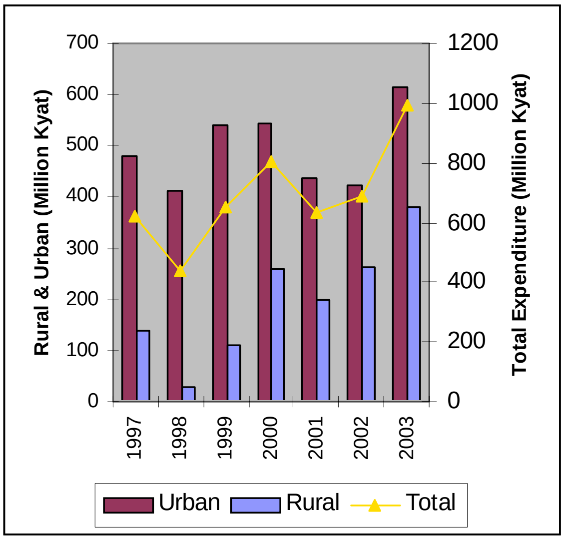
Justification: An additional 20 million people need to be provided access to safe drinking water if the target of water to all has to be met by 2010. Whereas the current rate of safe water access approx. 80% is commendable, additional work is required to meet the targets set of 2010 and 2015. The projected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

4.4 Response (Drinking Water)

Indicator: Expenditure on Drinking Water Supply 1997-2003

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. The 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, is the responsibility of municipal authorities [Yangon City 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 theses cities.

Figure 4.4: Expenditure for Rural and Urban Water Supply



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

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. The 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. The total investment for rural and urban water supply expressed at constant prices of 1997 reached 994 million kyat(MK) in 2003, 60% 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 annum, the rate of access to safe potable water was faster than that, around 2.5% 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 annum.

Suggested Rating: 2 Stars

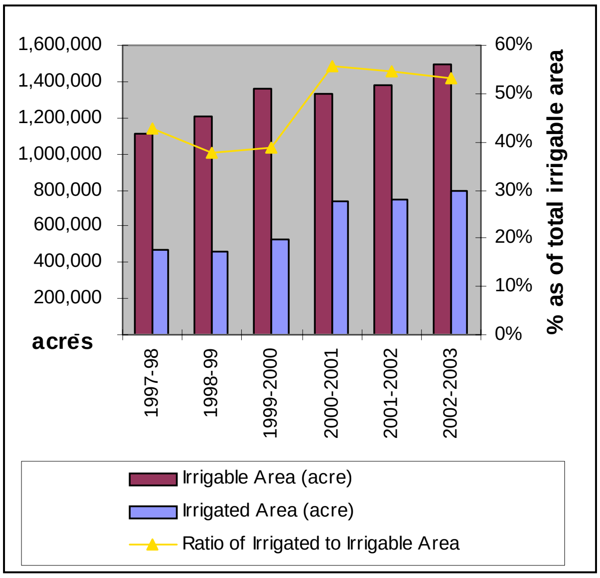
Justification: Notable progress has been made and Myanmar scores well in comparison to other GMS countries. Also, Myanmar seems to be making progress towards the objective of providing safe drinking water access for its entire population. Institutional responsibilities are being discharged by appropriate 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 a Percentage of Irrigable Area 1997-2002

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 from 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%. 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: Forest 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 1985-2002

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.

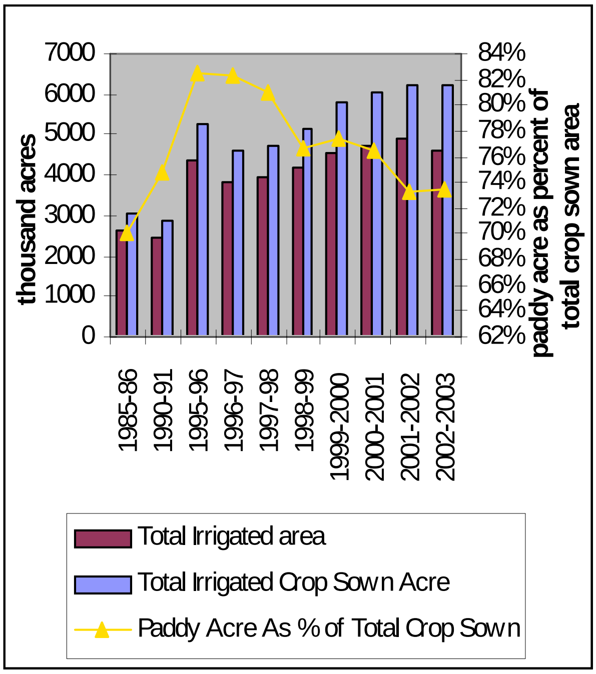
95. As observed in Figure 4.6, the value of the indicator rose to 6.2 million acres between 1985 and 2002, a nearly two-fold increase. The total area served by irrigation showed a similar increase reflecting the expansion of the irrigation water storage capacity described in the previous section of this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

96. In 2002, the area sown with 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% 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 paddies, 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)

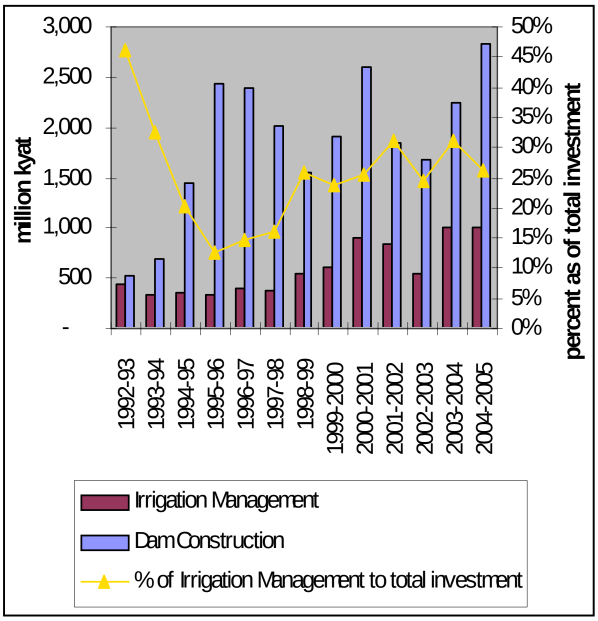
Indicator: Expenditure on Irrigation Management 1992-2004

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.

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%.

101. As noted earlier, the ratio of irrigated to irrigable area was approximately 50% 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%. However, more work is still required to capture the potential to further increase this percentage.

Figure 4.7. Expenditure on Irrigation Management



Source: Irrigation Department – ID 2005

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.

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.

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 has 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.

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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: Percentage of Solid Waste Collected in Yangon City 1983-2004

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.

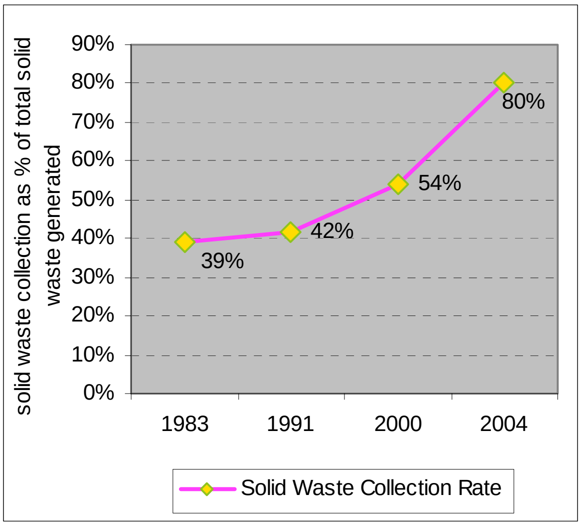
110. The values of the indicator (Figure 5.1) show that the total volume of solid waste collected in Yangon capital grew from 400 tons/day in 1983 to 1150 tons/day in 2003/04. The percentage of solid waste collected increased from 39% in 1983 to 80% in 2003. Solid waste management in Yangon has clearly 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 fact sheet for details). On a national basis, the percentage of solid waste disposed of in 2003 decreased to 28% from 24% in 1998. (see Figure 2 of the relevant fact sheet)

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 a 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.

Figure 5.1: Percentage of Solid Waste Collection in Yangon City



Source: Khin Maung (1995), Yamauchi and Sato (2001),

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 1983-2004

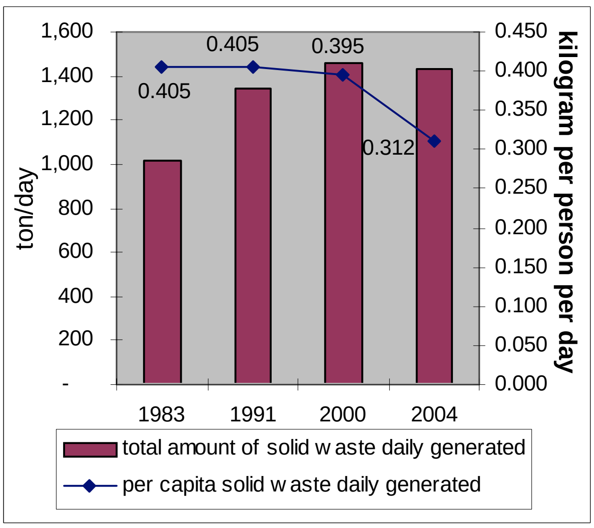
114. This indicator tracks the amount of solid waste generated per person per day in Yangon municipal area. As before, municipal solid waste is defined as the "non gaseous and non-liquid" waste generated by the community in the residential and commercial sector in an urban administrative area. It is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

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

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.

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. A 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)

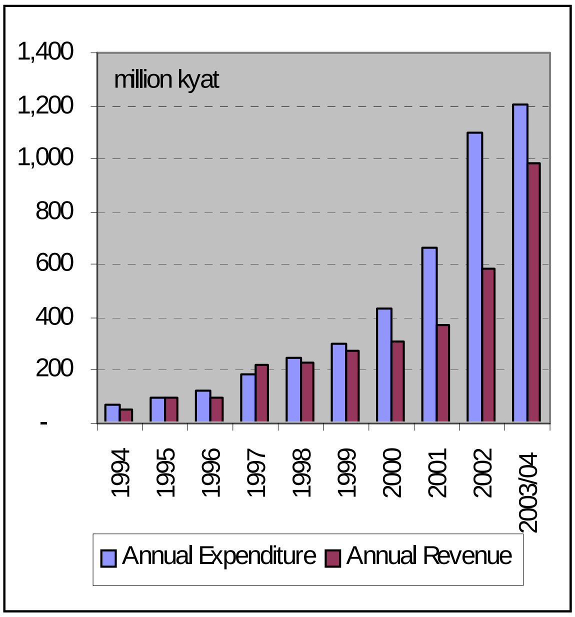
Indicator: Expenditure on Solid Waste Management in Yangon City 1994-2004

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.

Figure 5.3. Expenditure and Revenue in Solid Waste Management in Yangon (1994 Constant Price)



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

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.

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 remained 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% 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 on 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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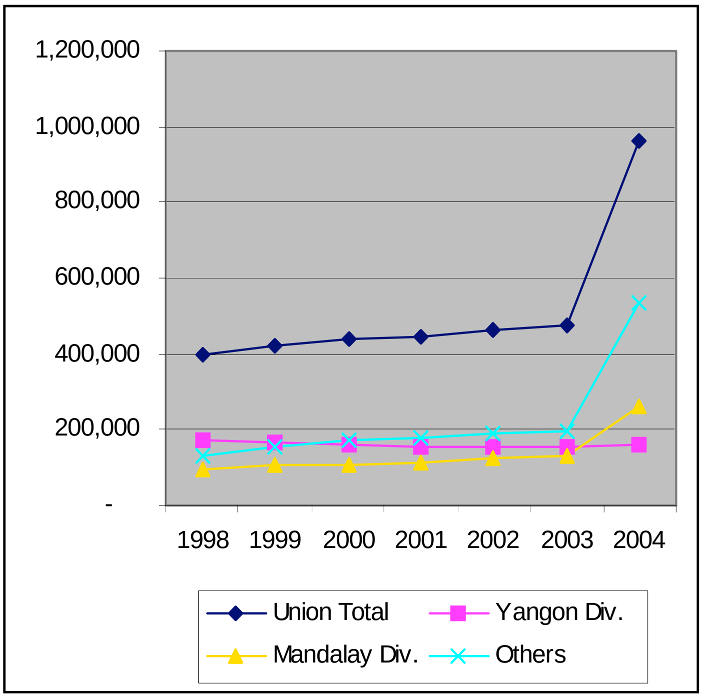
6. MOBILE SOURCE AIR POLLUTION

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.

Figure 6.1: Number of Total Registered Vehicles in Myanmar



Source: Energy Planning Department, EPD, 2005

126. Increases in vehicular density and in automotive fuel consumption have inevitably led to a rise in air pollution levels in the cities, particularly Yangon and Mandalay (see Figure 6.2). 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 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).

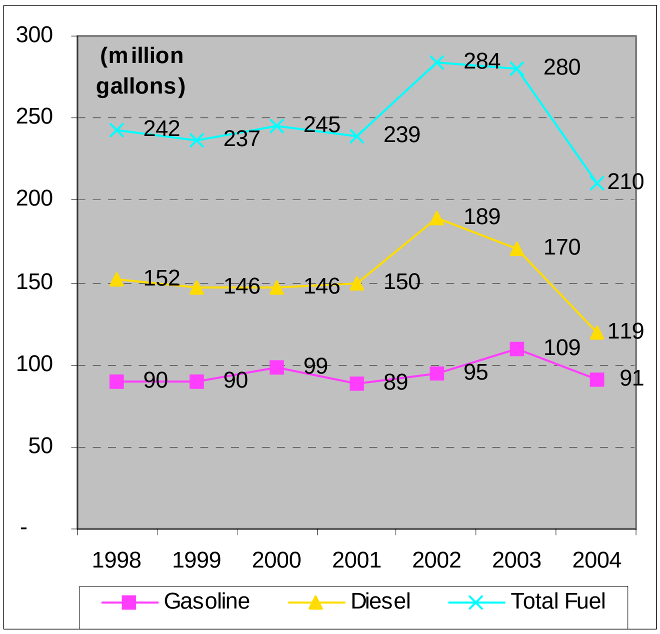
6.2. State

127. The concentrations of suspended particulate matter (SPM) in Yangon City have been chosen as an 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 1998-2000

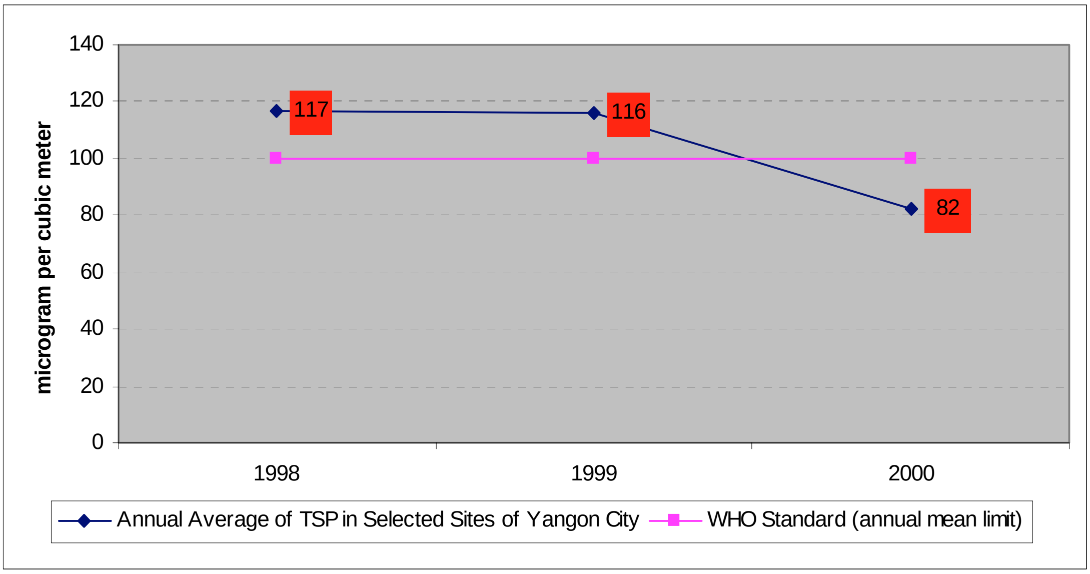
128. Figure 6.3 shows the concentrations of TSP (annual averages for selected sampling sites in Yangon city) during the period 1998 – 2000. The annual average of TSP concentrations exceeded the WHO standard of 100 µg/m3 in two out of the three years of the studied period. Not surprisingly, seasonal variations were observed (please refer to the relevant fact sheet), 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, SO2 concentrations are also presented in the relevant fact sheet. The annual average of lead concentrations in 1997, 1998 and 1999 ranged from 0.3 to 0.5 µg/m3. This was close to but below WHO's standard of 0.5 to 1 µg/

Figure 6.2: Automotive Fuel Sold in Myanmar



Source: Energy Planning Department- EPD, 2005

Figure 6.3: Annual Average of Total Suspended Particulate (TSP) Matter in Yangon



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

m³ (National Environmental Engineering Research Institute, 1996, pp: 7).

130. Data on SO2 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 SO2 were well above those of the wet season (Saw Kalayar, 2000). In 1999, the annual average was 54.4 µg/m3 exceeding the WHO standard of 50 µg/m3 or 0.02 ppm (ASEAN Secretariat 2001, pp: 109).

131. No information is available on the impact of TSP, SO2 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[12]", 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.[13]. 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.

12The first survey was carried out during 1994 – 1996 and a second study called "Overall and Cause Specific Under Five Mortality Survey was conducted from March 2002 to March 2003.
13Air pollution that affects the ARI might be sourced from either mobile vehicle or household cooking with poor ventilation in the house (indoor pollution)

6.3 Pressure

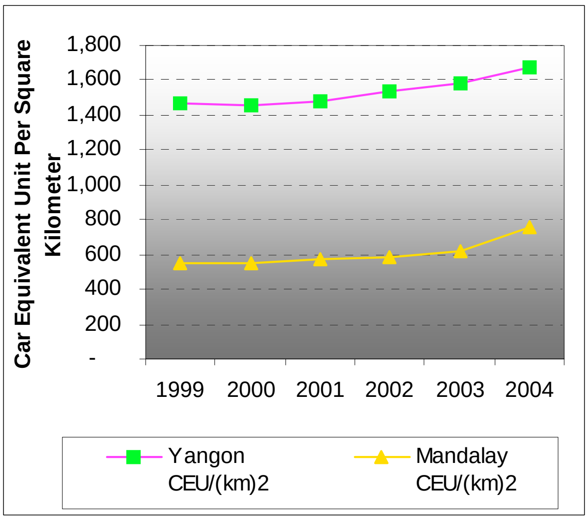
Indicator: Car Equivalent Unit per km2 in Major Cities 1999-2004

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 fact sheet). 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.
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, 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.

Figure 6.4. CEU per Sq-Km of Major Cities



Source: RTAD 2005, YCDC 2003, & GAD 2004

6.4 Response

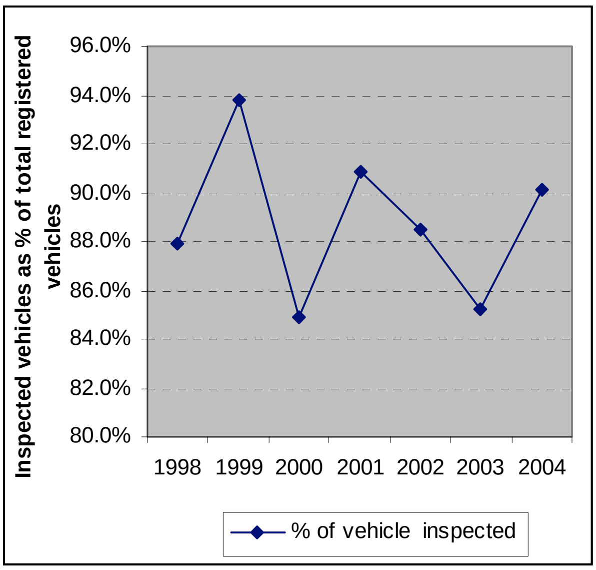
Indicator: Percentage of Vehicles Inspected 1998 -2004

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 fact sheet). 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.

Figure 6.5 Percentage of Vehicles Inspected



Source: Road Transport Administration Department,

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.

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. 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 a 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. The 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 emissions, 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: 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. 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.

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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 the 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).An assessment of Myanmar's response under UNFCCC has therefore been considered a suitable addition to this EPA. Myanmar is also a 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_2 Equivalent 1990-2005

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_2 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

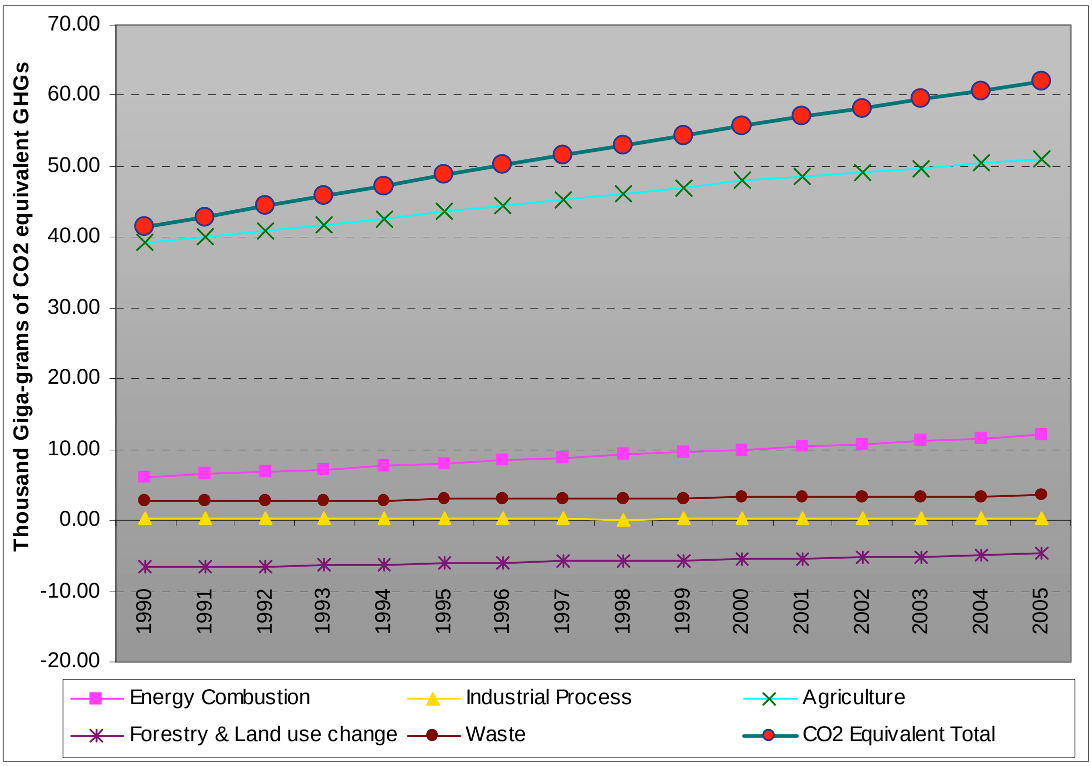
are projections only, their reliability naturally declining with the length of the projection period.

150. As can be seen in Figure 7.1 and the corresponding fact sheet, net GHG emissions in CO² equivalent were estimated at approximately 41,500 gigagrams (Gg) in the 1990 base year. These were projected to climb to 55,900 Gg in year 2000, 68,200 Gg in 2010 and 82,900 Gg 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.

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 Gg but this figure was estimated to decline to 2,400 Gg 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_2 emissions, Myanmar was a net sequester, i.e. the country absorbed more CO_2 gases that it generated. The growing forest stock and the abandonment of marginal lands compensated for all the CO_2 emissions of all the other sectors. The amounts are also significant here. Approximately 67,100 Gg of CO_2 were emitted; approximately 73,000 Gg were removed. The balance of 5,900 Gg was subtracted from the other gases in the CO_2-equivalent equation.

Figure 7.1: GHG Emissions in CO_2 Equivalent – 1990-2005



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

153. Most of the other CO_2-equivalent emissions were the result of rice cultivation. In the 1990 base year, approximately 1,327 Gg of methane or 27,900 Gg of CO_2-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 Gg. That figure is based on a tentative estimate of what the planet can withstand without undergoing climate change. Obviously Myanmar's 41,500 Gg share of the excess 37-million Gg 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_2 per person.

Suggested Rating: Low But Increasing

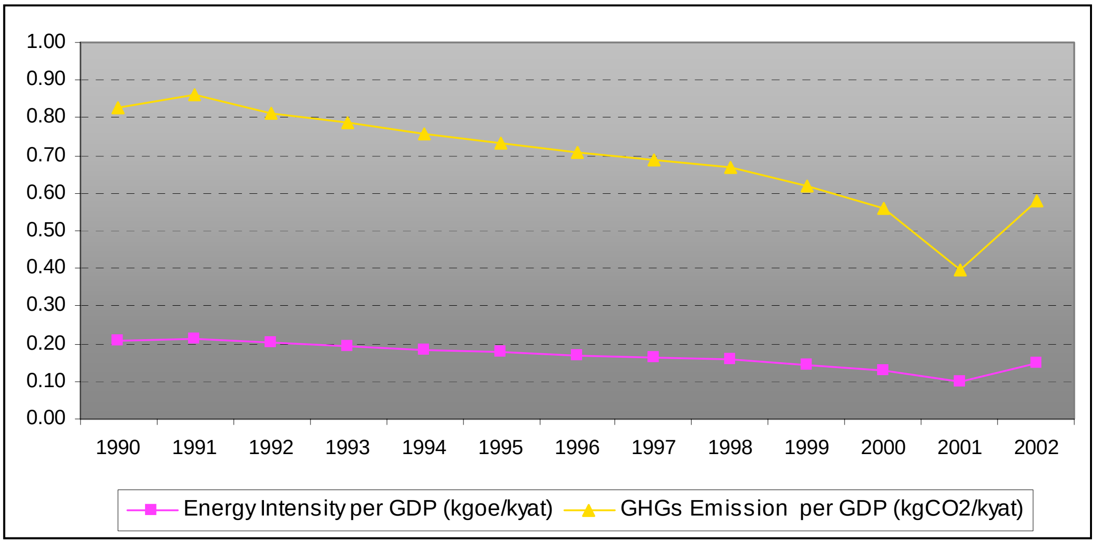
Justification: The current estimated emission level (1.1 metric ton of CO_2 per person) is relatively low comparing to other GMS countries like Thailand, Yunnan (PRC) and Viet Nam; the per capita rate is also low by international standards. However, the trend and the pressure are expected to increase as methane gases from rice cultivation continue to rise and as the sequestration of CO_2 by growing biomass diminishes.

7.4 Response

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

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_2 per Kyat (Kg CO_2/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 it 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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3 ENVIRONMENT AND ECONOMIC DEVELOPMENT: CROSSCUTTING 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 3.1 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.

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 states (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 polices; 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.”

Table 3.1: 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

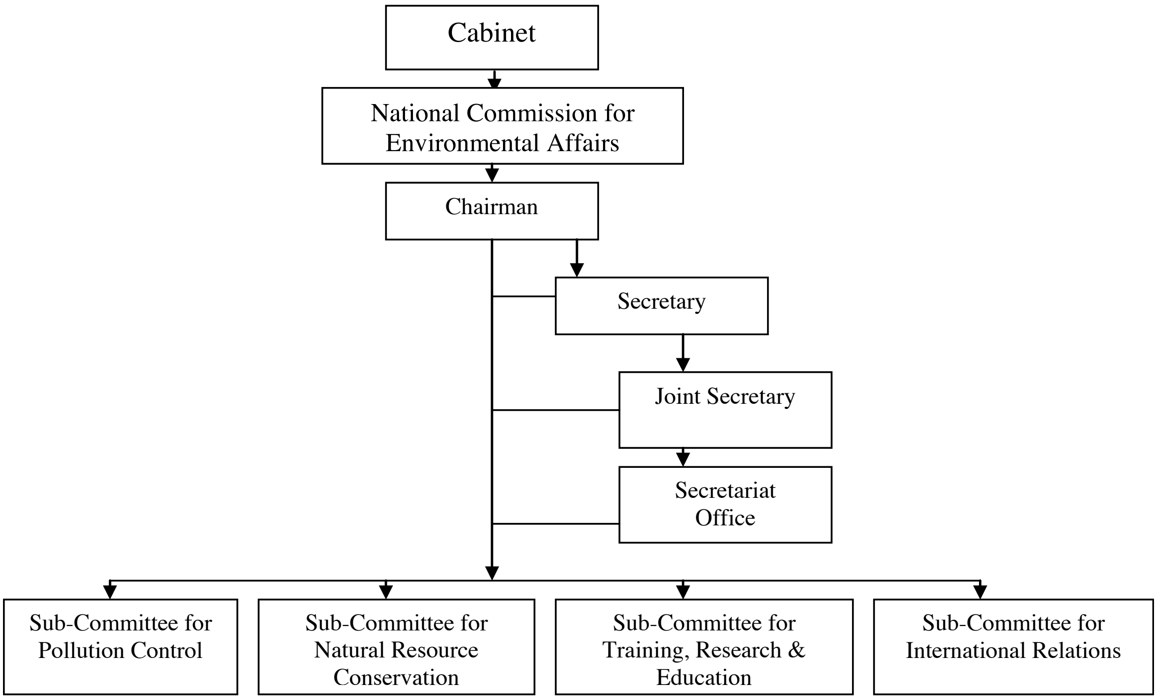
3.1.1 Policy and Institutional Integration

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 the 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 3.1: 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:

(i) Formulate policies on natural resource management,

(ii) Prepare environmental legislation (standards and regulations) for pollution control, monitoring and enforcement,

(iii) 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[14] 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:

(i) 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;

(ii) 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.

(iii) 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 3.2 below gives an indication of the budget's sectoral breakdown in 1999/2000. Of the total expenditure, only 11.8% was allocated to the agencies most closely linked to the management of natural resources

[14]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

(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.

182. Table 3.3 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 3.2: Financial Expenditure of Government Administrative Organization in Year 1999-2000

No.	Sector	Current		Capital		Both Current & Capital	
		Amount	%	Amount	%	Amount	%
1	Union Total	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.*

Table 3.3: 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, although the GMS program is a partial exception. At present, official development assistance (ODA) to Myanmar is channeled almost exclusively toward humanitarian assistance. The 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

(i) 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.

(ii) 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.

(iii) Normally, nature conservation is the responsibility of the Wildlife Division under the 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 regulations for the 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. A 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 if 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 are 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. Although 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.

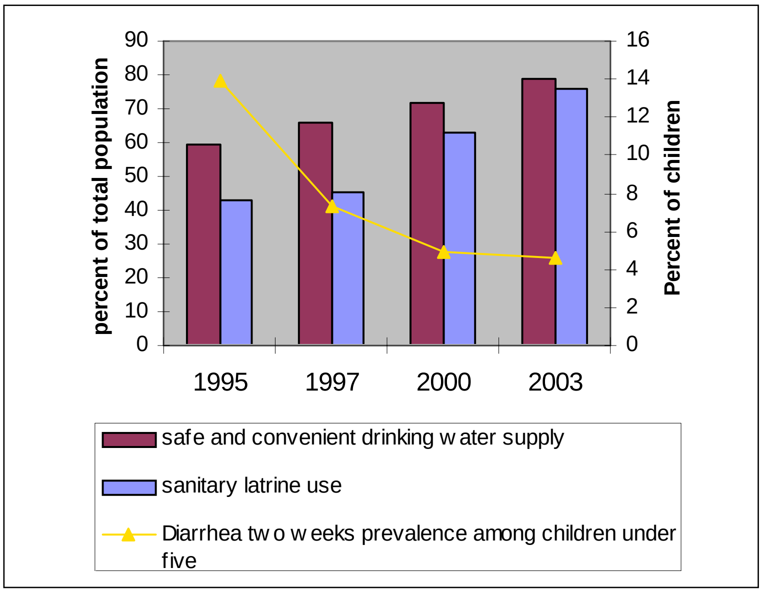
194. In urban areas, neighborhood groups are active in organizing sports, festival, religious ceremonies and social welfare activities. They sometimes campaign with local residents for drainage clearance, solid waste collection and disposal, and children health immunization. NGO presence is increasing 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 the 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 3.1 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

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.

Figure 3.1:Prevalence of Diarrhea Among the Children Under Five Versus Improved Water Supply and Sanitation



Source: Ministry of Health, (2003)

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. In practice, however, prior approval from heads of the agencies is required to release information.

198. In general, government agencies seek public participation in implementing the activities sanctioned in national planning documents. The 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 the 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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4 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. The 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 a 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 improves 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 working more closely with CITES as well as international NGOs like WWF.

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

a. Preparation and submission of 1st, 2nd and 3rd National Reports (due date for the 3rd 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 ecosystems, 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 a 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. The 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.

Crosscutting 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.

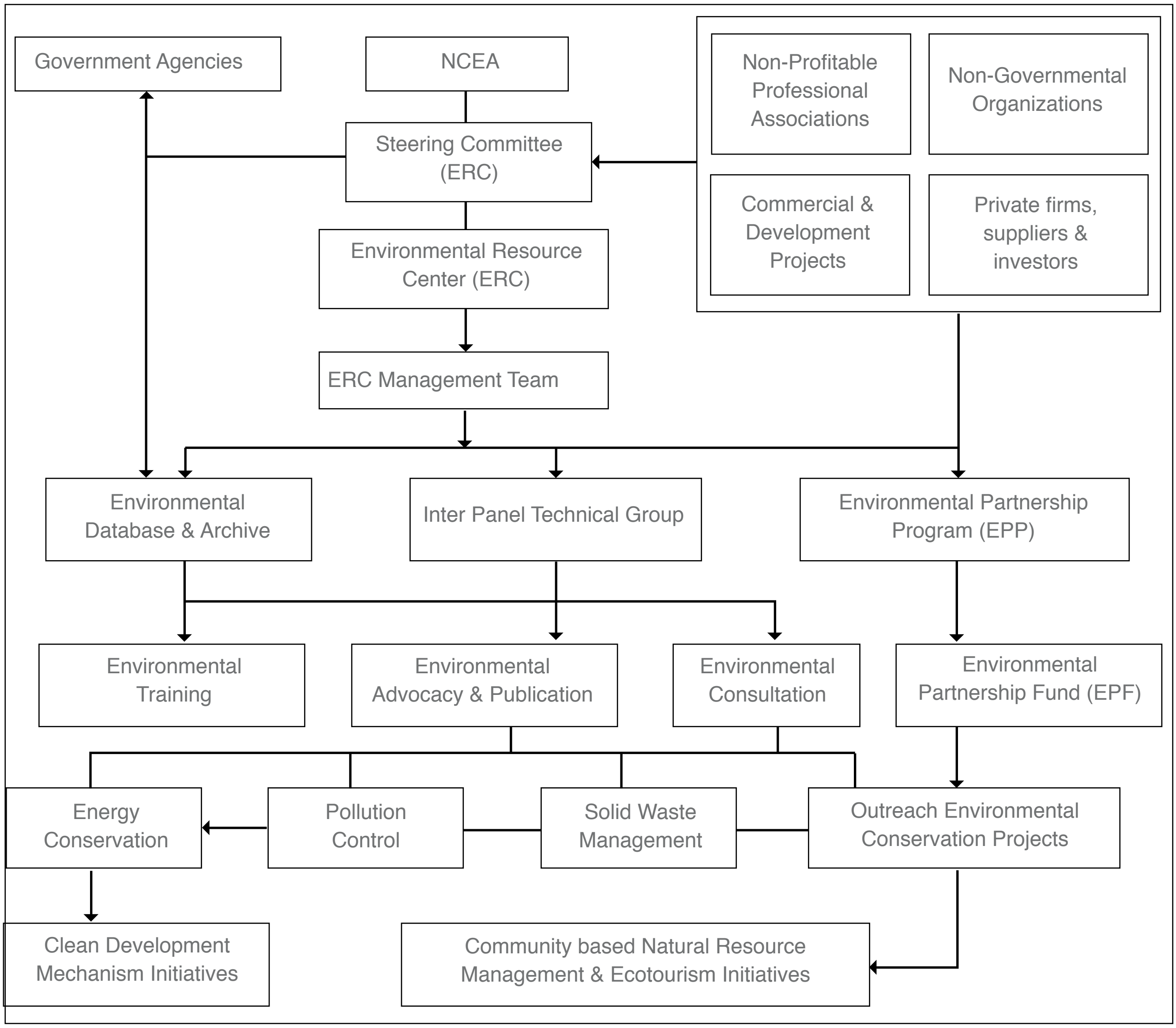
238. Greater funding is an essential (though not the only) precondition of improved environmental performance and better future EPAs as well. Funding should involve international partners (international NGOs, foundations, private sector etc.) and contain flexible financial mechanisms. An Environmental 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.) 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 an 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 4.1 Proposed Structure and Activities of the Environmental Resource Center



FACT SHEET APPENDIX

MYANMAR

1. FACT SHEET TEMPLATE AND GUIDELINES
2. FOREST RESOURCES FACT SHEETS
3. THREATS TO BIODIVERSITY FACT SHEETS
4. LAND DEGRADATION FACT SHEETS
5. WATER RESOURCES FACT SHEETS
6. SOLID WASTE MANAGEMENT FACT SHEETS
7. MOBILE SOURCE AIR POLLUTION FACT SHEETS
8. CLIMATE CHANGE FACT SHEETS

Greater Mekong Subregion
Indicator Fact Sheet Template

DATABASE INFORMATION	
Indicator ID	Use as appropriate or leave blank
Indicator Name	The name, or title, assigned to the indicator, e.g. "Population density in the Uplands", followed by the time range of the indicator data. e.g. "1914 to 2003" or "1990 and 2000"
Year of Assessment	The year in which the fact sheet was developed, e.g. 2004
Type of Indicator	Pressure, State or Response
Frequently Asked Question (FAQ)	The non-scientific FAQ that the indicator attempts to answer. e.g. " Is the water safe to drink?" for an indicator that reports on BOD levels in water
Priority Concern	The name of the priority concern that this indicator relates to. Normally it should relate to only one concern
Geographic Area	The name of the country or province in the GMS
Magnitude & Trend (for pressure indicator) or State & Trend (for state indicator) or Impact & Trend (for response indicator)	See Fact Sheet and EPA Evaluation Criteria for vocabulary to be places here for the final rating.
Key Message	In answer to the FAQ above, the "super-executive summary" of the fact sheet analysis results, including, if appropriate a statement of observed trend and a statement of the current situation in terms of targets.

TECHNICAL INFORMATION

A.Definition

This section should define very precisely what “the indicator” is and in what units the indicator is expressed. It should also include a precise definition of the terms that make up the indicator.The section should start out with a generic statement such as “This indicator attempts to track the amount of ... (give precise definition of what you are tracking) over ... (usually time); it is expressed as .... (give the precise units of the indicator, both numerator and denominator).

Follow this definition with the definition of other terms you have utilized for the definition of the indicator (e.g. define more precisely what “forest cover” means, what “expenditure” means, what “threatened species” means, etc.

B.Data Source

If the data originates from a known information system, give the name of such information (e.g. FAOSTAT) along with the name of the organization which maintains such information system (e.g. FAO). If the data was taken from a publication, give the full reference of that publication. If the data was extracted from the Internet, give the generic name of the website homepage but do not include the URL. Otherwise specify where or from whom you obtained the data.

C.Geographic Area / Population Coverage

If the data covers the entire country or province, or if the data represents 100% of the population you are describing, then simply state so (e.g. “the data and the indicator is representative of ... or the country as a whole”). Otherwise describe any gaps or restrictions on the geography (e.g. “excluding province X” or “only on agricultural soils’) or on the population (e.g. “only commercial fisheries” or “only reported cases”). If the data is only for a representative sample of the population (e.g. “only major rivers” or “only X cities”), then provide more details on the sub-sample (e.g. “Cities X and Y” or “X rivers with discharge greater than Y cms”.

D.Temporal Coverage

If the data represents a one-time measurement (e.g. land cover), state as precisely as you can the place in time when this measurement was taken (e.g. “represents ground condition in 1999”). If the data is expressed as a time series, given the start and end times along with an explanation of any gaps which may occur in the time series and/or how those gaps may have been filled in.

E.Methodology and Frequency of Coverage

Whenever possible, describe the methodologies that the originator utilized to compile the datasets that you are utilizing (e.g. “using un-supervised remote sensing classification on a Land-sat-7 satellite image” or “using a 1km by 1km random stratified grid’). Comment on the frequency of measurement and/or update (e.g. “a one-time measurement from a project” or “based on year 2000 data which will be updated shortly”) and on the likelihood that the measurement will be repeated (e.g. “maintained by a UN organization for the past four decades”).

F.Methodology of Data Manipulation

The focus here is on the manipulation that you may have made to the original data to get it into a form where it has become useful to you as an indicator; the focus is not on the methods that the originator utilized to obtain the data in the first place. Describe all the manipulations you have done on the original data, ensuring that enough detail is given so that the methodology can be repeated by others at a late data in time.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

Comment on the strengths and weaknesses of the data you have utilized, in relation to the phenomenon you were trying to measure. If the indicator is to show a trend over time, comment on the strengths (or weaknesses) of the data to show variance over time (present and future). Comment on any bias that is inherent with the data in respect of the phenomenon you are trying to measure.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

Comment on the reliability of the data, especially in relation to whom or where you got it from; quote all endorsements that were made on the data during the review process. Quote any accuracy measures that were given or published with the original data (e.g. "according to IHO standards" or "according to national mapping standards". Comment on the robustness of the data in terms of how it may have been used elsewhere and how it can still be applicable to the GMS subregion. State any assumptions you have made with the data and any relevant uncertainties.

C.Future Work Required (for data level and indicator level)

If applicable, comment of how the data could be improved to better serve the purposes of the indicator, or how the indicator could be improved with additional or alternative sources of data.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

The section should start with a graph (Figure 1) and a table (Table 1) which summarizes the value of the indicator over time. The graph will normally be re-produced in the EPA report, without the table. The table therefore should contain all the necessary data to re-produce the graph and, as much as possible, not too much else.

The title of the graph and table should correspond to the name of the indicator. If the indicator is expressed as a time series, the x-axis of the graph should also be expressed as a time series. Add as many supplemental graphs and tables, or maps, as required to further expand on the indicator or to include non-indicator specific information that might supplement the fact sheet but make sure supplemental information is used and referenced in the final Analysis Section of the fact sheet.

All graphs should be followed by the table with the data that was utilized to generate them. Graph titles and table titles should be placed outside the graph and table, as a bolded title on top of the figure or table. All tables should identify the source of the data in the last row of the table.

Try and keep the graphs and maps to the minimum size, but with sufficient resolution and detail so as to portray the trend or spatial distributions that are being evaluated. Number each table and each graph (or map) so that they can be referenced in the evaluation text. Give the same number to the table and the corresponding graphic; if you generate more than one graphic from the same table, use alphabetical sub-numbering.

SUMMARY

A.Policy Reference

This section on policy reference may not apply to some pressure and state indicators and to some very specific response indicators where related policies and regulations cannot be inferred. In these cases, the entire section can be omitted. But for normal response indicators, the lack of policy or regulation should be noted and highlighted as a "gaps".

1.Purpose:

Comment on the purpose of the indicator and (i) what function it performs in terms of environment performance assessment i.e. what parameter it assesses and what resource it protects, (ii) what objective's compliance it monitors and (iii) what potential corrective action (s) it requires.

2.Relevance to Environment Planning and Management:

Comment on the broad/general importance of this indicator for assessing other related environmental issues e.g. socio-economic relevance, link with any public health, quality of life related issues etc.

3.Linkage to Other Indicators:

Give a list of other indicators this indicator is linked to i.e. what other indicator values this indicator directly or indirectly affects.

4.Targets:

Give details on what targets have been set by the national environment agency or ministry for this indicator to comply with i.e. what are the quantifiable environmental standard this indicator has to comply with.

5.International Environment Treaties:

If applicable, give the name, scope, status of implementation of the international environmental treaty(s) your country has signed for this indicator and give an update on the progress of its implementation. Otherwise state "None applicable".

6.Laws

If applicable, name national laws that have some implication to the indicator. Otherwise leave out this sub-section.

B.Analysis

This section is dedicated to the analysis of the indicator and the final rating of the results. The first paragraphs should be focused on the description of the observed results, as observed in the tables and graphs (e.g. "As can be observed from Table 1 and Figure 1", describe the observed value and the observed trend of the indicator). State if the indicator values comply with the stipulated national target or standard and (in relevant cases) international standard. Comment on the size of the discrepancy between the two and its trend (can a reliable trend be established? Does it point to an underlying improvement or deterioration? Can the fluctuating values of the indicator be related to distinct policy interventions such as mitigation measures, changed pattern of economic incentives, or other corrective actions?). Say whether the results might be indicative of inappropriate or moving targets/standards rather than simply reflecting performance. Comment on the role, if any, of factors outside management control (climatic factors, natural disasters, etc.). Identify the factors most relevant to observed outcomes and specify key related indicators.

Keep in mind the ultimate purpose of your effort, i.e. to review performance by environmental concerns and groups of concerns such review normally resting on several indicators rather than a single one. Analysis of a single indicator to be performed below is important but it is in combining it with the analysis of other indicators that policy insights are generated and performance assessment gains depth.

The last paragraph of this analysis section should be focused on the justification of the indicator ranking, based on the vocabulary and guidelines given in “Fact sheet and EPA Evaluation Criteria”. The last sentence should highlight (in bold) the final ranking of the indicator results.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Percentage of Forest Cover Over Total Land – 1975 to 1998
Year of Assessment	2005
Type of Indicator	State
Frequently Asked Question (FAQ)	What is the current state and trend of forest cover in Myanmar?
Priority Concern	Forest Resources
Geographic Area	Union of Myanmar
State & Trend	Relatively Good but Deteriorating
Key Message	Forest cover declined steadily from 42 to 35 million ha from 1975 to 1998. Coinciding with the transitional period to an open market economy, annual forest loss during 1989 to 1998 (466,000 ha per annum) was four times higher than that of the years from 1975 to 1989 (108,000 ha per annum). This accounts for the higher deforestation rate of 1.2% per annum. However, half of the country is still covered by forest and its coverage is considered to be relatively good comparing to other GMS countries, though it is facing with the deteriorating trend.

TECHNICAL INFORMATION

A.Definition

This indicator attempts to track the amount of natural and plantation forest area tracked over time; it is expressed as a percentage of the total forest cover over the total land area of the country. Forest cover includes both open forest and closed forest. Closed forest is defined as area under forestry or no land use, spanning more than 0.5 ha; with trees higher than 5 m and a canopy cover of more than 40%, or trees able to reach these thresholds in situ. Open forest is defined as area under forestry or no land use, spanning more than 0.5 ha; with trees higher than 5 m and a canopy cover between 10% and 40%, or trees able to reach these thresholds in situ.

B.Data Source

All of the data utilized for the development of this indicator originate from the Myanmar Forest Department (FD).The following are references to sources of data employed in the development of this indicator:

Forest Department (2000), "Forest Resource Assessment 2000 of Myanmar", official data in collaboration with Food and Agriculture Organization, Yangon

Forest Department (2005), "Forest Resource Assessment 2005 of Myanmar", official data in collaboration with Food and Agriculture Organization, Yangon

Maung Maung Than(2002); "Review of Land Use and Land Degradation Status in Myanmar"; In Proceeding of National Workshop on Preparation for National Action Plan for Combating Desertification in Myanmar jointly organized by Forest Department and United Nations Convention of Combating Desertification-Asia/Pacific, Yangon

Kyaw Tint and Tun Hla (1991): "Forest Cover of Myanmar – the 1989 appraisal", Unpublished Technical Paper of Forest Department, Yangon

Food and Agriculture Organization (2000), "Global Forest Assessment 2000", Rome. www.fao.org/forestry/fo/fra/main/index.jsp

C.Geographic area / Population Coverage

Forest cover data utilized for the development of this indicator are representative of the Union of Myanmar as a whole and based on a total land area of 67,658,000 ha.

D.Temporal Coverage

The indicator is representative of trends in forest cover trends from 1975 to 1998, based on four different appraisals conducted by the Forest Department (FD).

E.Methodology and Frequency of Coverage

The data utilized to construct this percentage forest cover indicator are the result of four different appraisals conducted by FD as follows:

Appraisal for 1975: In Myanmar, the first appraisal of the country's forest cover using remote sensing techniques was initiated in 1980. The study was conducted by Myanmar foresters under an FAO/UNEP project using 1:1,000,000 scale Landsat Multi-spectral Scanner (MSS) imageries taken during 1972-1979.

Appraisal for 1989: As part of the work of the national inventory project (MYA/85/003), this appraisal was conducted in 1989-90 by using Landsat TM image of 1989-90 (1:500,000 scale). Manual interpretation was conducted for classifying forest cover. Ancillary information was derived from 1:25,000 scale aerial-photos of 1983.

Appraisal for 1997: For FRA2000 assessment in 1999 FD assessed and compiled updated forest cover data. Four separate survey data are used as baseline data. The Information System Development Project (ISDP) of JAFTA provided 67% of country coverage. Data for Taninthary Division was produced from 1997 imagery (average image year) using manual interpretation of 1:250,000 scale print outs of LANDSAT 5 TM. Mon State is covered by Land Use and Land Cover Mapping for Mon State, a test project for Japanese ADEOS satellite by the Forest Department attempted to monitor the land use and land cover changes of Mon State. The remaining areas of Shan State, Kachin State are estimated. The average year of all satellite images are 1997 and hence the name.

Appraisal for 1998: In 2004 FRA 2005 assessment had to be completed. These surveys provided full coverage. ISDP data was still utilized. Tanintharyi Division is covered by 2000 LANDSAT 7 ETM digital classification. Kachin State and Karen State are newly interpreted using 2000 LANDSAT 7 ETM data. Shan State is substituted by 2002 Land Use Survey done for United Nations Office of Drug and Crime (UNODC). The average year becomes 1998.

The frequency of assessments is normally 10 years but FAO have advised that it should be 5 years. The Forest Department is always updating whenever the new satellite data are acquired from various sources.

F.Methodology of Data Manipulation

Total forest area is quoted from officially recognized figures and has been expressed as a percentage of total land area assuming a total land area of 67,658,000 ha.

The rate of changes in forest cover over time is calculated for 3 periods; from 1975 to 1989, from 1989 to 1998 and from 1975 to 1998. The change of forest cover during the concerned period is a subtraction of the forest cover from the latter period to that of former period. The time lap between these two periods is used for dividing net change of forest area in order to calculate the annual rate of forest change (deforestation) in the given period. Two types of change rates are given: one based on the total land area of the country and the other on the total forest area of the starting year.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The indicator provides explicitly general information about the status of existing environmental and natural resource in Myanmar. It helps in understanding how this resource has been changed over time, either positive or negative, during last 30 years. Its absolute value also indicates comparable enrichment of natural resource potential to other countries. However, its generalized and broad definition on forest in terms of canopy coverage limits the understanding of changes of forest quality which is more crucial in determining degradation of forest resources and respected forest ecosystems rather than total depletion of the forest area. If the data are associated with the value of minor changes in forest cover over time, their interpretation may underestimate the degree and the nature of environmental deterioration process.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

Since different sets of spatial data with different techniques in forest assessment were employed in each appraisal, statistically they cannot be accurately compared. Because the technique between manual interpretation and digital processing may create an inconsistent base and larger differences in classifying forest area and area estimation. The data for 1998 seems more systematic and advanced in interpreting forest classification and calculating respected forest area with reasonable representation of ground-truthing. However, even in this case, combination of various set of Remote Sensing data for forest assessment may be associated with the problem of consistency in representing real time value of forest cover in respected areas at the provincial level.

C.Future Work Required (for data level and indicator level)

Assuming that a consistent technique was applied during 1998, the forest coverage in the past should be re-assessed. Within the spatial data available, it is possible to compare data from 1989 to 2002. A fairly representative point of ground-truthing should be statistically selected. Classification of forest should be more detailed in identifying various forest ecosystems such as Moist Upper Deciduous Forest, Evergreen Forest, Dry Forest and so on, in line with the method that the Forest Department used to classify different types of forest in the past. In doing so, it will be able to compare the changes of forest quality over time in understanding the deterioration of the forest ecosystem. Developing a forest density map will be also useful in analyzing this aspect. For better analysis, matrix changes of land use within the study period should be done for understanding changes from one land use to another. For example; how much land extent of bamboo forest in 1989 has remained in 1998 with the conversion of some portions to other land use like agriculture or shrub forest. Forest cover changes within established forest reserve area should be also studied in order to monitor the gap that existed between actual land cover and present land use by official registration and demarcation.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Percentage Forest Cover – 1975-1998

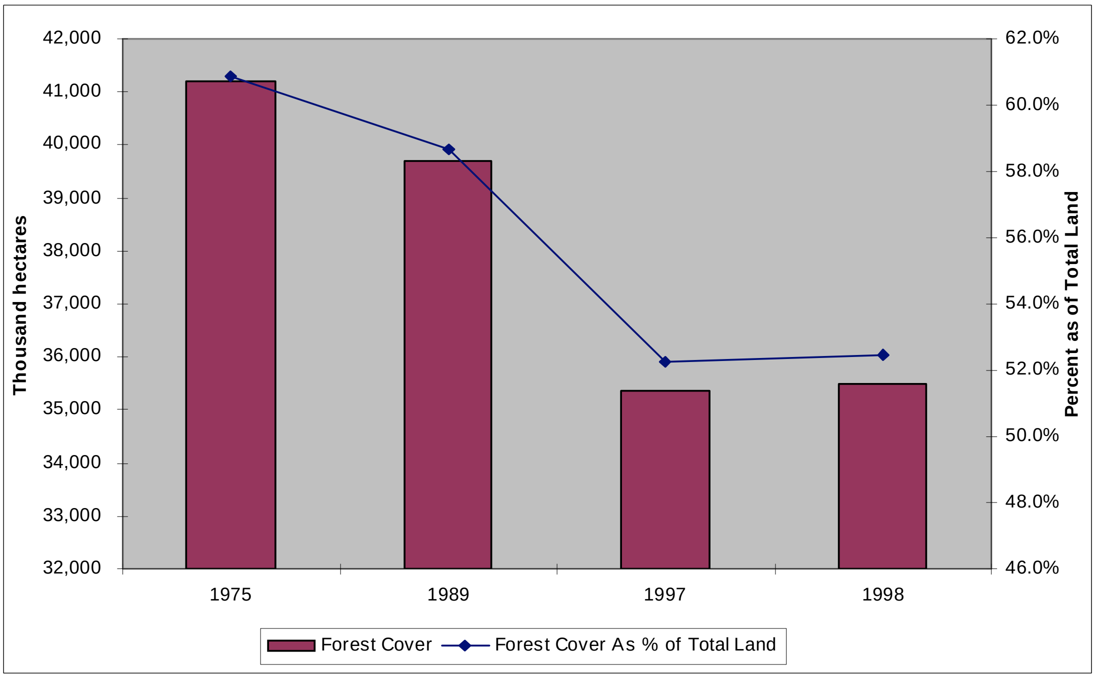


Table 1: Forest Cover as a Percentage of Total Land Area – 1975-1998

Year of Assessment	Forest Cover Thousand Hectares	Percentage of Total Land Area
1975	41,196	60.89%
1989	39,685	58.66%
1997	35,375	52.28%
1998	35,487	52.45%

Source: Forest Resource Assessment 2005, Forest Department (2005)

Figure 2: Forest Cover Change – 1975-1998

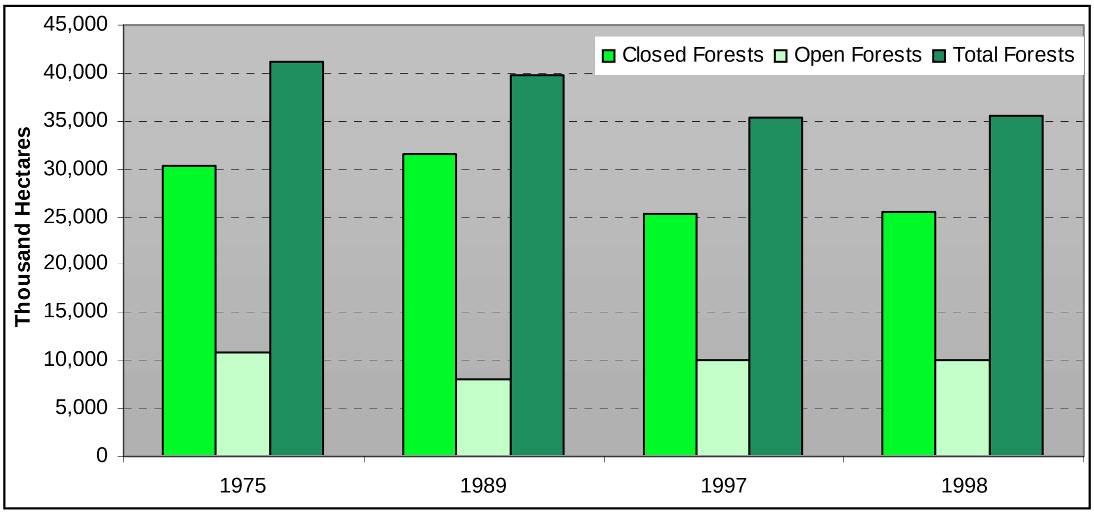


Table 2a: Forest Cover Change – 1975-1998

Forest Cover	Extent in Thousand Hectares			
	1975	1989	1997	1998
Closed Forests	30,322	31,554	25,294	25,517
Closed Forest As % of Total Land	44.82%	46.64%	37.38%	37.71%
Open Forests	10,874	8,131	10,081	9,971
Open Forest As % of Total Land	16.07%	12.02%	14.90%	14.74%
Total Forests	41,196	39,685	35,375	35,487
Forest cover As % of Total Land	60.89%	58.66%	52.28%	52.45%
Other wooded Land	8,876	10,178	11,919	10,547
Other Land (including water bodies)	17,587	17,793	20,364	21,624
Total Land area	67,658	67,658	67,658	67,658

Source: Forest Resource Assessment 2005, Forest Department (2005)

Table 2b: Deforestation Rates – 1975-1998

Period	Initial Cover (hectares)	Loss of Forest cover (hectares)	Duration (years)	Loss (hectares/ year)	% Change As of Tota l land (FD*)	% Change As of Total Forest (UN)**
1975- 1989	41,195.6	1,510.7	14	107.91	0.16%	0.26%
From 1989 to 1998	39,684.9	4,197.8	9	466.42	0.69%	1.18%
From 1975 to 1998	41,195.6	5,708.5	23	248.20	0.37%	0.60%

*Note: * Forest Department calculates deforestation rate as % of total land area*
*** UN calculates rate as % of total forest area*

Source: Forest Resource Assessment 2005, Forest Department (2005)

Table 2c: Forest Cover Change by State and Division – 1975-1998

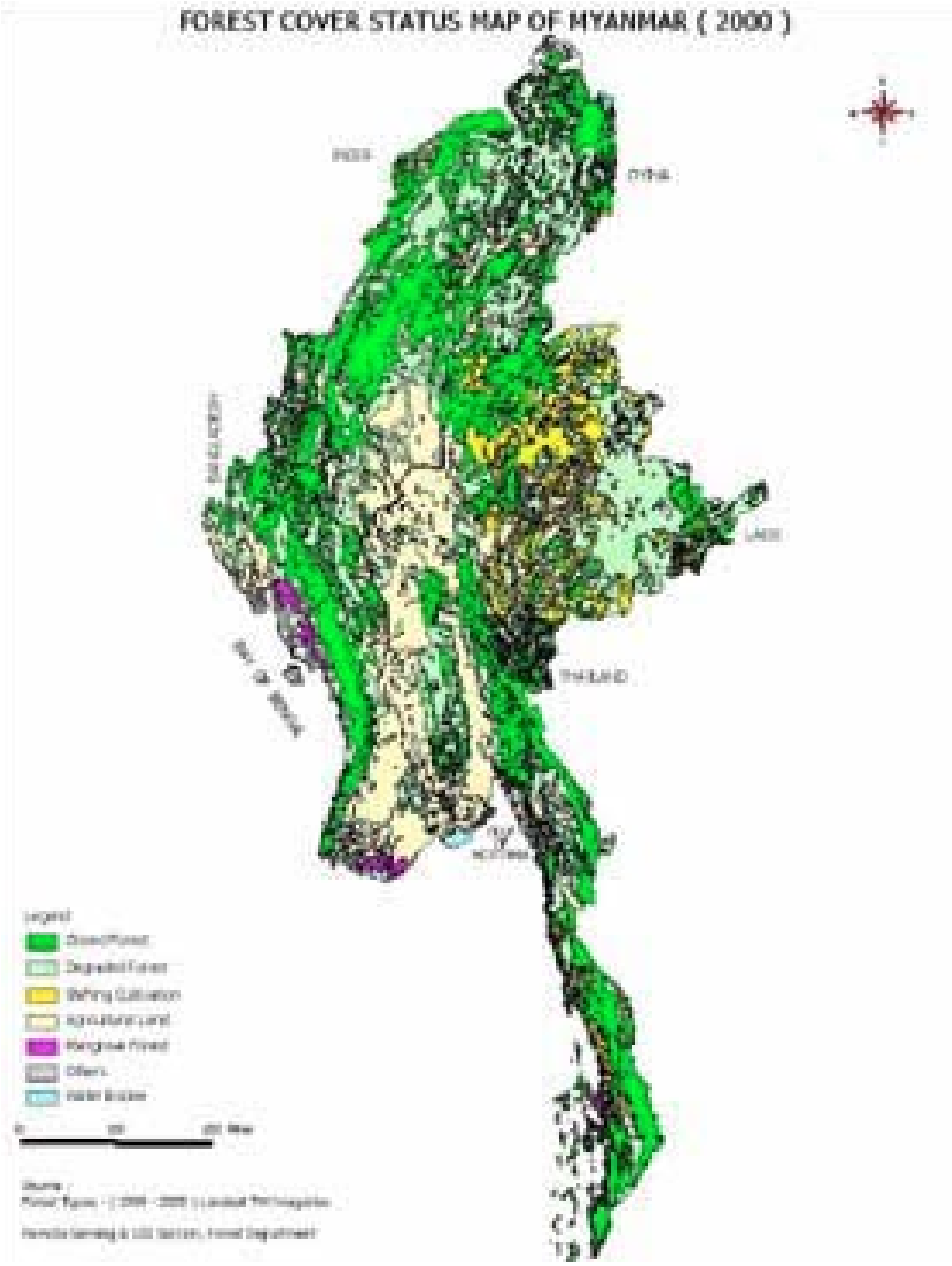
Area (State & Division)	Close Forest			Open Forest			Total Forest		
	75 to 89	89 to 98	75 to 98	75 to 89	89 to 98	75 to 98	75 to 89	89 to 98	75 to 98
Kachin	0.37%	-4.50%	-1.63%	11.42%	55.35%	63.23%	0.57%	-1.81%	-0.42%
Kayah	-1.77%	2.19%	-0.43%	0.21%	-0.93%	-0.24%	-1.17%	1.04%	-0.38%
Kayin	-0.02%	-2.65%	-1.05%	-1.46%	30.10%	8.49%	-0.34%	15.48%	5.57%
Chin	3.72%	-1.12%	1.60%	-6.20%	12.60%	-3.12%	-0.20%	-0.38%	-0.26%
Sagaing	0.53%	-3.36%	-1.09%	-0.42%	13.54%	4.73%	0.41%	-1.35%	-0.31%
Tanintharyi	0.92%	-2.14%	-0.39%	-3.40%	21.90%	2.43%	0.17%	-0.02%	0.10%
Bago	-0.01%	-7.86%	-3.08%	-3.76%	24.96%	2.34%	-1.03%	-2.88%	-1.59%
Magway	-2.10%	4.13%	-0.13%	-2.61%	-7.77%	-3.52%	-2.47%	-4.24%	-2.59%
Mandalay	-1.59%	-3.09%	-1.91%	1.02%	-7.07%	-2.54%	-0.60%	-4.97%	-2.15%
Mon	3.30%	2.21%	3.27%	-3.61%	-3.58%	-2.89%	-1.14%	0.02%	-0.69%
Rakhine	0.51%	-4.57%	-1.61%	-3.41%	12.76%	0.53%	-0.30%	-2.64%	-1.17%
Yangon	0.10%	-7.84%	-3.05%	0.34%	8.46%	3.67%	0.15%	-4.24%	-1.60%
Shan	-0.43%	4.35%	1.34%	-0.41%	-7.13%	-2.88%	-0.42%	0.09%	-0.22%
Ayeyarwady	-0.68%	-6.07%	-2.56%	-2.27%	-4.96%	-2.71%	-1.46%	-5.60%	-2.63%
Union Total	0.29%	-2.13%	-0.69%	-1.80%	2.51%	-0.36%	-0.26%	-1.18%	-0.60%

Source: Forest Resource Assessment 2005, Forest Department (2005)

Table 2d: Forest Cover in Other GMS Countries - 2000

Country/Region	Forest cover (Hectares)	Country Area (Hectares)	Forest Cover As % of Country Area
Cambodia	9,334,648	17,652,000	52.88%
PRC	163,480,282	932,745,000	17.53%
Lao PDR	12,561,170	23,080,000	54.42%
Myanmar	34,418,666	65,755,000	52.34%
Thailand	14,761,800	51,089,000	28.89%
Viet Nam	9,818,558	32,549,000	30.17%

Source: FAO (2000)


FOREST COVER STATUS MAP OF MYANMAR (2000)
LAOS
THAILAND

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of the indicator is to show the area covered by the forest formations of a region/ country over time.

2.Relevance to Environment Planning and Management:

Forests serve multiple ecological, socio-economic, and cultural roles in many countries. They are among the most diverse and widespread ecosystems of the world. Forests provide many significant resources and functions including: wood products, recreational opportunities, habitat for wildlife, water and soil conservation, and a filter for pollutants. They support employment and traditional uses, and biodiversity. There is general concern over human impact on forest health, and the natural processes of forest growth and regeneration. Combating deforestation to preserve soils, water, air and biological diversity is explicitly considered in Agenda 21.

The forest area of a country is not directly related to sustainable/unsustainable development. However, a continuing and fast decreasing forest area in a country might be an alarm signal of unsustainable practices in the forestry and agricultural sector. A change in the forested area in a country or region over time can be positive showing a loss of forest area or negative showing an increase. The availability of accurate data on a country's forest area, which is a basic characteristic of its forest resources, is an essential requirement for forest policy and planning within the context of sustainable development.

3.Linkage to Other Indicators:

The indicator is closely linked with several other environmental indicators, such as land use and land condition change, wood harvesting intensity, protected forest area, arable land, threatened species, sustainable use of natural resources in mountain areas, etc.

4.Targets:

The national forest policy adopted in 1995 requires that forested area equivalent to 30% of total land area should be fully protected as sustainable forest area under public forest estate in the category of either forest reserve or protected public forest, whereas another 5% should be under Protected Area System for nature conservation.

5.International Environment Treaties:

The following international treaties and agreements are concerned with forest cover:
International Tropical Timber Agreement for promotion of "Sustainable Forest Management"
Convention on Biological Diversity (CBD) for forest flora and fauna conservation
Convention on International Trade in Endanger Species (CITES) for efficient forest protection effective to conserving endanger species
Convention on the Conservation of Wetlands of International Importance (Ramsar Convention) for Contextual protection of forest ecosystem
Convention on Climate Change for forest environmental conservation
Convention to Combat Desertification for natural resource conservation

B.Analysis

As can be observed from Figure 1, forest cover has been declining during last 28 years from 1975 to 1998. Based on FD's estimates, total forest areas were 41.2, 39.7 and 35.5 million ha in 1975, 1989 and 1998, respectively, corresponding to 61%, 59% and 52% of the whole country (Table 1). Table 2a shows the loss in different types of forests and larger areas of closed forest (4.8 million ha) equivalent to approximately 7% of total land had disappeared during 1975 to 1998, while there was a lesser degree of losses in open forest area of 900 thousand ha equivalent to 1.3 % of total land. It was also found out that forest loss had been accelerating after 1989 compared to the period from 1975 to 1989. As seen in Table 2b, annual loss of forest area during 1989 to 1998

(466,000 ha per annum) was four fold higher than the loss (108,000 ha per annum) that occurred during 1975 to 1989. In comparison, the rate of deforestation was thus found to be 1.18% per annum for the former period and 0.26% per annum for the latter period. The higher acceleration of deforestation might be due to the growing timber business and export that was open to the private sector since the country adopted the market economy in 1988. Further analysis on deforestation rate of State and Division (Sub-administrative Area of the country) during 1989 to 1998 (as shown in Table 2c) could provide an explanation of this fact as stated below:

Ayeyarwaddy Division – Annual deforestation rate was 5.6% per annum as total forest cover declined from 24% of total area in 1989 to 12% in 1998. Major threats to forest loss in this region were over exploitation of mangrove forest for fuel wood supply to major urban city like Yangon and expansion of shrimp farming in recent years.

Mandalay Division – Annual deforestation rate was 4.97% per annum as the forest area decreased from 35% to 19% of total land between 1989 and 1989, 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.

Yangon Division – Annual deforestation rate was 4.97% per annum. Forest cover declined further 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 has also attributed to acceleration of forest exploitation.

Magwe Division – Annual deforestation rate was 4.24% per annum. Unlike in other regions, the overall deforestation took place predominantly in the open forest while a net increase was recorded in the closed forest after 1989. This was due mainly to the impact of stricter enforcement in the Shwe Setaw National Park and Forest Plantation contrasting with open access elsewhere. Within 9 years, the 38% forest cover (both open and closed forest) in 1989 declined to 23% in 1998.

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 the lucrative teak export.

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.

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 PRC 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.

From this explanation, it is clear that higher deforestation has been associated with a higher potential of the region for commercial forest production and an active local economy. This calls for attention to be paid to the need for integrating environmental considerations in the development of the timber business for sustainable use of forest resources. However, it is notable that the current level of forest cover in Myanmar still exceeds half of the country and it is still a higher coverage compared to other GMS countries' forest cover as shown in Table 2d. Therefore, the state of forest resources is relatively good but it shows a deteriorating trend as illustrated by this indicator.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Ratio of Wood Removal over Thousand Hectares of Forest Cover – 1975 to 2001
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	What are the impacts of wood extraction on the remaining forest resources?
Priority Concern	Forest Resources
Geographic Area	Union of Myanmar
Magnitude & Trend	High and Increasing
Key Message	Wood removal per thousand hectares of forest area has increased two fold from 624 to 1232 cubic meters during 1975 to 2000. The available global data (1961-1994) had suggested that this was relatively low (approx. half the magnitude) in Myanmar when compared to GMS or Asian countries. But as with all other GMS countries, the indicator value is 90% dependent on fuelwood removal, which itself can only be estimated. Therefore the absolute value of the indicator is subject to a high level of estimation errors. While the total removal rate is relatively low, another doubling of the removal rate would bring Myanmar at par with the rate of other GMS countries. The trend is moving in this direction, as removal from logging operations continue to rise and there is only slight evidence of relief on the fuelwood extraction.

TECHNICAL INFORMATION

A.Definition

This indicator is expressed as the ratio of total annual roundwood production, in m3, over the total forest area in thousands of hectares. The indicator represents the total wood extraction per 1000 ha of forested land.

Roundwood production refers to all wood in the rough, whether destined for industrial or fuelwood uses. All wood felled or harvested from forests and trees outside the forest, with or without bark, round, split, roughly squared, or in other forms such as roots and stumps, is included. Wood that is harvested for charcoal production is also included. All wood production data refer to both coniferous and non-coniferous species.

Total forest area includes both natural forests and plantations. Forest area is defined as land with tree crown cover of more than 10% on the ground and an area of more than 0.5 ha. Tree height at maturity should exceed 5 m.

B.Data Source

The data utilized for this indicator originate from the Planning and Statistics Division of the Forest Department and from the National Statistical Yearbooks of 1980, 1989, 1994, 1997 and 2002, published by the Central Statistical Organization (CSO) on a regular basis.

C.Geographic Area / Population Coverage

The data utilized for the construction of this indicator are representative of the Union of Myanmar as a whole and include both wood removal for domestic consumption and export.

D.Temporal Coverage

Figures for round wood removal, which forms the numerator of the indicator, were available on an annual basis from 1975 to 2001. Figures for forest cover, which forms the denominator of the indicator, were only available for 1975, 1989 and 1998.

E.Methodology and Frequency of Coverage

Annual extraction rates of teak and hardwood were given in statistical yearbooks of the Central Statistical Organization based on the data provided by government timber extraction agency. For fuelwood removal, annual volume of fuelwood extracted was estimated by Forest Department multiplying rural and urban population with the respected rate of per capita fuelwood consumption both in rural and urban area, which was based on the result of fuelwood surveys conducted by Forest Department in the past three decades. This per capita consumption rate included the household consumption of both firewood and charcoal.

Forest area was given for three representative years of 1975, 1989 and 1998 based on various studies of Forest Resource Assessment conducted by the Forest Department (FD) using remote sensing and geographical information system.

F.Methodology of Data Manipulation

Round wood extraction of teak and hardwood is summed up with total volume of fuelwood extraction in order to estimate total wood removal. Original figures for logs removal and fuelwood removal were expressed in hoppus tons and have been converted to cubic meters using conversion factor of 1.8024 cubic meters per hoppus ton. A straight line method was employed in interpolating forest area for those gap years during the period of 1975 to 2001. Total wood removal is then divided by total forest area and multiplied by 1000 for estimating the ratio of wood removal per thousand hectares of forest area.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

In countries dominated by natural forest areas, the relative value of the indicator is indicative of the pressure of the logging industry on the remaining forest resources. It may be less indicative of this pressure if the country has a high proportion of plantation forest.

The denominator of the indicator is not sensitive to and does not provide for forests under strict protection from logging operations. The indicator should nevertheless be reduced to zero if all of the remaining forest becomes protected from all logging operations.

The major weakness of the indicator, at the data level, is that more than 90% of the wood removal is for fuelwood, and fuelwood removal is estimated rather that measured.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

Some data discrepancy may exist for the following reasons:

Forest area estimates may be lower than actual cover due to inconsistencies applied in forest assessment, particularly between manual and digital technique in interpretation forest and due area calculation. Especially, delineating open forest area may be quite sensitive in data accuracy.

Official round wood extraction and fuelwood extraction may be associated with discrepancies such as underestimating measurement and under reporting of the total quantity for volume estimation, and interpreting the latter.

The rate of per capita fuelwood consumption which was linked to an estimation of household fuelwood production may be no longer valid in capturing the trend of recent years as it was last calculated 20 years ago.

Unofficial extraction of both log and fuelwood which is considered to be quite substantial, is not included in the total estimation.

C.Future Work Required (for data level and indicator level)

Improving data accuracy in estimation of forest area and round wood removal should be carried out. A new survey studying wood energy consumption and production, both rural and urban, should be carried out for updating the basic assumption and rate used in estimating fuelwood consumption and production at national level. Especially, the percentage of fuelwood supply from natural forest for the use of rural household and cottage industry should be sought in making a closer estimation of the real situation.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Ratio of annual Wood Removal to One Thousand Hectares of Forest Area

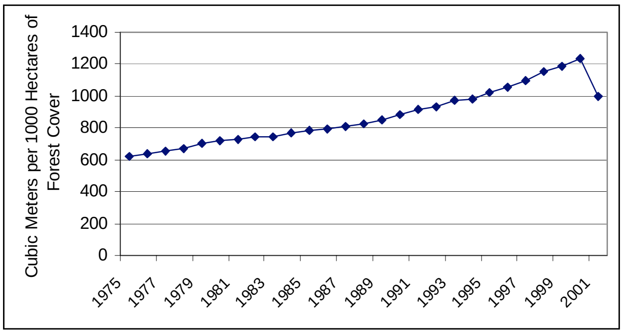


Table 1a: Ratio of Annual Wood Removal To One Thousand Hectares of Forest Area

Year	Forest Area (Thousand hectares)	Log (m3)	Fuelwood (m^3)	Total Removal (m^3)	Ratio of removal m^3/1000 H.	% of Fuelwood Removal
1975	41,196	1,187,625	24501377	25,689,001	623.58	95.4%
1976	41,088	1,289,583	25,001,240	26,290,823	639.87	95.1%
1977	40,980	1,288,763	25,509,166	26,797,929	653.93	95.2%
1978	40,872	1,534,318	26,025,154	27,559,472	674.29	94.4%
1979	40,764	2,165,405	26,557,267	28,722,672	704.61	92.5%
1980	40,656	2,178,581	27,097,442	29,276,023	720.09	92.6%
1981	40,548	2,056,410	27,645,680	29,702,090	732.51	93.1%
1982	40,440	1,943,467	28,201,979	30,145,446	745.43	93.6%
1983	40,332	1,251,432	28,750,217	30,001,648	743.86	95.8%
1984	40,225	1,700,326	29,314,579	31,014,905	771.04	94.5%
1985	40,117	1,736,218	29,887,003	31,623,221	788.28	94.5%
1986	40,009	1,427,932	30,475,552	31,903,484	797.41	95.5%
1987	39,901	1,347,397	31,072,164	32,419,560	812.50	95.8%
1988	39,793	1,376,021	31,676,837	33,052,858	830.62	95.8%
1989	39,685	1,635,191	32,273,449	33,908,640	854.44	95.2%
1990	39,218	1,896,815	32,886,185	34,783,000	886.91	94.5%
1991	38,752	1,930,515	33,498,921	35,429,435	914.26	94.6%
1992	38,286	1,755,595	34,119,719	35,875,314	937.05	95.1%
1993	37,819	1,966,604	34,764,704	36,731,308	971.24	94.6%
1994	37,353	1,365,772	35,409,689	36,775,462	984.55	96.3%
1995	36,886	1,600,439	36,070,799	37,671,239	1021.28	95.8%
1996	36,420	1,686,958	36,739,971	38,426,930	1055.11	95.6%
1997	35,953	1,921,295	37,409,144	39,330,439	1093.93	95.1%
1998	35,487	2,010,734	38828111	40,838,845	1150.81	95.1%
1999	35,021	2,003,557	39,610,156	41,613,713	1188.26	95.2%
2000	34,554	2,164,863	40,416,387	42,581,250	1232.30	94.9%
2001	34,088	2,544,789	31,586,825	34,131,614	1001.29	92.5%

Source: Forest Department 2005, Statistical Yearbooks CSO, 1980, 1989, 1994, 1997 & 2002

Figure 2: Volume of Round Wood Extracted for Teak and Hardwood in Hoppus Tons

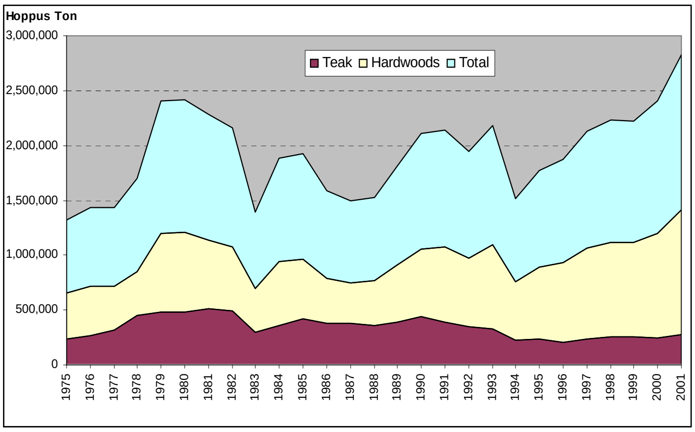


Table 2: Volume of Round Wood Removal (Commercial Logging in Hoppus Tons)

Year	Teak	Hardwoods	Total	% of Teak Removal
1975	231,084	427,829	658,913	35.1%
1976	265,199	450,282	715,481	37.1%
1977	317,330	397,696	715,026	44.4%
1978	449,479	401,785	851,264	52.8%
1979	478,214	723,187	1,201,401	39.8%
1980	485,079	723,632	1,208,711	40.1%
1981	516,886	624,043	1,140,929	45.3%
1982	489,019	589,247	1,078,266	45.4%
1983	296,682	397,632	694,314	42.7%
1984	358,123	585,245	943,368	38.0%
1985	416,466	546,815	963,281	43.2%
1986	383,275	408,964	792,239	48.4%
1987	381,180	366,377	747,557	51.0%
1988	357,076	406,362	763,438	46.8%
1989	387,753	519,477	907,230	42.7%
1990	441,588	610,795	1,052,383	42.0%
1991	388,697	682,383	1,071,080	36.3%
1992	345,186	628,846	974,032	35.4%
1993	331,944	759,159	1,091,103	30.4%
1994	226,453	531,299	757,752	29.9%
1995	232,397	655,552	887,949	26.2%
1996	203,122	732,829	935,951	21.7%
1997	239,147	826,818	1,065,965	22.4%
1998	251,932	863,655	1,115,587	22.6%
1999	260,966	850,639	1,111,605	23.5%
2000	250,500	950,600	1,201,100	20.9%
2001	276,068	1,135,821	1,411,889	19.6%

Source: Statistical Year Books, Central Statistical Organization

Figure 2: Volume of Round Wood Extracted for Teak and Hardwood in Hoppus Tons

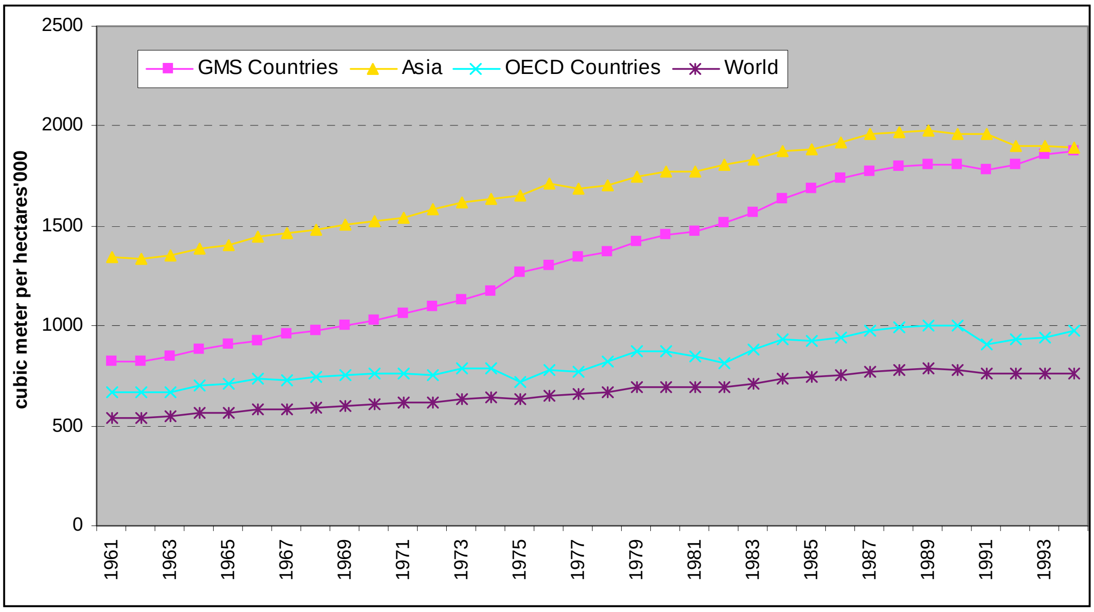


Table 3: Ratio of Round Wood Production to Total Forest Area (cubic meters per 1000 hectares) – GMS and the World – 1961-1994

Year	GMS Countries	Asia	OECD Countries	World
1961	824	1348	671	536
1962	820	1339	672	539
1963	851	1355	667	545
1964	882	1383	699	562
1965	905	1401	710	568
1966	926	1447	740	580
1967	956	1468	732	585
1968	980	1484	741	592
1969	1004	1510	755	599
1970	1030	1521	764	610
1971	1060	1543	764	617
1972	1097	1586	754	619
1973	1128	1615	787	636
1974	1175	1634	787	639
1975	1270	1654	717	630
1976	1303	1711	780	654
1977	1341	1684	774	656
1978	1374	1708	823	672
1979	1425	1748	870	693
1980	1459	1771	871	693
1981	1471	1768	849	691
1982	1516	1808	817	691
1983	1564	1834	879	714
1984	1638	1874	929	737
1985	1688	1880	924	741
1986	1734	1914	945	753
1987	1774	1957	975	771
1988	1800	1970	989	779
1989	1810	1980	1004	789
1990	1804	1958	999	783
1991	1782	1957	910	758
1992	1809	1901	933	766
1993	1854	1902	943	763
1994	1877	1892	978	765

Source: FAOSTAT, 2004

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of this indicator is to measure the relative pressure of logging and fuelwood operations on the forest as a whole, regardless of protection status. It compares the total forest felling as a ratio to the total remaining forest area.

The United Nations have proposed a wood harvesting intensity indicator with a similar enumerator but with a much different denominator. The UN indicator proposes to make use of total annual productive forest increment as the denominator, hence comparing the total forest fellings as a percentage of net annual increment. The UN however admits that such a denominator does not yet exist for most tropical natural forests and that more work is needed to develop such an enumerator. Hence the substitution of total forest area for the development of this indicator.

2.Relevance to Environment Planning and Management:

Unlike the proposed UN indicator which aims at assessing whether forests are being used within the limits of their actual productivity, this indicator is aimed at measuring the rate at which intensive logging and wood-cutting activities destroy the overall forest cover. Maintaining or increasing the percentage forest cover is a high priority in most GMS countries; hence the appropriateness of this indicator which utilizes total forest area as the denominator.

3.Linkage to Other Indicators:

This indicator is closely related to a separate indicator which measures the per capita fuelwood production. This indicator is based on total roundwood production and includes fuelwood and wood use for charcoal production along with wood used for commercial timber. The majority of roundwood production in Myanmar is utilized for fuelwood and commercial timber operations have less of an impact on the overall forest resources.

4.Targets:

Following the principles of sustainable yield management which Myanmar has been practicing over decades, a logging target which is known as Annual Allowable Cut (AAC) exists for the extraction of teak and hardwood based on balance of stocking density in remaining forest. Since 1996, AAC for teak is set at 227,000 Hoppus Ton Per Annum (approximately equivalent to 400,000 cubic meters per annum). Before 1986, it was 350,000 Hoppus Ton.

There is no quantifiable target exist for fuelwood extraction although general policy aims for reducing its consumption and production by wood energy saving and alternative energy development such as promoting hydro-electricity generation.

5.International Environment Treaties:

Many international agreements cover forests. Myanmar is supported to maintain or increase their forested areas, and discouraged to strongly reduce their forest lands. Specific forest agreements would include the Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests (the Forest Principles of the United Nations Conference on Environment and Development (UNCED)); and the International Tropical Timber Agreement. Many other international agreements deal with forests within the context of natural resources and environment conservation, for example Convention on International trade in Endangered Species (CITES), Convention on the Conservation of Wetlands of International Importance (Ramsar Convention), Convention on Biological Diversity, Convention on Climate Change, Convention to Combat Desertification. In addition, ASEAN agreements on sustainable natural resource management have been established.

B.Analysis

As can be observed from Figure 1 and Table 1a, the ratio of wood removal per unit of forest area has increased steadily from approx. 625 cubic meters per thousand hectares in 1975 to more than 1000 cubic meters from 1995 onwards. The rate of removal doubled during the period of the first forest cover assessment (1975 to 1989) and this level of incline continued through to year 2000. There is a noticeable drop in the ratio of the indicator between year 2000 and 2001 but it is noted that this decline is based on a single observation and based on an un-confirmed decline in the fuelwood extraction rate.

As can be observed from Figure 2 and Table 2, commercial logging operations doubled during the same 25-year period but with fluctuating or oscillating pattern.

Since 1975 it had been gradually increased reaching to second highest peak in total production of both teak and hardwood at 1.2 million tons in 1980. The increase during early 1980 might be strongly related to the policy at that time in reducing the exploitation girth limit of timber species for the sake of successive economic return and growth in forestry sector under socialist planning.

Teak extraction had reached the highest peak level in production around 1980. Total production of commercial logging including teak had somewhat declined after 1980 until 1988. The increasing total production during 1989 to 1993 was related to liberalizing the commercialization of forest production largely due to the private sector since Myanmar adopted an open market system in 1988. At that time, forest concession along the Thai-Myanmar border area had also resulted in increasing total production volume. When opening annual forest concessions to the private sector on a competitive basis had stopped around 1993, total production had again declined for 3 years from 1994 to 1996 before resuming its rise in production since 1997 when the economic recession in South East Asia started. The highest level of wood removal by commercial logging for the last 30 years was reached in 2001 with a total volume of 1.4 million tons.

Alongside this fluctuating upward trend within the last 30 years, teak had also relatively followed a rise in production, however, stagnant or stable extraction has remained around 200,000 to 250,000 tons per annum level in recent years indicating its decline in productive capacity from remaining natural forest. In contrast, hardwood production has been noticeably boosted in recent decades. Increasingly land clearing for dam construction at the target of completing 12 dams per year has been somehow conducive to a gradual increase in wood removal in recent years. Historically, it is noticeable within last 3 decades that a higher rise in round wood removal has been affected and derived by the concern of progressive economic growth. Fluctuating wood removal for the logging industry also creates the argument about meeting the sustainable yield management in which the production trend is quite stable without frequent rise and fall.

The current ratio of wood removal in Myanmar is approx. 1000 cubic meters per 1000 hectares of forest land. As illustrated in Figure 3 and Table 3, this is not an excessive amount when compared to OECD countries and is well below the average of all GMS or other Asian countries. However, this data set was only for the years up to 1994 and only gave a glance at the scenario for the last ten years ago. With the increasing population and higher dependency on forest biomass for household energy, the trend of wood removal is going to be continued until now as it increased two fold during the period from 1975 to 2000. This fact concludes the determination of this indicator that the pressure from wood removal onto forest resource is high and increasing.

Greater Mekong Subregion **Indicator Fact Sheet**	
DATABASE INFORMATION	
Indicator ID	
Indicator Name	Expenditure on Forest Conservation - 1988 to 2001
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	Have sufficient funds been allocated to the conservation and management of forest resources in Myanmar?
Priority Concern	Forest Resources
Geographic Area	Union of Myanmar
Impact & Trend	Average and Intermittent
Key Message	From 1988 to 2001, financial expenditure of both the Forest Department and Dry Zone Greening Department on forest conservation ranged from 92 to 283 Million Kyat with a fluctuating trend. In only two years, 2000 and 2001, was the level of spending higher than that of 1988. Thus, the response for improving forest resource is intermittent over the period and its magnitude is considered average as the level of spending in 2001, especially capital expenditure was not markedly different from the1988 level and it is likely to decline further under the continuous trend of market inflation.

TECHNICAL INFORMATION

A.Definition

This indicator attempts to track expenditures on forest conservation over time. Expenditures are expressed in local currency (Kyats) and adjusted to 1988 base-year level using the Consumer Price Index (CPI).

Expenditure on forest conservation includes expenses on forest plantation, management of forest reserves, enhancement of natural regeneration, forestry research, training, wildlife conservation, personnel and administration.

Expenditure figures for the main indicator value are differentiated as capital or current expenditure. Capital expenditure includes expenditure for permanent buildings, roads, machinery etc., plus forest plantation. Current expenditure includes operational expenses such as wages, training, office supplies, etc.

Expenses on Forest Plantation: This is the sum of current and capital expenditure that the Forest Department incurred for the establishment of all type of forest plantations which include watershed plantation, commercial teak and hardwood species plantation, fuelwood plantation, industrial plantation and aesthetic plantation.

Expenses on Management of Forest Reserve: This is the sum of current and capital expenditure that the Forest Department incurred for forest operations related to the expansion and maintenance of existing forest reserves such as boundary demarcation, fire protection, improvement felling, etc.

Expenses on Natural Regeneration: This is the sum of current and capital expenditure that the Forest Department (FD) incurred for natural regeneration of selected species in natural forest.

Expenses on Forestry Research: This is the sum of current and capital expenditure that FD incurred for conducting forestry research works dedicated to sustainable forest management by Forest Research Institute under Ministry of Forestry.

Expenses on Forestry Training: This is the sum of current and capital expenditure that FD incurred for the training of forestry staff and communities who are active personnel in the protection and conservation of forest throughout the country.

Expenses on Wildlife Conservation: This is the sum of current and capital expenditure that FD incurred for field operations related to the maintenance of wildlife parks and sanctuaries and maintenance of forest reserves.

Expenses on Personnel: This is the sum of current expenditure of FD incurred for salary and remuneration of staff working under FD.

Expenses on Administration: This is the sum of current and capital expenditure that the Forest Department incurred for stationery, office maintenance, transportation and overall administration in running day-to-day work of FD both at headquarters and in township offices throughout the country.

B.Data Source

Expenditure figures for both departments were obtained at source, at the request of the National Commission for Environmental Affairs (NCEA). They originate from annual budget reports. Consumer Price Index figures originate from Central Statistical Organization reports.

C.Geographic Area / Population Coverage

The figures for financial expenditure by FD and the Dry Zone Greening Department and representative of the expenditures of those two departments throughout the Union of Myanmar. They do not include expenditures on forest conservation incurred by other parties.

D.Temporal Coverage

Expenditure figures for the Forest Department cover the period of 1994 to 2001 consecutively and selectively for year 1988 to 2002. Dry Zone Greening Department data cover the period from 1997 to 2001 as the Department was established in 1997.

E.Methodology and Frequency of Coverage

Financial figures are excerpted and compiled from annual budget reports of FD (1994-2001) and for Dry Zone Greening Department from Second National Report on UNCCD Implementation of the Union of Myanmar (April 2002).

F.Methodology of Data Manipulation

Annual expenditures, in millions of kyat, have been adjusted to 1988 levels using the rise in CPI since that base year (see last column of Table 1a). The adjustment for a given year is the result of multiplying the expenditure by 100 (the CPI for the base year 1988) and dividing the result by the corresponding CPI value.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The major strength of this indicator, especially when adjusted to CPI, is that it tracks annual government expenditures on forest conservation without any influence from other non-government or international agencies who may at times be making significant expenditure in the same area. The purpose of the indicator is to track Union of Myanmar government expenditure and not all expenditure on forest conservation in Myanmar.

One of the weaknesses of the indicator is that the expenditure values are expressed in local currency, and the indicator is not normalized to some measure of conservation forest area. Both of these factors make it difficult to draw any conclusion as to whether or not the conservation effort is sufficiently funded to start with and/or to compare the relative trend with other GMS countries.

Another weakness of the indicator is that it does not give an indication of what conservation efforts are included in the expenditure, and how much of the expenditure is dedicated to operational overheads. In this fact sheet, this weakness has been partially overcome but providing similar tables by various categories of conservation effort.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

Expenditure figures are quoted from official government sources and are subject to the same reliability, accuracy and uncertainties of any other government expenditures.

C.Future Work Required (for data level and indicator level)

It will be necessary too update the fact sheet on an annual basis as newer data become available.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Expenditure on Forest Conservation at 1988 Constant Price Level

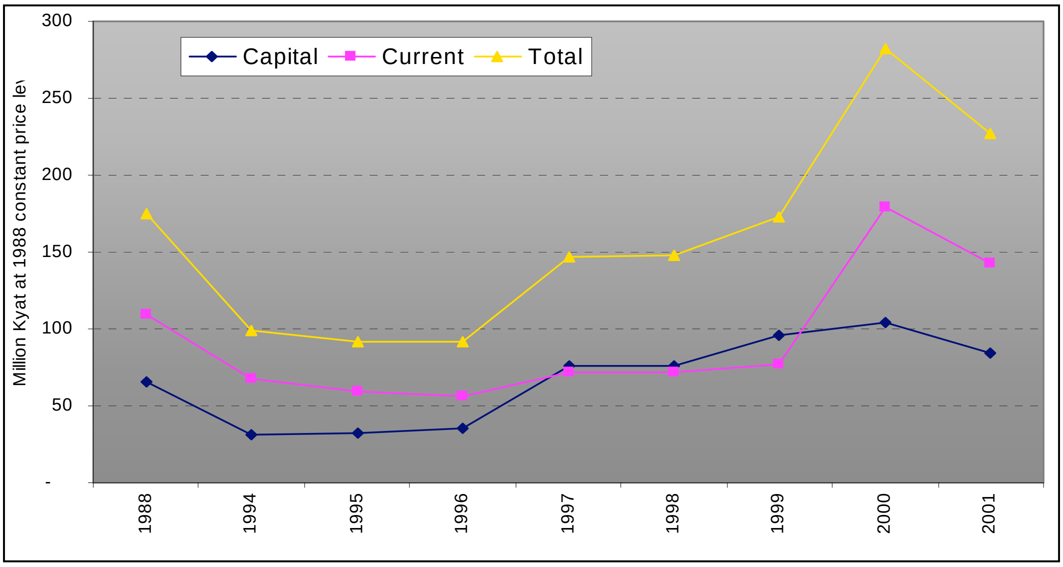


Table 1a: Annual Expenditure of Forest Department and Dry Zone Greening Department on Forest Conservation at 1988 Constant Price Level (Million Kyats)

Year	Forest Department			Dry Zone Greening Department			Both Forest Dept & DZGD			CPI 1988=100
	Capital	Current	Total	Capital	Current	Total	Capital	Current	Grand Total	
1988	66	109	175	-	-	-	66	109	175	100
1994	31	68	99	-	-	-	31	68	99	389
1995	32	60	92	-	-	-	32	60	92	475
1996	35	56	92	-	-	-	35	56	92	570
1997	55	62	116	21	10	31	76	72	147	584
1998	51	54	105	24	19	43	76	72	148	760
1999	72	59	131	24	18	42	96	77	173	879
2000	80	144	224	24	34	58	104	179	283	864
2001	66	114	180	19	28	47	84	143	227	1162

Source: Calculated based on CSO 2002, Forest Department 2005 and NCEA 2002

Table 1b: Nominal Value of Annual Expenditure of Forest Department and Dry Zone Greening Department on Forest Conservation (Million Kyats)

Year	Forest Department			Dry Zone Greening Department			Both Forest Dept & DZGD		
	Capital	Current	Total	Capital	Current	Total	Capital	Current	Grand Total
1988	66	109	175	-	-	-	66	109	175
1994	121	265	387	-	-	-	121	265	387
1995	153	283	436	-	-	-	153	283	436
1996	202	320	522	-	-	-	202	320	522
1997	319	360	679	123	58	181	442	418	860
1998	390	409	799	185	141	327	575	550	1,125
1999	633	518	1151	212	158	370	845	675	1,521
2000	691	1248	1939	205	298	503	896	1,546	2,442
2001	762	1326	2089	216	330	546	978	1,656	2,635

Source: CSO2002, Forest Department 2005 and NCEA 2002

Figure 2: Percentage Share of Itemized Annual Expenditure of Forest Department at 1988 Constant Prices

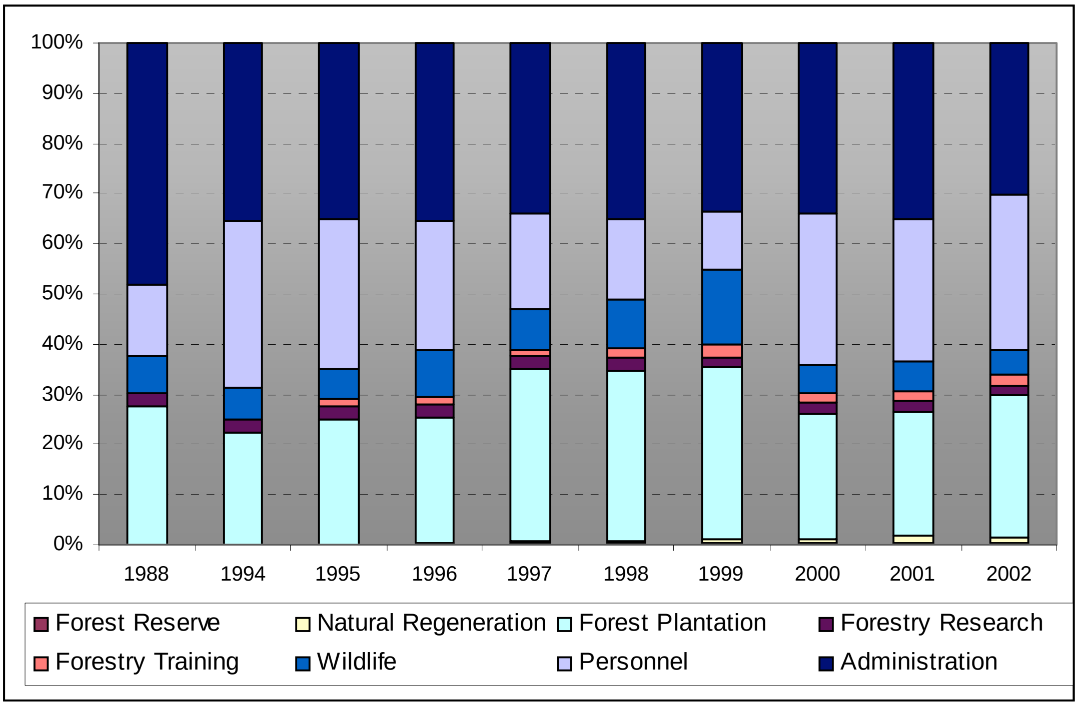


Table 2a: Percentage Share of Itemized Expenditure of Forest Department at 1988 Constant Prices

Year	Forest Reserve	Natural Regeneration	Forest Plantation	Forestry Research	Forestry Training	Wildlife	Personnel	Administration	Total
1988	0.06%	0.05%	27.56%	2.72%	0.00%	7.13%	14.19%	48.29%	100%
1994	0.04%	0.05%	22.45%	2.44%	0.00%	6.41%	33.07%	35.54%	100%
1995	0.07%	0.04%	24.77%	2.74%	1.32%	6.08%	29.98%	35.00%	100%
1996	0.16%	0.14%	24.97%	2.88%	1.22%	9.32%	25.81%	35.50%	100%
1997	0.55%	0.37%	34.22%	2.69%	1.11%	8.01%	19.17%	33.89%	100%
1998	0.42%	0.25%	34.20%	2.41%	1.87%	9.66%	16.29%	34.90%	100%
1999	0.53%	0.48%	34.57%	1.70%	2.47%	15.26%	11.56%	33.42%	100%
2000	0.44%	0.58%	25.15%	2.15%	1.85%	5.49%	30.52%	33.82%	100%
2001	0.34%	1.61%	24.56%	2.27%	1.97%	5.75%	28.34%	35.16%	100%
2002	0.28%	1.35%	28.04%	2.08%	2.17%	4.96%	30.76%	30.36%	100%

Source: Forest Department (2005) & CSO 2002

Table 2b: Annual Expenditure of Forest Department at 1988 Constant Price Level (Million Kyats)

Year	Forest Reserve	Natural Regeneration	Forest Plantation	Forestry Research	Forestry Training	Wildlife	Personnel	Administration	Total
1988	0.11	0.08	48.30	4.77	0.00	12.50	24.86	84.63	175.25
1994	0.04	0.05	22.30	2.42	0.00	6.37	32.84	35.30	99.31
1995	0.07	0.04	22.76	2.52	1.21	5.59	27.55	32.16	91.89
1996	0.15	0.12	22.89	2.64	1.12	8.54	23.67	32.55	91.68
1997	0.64	0.43	39.78	3.12	1.29	9.31	22.28	39.40	116.24
1998	0.44	0.27	35.94	2.53	1.96	10.15	17.12	36.67	105.08
1999	0.70	0.62	45.25	2.23	3.24	19.98	15.14	43.75	130.90
2000	0.98	1.30	56.46	4.82	4.15	12.31	68.51	75.92	224.45
2001	0.61	2.90	44.16	4.07	3.54	10.34	50.94	63.21	179.76
2002	0.42	2.03	42.25	3.14	3.27	7.47	46.34	45.73	150.65

Source: Forest Department (2005) & CSO 2002

Table 2c: Nominal Value of Annual Expenditure incurred by Forest Department

Year	Forest Reserve	Natural Regeneration	Forest Plantation	Forestry Research	Forestry Training	Wildlife	Personnel	Administration	Total
1988	0.11	0.08	48.30	4.77	0.00	12.50	24.86	84.63	175.25
1994	0.15	0.18	86.85	9.43	0.00	24.81	127.89	137.47	386.77
1995	0.31	0.19	108.00	11.94	5.74	26.53	130.72	152.62	436.04
1996	0.85	0.71	130.37	15.05	6.37	48.64	134.79	185.37	522.14
1997	3.72	2.50	232.43	18.26	7.54	54.39	130.20	230.21	679.25
1998	3.34	2.03	273.19	19.26	14.90	77.19	130.17	278.77	798.85
1999	6.13	5.47	397.78	19.60	28.46	175.67	133.06	384.63	1150.81
2000	8.49	11.23	487.77	41.67	35.84	106.37	591.94	655.95	1939.26
2001	7.13	33.68	513.12	47.33	41.13	120.10	591.91	734.49	2088.88
2002	7.72	37.33	776.20	57.67	60.03	137.25	851.37	840.25	2767.81

Source: Forest Department (2005) & CSO 2002

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of the indicator is to measure expenditures on forest conservation as a societal response to preserving existing forest resources.

2.Relevance to Environment Planning and Management:

Expenditure on forest conservation provides a general indication of a country's financial efforts directed towards forest conservation. However, as absolute figures, their relevance for policy purposes is limited and forest conservation expenditure has to be related to other variables, such as Gross Domestic Product (GDP) or Consumer Price Index (CPI). The relation between forest conservation expenditure and the state of the forest resources can only be explored with supplementary information on the overall context of a country. Out of context, high forest conservation expenditure can be associated both with low environmental quality (the situation makes expenditure necessary) and with high environmental quality (which has improved as a result of the conservation expenditure).

3.Linkage to Other Indicators:

This indicator may be linked with other indicators concerned with forest conservation as a response measure to biodiversity, land degradation, etc.

B.Analysis

As shown in Figure 1, the trend of financial resource available for forest conservation has been mixing with the up and down trend over the period 1988 to 2001. In fact, annual expenditure for forest conservation rose 15 times in nominal terms over the same period 1988 to 2001. Adjusted for price inflation, however, the expenditure has decreased. The total expenditure at constant price of both Forest Department (FD) and Dry Zone Greening Department (DZGD) during the period of 1994 to 1999 was lower than the 1988 levels (Table 1a). Increase in total real expenditure after 1999 was mainly due to an increase in current expenditure (mainly salaries of government employees). It is observable in figure 1 that the trend of current expenditure showed an increase in 2000 while there was not much change in the trend of capital expenditure.

The trend in allocating the given financial resources by the Forest Department for forest conservation was depicted by the percentage share of itemized budget expenditures in Figure 2 based on data given in Table 2a, Table 2b and Table 2c. Obviously, the expenditure incurred for personnel and administration constituted the major shares of total budget ranging from minimal 45% to maximum 69% of total expenditure over the period 1994 to 2001. Budget available for Forest Plantation was modest with the expenditures accounting for 25% to 35% of total expenditure during the same period. Expenditure for important conservation works such as maintaining forest reserve, conducting natural regeneration and promoting forestry training and research are very minimal and account for not more than 7% of total expenses in peak year (2001) even if all of them are combined.

Given the inflation rate over the period 1988 to 2001, the financial resource made available for forest conservation had been weakened and total expenditure that was higher than 1988's level was observed only in the years 2000 and 2001. With the fluctuating trend and limited capital expenditure, total financial expenditure on forest conservation is considered average and intermittent in responding to the improvement of forest resources.

Greater Mekong Subregion

Indicator Fact Sheet

DATABASE INFORMATION

Indicator ID	
Indicator Name	Permanent Forest Estate as a Percentage of Total Land Area -1985 to 2003
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	Is the area of Permanent Forest Estate increasing and sufficient for legal protection of forest resources?
Priority Concern	Forest Resources
Geographic Area	Union of Myanmar
Impact & Trend	Average & Consistent
Key Message	Permanent Forest Area (PFE) has increased from 15% of total land area in 1995 to 22% in 2003/04. The PFE target in the 1995 Forest Policy is 30% and forested area equivalent to 1% of total land has been annually reclaimed for PFE during the period from 1998 to 2003. As PFE area before 1995 was 15%, the present PFE coverage is intended to achieve a further 7%, equivalent to half the additional target since the policy became effective. Thus, the response in protecting forest resource is consistent and the magnitude of this indicator is average in achieving the policy target.

TECHNICAL INFORMATION

A.Definition

This indicator attempts to track the amount of natural and plantation area under forest legal protection tracked over time; it is expressed as a percentage of the permanent forest estate area over the total area of the country.

PFE (Permanent Forest Estate) means all Reserved Forest and Protected Public Forest land areas declared under Forest Law (1992).

Protected Public Forest means land constituted as “protected public forest” under Forest Rules (1992) which is the property of Government and in such forest, most of the activities are allowed unless prohibited.

B.Data Source

All of the data utilized for the development of this indicator originate from the Myanmar Forest Department.

C.Geographic Area / Population Coverage

The data utilized for the development of this indicator are representative permanent forest estate area for the Union of Myanmar as a whole and based on a total land area of 67,658,000 ha.

D.Temporal Coverage

The indicator is representative of trends in Permanent Forest Estate area from 1985 to year 2003.

E.Methodology and Frequency of Coverage

Forest Department updates PFE areas on real-time basis.

F.Methodology of Data Manipulation

Total PFE area (excluding proposed areas) is expressed as a percentage of total land area assuming a total land area of 67,658,000 hectares.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The indicator provides general information about the status of legal protection of forest resources in Myanmar. The trend shows the current drive to reach the policy target of 30% in 2030. However, it limits the detailed information about the forest cover and land use situation for each PFE which might have been facing changes over time.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

Reliability and accuracy of the data is quite good as the Forest Department (FD) has to update the PFE database in real time for its administrative purposes.

C.Future Work Required (for data level and indicator level)

To update in a regular manner, forest cover and land use changes within each PFE should be further monitored as a supplement to this indicator for a better understanding of the effectiveness and efficiency of forest conservation by the PFE system.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Percentage of Permanent Forest Estate (PFE) over Total Land Area 1975-1998

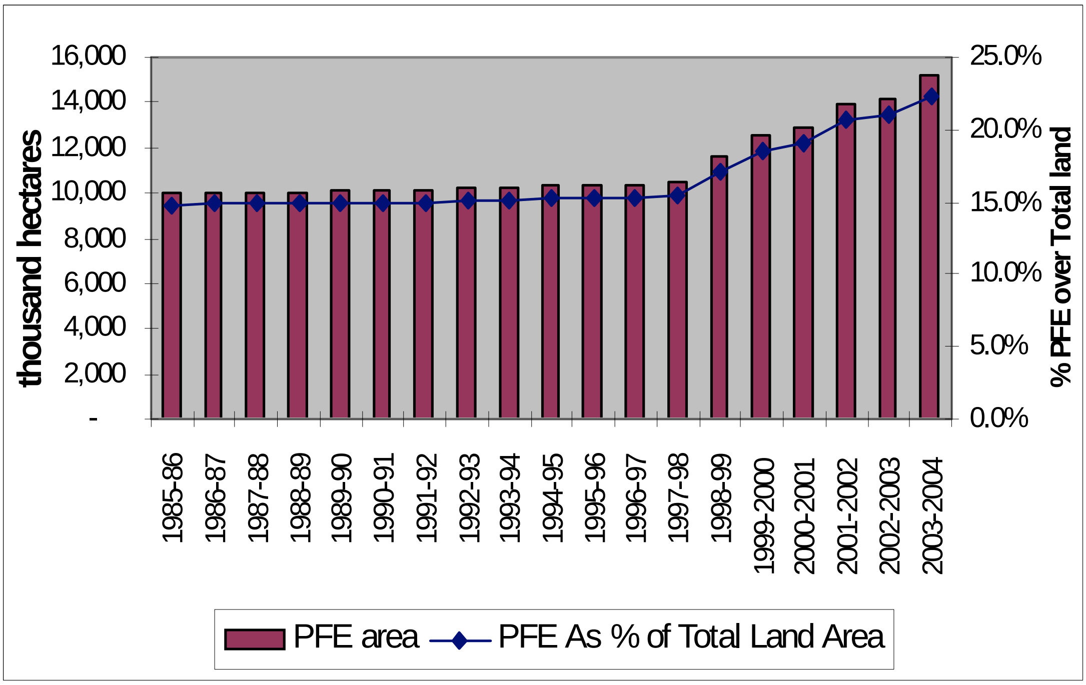


Table 1: Percentage of Permanent Forest Estate (PFE) Over Total Land Area 1975-1998

Year	PFE area 1000 ha	PFE as % of Total Land Area	Total Land Area 1000 ha
1985-86	10,025	15%	67,658
1986-87	10,052	15%	67,658
1987-88	10,059	15%	67,658
1988-89	10,069	15%	67,658
1989-90	10,100	15%	67,658
1990-91	10,142	15%	67,658
1991-92	10,143	15%	67,658
1992-93	10,192	15%	67,658
1993-94	10,270	15%	67,658
1994-95	10,309	15%	67,658
1995-96	10,321	15%	67,658
1996-97	10,396	15%	67,658
1997-98	10,475	15%	67,658
1998-99	11,618	17%	67,658
1999-00	12,590	19%	67,658
2000-01	12,945	19%	67,658
2001-02	13,983	21%	67,658
2002-03	14,182	21%	67,658
2003-04	15,143	22%	67,658
2030	10,025	30%	67,658

Source: Forest Department (2005)

SUMMARY

A.Policy Reference

1.Purpose:

This indicator represents the extent to which areas important for managing forest resources for timber extraction, are protected from incompatible uses.

2.Relevance to Environment Planning and Management:

The Permanent Forest Estate areas, although not in a scale on a par with the Protected Area Systems (PAS), also contribute as a tool for ecosystem conservation, with functions going well beyond the conservation of biological diversity. As such, they are one of the building blocks of sustainable development.

3.Linkage to Other Indicators:

This indicator is linked to other indicators, which have implications for land and resource use. These would include: land use change, wood harvesting intensity, forest area, ratification of global agreements, etc.

4.Targets:

The current forest policy clearly declares that 30% of total land area should be under PFE for forest management.

5.International Environment Treaties:

The following are international treaties and agreement related to the concern of PAS cover:

- International Tropical Timber Agreement for promotion of "Sustainable Forest Management".
- Convention on Biological Diversity (CBD) for forest flora and fauna conservation.
- Convention on International Trade in Endangered Species (CITES) for efficient forest protection effective to conserving endanger species.
- Convention on the Conservation of Wetlands of International Importance (Ramsar Convention) for contextual protection of forest ecosystem.
- Convention on Climate Change for forest environmental conservation.
- Convention to Combat Desertification for natural resource conservation.

B.Analysis

As can be observed in Table 1 and Figure 1, there was almost no or very little change in PFE area during 1985 to 1997. The only observable change that occurred from 1998 to 2003, was the total area of PFE increasing to 22% of total land which approached the target of the Forest Policy. With the current momentum, the targeted 30% of total land will be achieved in the targeted year 2030.

Before this policy target was set by the 1995 Forest Policy, the total PFE area was approximately 15% of total land. As the policy target is 30% of Total land, an additional 15% increase will be achieved by expanding the PFE area. From 1995 to 2003, the net increase in PFE area is equivalent to 7% of total land so that almost 50% of the additional target has been achieved since the policy was implemented.

Annually, forested area equivalent to 1% of total land has been reclaimed under PFE across the country and 50% of the additional target of PFE area set by the 1995 Forest Policy was realized in recent years from 1998 to 2003. Therefore, the level of performance in managing forest resource has been considered average with a consistent improvement

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Threatened Species as a Percentage of Globally Threatened Species - 1996 to 2004
Year of Assessment	2005
Type of Indicator	State
Frequently Asked Question (FAQ)	How seriously is biodiversity being depleted in the Union of Myanmar?
Priority Concern	Threats to Biodiversity
Geographic Area	Union of Myanmar
State & Trend	On Average with no Observable Trend
Key Message	As of the latest 2004 assessment, Myanmar could be providing sanctuary to approximately 2.4% of the globally threatened species. This percentage is on average with other GMS countries. The main focus for conservation should be on species, some of which are endemic to Myanmar.

TECHNICAL INFORMATION

A.Definition

This indicator tracks the number of globally threatened species in Myanmar over time. It 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 (ICUN) 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 this 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. Sub-indicator values are also given for mammals, birds, reptiles, amphibians and fish species.

For more information on the criteria utilized to classify threatened species as critically endangered, endangered or vulnerable, see “Categories & Criteria” at www.iucnredlist.org.

For more information on the species habitat definitions utilized in the IUCN Red List, see Major Habitats Authority File at www.iucnredlist.org.

For more information on the major threats definition utilized in the IUCN Red List, see Major Threats Authority File at www.iucnredlist.org.

B.Data Source

All data utilized to construct this indicator were extracted from the IUCN Red List on the Internet (see www.iucnredlist.org), in early 2005 and based on the 2004 online version of the IUCN Red List.

C.Geographic Area / Population Coverage

Figures are representative of the country as a whole and are not differentiated by any other spatial sub-category. The indicator value is computed for the total number of threatened mammals, birds, reptiles, amphibians and fish species; sub-indicator values are also given for each later category of species.

D.Temporal Coverage

Figures correspond to the contents of the 1996, 1998 (plants only), 2000, 2002, 2003 and 2004 IUCN Red Books.

E.Methodology and Frequency of Coverage

The IUCN Red List is continuously being updated and the equivalent of the paper IUCN Red Book is being produced on an annual basis. The IUCN online Red List (see www.iucnredlist.org) will be the most likely source for updating this indicator in the future.

F.Methodology of Data Manipulation

All the figures given in this fact sheet were either extracted from the online IUCN Red List database, through successive search criteria, or computed from the results of such searches.

The search criterion for the online IUCN Red List is flexible; the flexibility also adds to the complexity. Two forms of search are available: simple search or expert search. For the compilation of this fact sheet, only the simple search menu was utilized since the expert search menu did not offer any added advantage.

Except for plants which are not part of the indicator definition, all searches were made against the entire database using an exact phrase search for keyword “Mammals” or “Birds” or “Reptiles” or “Amphibians” or “Fish”. For plants, the search was made against the taxonomy database using the “Plantae” keyword. For plants, using a keyword of “plants” against the entire database resulted in fewer hits. Likewise, keywords of “mammalia”, “aves”, “reptilia”, etc. against the taxonomy database may lead to un-predictable results.

For the purpose of reporting progress to date in the evaluation of potential threatened species (see Table 2), the Red List category of “All Evaluated (excluding Least Concern)” was utilized to report the number of evaluated species. For the purpose of reporting the overall number of threatened species, a multiple selection of “CR-Critically Endangered” + “EN-Endangered” + “VU–Vulnerable” categories were selected.

For the reporting of threatened species by Red List over time, multiple queries were conducted, with the above screening criteria and with the Red List Assessment Year criteria added.

For the purpose of reporting threatened species by major habitat type or by major threat, the above threatened species criteria was applied against all years of the Red List year of assessment with the 1st level definition of the habitat or threat as additional search criteria.

The calculation of ratios or percentages related to the downloaded figures should be obvious from the contents of the data tables. It is noted however that the percentage figure associated with the main indicator is based on the cumulative number of species added to the Red List, since 1996, and not just the annual figure.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The IUCN Red Books, or the IUCN online Red List, is a relatively new instrument to measure the degree of biodiversity loss of a particular country or region. It was initiated in 1996 without plant species, updated with only plant species in 1998, updated in year 2000, skipped in year 2001 and it is only since year 2002 that it shows some degree of completeness and annual updating. This will improve in the next few years but the temporal trends which can be observed to 2004 are largely based of the level of effort that IUCN biologists have placed on certain species groups in certain years. The IUCN Red List is nevertheless the best source of consistent information of threatened species.

For reasons stated above, the absolute number of threatened species that is placed on the Red List on an annual basis is not very indicative of the trends of biodiversity loss in a particular country or region. A cumulative number might be more indicative but the indicator demands a denominator so that the result can be compared with other countries or regions, and so that the indicator value is less biased by the progress of the work of the IUCN biologists.

The annual ratio of (new) threatened species over the number of evaluated species was considered (see Table 2) but once again this indicator would be biased by the progress of the individual species assessments. Other denominators were considered, such as the annual number of threatened species over the cumulative number of threatened species for a particular country or region, but in the end the number of globally threatened species, or the number of known threatened species to date, was selected as the denominator.

The number of globally threatened species as the denominator provides a neutral denominator for the purpose of comparing one country or region to the other; it is also self-adjusting in terms of the progress that IUCN is having in terms of identifying and mapping the (country) range of all threatened species. IUCN provides these totals including the 2004 assessment year in the statistics section of their homepage (see www.iucnredlist.org).

The indicator value, somewhat representing the global responsibility that the specific country or region has to protect the enumerated species at the start of the assessment, may appear extreme at the start of the assessment period but may well be reduced as assessments for other countries or continents, for related species or species groups, continues. In other cases, it may increase as the assessment regime approaches non-evaluated species in the biome of specific countries or regions. The selected indicator value and denominator is far from being perfect, but at the time of this initial assessment it appears to be the one best suited (given the room for improvement as discussed in one of the following sub-sections).

The main weakness of the indicator (as discussed in the Future Work Required section below, is that is does not give added weight to the threatened species that are endemic to the country or region being considered, or to the lesser concern for species that are globally threatened but abundant in one specific country or region.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

As with all indicators that attempt to track and environmental phenomena over time, this indicator is subject to much international debate and peer review with respect to choice of indicator (based on data availability), reliability, accuracy, robustness and uncertainty.

The reliability of the indicator, especially its denominator, is very much hinged on the future success of IUCN in getting a true global perspective database on threatened species. The accuracy is not questioned and the future use of the indicator (given IUCN's future perspective) appears quite robust. And as with all other indicators which attempt to reduce a complex phenomenon into a single variable, there is some level of uncertainty as to the appropriate (future) use of the indicator as new information sources emerge.

One note is inserted here with respect to uncertainty and the targeting of one threatened species to a specific country. The IUCN online database sometimes targets one threatened species to a country with an implied level [a question mark (?)] of uncertainty. For the purpose of this indicator development and limited by the IUCN Red List query capability; these questionable cases have been included with country or region-specific tabulations.

C.Future Work Required (for data level and indicator level)

The indicator value, with incremental annual figures, and especially the denominator, should be updated annually, provided IUCN provides such facility on an ongoing basis. It is expected the indicator value will converge to its intended purpose within less than half a decade, if not earlier. It is assumed that IUCN will provide updated global totals to serve as denominator in subsequent versions of this indicator

As was previously mentioned above in the discussion on strengths and weaknesses of the indicator, the indicator could be improved, given time and Internet access resources, in giving added weight to threatened species which are endemic to the country or region of concern, and less weight to species which are threatened but which have a larger geographic range. The current online search facility is not ideal for this kind of tabulation (depends on manual count of enumerated countries), but such a tabulation and weight-ranking is not impossible.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Threatened Species as a Percentage of Globally Threatened Species – 1996 to 2004

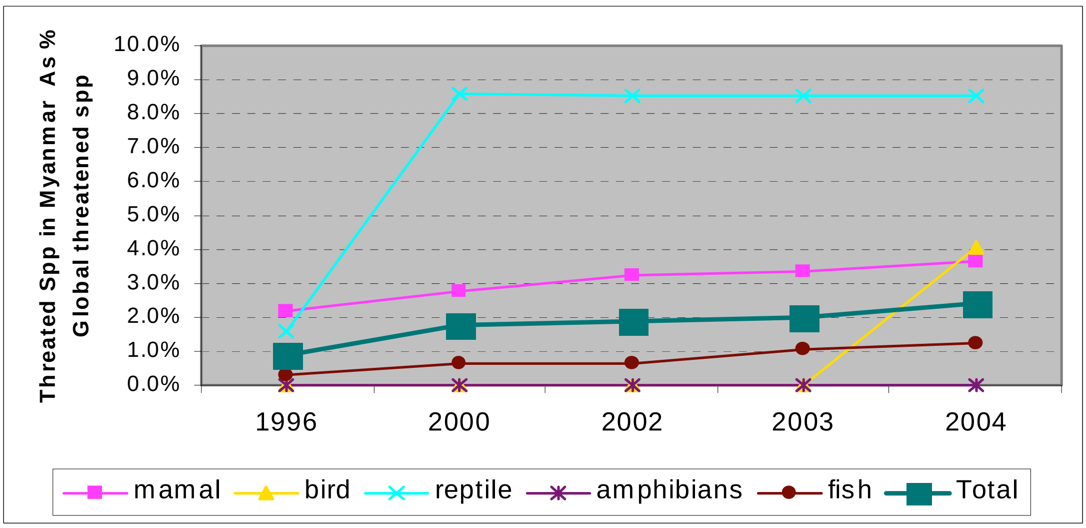


Table 1: Threatened Species as a Percentage of Globally Threatened Species – 1996 to 2004

Assessment Year	Globally Threatened (cumulative number)	Nationally Threatened (cumulative number)	National/Global (%)
Mammals			
1996	1096	24	2.19%
2000	1130	31	2.74%
2002	1137	37	3.25%
2003	1130	38	3.36%
2004	1101	40	3.63%
Birds			
Assessment Year	**Globally Threatened (cumulative number)**	**Nationally Threatened (cumulative number)**	**National/Global (%)**
1996	1107	0	0.00%
2000	1183	0	0.00%
2002	1192	0	0.00%
2003	1194	0	0.00%
2004	1212	49	4.04%
Reptiles			
Assessment Year	**Globally Threatened (cumulative number)**	**Nationally Threatened (cumulative number)**	**National/Global (%)**
1996	253	4	1.58%
2000	291	25	8.59%
2002	293	25	8.53%
2003	293	25	8.53%
2004	304	26	8.55%
Amphibians			
Assessment Year	**Globally Threatened (cumulative number)**	**Nationally Threatened (cumulative number)**	**National/Global (%)**
1996	124	0	0.00%
2000	146	0	0.00%
2002	157	0	0.00%
2003	157	0	0.00%
2004	1770	0	0.00%

Fish			
Assessment Year	Globally Threatened (cumulative number)	Nationally Threatened (cumulative number)	National/Global (%)
1996	734	2	0.27%
2000	752	5	0.66%
2002	742	5	0.67%
2003	750	8	1.07%
2004	801	10	1.25%

All Threatened Mammals, Birds, Reptiles, Amphibians and Fish			
Assessment Year	Globally Threatened (cumulative number)	Nationally Threatened (cumulative number)	National/Global (%)
1996	3314	30	0.91%
2000	3502	61	1.74%
2002	3521	67	1.90%
2003	3524	71	2.01%
2004	5188	125	2.41%

Source: IUCN Red List 2004

Table 2: Species Evaluated and Threatened – 1996-2004

Mammals			
Assessment Year	Evaluated Species (annual number)	Threatened Species (annual number)	Ratio (%)
1996	69	24	34.78%
2000	11	7	63.64%
2002	6	6	100.00%
2003	1	1	100.00%
2004	4	2	50.00%

Birds			
Assessment Year	Evaluated Species (annual number)	Threatened Species (annual number)	Ratio (%)
1996	0	0	
2000	0	0	
2002	0	0	
2003	0	0	
2004	124	49	39.52%

Reptiles			
Assessment Year	Evaluated Species (annual number)	Threatened Species (annual number)	Ratio (%)
1996	5	4	80.00%
2000	25	21	84.00%
2002	0	0	
2003	0	0	
2004	1	1	100.00%
Amphibians			
Assessment Year	Evaluated Species (annual number)	Threatened Species (annual number)	Ratio (%)
1996	0	0	
2000	0	0	
2002	0	0	
2003	0	0	
2004	25	0	0.00%
Fish			
Assessment Year	Evaluated Species (annual number)	Threatened Species (annual number)	Ratio (%)
1996	5	2	40.00%
2000	15	3	20.00%
2002	0	0	
2003	7	3	42.86%
2004	6	2	33.33%
Plants			
Assessment Year	Evaluated Species (annual number)	Threatened Species (annual number)	Ratio (%)
1996	52	36	69.23%
2000	2	1	50.00%
2002	0	0	
2003	2	1	50.00%
2004	0		

Source: IUCN Red List 2004

Table 3: Threatened Species by Major Habitat Type - 2004

Habitat	Mammals	Birds	Reptiles	Amphibians	Fish	Total	Citations %
Forest	26	37	0	0	0	63	36.00%
Wetlands	3	22	0	0	3	28	16.00%
Grasslands	5	15	0	0	0	20	11.43%
Shrubland	7	11	0	0	0	18	10.29%
Artificial/ Terrestrial	0	17	0	0	0	17	9.71%
Sea	4	1	2	0	5	12	6.86%
Coastlines	1	5	2	0	1	9	5.14%
Savanna	3	3	0	0	0	6	3.43%
Artificial/ Aquatic	1	1	0	0	0	2	1.14%
Rocky Areas	0	0	0	0	0	0	0.00%
Caves and Sub-Terrananean Habitats	0	0	0	0	0	0	0.00%
Desert	0	0	0	0	0	0	0.00%
Introduced Vegetation	0	0	0	0	0	0	0.00%
Other	0	0	0	0	0	0	0.00%
Unknown	0	0	0	0	0	0	0.00%
Total Citations	50	112	4	0	9	175	100.0%

Source: IUCN Red List - 2004

Table 4– Threatened Species by Major Threat Category - 2004

Major Threat	Mammals	Birds	Reptiles	Amphibians	Fish	Total	Citations %
Habitat Loss - Human Induced	29	49	5	0	5	88	32.47%
Harvesting (hunting-gathering)	24	32	13	0	7	76	28.04%
Pollution (affecting habitat)	4	18	1	0	2	25	9.23%
Human Disturbance	3	21	0	0	1	25	9.23%
Persecution	4	11	0	0	0	15	5.54%
Accidental Mortality	4	5	2	0	3	14	5.17%
Intrinsic Factors	5	0	3	0	4	12	4.43%
Changes in native species dynamics	7	3	0	0	1	11	4.06%
Invasive alien species	2	0	0	0	0	2	0.74%
Natural Disasters	1	1	0	0	0	2	0.74%
Unknown	1	0	0	0	0	1	0.37%
Other	0	0	0	0	0	0	0.00%
Total Citations	84	140	24	0	23	271	100.0%

Source: IUCN Red List - 2004

Table 5 – List of Individual Threatened Species - 2004

Scientific Name	Class	Year Evaluated	Status	Population Trend	Country Endemic?	GMS Endemic?
Ailurus fulgens	mammals	1996	Endangered	Unknown	No	No
Balaenoptera musculus	mammals	1996	Endangered		No	No
Balaenoptera physalus	mammals	1996	Endangered		No	No
Bos frontalis	mammals	2000	Vulnerable	Declining	No	No
Bos javanicus	mammals	2000	Endangered	Declining	No	No
Budorcas taxicolor	mammals	1996	Vulnerable	Unknown	No	
Bunopithecus hoolock	mammals	2000	Endangered	Unknown	No	No
Callosciurus pygerythrus	mammals	1996	Vulnerable	Unknown	No	No
Callosciurus quinquestriatus	mammals	1996	Vulnerable	Unknown	with PRC	Yes
Capricornis sumatraensis	mammals	1996	Vulnerable	Unknown	No	No
Catopuma temminckii	mammals	2002	Vulnerable	Declining	No	No
Cervus eldii	mammals	1996	Vulnerable		No	No
Cuon alpinus	mammals	2004	Endangered	Declining	No	No
Dicerorhinus sumatrensis	mammals	1996	Critically Endangered	Unknown	No	No
Dugong dugon	mammals	1996	Vulnerable		No	No
Elephas maximus	mammals	1996	Endangered		No	No
Hylopetes alboniger	mammals	1996	Endangered	Unknown	No	No
Hystrix brachyura	mammals	1996	Vulnerable		No	No
Lutrogale perspicillata	mammals	2004	Vulnerable	Declining	No	No
Macaca arctoides	mammals	2000	Vulnerable	Unknown	No	No
Macaca assamensis	mammals	2000	Vulnerable	Declining	No	No
Macaca leonina	mammals	2000	Vulnerable	Unknown	No	No
Muntiacus crinifrons	mammals	1996	Vulnerable		with PRC	Yes
Mustela strigidorsa	mammals	1996	Vulnerable	Unknown	No	No
Naemorhedus baileyi	mammals	1996	Vulnerable	Unknown	No	with India
Naemorhedus caudatus	mammals	1996	Vulnerable	Unknown	No	No
Neofelis nebulosa	mammals	2002	Vulnerable	Declining	No	No
Panthera tigris	mammals	2002	Endangered	Declining	No	No
Pardofelis marmorata	mammals	2002	Vulnerable	Declining	No	No
Physeter macrocephalus	mammals	1996	Vulnerable		No	No

Pipistrellus anthonyi	mammals	1996	Critically Endangered	Unknown	Yes	Yes
Pipistrellus joffrei	mammals	1996	Critically Endangered	Declining	Yes	Yes
Prionailurus planiceps	mammals	2002	Vulnerable	Declining	No	No
Prionailurus viverrinus	mammals	2002	Vulnerable	Declining	No	No
Rattus sikkimensis	mammals	1996	Vulnerable		No	No
Rhinoceros sondaicus	mammals	1996	Critically Endangered	Unknown	No	No
Tapirus indicus	mammals	2003	Vulnerable	Declining	No	with Malaysia
Trachypithecus pileatus	mammals	2000	Endangered	Unknown	No	No
Ursus thibetanus	mammals	1996	Vulnerable	Unknown	No	No
Vernaya fulva	mammals	1996	Vulnerable		with PRC	Yes
Aceros nipalensis	birds	2004	Vulnerable	Declining	No	No
Aceros subruficollis	birds	2004	Vulnerable	Declining	No	with Malaysia
Acrocephalus tangorum	birds	2004	Vulnerable	Declining	No	No
Alcedo euryzona	birds	2004	Vulnerable	Declining	No	No
Anas formosa	birds	2004	Vulnerable	Declining	No	No
Anser erythropus	birds	2004	Vulnerable	Declining	No	No
Aquila clanga	birds	2004	Vulnerable	Declining	No	No
Aquila heliaca	birds	2004	Vulnerable	Declining	No	No
Ardea insignis	birds	2004	Endangered	Declining	No	No
Aythya baeri	birds	2004	Vulnerable	Declining	No	No
Brachypteryx hyperythra	birds	2004	Vulnerable	Declining	No	with India
Cairina scutulata	birds	2004	Endangered	Declining	No	No
Chrysomma altirostre	birds	2004	Vulnerable	Declining	No	No
Ciconia boyciana	birds	2004	Endangered	Declining	No	No
Columba punicea	birds	2004	Vulnerable	Declining	No	No
Eurynorhynchus pygmeus	birds	2004	Endangered	Declining	No	No
Falco naumanni	birds	2004	Vulnerable	Declining	No	No
Gallinago nemoricola	birds	2004	Vulnerable	Declining	No	No
Grus antigone	birds	2004	Vulnerable	Declining	No	No
Gyps bengalensis	birds	2004	Critically Endangered	Declining	No	No
Gyps tenuirostris	birds	2004	Critically Endangered	Declining	No	No
Haliaeetus leucoryphus	birds	2004	Vulnerable	Declining	No	No
Heliopais personata	birds	2004	Vulnerable	Declining	No	No
Leptoptilos dubius	birds	2004	Endangered	Declining	No	No

Leptoptilos javanicus	birds	2004	Vulnerable	Declining	No	No
Lophophorus sclateri	birds	2004	Vulnerable	Declining	No	with India
Megapodius nicobariensis	birds	2004	Vulnerable	Declining	No	with India
Mergus squamatus	birds	2004	Vulnerable	Declining	No	No
Otis tarda	birds	2004	Vulnerable	Declining	No	No
Otus sagittatus	birds	2004	Vulnerable	Declining	No	with Malaysia
Pavo muticus	birds	2004	Vulnerable	Declining	No	No
Pelecanus philippensis	birds	2004	Vulnerable	Declining	No	No
Pitta gurneyi	birds	2004	Critically Endangered	Declining	with Thailand	Yes
Polyplectron malacense	birds	2004	Vulnerable	Declining	No	No
Pseudibis davisoni	birds	2004	Critically Endangered	Declining	No	with Indonesia
Pycnonotus zeylanicus	birds	2004	Vulnerable	Declining	No	No
Rhodonessa caryophyllacea	birds	2004	Critically Endangered	Unknown	No	No
Rynchops albicollis	birds	2004	Vulnerable	Declining	No	No
Sitta formosa	birds	2004	Vulnerable	Declining	No	No
Sitta magna	birds	2004	Vulnerable	Declining	No	Yes
Sitta victoriae	birds	2004	Endangered	Declining	Yes	Yes
Spizaetus nanus	birds	2004	Vulnerable	Declining	No	No
Stachyris oglei	birds	2004	Vulnerable	Declining	with India	with India
Syrmaticus humiae	birds	2004	Vulnerable	Declining	No	with India
Tragopan blythii	birds	2004	Vulnerable	Declining	No	No
Treron capellei	birds	2004	Vulnerable	Declining	No	No
Tringa guttifer	birds	2004	Endangered	Declining	No	No
Turdoides longirostris	birds	2004	Vulnerable	Declining	No	No
Turdus feae	birds	2004	Vulnerable	Declining	No	with India
Amyda cartilaginea	reptiles	2000	Vulnerable Critically		No	No
Batagur baska	reptiles	2000	Endangered		No	No
Caretta caretta	reptiles	1996	Endangered		No	No
Chelonia mydas	reptiles	2004	Endangered	Declining	No	No
Chitra indica	reptiles	2000	Endangered Critically		No	No
Crocodylus siamensis	reptiles	1996	Endangered		No	with Indonesia
Cuora amboinensis	reptiles	2000	Vulnerable		No	No
Dermochelys coriacea	reptiles	2000	Critically Endangered		No	No
Eretmochelys imbricata	reptiles	1996	Critically Endangered		No	No

Geochelone platynota	reptiles	2000	Critically Endangered		Yes	Yes
Heosemys depressa	reptiles	2000	Critically Endangered		Yes	Yes
Heosemys grandis	reptiles	2000	Vulnerable		No	with Malaysia
Heosemys spinosa	reptiles	2000	Endangered		No	No
Hieremys annandalii	reptiles	2000	Endangered		No	with Malaysia
Indotestudo elongata	reptiles	2000	Endangered		No	No
Kachuga trivittata	reptiles	2000	Endangered		Yes	Yes
Lepidochelys olivacea	reptiles	1996	Endangered		No	No
Manouria emys	reptiles	2000	Endangered		No	No
Manouria impressa	reptiles	2000	Vulnerable		No	with Malaysia
Morenia ocellata	reptiles	2000	Vulnerable		Yes	Yes
Nilssonia formosa	reptiles	2000	Endangered		Yes	Yes
Notochelys platynota	reptiles	2000	Vulnerable		No	No
Pelochelys cantorii	reptiles	2000	Endangered		No	No
Platysternon megacephalum	reptiles	2000	Endangered		No	Yes
Pyxidea mouhotii	reptiles	2000	Endangered		No	with India
Siebenrockiella crassicollis	reptiles	2000	Vulnerable		No	No
Scleropages formosus	fish	1996	Endangered		No	No
Thunnus obesus	fish	1996	Vulnerable		No	No
Anoxypristis cuspidata	fish	2000	Endangered	Declining	No	No
Pristis pectinata	fish	2000	Endangered	?	No	No
Rhincodon typus	fish	2000	Vulnerable	Declining	No	No
Aetomylaeus nichofii	fish	2003	Vulnerable	Declining	No	No
Negaprion acutidens	fish	2003	Vulnerable	Declining	No	No
Pangasianodon gigas	fish	2003	Critically Endangered	Declining	No	Yes
Cheilinus undulatus	fish	2004	Endangered	Declining	No	No
Haliaeetus leucoryphus	fish	2004	Vulnerable	Declining	No	No
	Vulnerable				75	
	Endangered				34	
	Critically Endangered				16	
	Endemic to Myanmar				8	

	Endemic to Myanmar plus one other				5	
	Endemic to GMS				15	
	Endemic to GMS plus one other				16	

Source: IUCN Red List - 2004

Table 6: Comparative Indicator Values in 2004 for All GMS Countries

Country	Mammals	Birds	Reptiles	Amphibians	Fish	Total
Cambodia	2.54%	2.15%	4.93%	0.17%	1.62%	1.64%
Lao PDR	3.09%	2.06%	3.95%	0.23%	0.75%	1.56%
Myanmar	3.63%	4.04%	8.55%	0.00%	1.25%	2.41%
Thailand	3.45%	4.13%	7.24%	0.17%	4.74%	2.91%
Viet Nam	4.00%	3.63%	8.88%	0.85%	3.50%	3.05%
Yunnan Province	2.91%	1.49%	3.95%	0.11%	-	1.23%
GMS Average:	3.27%	2.92%	6.25%	0.26%	n/a	2.13%

Source: IUCN Red List - 2004

SUMMARY

A.Policy Reference

1.Purpose:

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

2.Relevance to Environment Planning and Management:

Maintenance of biodiversity is essential for ecosystem wellbeing. Species diversity is one of the three main levels of biodiversity, the others being ecosystem and genetic diversity.

3.Linkage to Other Indicators:

This indicator is linked to other indicators that have implications for biodiversity. These include: protected area as a percent of total area, loss of designated habitat, protected species, etc.

4.Targets:

No specific targets have been set for this indicator and it is quite unlikely that a target specific to this indicator would be established.

5.International Environment Treaties:

For this indicator, the more relevant convention is the Convention on Biological Diversity, ratified 25/11/94.

B.Analysis

As can be observed from Figure 1 and Table 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. To date, there are no globally threatened amphibians which have sanctuary in Myanmar.

As can be observed from Table 2, 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 and is not necessarily indicative of a trend of loss of biodiversity.

As can be observed from Table 2, the 0.91% value in 1996 is based on the first version of the IUCN Redbook at which time most relevant mammals had been evaluated, few reptile and fish species had been evaluated and at which time amphibians and birds were not part of the equation. The relevant amphibians and birds were in fact not evaluated until 2004 and therefore the indicator value and trend before 2004 has very little meaning.

But now that the indicator value is inclusive of all threatened species types, 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 threatened species have sanctuary outside of Myanmar. Some of this artificial oscillation can already be observed in the reptile species since 2000. While the indicator serves well to measure Myanmar's share of the global priority, only changes in the status of individual species (see Table 5) can be utilized to measure progress at the national level.

Apart from the indicator value itself, the IUCN database of threatened species has also provided some insight as to what are the habitats of those species relevant to Myanmar and what are the major threats to those threatened species. As can be observed from Table 3, forests are the dominant habitat for approximately 36% of the threatened mammal and bird species in Myanmar but loss of wetlands and grasslands are equally important to threatened bird species. Therefore societal responses which attempt to protect non-forest areas may be of equal importance and the last column of Table 3 might be a model for the ideal composition of protected areas in Myanmar.

Based on the same IUCN database, Table 4 provides some insight as to the major threats relevant to the threatened species in Myanmar. Loss of habitat is the dominant threat for a third of the threatened species but harvesting and gathering is a close second. Therefore societal responses which deal with the hunting and gathering of these threatened species may be of equal importance as those societal responses which attempt to protect their habitats.

Table 5 lists all of the currently threatened species which have sanctuary in Myanmar along with their current 2004 standing on the IUCN Red List. As of 2004, 75 species were listed as vulnerable, 34 as endangered and 16 as critically endangered. Any future decrease in the level of endangerment of these species, or the removal of the species from this list, is indicative of progress in conserving biodiversity; any future increase in the level of endangerment will be a negative indication of progress.

It can also be noted from Table 5 that not all of Myanmar's share of the globally threatened species are 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 total responsibility. It can also be observed from Table 5 that 15 of Myanmar's current 125 threatened species are endemic to GMS countries.

Table 6 provides the basis for comparing the current value of the indicator with other GMS countries, or with GMS countries as a whole. As can be observed from Table 6, Myanmar's 2.4% of globally threatened species is slightly above the average of all GMS countries combined. Reptiles are the largest contribution 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 and again Myanmar is not solely responsible for all of these threatened reptile species. But at the same time, Myanmar could provide a safe heaven to a relatively high proportion of globally threatened reptiles.

Based on this comparison of this indicator with the indicator value of other GMS countries, 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.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Loss of Tropical Rainforest in Tanintharyi Division - 1990 to 2000
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	Are tropical rain forests in the Union of Myanmar declining?
Priority Concern	Threats to Biodiversity
Geographic Area	Union of Myanmar
Magnitude & Trend	High and Increasing
Key Message	Loss of Rainforest in Tanintharyi Division, which is considered as the last stronghold of the South East Asian Tropical Forest, is accelerating at the rate of 2.8% per annum. As the deforestation rate of the country is reported at 1.2% by the "state" indicator of Forest Resource, habitat loss of tropical rainforest is increasing and relatively high.

TECHNICAL INFORMATION

A.Definition

This indicator attempts to evaluate how much tropical rain forest areas of Myanmar has been lost and into which type of land use.

Almost all forests in the Tanintharyi divisions are considered or were considered tropical rain forests. Therefore no special classification has been done on forest area except on mangroves.

Closed forest is defined as an area under forestry or no land use, spanning more than 0.5 ha; with trees higher than 5 m and a canopy cover of more than 40%, or trees able to reach these thresholds in situ. Open forest is defined as area under forestry or no land use, spanning more than 0.5 ha; with trees higher than 5 m and a canopy cover between 10% and 40%, or trees able to reach these thresholds in situ.

B.Data Source

All of the data utilized for the development of this indicator originate from Myanmar Forest Department and summarize in the following technical paper:

Forest Department and Food and Agriculture Organization (2004), “A study on forest resources and land use changes in the Tanintharyi Division, southern part of Myanmar”, unpublished technical paper, Yangon.

C.Geographic Area / Population Coverage

The data utilized for the construction of the indicator is limited to the extent of the southernmost Tanintharyi Division of Myanmar. However this Division, with a total area of 77,119.61 km2., is representative of all tropical rain forests in the Union of Myanmar, i.e. tropical rain forests only occur in the Tanintharyi Division.

D.Temporal Coverage

The data and the indicator are representative of changes in tropical forest areas between 1990 and 2000.

E.Methodology and Frequency of Coverage

The Forest Department aims to monitor forest cover change in the Tanintharyi Division on a continuous basis, depending upon the availability of remote sensing data. However the present data, in the form of a change matrix, is the first of its kind.

F.Methodology of Data Manipulation

The assessment of forest cover and land use between 1990 and 2000 has been implemented using remote sensing techniques. Two sets of multi-temporal satellite scenes (seven Landsat 5 and Landsat 7 images for each year) have been digitally interpreted using ground-truths taken on various surveys of the area in the past by the Forest Department, including aerial photographs. A digital method of change assessment (the first time for Myanmar) has been performed. The classified information has been overlaid in GIS with both civil administrative boundaries and forest administrative boundaries. Change matrixes are the best from of expressing land use and habitat loss. However, to simplify calculation, only major types of land class (habitat class) have been analyzed. They are Closed Forest and Open Forest (almost most of them are tropical ever greens), Mangrove Forests (coastal habitat), Agriculture and Scrub and Grasslands

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

This kind of change matrix information is available only when such a project exists. The Forest Department should be performing this kind of monitoring work in a routine manner in a prefixed period (every 5 or 10 years) on other States and Divisions also.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

The indicator provides information as to where the changed habitats are going. The strength and weakness lies in the resolution of the satellite (here 30-meter resolution). At least two seasonal scenes are needed for each temporal period. However due to financial limitations and cloud-cover, this change analysis makes the use of only one season (summer time) for all 1990 and 2000 datasets.

C.Future Work Required (for data level and indicator level)

Digital images of 1975 should be acquired from NASA archives. Current status on the effects of oil palm plantation developments should be studied using 2005 satellite data. Biodiversity information and corridor mapping etc. should be performed together with these exercises.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Loss of Tropical Rain Forest Area in Tanintharyi Division – 1990-2000

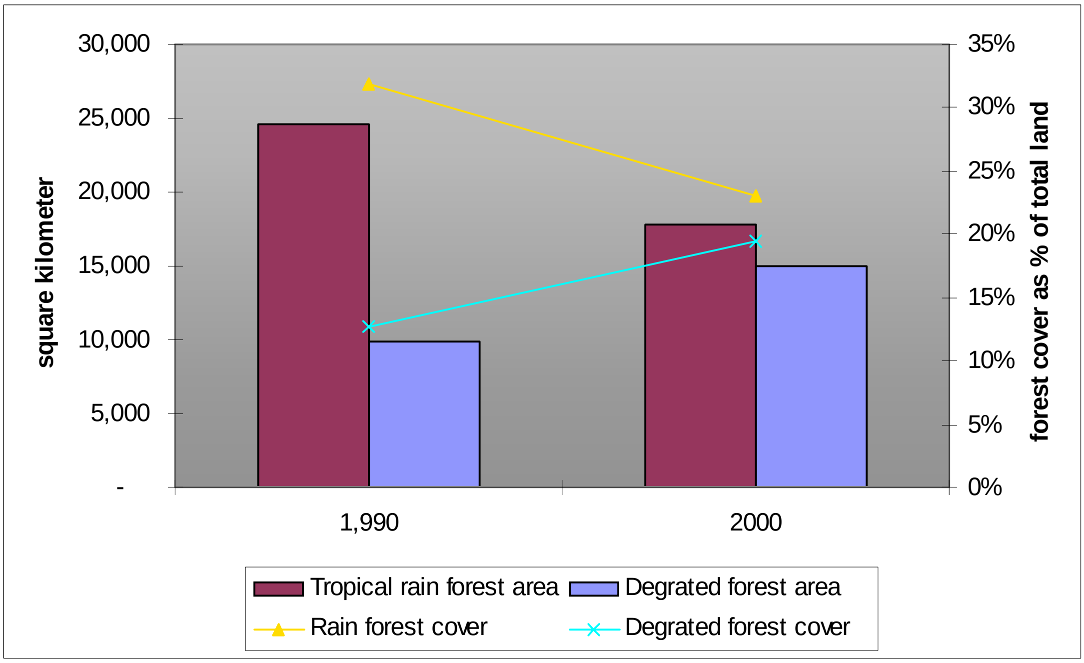


Table 1a: Land Cover Change Matrix in Tropical Rainforest Area in Tanintharyi Division – 1990 and 2000

2000 Km^2 / 1999 Km^2	Closed Forest	Degraded Forest	Mangrove	Agriculture	Water body	Scrub & Grass Land	Sand & Beach	Grand Total of 1990
Closed Forest	17,820	6,350	-	77	-	357	-	24,603
Degraded Forest	-	8,438	-	212	-	1,170	-	9,821
Mangrove	-	164	2,379	142	164	61	-	2,909
Agriculture	-	-	-	1,124	-	-	-	1,124
Water	-	-	-	-	36,127	24	-	36,152
Scrub & Grass Land	-	-	-	228	-	2,220	-	2,448
Sand & Beach	-	-	-	-	-	-	63	63
Grand Total of 2000	17,820	14,953	2,379	1,603	36,291	4,012	63	77,120

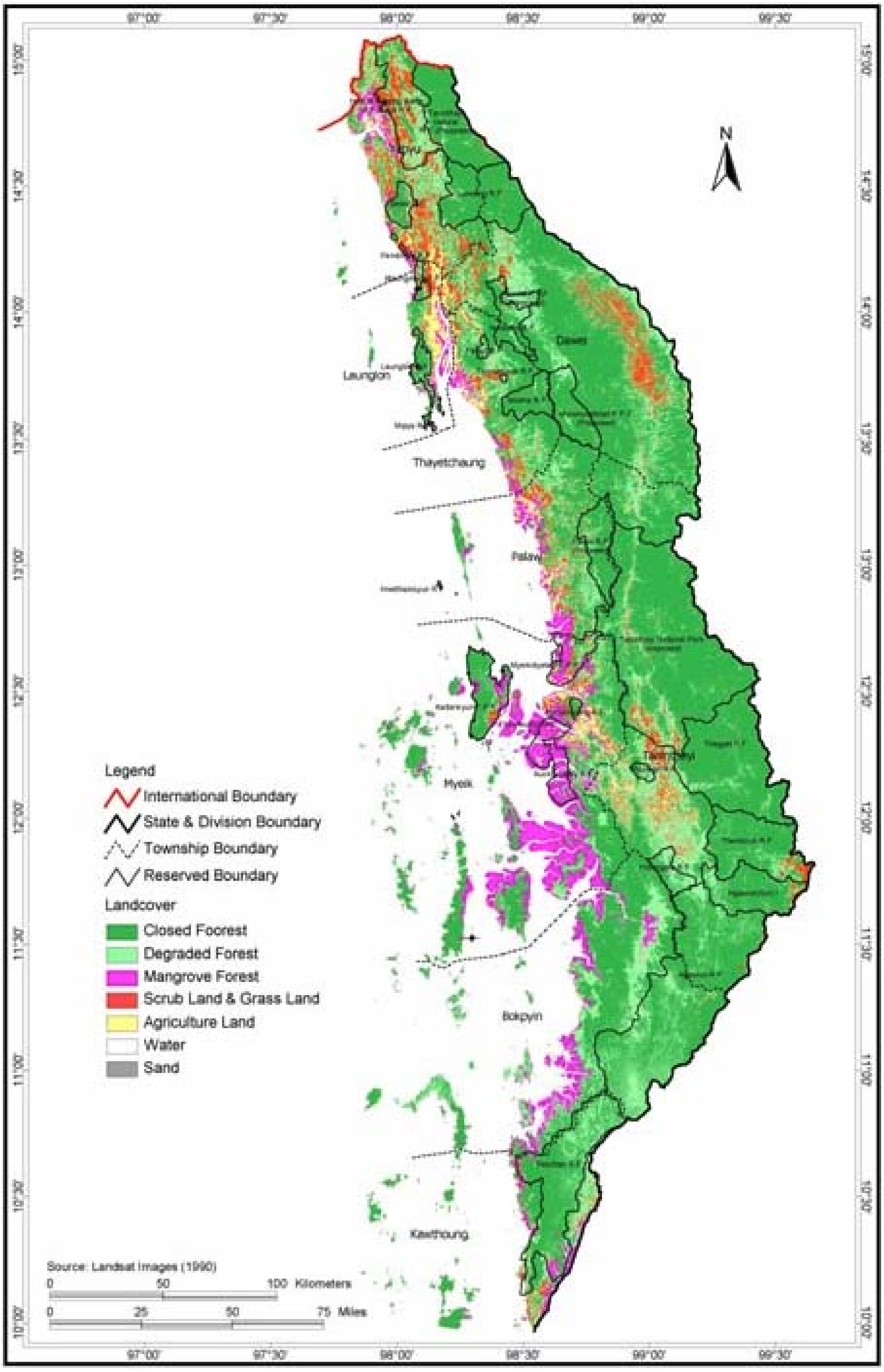
Source: Forest Department and Food and Agriculture Organization, 2004

Table 1b: Rate of Change in Tropical Forest Area in Tanintharyi Division – 1990-2000

Land Use and Habitat	1990		2000		Net Changes	
	Square Kilometer	% of total	Square Kilometer	% of total	Square Kilometer	% changed
Closed Forest	24,603	31.90%	17,820	23.11%	(6,783)	-27.57%
Degraded Forest	9,821	12.73%	14,953	19.39%	5,132	52.26%
Mangrove	2,909	3.77%	2,379	3.08%	(531)	-18.24%
Agriculture	1,124	1.46%	1,603	2.08%	478	42.53%
Water	36,152	46.88%	36,291	47.06%	139	0.39%
Scrub & Grass Land	2,448	3.17%	4,012	5.20%	1,565	63.93%
Sand & Beach	63	0.08%	63	0.08%	-	0.00%
TOTAL	77,120	100.00%	77,120	100.00%		

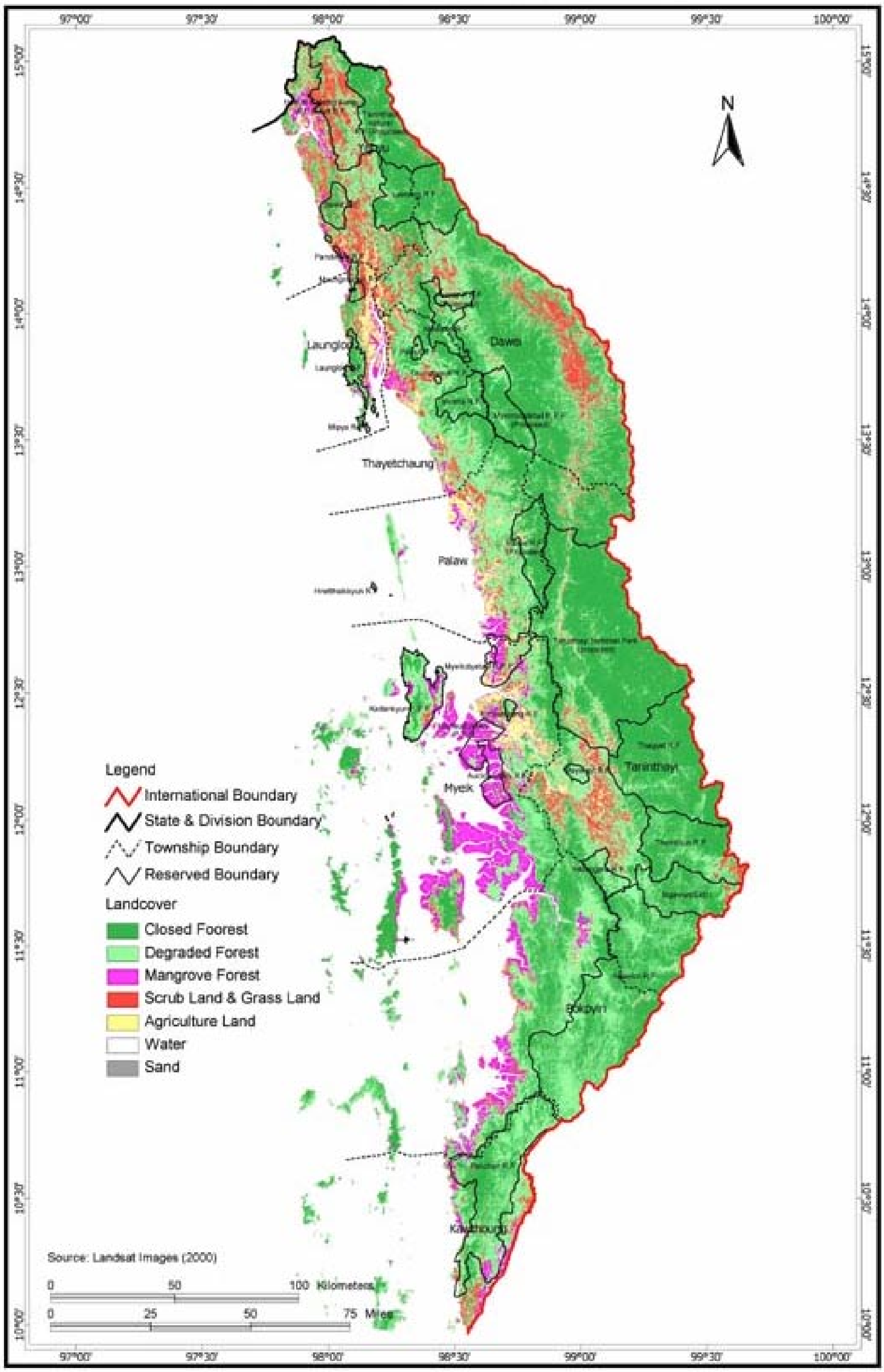
Source. Forest Department and Food and Agriculture Organization, 2004

Map 1: Land Cover Map of Tanintharyi Division in 1990



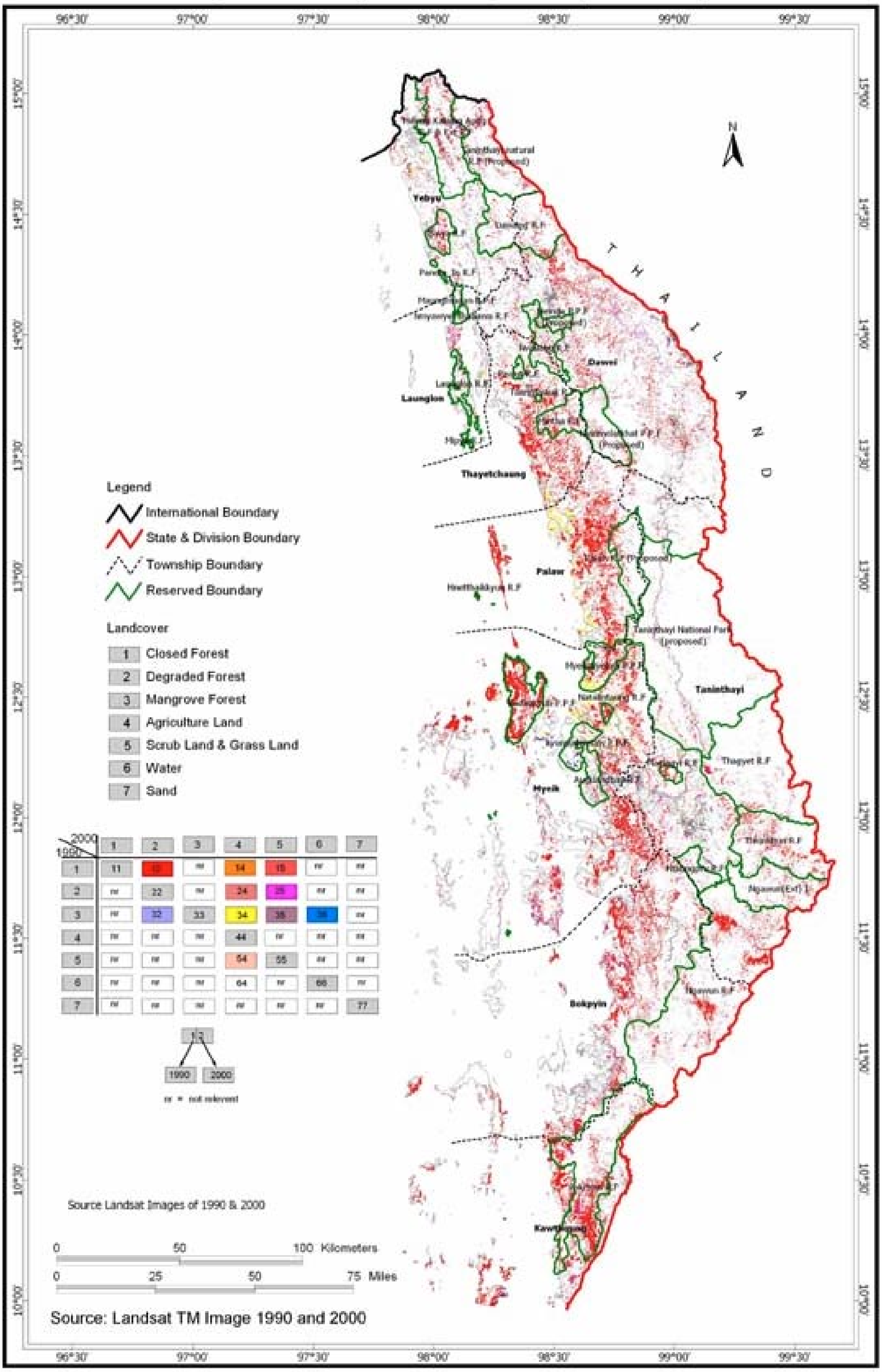
Source: Forest Department and Food and Agriculture Organization, 2004

Map 2: Land Cover Map of Tanintharyi Division in 2000



Source: Forest Department and Food and Agriculture Organization, 2004

Map 3: Change Detection Map of Tanintharyi Division between 1990 and 2000



Source: Forest Department and Food and Agriculture Organization, 2004

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of the indicator is to estimate the changes of tropical rainforest and habitat losses particularly in Tanintharyi Division, in the southern part of the country where it is known as being one of the last strongholds of Southeast Asian tropical rainforests.

2.Relevance to Environment Planning and Management:

Finding land uses where natural habitats have to give way for development will enable sound land use planning and solve conflicts essential for management.

3.Linkage to Other Indicators:

The indicator may relate to other indicators of forest cover changes, land degradation, threat to coastal areas (mangrove forests turned into water means coastal bank erosion) etc.

4.Targets:

None applicable, as of the year of assessment.

5.International Environment Treaties:

Many international agreements cover forests and biodiversity conservation. Myanmar is supported to maintain or increase their forested areas, and discouraged to strongly reduce their forest lands. Specific forest agreements would include the Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests [the Forest Principles of the United Nations Conference on Environment and Development (UNCED)]; and the International Tropical Timber Agreement. Many other international agreements deal with forests within the context of natural resources and environment conservation, for example Convention on International trade in Endangered Species (CITES), Convention on the Conservation of Wetlands of International Importance (Ramsar Convention), Convention on Biological Diversity, Convention on Climate Change, Convention to Combat Desertification. In addition, ASEAN agreements on sustainable natural resource management have been established.

B.Analysis

As can be observed from Figure 1 and Maps 1-3, the area of rainforests (closed forest) in Tanintharyi Division declined from 24603 km2 or 31.9% of the division area to 17,820 km2 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 (see Table 1b) 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, is highly coincident with the 1988 open market economy and the competition from other land uses.

The loss of 6,783 km2 tropical rain forest is counter-balanced by a 4,772 km2 increase in the area of degraded forest which increased from 9,820 km2 in 1990 to 14,592 km2 in 2000 (see Table 1b). 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 km2 were lost from closed forest to degraded forest. Given the closure of all forest concessions along the Thai-Myanmar border in 1992-1993, the loss of tropical forests in Tanintharyi Division is highly suspect of illegal logging activities. Palm oil plantations may also be a contributing factor.

Owing to the fact that deforestation rate at the national level (1989 to 1998) was 1.2% per annum, the loss of tropical rainforest in the Tanintharyi Division at the rate of 2.8% per annum (1990 – 2000) is relatively high. With the growing tendency in expansion of palm oil and rubber plantation in the region, there is increasing pressure on loss of habitat.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Loss of Mangroves in the Delta Forest Reserves - 1924 to 2001
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	How serious is the loss of mangrove forests in places like the Delta Forest Reserve?
Priority Concern	Threats to Biodiversity
Geographic Area	Union of Myanmar
Magnitude & Trend	High and Increasing
Key Message	Historically, delta mangroves have been subject to expansion of paddy cultivation and charcoal production since 1924. Only 44% of total mangrove forest in 1924 remained in 2001. Commercial shrimp farming became popular in the post-1990s and the loss of mangrove habitat peaked in 2001 when another 35,836 hectares of mangroves disappeared. This is equivalent to 24% of total mangrove forest in the year 2000. Therefore, the pressure on biological diversity of mangrove ecosystem is high and increasing.

TECHNICAL INFORMATION

A.Definition

This indicator attempts to track the change or loss of mangrove forest cover in nine delta forest reserves of the Ayeyarwady delta of Myanmar.

Mangrove forests are the characteristic littoral plant formations of tropical and subtropical sheltered coastlines. Generally mangroves are trees and bushes growing below the high water level of spring tides. Their root systems are thus regularly inundated with saline water, even though it may be diluted due to freshwater surface run-offs and only flooded once or twice a year. Its ecosystems are very unique and very rich both in flora and fauna. Reserved Forest means land constituted as "reserved forest" under Forest Law (1992) which is property of the Government and in such forest, most of the activities are prohibited unless allowed.

B.Data Source

Data employed in this indicator are provided by the Remote Sensing and Geographical Information System (RS/GIS) Section of Forest Department based on their study carried out in 2003 for the assessment on Forest Cover Changes in Ayeyarwaddy Delta Forest.

C.Geographic Area / Population Coverage

This indicator is only representative of nine delta Forest Reserves in Bogalay and Latputa Townships of Ayeyarwady Division with the total land coverage of 253,018 ha in the lower part of the country.

D.Temporal Coverage

The indicator is representative of trends in Delta mangrove areas in the years of 1924, 1954, 1974, 1980, 1983, 1990, 1995, 2000, and 2001.

E.Methodology and Frequency of Coverage

Forest Department monitors and updates the delta mangrove database regularly, as remote sensing data becomes available.

F.Methodology of Data Manipulation

1924, 1954, 1983 data are from aerial photography interpretation. 1974 data is from Landsat MSS, and the rest are digital interpretations of Landsat TM. All interpretation data are put into GIS and the areas are calculated using one forest administrative boundary GIS database for a total land area of 253,018 ha.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The indicator provides a historical timeline trend of mangrove forest coverage in Ayeyarwaddy Delta for a period of more than 80 years. However, the indicator only represents the status of larger mangrove areas in the lower part of the country and mangrove habitats elsewhere along the coastal areas and outside of the studied forest reserve areas in Ayeyarwaddy delta were are not included for the analysis.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

Reliability is high since mangrove cover is an easily disguisable feature using remote sensing techniques. All the interpretations and interpreters have been supported by intensive ground-truths.

C.Future Work Required (for data level and indicator level)

Further updating of the existing database as well as extending of the study for mangrove area in Rakhine and Tanintharyi Coasts are desirable. It should also develop for matrix changed data to correlate the land use changes within the given land categories.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Loss of Mangrove in Delta Forest Reserves - 1924-2001

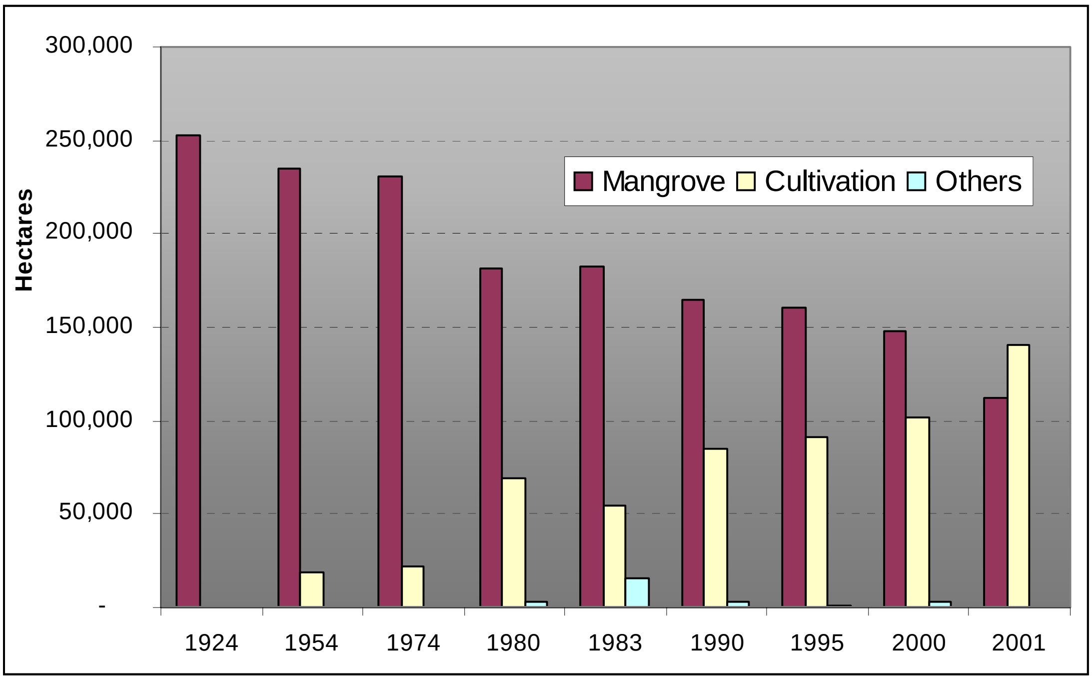


Table 1: Loss of Mangrove in Delta Forest Reserves - 1924-2001

Year	Mangrove Forest (ha)	Cultivation (ha)	Others (ha)	Total 9 Forest Reserve Area (ha)
1924	253,018	-	-	253,018
1954	234,510	18,508	-	253,018
1974	231,042	21,921	55	253,018
1980	181,060	69,217	2,741	253,018
1983	182,363	54,869	15,786	253,018
1990	164,417	85,463	3,138	253,018
1995	161,014	90,763	1,241	253,018
2000	147,775	101,708	3,536	253,018
2001	111,939	140,581	498	253,018

Source. Forest Department 2005

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of this indicator is to examine the changes of mangrove forest in the Delta Forest Reserves and thereby to review the loss of mangrove habitat in general by highlighting the level of threat on biological diversity as a whole.

2.Relevance to Environment Planning and Management:

This indicator is relevant to the conservation of an important wetland ecosystem as well as rehabilitation of degraded coastal areas for natural disaster prevention and fishery resource management.

3.Linkage to Other Indicators:

The indicator is linked to other indicators such as forest cover, land use changes, percentage of protected area system and percentage of permanent forest estate.

4.Targets:

In preparation for the national action plan for combating desertification in Myanmar in compliance with UNCCD, Ayeyarwaddy delta is selected as an important site for conservation priority. However, there are no specific targets established for this indicator.

5.International Environment Treaties:

Many international agreements cover forests and biodiversity conservation. Myanmar is supported to maintain or increase their forested areas, and discouraged to strongly reduce their forest lands. Specific forest agreements would include the Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests [the Forest Principles of the United Nations Conference on Environment and Development (UNCED)]; and the International Tropical Timber Agreement. Many other international agreements deal with forests within the context of natural resources and environment conservation, for example the Convention on International trade in Endangered Species (CITES), Convention on the Conservation of Wetlands of International Importance (Ramsar Convention), Convention on Biological Diversity, Convention on Climate Change and Convention to Combat Desertification. In addition, ASEAN agreements on sustainable natural resource management have been established.

B.Analysis

As can be observed from Figure 1 and Table 1, mangrove forests in the Delta Forest Reserve have declined at an alarming rate from 253,018 ha in 1924 to 111,939 ha in 2001. Only 44% of the original mangroves remain. The increase in the area of rice cultivation during the past 25 years is probably the main contributing factor. The cultivated area is now more than half the total reserve area. Fuelwood extraction for charcoal production has also been a contributing factor in the 1980s but was banned in the post-1990s. Shrimp farming is now the main contributing factor for the loss of mangrove forest in the delta area. Habitat loss peaked in 2001 with the loss of 35,836 ha within one year, equivalent to 24% of total mangrove forest area in 2000.Therefore, the loss of mangrove habitat is accelerating at an alarming rate and its magnitude has been high and increasing.

Greater Mekong Subregion **Indicator Fact Sheet**	
DATABASE INFORMATION	
Indicator ID	
Indicator Name	Percentage of Protected Area Over Total Land Area 1918 - 2004
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	To what extent is biodiversity being safeguarded and preserved by the System of Protected Areas?
Priority Concern	Threats to Biodiversity
Geographic Area	Union of Myanmar
Impact & Trend	Low but Consistent
Key Message	The system of protected areas in Myanmar has steadily increased since 1996. By 2004, it accounts for 7.24% of total land area. Thus the government response to biodiversity conservation is consistent but total coverage of system is low when compared to that of other GMS countries, i.e. Cambodia (32%), Thailand (27.5%) and Lao PDR (14%).

TECHNICAL INFORMATION

A.Definition

This indicator attempts to track the amount of natural biodiversity area under legal protection tracked over time; it is expressed as a percentage of the Protected Area System area over the total area of the country.

PAS (Protected Area System) means all national parks, game parks, mountain parks, bird sanctuaries etc. declared as PAS areas under "Protection of Wildlife and Wild Plants and Conservation of Natural Areas Law", enacted in June 1994.

B.Data Source

All of the data utilized for the development of this indicator originate from the Myanmar Forest Department (FD).

C.Geographic Area / Population Coverage

The protected areas system data utilized for the development of this indicator are representative of all protected areas in the Union of Myanmar as a whole and based on a total land area of 67,658,000 ha.

D.Temporal Coverage

The indicator is representative of trends in protected areas system since its inception in 1918 until the year 2004.

E.Methodology and Frequency of Coverage

The Forest Department updates PAS areas on a continuous basis.

F.Methodology of Data Manipulation

Total PAS areas (including proposed areas to show the current efforts) are expressed as a percentage of total land area assuming a total land area of 67,658,000 ha.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The indicator provides explicit general information about the status of biodiversity conservation in Myanmar. A historical timeline trend is also observable for percentage change in the protected area system. However, it does not give the change of status of habitats with each PAS area.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

The records of the Forest Department are considered highly reliable, within the limits of accuracy of their accounting system for protected areas.

C.Future Work Required (for data level and indicator level)

There will be a requirement to update the indicator and this fact sheet on a regular or annual basis. Also, the habitat status within each PAS should be monitored to analyze the effectiveness of the current PAS for biodiversity conservation. A study should also be initiated for the comparison of the PAS against the total area of critically important ecosystems.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Percentage of Protected Area Over Total Land Area – 1918-2004

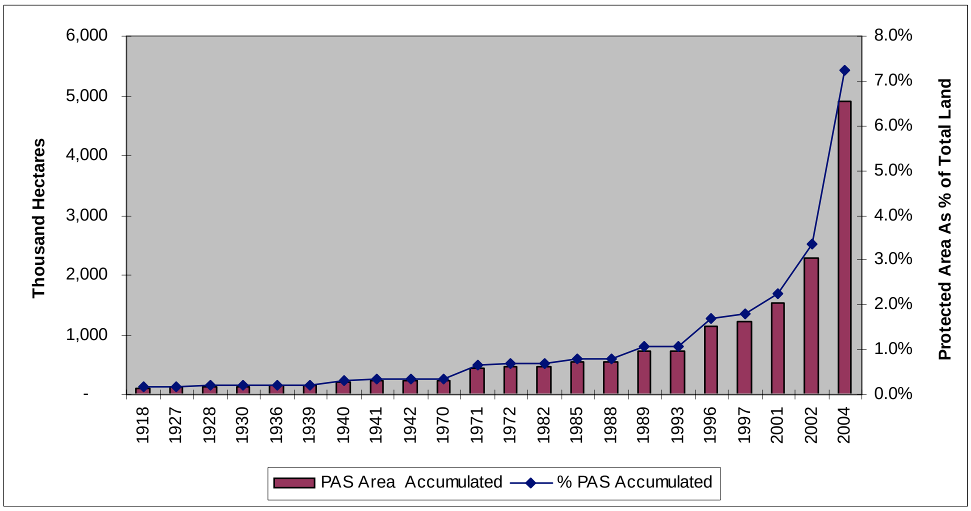


Table 1: Percentage of Protected Area Over Total Land Area – 1918-2004

Year	PAS Area Yearly Established (1000 ha)	Accumulated Area of PAS (1000 ha)	Accumulated PAS As % of Total Land	No of PAS Yearly Established	No of Accumulated PAS
1918	115.11	115	0.17%	3	3
1927	4.92	120	0.18%	1	4
1928	16.06	136	0.20%	1	5
1930	1.61	138	0.20%	1	6
1936	13.85	152	0.22%	1	7
1939	0.44	152	0.22%	1	8
1940	55.27	207	0.31%	1	9
1941	26.94	234	0.35%	1	10
1942	2.45	237	0.35%	1	11
1970	0.09	237	0.35%	1	12
1971	215.07	452	0.67%	1	13
1972	20.59	472	0.70%	1	14
1982	0.62	473	0.70%	1	15
1985	64.23	537	0.79%	1	16
1988	10.36	548	0.81%	1	17
1989	172.62	720	1.06%	2	19
1993	13.67	734	1.08%	1	20
1996	413.72	1,148	1.70%	4	24
1997	72.31	1,220	1.80%	2	26
2001	301.54	1,521	2.25%	4	30
2002	762.62	2,284	3.38%	5	35
2004	2,617.19	4,901	7.24%	4	39

Source: Nature and Wildlife Conservation Division, Forest Department 2005

Table 2: Protected Area by Habitat Type – 2004

Habitat	Area Extent of Relevant PAS (ha)	% of Total PAS
Marine PAS	39,161	0.80%
Terrestrial PAS	4,705,575	96.01%
Wetland PAS	156,531	3.19%
Grand Total	4,901,267	100%

Source: Nature and Wildlife Conservation Division, Forest Department 2005

Table 3a: Individual Protected Areas by Year of Establishment and Aerial Extent - 2004

No.	Name	Year	Areas		General Location
			Acres	Sq. miles	
1.	Pidaung wildlife Sanctuary	1918	172,452.34	269.46	Kachin State
2.	Shwe-U-Daung Wildlife Sanctuary	1918	51,106.00	79.85	Mandalay Division
	Shwe-U-Daung Wildlife Sanctuary	1929	29,440	46	Shan State
3.	Pyin-O-Lwin Bird Sanctuary	1918	31,443.2	49.13	Mandalay Division
4.	Moscos Islands Wildlife Sanctuary	1927	12,153.6	18.99	Taninthayi Division
5.	Kahilu Wildlife Sanctuary	1928	39,673.6	61.99	Karen State
6.	Taunggyi Bird Sanctuary	1930	3,968	6.2	Shan State
7.	Mulayit Wildlife Sanctuary	1936	34,233.6	53.49	Karen State
8.	Wethtikan Bird Sanctuary	1939	1,088	1.70	Magwe Division
9.	Shwesettaw Wildlife Sanctuary	1940	136,576	213.4	Magwe Division
10.	Chatthin Wildlife Sanctuary	1941	66,273	104	Sagaing Division
11.	Kelatha Wildlife Sanctuary	1942	6,048	9.45	Mon State
12.	Thamihla Kyun Wildlife Sanctuary	1970	217.6	0.34	Ayeyarwady Division
13.	Htamanthi Wildlife Sanctuary	1971	531,456	830.4	Sagaing Division
14.	Minwuntaung Wildlife Sanctuary	1972	50,873.6	79.49	Sagaing Division
15.	Hlawga Park	1982	1,540	2.41	Yangon Division
16.	Inlay Wetland Bird Sanctuary	1985	158,720	248	Shan State
17.	Moeyongyi Wetland Bird Sanctuary	1988	25,600	40	Bago Division

18.	Alaungdaw Kathapa National Park	1989	394,779.52	616.843	Sagaing Division
19.	Popa Mountain Park	1989	31,763.2	49.63	Mandalay Division
20.	Meinmahla Kyun Wildlife Sanctuary	1993	33,776	52.78	Ayeyarwady Division
21.	Lampi Island Marine N. Park	1996	50,617.6	79.09	Taninthary Division
22.	Hkakaborazi National Park	1996	942,080	1472	Kachin State
23.	Loimwe Protected Area	1996	10,585.6	16.54	Shan State
24.	Parsar Protected Area	1996	19,032.4	29.74	Shan State
25.	Natmataung National Park	1997	178,560	279	Chin State
26.	Lawkananda Wildlife Sanctuary	1997	115.2	0.18	Mandalay Division
27.	Indawgyi Wetland Wildlife Sanctuary	2004	191,564.8	314.67	Kachin State
28.	Kyaikhtiyoe Wildlife Sanctuary	2001	38,606	60.32	Mon State
29.	Minsontaung Wildlife Sanctuary	2001	5,584	8.725	Mandalay Division
30.	Hukaung Valley Wildlife Sanctuary	2004	1,574,400	2460	Kachin State
31.	Kyauk Pan Taung Wildlife Sanctuary	2001	32,768	51.2	Chin State
32.	Hponkanrazi Wildlife Sanctuary	2001	668,160	1044	Kachin State
33.	Rakhine Yoma Elephant Range	2002	43,3843.2	677.88	Rakhine State
34.	Panlaung-pyadalin Cave Wildlife Sanctuary	2002	82,483.2	128.88	Shan State
35.	Maharmyaing Wildlife Sanctuary	2002	291,680	455.75	Sagaing Division
36.	Lenya National Park	2002	436,480	682	Taninthary Division
37.	Taninthary National Park	2002	640,000	1000	Taninthary Division
38.	Bumhpabum Wildlife Sanctuary	2004	460,160	716	Kachin State
39.	Hukaung Valley Wildlife Sanctuary (extension)	2004	3,813,120	5958	Kachin State
40.	Taninthayi Nature Reserve	2004	420,076.8	656.37	Taninthayi Division
	Grand Total		10,647,296.89	18,923.898	

Source: Nature and Wildlife Conservation Division, Forest Department 2005

Table 3b: Key Protected Species by Protected Area

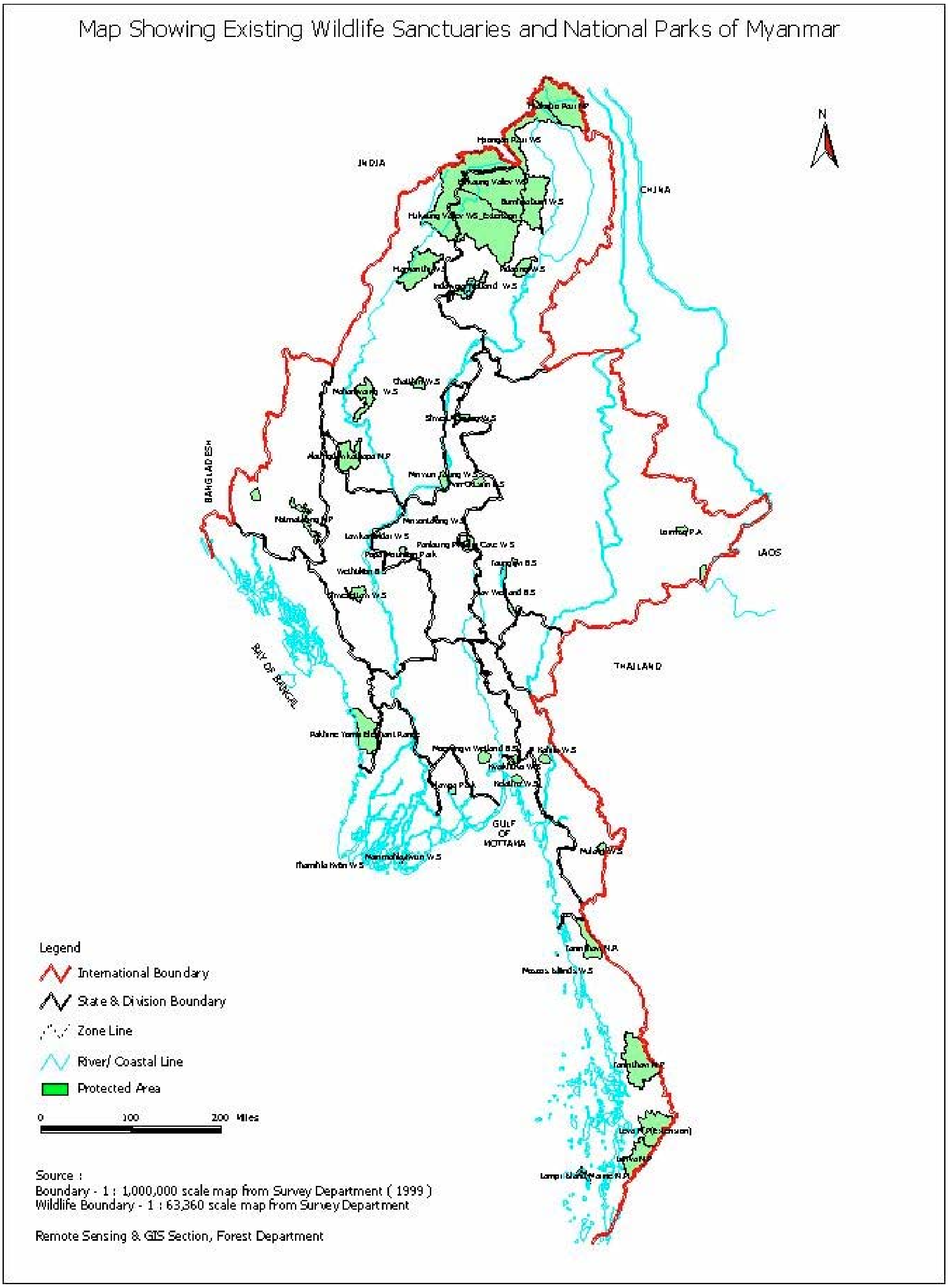
No.	Name	Bio-Unit	Key Species Protected	Management Status	Remark
1.	Pidaung wildlife Sanctuary	9 b. Terrestrial Between N 25º 15' & 25º 35', Between E 97º 14' & 97º 20'	Elephant, Gaur, Banteng, Sambar, Tiger, Leopard, Bear.	Managed under Nature and Wildlife Conservation Division	Protected Areas
2.	Shwe-U-Daung Wildlife Sanctuary Shwe-U-Daung Wildlife Sanctuary	10 b. Terrestrial Between N 23º 5' & 22º 57', Between E 99º 5' & 96º 22'	Rhinoceros, Elephant, Gaur, Banteng, Sambar, Serow, Tiger Bear.	Managed under Nature and Wildlife Conservation Division	- / -
3.	Pyin-O-Lwin Bird Sanctuary	10 b. Terrestrial 22º 00' N & 96º 30'E	Barking deer, Pheasant	Managed under Forest Department	
4.	Moscos Islands Wildlife Sanctuary	4. Island marine	Barking deer, Sambar, Swiftlet	Managed under Forest Department	Protected Areas Notification No. 188/28 (1-9-1928)
5.	Kahilu Wildlife Sanctuary	4. Terrestrial 17º 3' N & 97º 6' E	Rhinoceros, Serow, Mouse deer, Hog deer	Managed under Forest Department	- / -
6.	Taunggyi Bird Sanctuary	10 b. Terrestrial 20º 45' N & 97º 04'E	Avifauna	Managed under Forest Department	- / -
7.	Mulayit Wildlife Sanctuary	10 a. Terrestrial 16º 7' N & 98º 30' E	Barking deer, Tiger, Leopard	Managed under Forest Department	Protected Areas Notification No. 275/39 (1-9-1939)
8.	Wethtikan Bird Sanctuary	9 a. Wetland 20º 00' N & 96º 30'E	Wetland birds	Managed under Forest Department	- / -
9.	Shwesettaw Wildlife Sanctuary	9 a. Terrestrial 20º 12' N & 94º 35'E	Eld's deer, Sambar, Barking deer, Gaur	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 210/40 (1-9-1940)
10.	Chatthin Wildlife Sanctuary	9 a. Terrestrial 23º 36' N & 95º 32' E	Eld's deer, Sambar, Barking deer	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 177/41 (1-9-1941)
11.	Kelatha Wildlife Sanctuary	4. Terrestrial 17º 13' N & 97º 6' E	Serow, Avifauna	Managed under Forest Department	Protected Areas
12.	Thamihla Kyun Wildlife Sanctuary	4. Marine 15º 5' N & 94º 17' E	Marine turtle	Managed under Forest Department	Protected Areas Notification No. 289/70 (1-12-1970)
13.	Htamanthi Wildlife Sanctuary	9 b. Terrestrial 25º 26' N & 95º 37' E	Rhinoceros, elephant, Gaur, Tiger	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 31/74
14.	Minwuntaung Wildlife Sanctuary	9 a. Terrestrial 22º 2' N & 95º 58' E	Barking deer, Avifauna	Managed under Forest Department	Protected Areas
15.	Hlawga Park	4. Terrestrial 17º 01' N & 98º 05' E	Enclosed wildlife park. Sambar, Barking deer, Hog deer, Eld's deer, mythun, migratory birds	Managed under Nature and Wildlife Conservation Division	- / -

16.	Inlay Wetland Bird Sanctuary	10 b. Wetland /Lake Between N 19º 46' & 20º 38', Between E 96º 47' & 97º 6'	Wetland and migratory bird	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 15/85 (30-1-1985)
17.	Moeyongyi Wetland Bird Sanctuary	4. Wetland reservoir 17º 34' N & 96º 35'E	Migratory birds	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 93/88 (22-4-1988)
18.	Alaungdaw Kathapa National Park	9 a. Terrestrial 22º 30' N & 94º 20'E	Elephant, Tiger, Leopard, Gaur, Sambar, Serow, bear	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 31/89 (1-1-1989)
19.	Popa Mountain Park	9 a. Terrestrial 95º 15' E & 20º 53' N	Barking deer, Leopard, Geomorphologic features	Managed under Nature and Wildlife Conservation Division	Protected Areas
20.	Meinmahla Kyun Wildlife Sanctuary	4. Marine 16º 05' N & 95º 18'E	Mangrove crocodiles, birds	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 91/93 (5.1.1993)
21.	Lampi Island Marine N. Park	7 b. Marine Between N 10º 41.5' & 10º 95.3' Between E 98º 4.9' & 98º 18.3'	Coral reefs, Mousedeer and Salon ethnic culture	Managed under Forest Department	Protected Areas Notification No. 40/96 (20.8.1996)
22.	Hkakaborazi National Park	H d. Terrestrial 28º 05' N & 97º 44'E	Takin, Musked deer, Red goral, Black barking deer	Managed under Forest Department	Protected Areas Notification No. 3/96 (30.1.1996)
23.	Loimwe Protected Area	10 b. Terrestrial E 99º 45', N 21º 8'	Tiger, Bear, Pangolin, Pheasant	Managed under Forest Department	Protected Areas Notification No. 2/96 (30.1.1996)
24.	Parsar Protected Area	10 a. Terrestrial E 99º 53', N 20º 29'	Jungle fowl, Chinese pangolin	Managed under Forest Department	Protected Areas Notification No. 4/96 (30.1.1996)
25.	Natmataung National Park	9 c. Terrestrial E 94º 00', N 21º 12'	Gaur, Serow, Goral and Avifauna	Managed under Nature and Wildlife Conservation Division	Proposed Protected Areas Notification No. 6/97 (23.7.1997)
26.	Lawkananda Wildlife Sanctuary	9 a. Terrestrial E 94º 47', N 21º 15'	Avifauna, Cultural diversity	Managed under Nature and Wildlife Conservation Division	Protected Areas
27.	Indawgyi Wetland Wildlife Sanctuary	9 a. Wetland/ Lake Between N 24º 56' & 25º 24', Between E 96º 0' & 96º 39'	Elephant, Tiger, Sambar deer, Leopard, Bear, Serow, Gaur	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 39/2004 (9.8.2004)
28.	Kyaikhtiyoe Wildlife Sanctuary	4. Terrestrial Between N 17º 24' & 17º 34', Between E 97º 01' & 97º 10'	Tiger, Goral, Gaur, Sambar, Monkey	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 37/2001 (6.7.2001)
29.	Minsontaung Wildlife Sanctuary	9 a. Terrestrial E 95º 43', N 21º 28'	Barking deer, Rabbit, Dhole, Reptiles, Land tortoise, Wild cat, Snakes	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 14/2001(22.3.2001)

30.	Hukaung Valley Wildlife Sanctuary	9 b. Terrestrial E 97º 41', N 26º 17'	Elephant, Leopard, Tiger, Gaur, Sambar, Bear, Wildboar, Serow	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 34/2004 (3.6.2004)
31.	Kyauk Pan Taung Wildlife Sanctuary	9 c. Terrestrial Between N 21º 19' & 21º 24', Between E 92º 59' & 93º 4'	Seraw, Goral, Sambar, Leopard, Clouded leopard, Wild cats, Barking deer, Wildboar	Managed under Nature and Wildlife Conservation Division	Proposed Protected Areas Notification No. 17/2001(18.4.2001)
32.	Hponkanrazi Wildlife Sanctuary	9 b. Terrestrial E 97º 43', N 27º 30'	Barking deer, Avifauna, Red Goral, Gibbon, Wild dogs, Mangooses	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 47/2001(21.8.2001)
33.	Rakhine Yoma Elephant Range	4. Terrestrial E 94º 30', N 17º 31'	Elephant, Gaur, Leopard, Jackal, Bear	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 21/2002 (5.2.2002)
34.	Panlaung-pyadalin Cave Wildlife Sanctuary	10 b. Terrestrial E 96º 28', N 21º 10'	Elephant, Tiger, Leopard, Gaur, Banteng, Golden cat, Clouded leopard, Serow, Gibbon	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 20/2002(18.5.2002)
35.	Maharmyaing Wildlife Sanctuary	9 a. Terrestrial Between N 22º 50' & 23º 45', Between E 94º 15' & 95º 00'	Sambar, Wildboar, Banteng, Feline, Gibbon, Wild dogs, Mangooses	Managed under Nature and Wildlife Conservation Division	Proposed Protected Areas Notification No. 18/2002(15.3.2002)
36.	Lenya National Park	7 b. Terrestrial Between N 10º 48' & 99º 20', Between E 98º 49' & 99º 20'	Tapir, Elephant, Monkeys, Barking deer, Sambar, Wildboar, Bear, Mouse deer, Wild cats, Pangolin, Lizards, Birds, Tiger	Managed under Nature and Wildlife Conservation Division	Proposed Protected Areas Notification No. 21/2002 (18.3.2002)
37.	Taninthary National Park	5 a. Terrestrial E 97º 00', N 12º 02'	Sambar, Barking deer, Serow, Goral, Leopard, Wild elephant, Birds, Tiger	Managed under Nature and Wildlife Conservation Division	Proposed Protected Areas Notification No.19/2002 (18.3.2002)
38.	Bumhpabum Wildlife Sanctuary	9 b. Terrestrial E 97º 31', N 26º 29'	Elephant, Gaur, Serow, Deer Spp:, Clouded leopard, Golden cat, Jackal, Goral, Mancaques, Civets, Bear, Leopard, Pheasant, Hornbills	Managed under Nature and Wildlife Conservation Division	Protected Areas Notification No. 40/2004 (9.8.2004)
39.	Hukaung Valley Wildlife Sanctuary (extension)		Elephant, Leopard, Tiger, Gaur, Sambar, Bear, Wild Boar, Serow	Managed under Nature and Wildlife Conservation Division	Proposed Protected Areas Notification No. 7/2004 (1.3.2004)
40.	Taninthayi Nature Reserve		Gurney's Pitta, Tiger, Elephant, Tapir	Managed under Nature and Wildlife Conservation Division	Proposed Protected Areas Notification No. 31/2004 (10.5.2004)

Source: Nature and Wildlife Conservation Division, Forest Department 2005

Figure 2: Wildlife Sanctuaries and National Parks – 2004



SUMMARY

A.Policy Reference

1.Purpose:

This indicator represents the extent to which areas important for conserving biodiversity, cultural heritage, scientific research (including baseline monitoring), recreation, natural resource maintenance, and other values, are protected from incompatible uses.

2.Relevance to Environment Planning and Management:

Protected areas are an essential tool for ecosystem conservation, with functions going well beyond the conservation of biological diversity. As such, they are one of the building blocks of sustainable development.

3.Linkage to Other Indicators:

This indicator is linked to other indicators, which have implications for land and resource use. These would include: land use change, wood harvesting intensity, forest area, ratification of global agreements, etc.

4.Targets:

The present Myanmar forest policy clearly declares 10 % should be under the Protected Area System for nature conservation. The UN suggests that under The 1991 Caring for the Earth: A Strategy for Sustainable Living establishes a target of 10% protected area for each major ecological region for countries by 2000. A similar target was agreed to by the 5th World Congress on National Parks and Protected Areas in 1992. Both targets reflect recognition that representation of ecosystem diversity is more meaningful than a flat percentage of the country's area.

5.International Environment Treaties:

The following international treaties and agreements relate to the concern of PAS cover;

- nternational Tropical Timber Agreement for promotion of "Sustainable Forest Management"
- Convention on Biological Diversity (CBD) for forest flora and fauna conservation
- Convention on International Trade in Endanger Species (CITES) for efficient forest protection effective to conserving endanger species
- Convention on the Conservation of Wetlands of International Importance (Ramsar Convention) for contextual protection of forest ecosystem
- Convention on Climate Change for forest environmental conservation
- Convention to Combat Desertification for natural resource conservation

B.Analysis

As illustrated in Figure 1 and Table 1, the system of protected areas when it was formally established by Wildlife Protection Law in 1994 did not include much more than 1% of the total land area. As of 1993, the system included 20 individual protected areas but, with the exception of Pidaung Wildlife Sanctuary and Alaungdaw Kathapa National Park, their overall area was not significant. 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 the total land area.

In 2004 notification was given to add another three protected areas, including the. Tanintharyi 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 39 protected areas equivalent to 7.2% of total land area, or approximately 4.9 million hectares (PAS Extension Area is not counted as a separate protected area).

There are currently no targets directly associated with protected areas. However, the National Forest Policy which was proclaimed in 1995 has set an indirect target to have a forest area equivalent to 5% of the total land area under the system of protected areas (MOF, 1995)[1]. The Forestry Master Plan (2001/2002 – 2030/31) has also adjusted this target for 10 % in the long-term (MOF, 2001), while considering 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). Therefore, the present coverage of protected area has already met the short-term target. However, it is notable that currently the establishment of protected area is concentrated on conserving forest-based habitats (96%) and there are only a few areas for protecting wetland (0.8%) and marine habitats (3.2%) (See Table 2). In the meantime, it is found that protected area as a percentage of total land has been higher in other GMS countries; e.g. 32% in Cambodia (2002)[2], 27.5% in Thailand (2004)[3] and 14% in Lao PDR (1999). Therefore, the response in biodiversity conservation is consistent in term of expanding PAS areas yearly, but the magnitude of this indicator is low comparing to other GMS countries.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Vulnerable Farm Area as a Percentage of Total Cultivated Area - 1998
Year of Assessment	2005
Type of Indicator	State
Frequently Asked Question (FAQ)	To what extent is agriculture land vulnerable to soil erosion?
Priority Concern	Land Degradation
Geographic Area	Union of Myanmar
State & Trend	Average with Undetermined Trend
Key Message	From RS/GIS data for 1998, it was found that 10% of total cultivated land throughout the country is vulnerable to serious soil erosion. Regions such as Shan, Sagaing and Chin have the largest extent of vulnerable farming area at 1.6, 1.1 and 0.8 million acres respectively. However, agriculture land use in Chin, Kayah and Kayin States is more vulnerable as the percentage of vulnerable farmland over total cultivated area is highest among others accounting for 76%, 31% and 24% respectively. Since data are only available for one year, the trend of the indicator is undetermined. However, the percentage of vulnerable farming area is neither high nor low and that level of land degradation is considered to be on average.

TECHNICAL INFORMATION

A.Definition

This indicator tracks the total extent of vulnerable farming area of sub-administrative areas of the country, which are known as “State and Division”. (Division is the area where the majority of people living are dominantly Bamar whereas the area with the various ethnic groups is referred to as State). It is expressed in acres. Vulnerable farming area is meant for the cultivated land where susceptibility to soil erosion is higher in decreasing soil productivity. If the farmland being located at or higher than 1000 feet above sea level with an underlying slope of 10 degree and above, susceptibility to soil erosion is high and defined as vulnerable farming area. (According to slope classification, the area with an underlying slope of 10 degree and above is already steeper in inducing severe soil erosion if the land is open for agriculture and farming – also available data is limited itself only for two slope classes, 5 degrees and 10 degrees and above.)

B.Data Source

The data utilized for the development of this indicator originate from the Remote Sensing and Geographical Information System (RS/GIS) Section of Forest Department.

C.Geographic Area / Population Coverage

The data and the indicator are representative of vulnerable farm area for the Union of Myanmar as a whole.

D.Temporal Coverage

Data on vulnerable farm area are only available for 1998.

E.Methodology and Frequency of Coverage

Originally, land use and land cover of the whole country was based on the data of remote sensing and geographical information system (RS/GIS) that was derived from 30 meters resolution image of Landsat TM for the year 1998.

Digital Elevation Model (DEM) that was used for defining sloping classes and upland area was based on the existing model developed by NASA in 90 meters resolution.

F.Methodology of Data Manipulation

By overlaying RS/GIS data, land cover classifications for forest cover and cultivated area were developed for two sloping classes (5 degrees and 10 degrees and above) versus two altitudinal levels (below and above 1000 feet). From this development, it excerpted the upland cultivated area which is located at equal to or higher than 1000 feet above sea level and with a slope of 10 degrees or above.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The indicator is useful in estimating the farmland of various sub-administrative areas vulnerable to soil erosion; it also provides a picture of the degree of land degradation in these sub-administrative areas in terms of the percent coverage of vulnerable farmland against total cultivated land. The main weakness of the data and the indicator is that it does not provide a trend over time.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

It is possible that the use of coarse scale DEM is unable to detect some agriculture land underlying above 10° slope if landscape is changed with higher variation within a 90 m interval. There is the possibility of other types of land use having been included in delineated cultivated land as the use of RS/GIS data was specifically for classifying forest cover and detecting other land use and land cover was broadly done.

C.Future Work Required (for data level and indicator level)

Better Remote Sensing Data and Digital Elevation Model should be further applied for improving data accuracy. Agriculture land use and land cover should be also well defined with intensive ground truth data. All information should be made available for time series coverage for better analysis on the trend of vulnerable farming. In addition, other indicators like "Top soil loss" and Level of Soil Erosion Susceptibility" should be developed for better describing the State of Land Degradation.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1:Vulnerable Farming Area as a Percentage of Total Cultivated Area - 1998

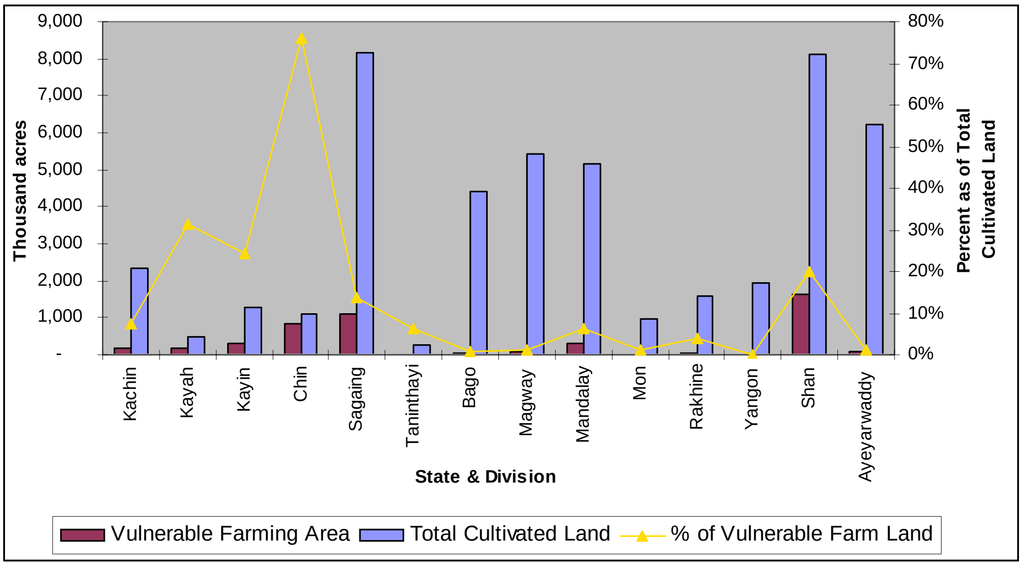


Table 1: Vulnerable Farming Area as a Percentage of Total Cultivated Area - 1998

No.	State & Division	Area (acres) Cultivated land underlying with slope 10 degree & above	Total Cultivated Land	Vulnerable Farm as % of total cultivated area
1	Kachin	178,691	2,347,450	7.6%
2	Kayah	155,063	494,200	31.4%
3	Kayin	311,080	1,284,920	24.2%
4	Chin	824,932	1,087,240	75.9%
5	Sagaing	1,124,869	8,179,010	13.8%
6	Taninthayi	17,610	276,752	6.4%
7	Bago	31,904	4,423,090	0.7%
8	Magway	72,461	5,436,200	1.3%
9	Mandalay	317,084	5,179,216	6.1%
10	Mon	10,824	973,574	1.1%
11	Rakhine	65,992	1,606,150	4.1%
12	Yangon	0.00	1,927,380	0.0%
13	Shan	1,617,559	8,132,061	19.9%
14	Ayeyarwaddy	68,122	6,204,681	1.1%
	Union Total	4,796,192	47,551,924	10.1%

Source: Remote Sensing and Geographical Information System Section, FD (2005)

Table 1b: Total Land Extent in Acres of Administrative Townships (T/S) with Upland Area of 1000 Feet Above Sea Level

State or Division	Area of T/S with 75 % & above upland coverage	Area of T/S with 50 - 74 % upland coverage	Area of T/S with 25 - 49 % upland coverage	Area of T/S with less than 25 % upland coverage	Grand Total (acres)
Ayeyarwady Division			264,402	2,371,708	2,636,110
Bago Division			1,685,005	5,680,930	7,365,935
Chin State	5,483,988	3,616,867			9,100,855
Kachin State	10,314,138	9,207,604	3,157,747	516,695	23,196,184
Kayah State	2,411,986	486,796			2,898,782
Kayin State	924,425	2,454,674	2,987,803	1,146,968	7,513,870
Magway Division	790,734	1,649,916	2,778,195	5,475,339	10,694,184
Mandalay Division	776,649	1,556,016	3,545,948	3,169,855	9,048,469
Mon State				2,764,032	2,764,032
Rakhine State		878,950	3,776,497	3,561,516	8,216,963
Sagaing Division	3,820,481	4,978,412	6,990,089	5,442,227	21,231,210
Shan State	29,185,995	716,603		1,303,723	31,206,320
Tanintharyi Division		1,643,746	2,735,684	7,096,513	11,475,943
Yangon Division				375,104	375,104
Grand Total (acres)	53,708,396	27,189,585	27,921,369	38,904,612	147,723,961

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

Table 1c: Number of Administrative Townships (T/S) with Upland Area of 1000 Feet Above Sea Level

State or Division	Area of T/S with 75 % & above Upland Coverage	Area of T/S with 50 - 74 % Upland Coverage	Area of T/S with 25 - 49 % Upland Coverage	Area of T/S with less than 25 % Upland Coverage	Grand Total & Percent of Upland T/S over Total Townships
Ayeyarwady Division			1	5	6 (23%)
Bago Division			3	14	17 (61%)
Chin State	7	2			9 (100%)
Kachin State	8	6	3	1	18 (100%)
Kayah State	6	1			7 (100%)
Kayin State	1	2	2	2	7 (100%)
Magway Division	2	3	5	14	24 (96%)
Mandalay Division	2	3	7	11	23 (35%)
Mon State				8	8 (8%)
Rakhine State		1	3	8	12 (57%)
Sagaing Division	4	5	9	8	26 (70%)
Shan State	43	1		1	45 (82%)
Tanintharyi Division		1	1	8	10 (100%)
Yangon Division				1	1 (25%)
Grand Total	73	25	34	81	213 (66%)

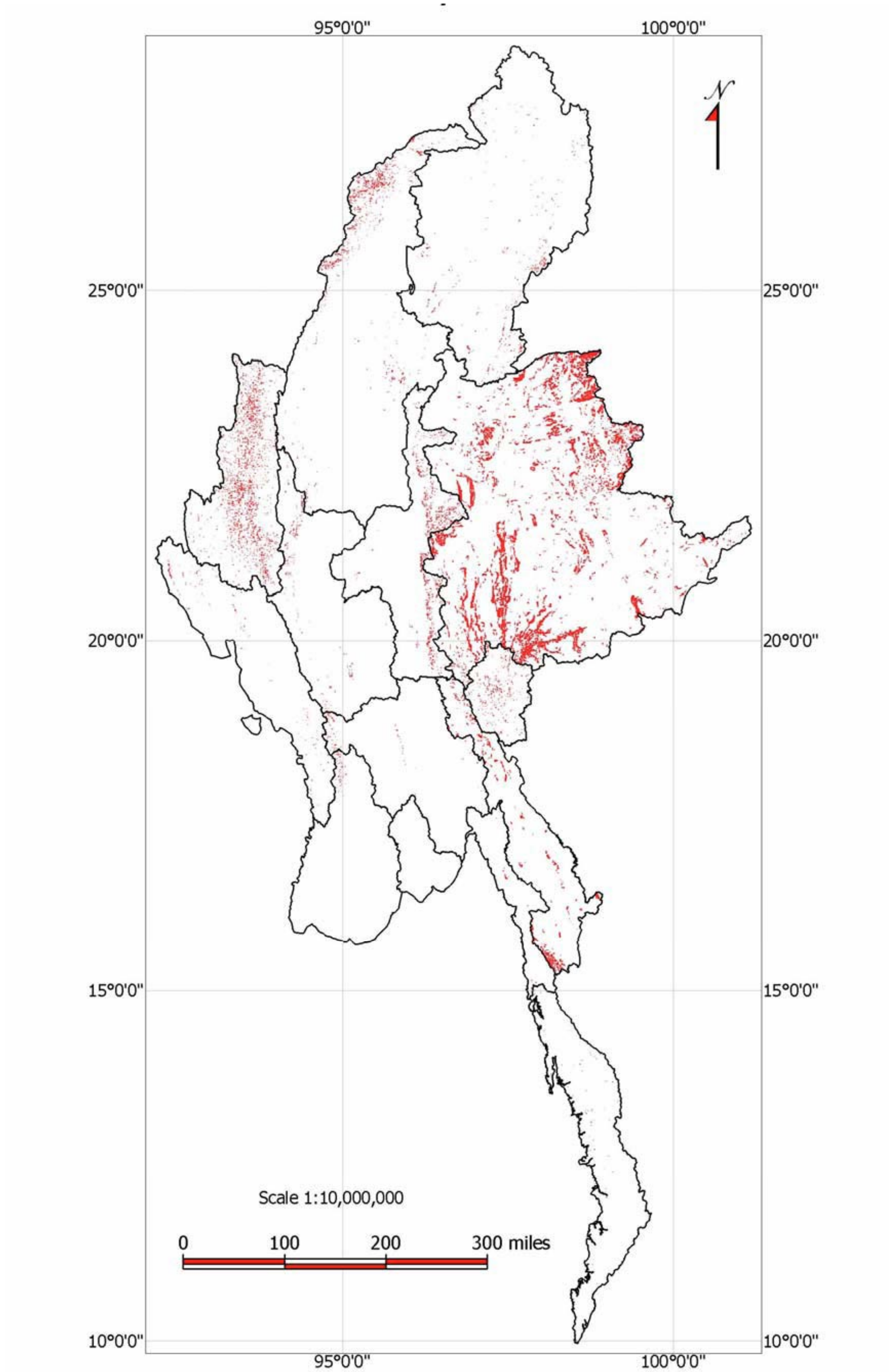
Source: Remote Sensing and Geographical Information System Section, Forest Department (2005)

Table 2: Changes in Area Susceptible to Soil Erosion in Chindwin Watershed – 1990 to 2000

Erosion Class (Tolerable)	Erosion Rate (Ton/Acre/year)	Area Susceptible to Soil Erosion (km2)	
		1990	2000
Very low	<3	67,282	43,640
Low	3-5<	11,276	7,917
Moderate	5-10<	9,684	5,923
High	10-15<	5,111	4,247
Severe	>15	4,799	36,429

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

Figure 2: Distribution of Shifting Cultivation Above 10% Slope in Myanmar



SUMMARY

A.Policy Reference

1.Purpose:

The purpose of this indicator is to better understand the level of vulnerability that agriculture land use is currently facing in terms of the percentage of total cultivated areas susceptible to severe soil erosion.

2.Relevance to Environment Planning and Management:

The scenario of potential land degradation by this indicative value could form the basis in developing a national action plan for conservation priority and investment for combating land degradation.

3.Linkage to Other Indicators:

This indicator is linked to the indicators such as forest cover, land use and land cover change, annual soil loss and percentage of land rehabilitation.

4.Targets:

None currently applicable to this indicator.

5.International Environment Treaties:

The UN Convention on Combating Desertification is directly relevant in the context of conserving degraded land. Currently, three regions (State and Division), namely Dry Zone, Ayeyarwaddy Delta and Northern Shan State, are selected as priority area for reducing the land degradation.

B.Analysis

Either partially or wholly, 213 townships accounting for 66% of total administrative townships in Myanmar are sharing the upland area within its administrative boundary. Except in Yangon, Mandalay, Ayeyarwaddy and Mon, more than half of the total administrative townships appear as upland townships in all States and Divisions (Table 1c). Among these upland townships, approximately more than 50% of total territory has belonged to denser upland areas (Table 1b). As there is a higher proportion of denser upland areas, the degree of risk associated with soil erosion is relatively high for the country if land use in upland areas of these townships is not properly developed and managed.

According to RS/GIS data for 1998, total vulnerable farming area, the cultivated area underlying with a slope of 10 degrees and above in those upland townships, was found to be 4.8 million acres (Table 1a). A larger extent of vulnerable farming area existed in Shan State (1.6 million acres), Sagaing Division (1.1 million acres) and Chin State (0.8 million acres). They were followed by Mandalay Division, Kayin State, Kachin State and Kayah State with moderately extensive area of vulnerable farming at 0.32, 0.31, 0.18 and 0.16 million acres respectively. In comparing vulnerable farming area with total cultivated area in those States and Division, a higher percentage of vulnerable farming area were found in Chin State (76%), Kayah State (31%), Kayin State (24%) and Shan State (20%). As total cultivated area is proportionately large in Sagaing Division and Mandalay Division, the percentage of total cultivated land under vulnerable farming had decreased to 14% and 6% respectively in those regions; thought the total extent of vulnerable farming area was large. As a whole, the data show that 10% of total cultivated land throughout the country is vulnerable to a higher risk of soil erosion.

At present, attention has been paid to Shan and Chin States for implementing soil conservation but this indicator has elaborated the need for conservation priority as well in Kayah, Kayin, Kachin and Sagain because of the relatively higher percentage of vulnerable farming area and its total extent. From the study conducted for "Soil Loss in Chindwin Watershed" where territory is shared with the administrative areas of Kachin, Sagain and Chin, it was found that the total area tolerable to severe soil erosion has increased seven fold from 4,799 km2 in 1990 to 36,429 km2 in 2002 because of rapid deterioration in natural vegetation coverage. (Table 2). As all of these administrative areas within Chindwin Watershed have been associated with a higher extent and percentage of vulnerable farming area as stated earlier, a causal link between vulnerable farming coverage and soil erosion has been very marked, indicating serious land degradation. Due to the deficiency in time series data, the trend of the indicator is not observable (undetermined), but percentage of vulnerable farming area (10% of total cultivated land) is considered to be neither small nor high. Even this percentage is likely to be increased if better RS/GIS data is employed in detecting it. Therefore, state of land degradation in Myanmar is to be rated as "average".

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Growth in Upland Population - 1980 to 2000
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	How has growth in upland population affected land degradation?
Priority Concern	Land Degradation
Geographic Area	Union of Myanmar
Magnitude & Trend	Medium and Steady
Key Message	From 1980 to 2000, the upland population grew by 6.8 million people. As of 2000, the upland population reached 21 million people accounting for 42% of the total national population. There was only a slight increase in population growth rate between 1980 to 1990 and 1990 to 2000. Hence the stress on land degradation by the upland population has risen because of existing population size and its growth, but the degree of pressure is still medium and steady since no significant rise of population was observed.

TECHNICAL INFORMATION

A.Definition

This indicator attempts to track the rate of change in the population of townships within states that are either partially or fully occupied by upland areas.

Upland area is further defined as the area where topographically altitudes are equal or higher than 1000 feet above sea level. It is also assumed that the majority of the populations residing in the upland areas are engaged in livelihoods that rely upon agriculture, fuel wood or such land related activities.

B.Data Source

This indicator was developed based on population data from the Department of Population and geomorphologic data from the Remote Sensing and Geographical Information System Section of the Forest Department.

C.Geographic Area / Population Coverage

This indicator is based on an approximation of the upland population is Myanmar using the township fabric to approximate populations that are considered as upland. The result therefore is an approximation of the upland population for the Union of Myanmar as a whole.

D.Temporal Coverage

The data and the indicator as based on 10-year population estimates starting in 1980 and ending in year 2000.

E.Methodology and Frequency of Coverage

The 10-year population estimates provided by the Department of Population are based on the 1983 population census. The Digital Elevation Model (DEM) utilized to identify upland townships is a one-time elevation model developed by the US National Atmosphere and Satellite Agency (NASA).

F.Methodology of Data Manipulation

An administrative boundary map was overlaid on a three-dimensional geomorphologic map of the country by using Remote Sensing and Geographical Information System tools in order to define the upland area. Upland area as a percentage of total township area was then calculated for all upland townships. This upland percentage of each township was further used as a multiplier in estimating upland population based on the total population within the administrative boundary of each township. The net change in upland population was also calculated for two studied periods, the years 1980 to 1990 and the years 1990 to 2000. For each period, the percentage change in population was calculated based on the population in the initial year of the studied period.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

The indicator gives the general trend of population growth in upland townships which have influence on the condition of the land resource by their expansion and exploitation for livelihood subsistence. However, the estimation of the upland population is derived from the percentage of upland area within the administrative boundary of the respective townships and there might be variations in the actual population. On the other hand, not necessarily all the people living in an upland area may cause degradation of nearby land resources.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

The population estimates are based on a population census conducted 20 years ago; demographic trends may therefore be assumed.

C.Future Work Required (for data level and indicator level)

An effort should be made to provide population figures closer to the real situation. If possible, population data should be provided for the village tract level in order to stress the upland population data coinciding with RS/GIS's map development, in scaling down the administrative area up to village tract level based on all available spatial data.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Growth in Upland Population – 1980-2000

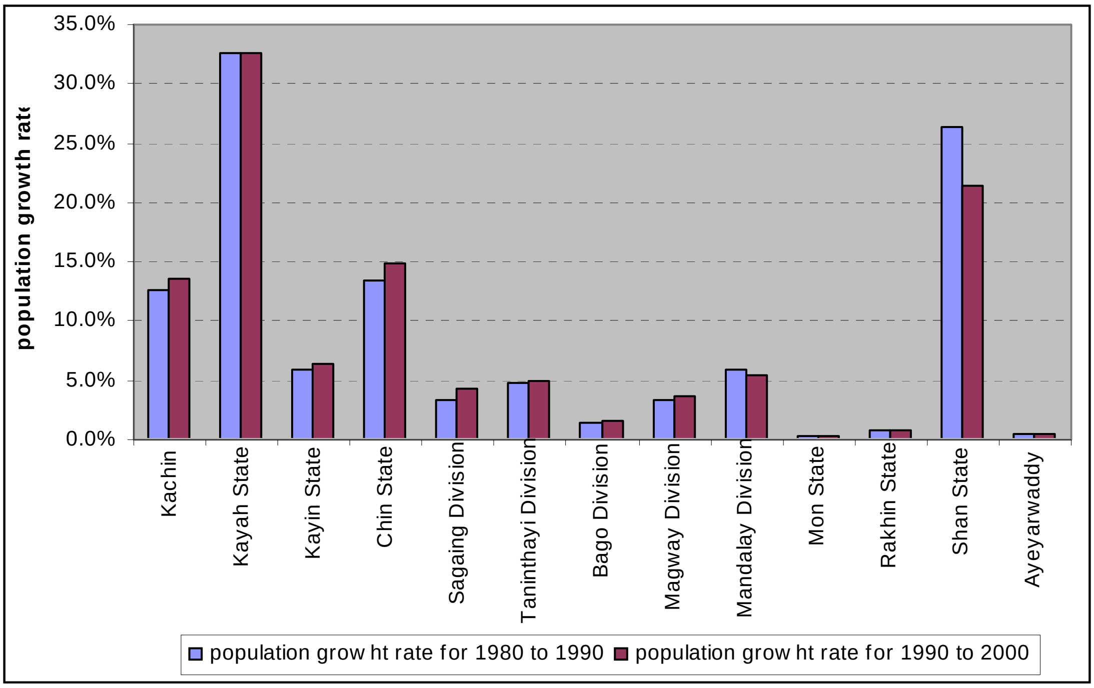


Table 1: Upland Population Growth Rate Versus Vulnerable Farming Area

No.	State & Division	Population Growth Rate		Vulnerable farm area as % of total cultivated land
		1980-1990	1990-2000	
1	Kachin State	12.60%	13.56%	7.61%
2	Kayah State	32.67%	32.56%	31.38%
3	Kayin State	5.96%	6.35%	24.21%
4	Chin State	13.49%	14.92%	75.87%
5	Sagaing Division	3.39%	4.37%	13.75%
6	Taninthayi Division	4.73%	4.96%	6.36%
7	Bago Division	1.50%	1.56%	0.72%
8	Magway Division	3.41%	3.64%	1.33%
9	Mandalay Division	5.89%	5.46%	6.12%
10	Mon State	0.37%	0.38%	1.11%
11	Rakhin State	0.76%	0.83%	4.11%
12	Yangon Division	-	-	-
13	Shan State	26.30%	21.41%	19.89%
14	Ayeyarwaddy	0.44%	0.48%	1.10%

Source: Adapted from Department of Population's data by RS/GIS Section, Forest Department 2004

Table 2: Upland Population and Growth Rate 1980-2000

State & Division	Population 1980	Population 1990	Population 2000	Population Change 1980-1990	Population Change 1990-2000	Change Rate 1980-1990	Change Rate 1990-2000
Kachin	861,013	1,054,686	1,310,248	108,449	143,002	12.60%	13.56%
Kayah State	153,997	206,499	276,686	50,314	67,242	32.67%	32.56%
Kayin State	1,004,020	1,224,254	1,511,865	59,869	77,724	5.96%	6.35%
Chin State	358,057	411,775	479,988	48,287	61,437	13.49%	14.92%
Sagaing Division	3,658,005	4,350,468	5,418,064	123,898	190,246	3.39%	4.37%
Taninthayi Division	863,006	1,088,562	1,388,086	40,838	53,942	4.73%	4.96%
Bago Division	3,636,015	4,309,742	5,146,514	54,433	67,376	1.50%	1.56%
Magway Division	3,080,004	3,770,933	4,674,609	104,910	137,374	3.41%	3.64%
Mandalay Division	8,197	10,467	12,906	483	571	5.89%	5.46%
Mon State	7,347	9,289	11,853	27	36	0.37%	0.38%
Rakhin State	4,794	5,696	6,879	36	47	0.76%	0.83%
Yangon Division	785,134	971,148	942,727	-	-	0.00%	0.00%
Shan State	2,305	2,747	3,326	606	588	26.30%	21.41%
Ayeyarwaddy	7,984	9,539	11,577	35	46	0.44%	0.48%
Union	14,429,878	17,425,805	21,195,328	592,185	799,631	4.10%	4.59%

Source: Modified from Department of Population's data by RS/GIS Section, Forest Department (2004)

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of the indicator is to better understand the current pressure of population in upland areas which has a strong influence on the expansion of agriculture land. Unsustainable methods of land use such as slash and burn farming are used in upland areas where the degree of land degradation may be higher in comparison to lowland areas.

2.Relevance to Environment Planning and Management:

The indicator is directly relevant to local agriculture planning as well as to integrated watershed management in securing sustainable local food security.

3.Linkage to Other

The indicator links to indicators like “Vulnerable farming area” and “Forest cover” as a pressure on forest resource of upland area, “Per capita land available per person” and “Area of shifting cultivation”.

B.Analysis

As of 2000, the upland population nationwide was 21 million accounting for almost 42% of the total population. There was increase of 3.7 and 6.7 million people in comparison to 1990 and 1980, respectively. It represented change rates of 4.1% for the former period of 1980 to 1990 and of 4.6% for the latter period of 1990 to 2000. There is only a slight increase of population change rate during these two periods. (see Table 2).

In calculation of the population change rate for sub-administrative areas, it was found that the areas where vulnerable farming areas are proportionately higher, had a higher population growth rate. For example, there were population change rates of around 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 Sate. As the national average is 2% per annum for the whole population, the population change rates these upland areas is considered to be relatively high. Except in Shan State, the general trend of these population change rates had been slightly increasing between the two periods of from 1980 to 1990 and from 1990 to 2000.

Population increases in those upland areas might be leading to over exploitation of natural resource. Unsustainable methods of agriculture practiced in steeper upland areas by local people for their subsistent livelihood may cause land degradation. Nevertheless, the population change rate in upland area was on average as a whole, though there were some cases of higher increase in some regions; the level of stress is generally considered as “Medium” and “Steady”.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Land Rehabilitated as a Percent age of Area Sown to Crops - 1974 to 2002
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	What has been the impact of land rehabilitation programs?
Priority Concern	Land Degradation
Geographic Area	Union of Myanmar
Impact & Trend	Low and Intermittent
Key Message	Approximately 3 million acres of agriculture land were covered by annual conservation activity of Ministry of Agriculture and Irrigation. Despite the fact that the area of rehabilitated agriculture land increased from 1974 to 2002, the trend is descending when compared to total crop sown area, of which annual growth has outpaced that of land rehabilitation. As only 10% of total crop sown area is annually rehabilitated on average, the response in combating land degradation is low but the magnitude of the effort is considered "intermittent" due to increasing conservation programs and initiatives underway for implementation in recent years by various agencies.

TECHNICAL INFORMATION

A.Definition

This indicator tracks the success achieved in implementing land rehabilitation programs by measuring the percentage of agriculture land brought under the various conservation measures as a percentage of total crop sown area throughout the country. Crop sown area is defined as the total cumulative area brought under cultivation from all the crops that are cultivated on a particular farm. Conservation measures include the following activities.

Contour bund is a cross sectional physical barrier along the contour line of the sloping agriculture land in order to slow down the water run off from the above during the rain. Either earthen soil or rock or other concrete materials might be used for constructing contour bunds.

Terrace is leveling of sloping area of cultivated land for farming with lesser degree of soil erosion.

Wind break is planting tree or shrub or perennial vegetation closer to farming area. Planting tree around the boundary of cultivated land is also included.

SALT is meant for sloping agriculture land technology and it is growing the mixture of perennial vegetation and annual crop along the contour of steeper sloping agriculture land.

E.M/Organic Farming is growing annual crops or vegetables by utilizing compost or green manure or Effective Micro-organisms, which are media added to organic fertilizer to produce healthy plant growth without affecting the physical and chemical properties of the soil in the long-term.

Flood protection is constructing dyke or making embankment in order to prevent the farming areas from seasonal flooding, water inundating and saline water intrusion by the regular tides.

B.Data Source

Data from the Department of Agriculture Planning are a major source for developing this indicator.

C.Geographic Area / Population Coverage

Data cover for the conservation areas undertaken by the Ministry of Agriculture and Irrigation throughout the whole country.

D.Temporal Coverage

The temporal coverage of this indicator is from 1975 to 2002.

E.Methodology and Frequency of Coverage

Annually implemented areas under the various conservation activities of Ministry of Agriculture and Irrigation were counted as total rehabilitated areas of agriculture land for respective years. Data were only given for representative years of 1974 and 1984 in the earlier temporal coverage before it was consecutively compiled for 14 years from 1989 to 2002.

F.Methodology of Data Manipulation

Total rehabilitated area is a sum of all areas under different conservation activities. Percentage of rehabilitated area is calculated based on total crop sown acres throughout the country.

QUALITATIVE INFORMATION

A.Strength and Weakness (data level)

This indicator provides time series data of implementation status and coverage in combating land degradation by different soil conservation activity, particularly rehabilitating the agriculture area for better land quality. However, this is only for rehabilitation activities of the agencies related to agriculture development and conservation areas under other agencies and non-governmental organization are not included. Again, this only indicates the implemented area under land rehabilitation or soil conservation and is not necessarily meant to indicate the quality of rehabilitation and success in restoring the ecology or land quality.

B.Reliability, Accuracy, Robustness, Uncertainty (data level)

As data were based on the accomplishment of physical implementation, the reliability of the indicator is seemingly high.

C.Future Work Required (for data level and indicator level)

Data related to conservation by other agencies should be collected and integrated into this indicator. If possible, successfully rehabilitated areas should be enumerated as well and compared with annual vulnerable farming areas in order to determine the recovery of total degraded land.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Rehabilitated Area As a Percentage of Total Area Sown to Crops

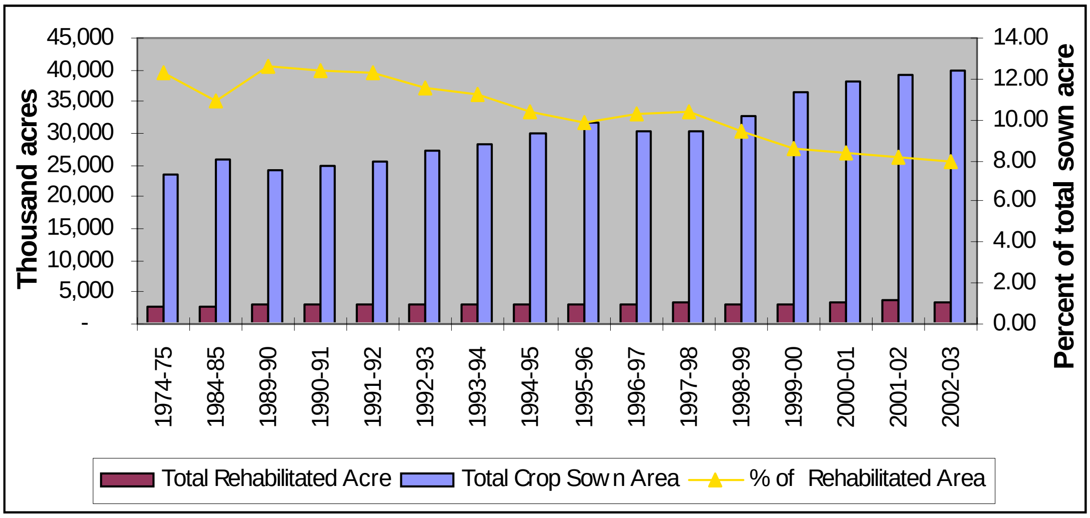


Table 1: Rehabilitated Area As a Percentage of Total Area Sown to Crops

Years	Total Agriculture Land Rehabilitated (Thousand Acres)	Total Crop Sown Area (Thousand Acres)	Rehabilitated Agriculture Land as % of Total Crop Sown Area
1974-75	2,893	23,474	12.32
1984-85	2,852	25,984	10.98
1989-90	3,085	24,344	12.67
1990-91	3,113	25,024	12.44
1991-92	3,132	25,426	12.32
1992-93	3,132	27,200	11.51
1993-94	3,150	28,134	11.20
1994-95	3,130	30,005	10.43
1995-96	3,126	31,837	9.82
1996-97	3,123	30,422	10.26
1997-98	3,260	30,336	10.34
1998-99	3,173	32,882	9.49
1999-00	3,185	36,582	8.55
2000-01	3,331	38,178	8.34
2001-02	3,797	39,153	8.12
2002-03	3,405	39,896	7.99

Source: Department of Agriculture Planning , 2005

Table 2: Total Area Under Various Conservation Activities (Thousand acres)

Years	Contour Bund	Terrace	Wind Break	SALT	E.M/ Organic Farming	Flood Protection	Total Conservation Area
1974-75	0.00	16.00	0.00	0.00	0.00	2,877	2,893
1984-85	0.00	33.00	0.00	0.00	0.00	2,819	2,852
1989-90	0.00	67.00	0.00	0.00	0.00	3,018	3,085
1990-91	0.00	70.00	0.00	0.00	0.00	3,043	3,113
1991-92	0.00	60.00	0.00	0.00	0.00	3,072	3,132
1992-93	0.00	64.00	0.00	0.00	0.00	3,068	3,132
1993-94	0.00	65.00	1.00	0.01	0.00	3,084	3,150
1994-95	0.06	65.00	1.11	0.02	0.00	3,064	3,130
1995-96	0.04	66.04	1.51	0.04	0.00	3,058	3,126
1996-97	0.07	66.04	0.45	0.06	0.00	3,056	3,123
1997-98	15.06	68.05	1.83	0.08	123.41	3,052	3,260
1998-99	0.07	71.10	1.60	0.09	53.46	3,047	3,173
1999-00	3.05	75.13	1.78	0.10	56.44	3,049	3,185
2000-01	23.04	77.02	1.65	0.09	145.60	3,084	3,331
2001-02	7.05	81.08	1.15	0.12	619.05	3,089	3,797
2002-03	10.02	85.07	0.70	0.13	217.03	3,092	3,405

Note: SALT is for Sloping Agriculture Land Technology and E.M is for Effective Micro-organism

Source: Department of Agriculture Planning 2005

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of the indicator is to examine the present level of performance in combating land degradation and to focus on its limitation in addressing the issue.

2.Relevance to Environment Planning and Management:

The indicator is relevant to land use planning and effective land resource management including the integrated management of critical watershed.

3.Linkage to Other Indicators:

The indicator may link to other indicators such as Vulnerable farming area, Upland Population, Habitat loss and Expenditure on Natural Resource Management.

4.Targets:

Three priority areas, namely, Shan Plateau, Dry Zone and Ayeyarwaddy Mangrove area, are currently selected for conservation investment in combating land degradation (UNCCD related national action plan). According to the Highland Farmland Reclamation Plan (2003 – 2007) under the Ministry of Agriculture and Irrigation, the target is set to reclaim 111,900 acres of permanent sloping agriculture land for rehabilitating 223,816 acres of slash and burn area within the period from 2003 to 2007 in Eastern and Northern Shan State and Chin State ("Magnificent Myanmar 1988-2003", Ministry of Information, Yangon, 2004, pp:68).

5.International Environment Treaties:

The United Nations Convention on Combating Desertification (UNCCD) is relevant to this indicator.

B.Analysis

In addressing the issues of soil erosion and decline of soil fertility as far as land degradation is concerned for agriculture land, land rehabilitation activities undertaken by Ministry of Agriculture and Irrigation are promotion of terracing, contour bund making, introducing SALT, extension on the use of Organic Fertilizer and prevention of farmland from seasonal flooding and saline water intrusion. As shown in Figure 1 and Table 1, the total area implemented by these conservation activities has been gradually increasing over time. In 2003, the total area of land rehabilitated was 3.4 million acres. In comparison to 1989, it was a slight increase of 0.3 million acres and roughly accounted for 10%. In fact, spatial coverage of land rehabilitation was extensive mainly due to larger effective farming area under flood protection measures of multipurpose irrigation development scheme and if excluded, the annual conservation area for soil erosion control and soil fertility improvement became merely around 0.1 to 0.3 million acres per annum during the recent years from 1997 to 2002, except for 2001. Implementation of these activities in 2002 was relatively higher and covered an area of approximately 0.7 million acres because of increased coverage of the organic farming area. (see Table 2).

In order to understand the present coverage of annual conservation area over all the required agriculture land, the area under various soil conservation activities was compared with the total crop sown area of the whole country for calculating the percentage of land rehabilitation. Despite it not being ideal to use total crop sown area for calculating land rehabilitation coverage, it is justifiable in terms of the need of all cultivated land in improving soil fertility for sustaining crop productivity. As seen in Figure 1, the percentage of land rehabilitated over crop-sown area has been oscillating around ten and declining gradually since 1989, although there is an increase in the total conservation area annually. This low figure shows that the progress presently made by land rehabilitation is lower than annual growth of agriculture expansion. If agriculture expansion is taking place in the area where susceptibility to soil erosion or land degradation is higher, there might be a situation where the increase in vulnerable farmland exceeds the capacity to take action annually to conserve soil and the fertility of agriculture land. However, there is more attentions and initiatives by different Ministries on conservation and this indicator is thus rated as 'Low and Intermittent".

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Percentage Population with Access to Safe Drinking Water - 1995 to 2003
Year of Assessment	2005
Type of Indicator	State
Frequently Asked Question (FAQ)	What percentage of the population of Myanmar has access to safe drinking water?
Priority Concern	Water Resources
Geographic Area	Union of Myanmar
State & Trend	On Average and Improving
Key Message	The percentage of the population with access to safe drinking water supply has increased from 59.7% to 80% within the 8-year period from 1995 to 2003. By the year 2003, a higher percentage is found in urban areas (92.1%) than in rural area (74.4%). According to the available data for the year 2000, the percentage of the population with access to safe water supply in GMS countries ranged from 30% to 80%,in which Myanmar was reported as 71%. The "State" of the drinking water resource in Myanmar is thus on average with an improving trend.

TECHNICAL INFORMATION

A. Definition

This indicator is to track the people's access to water supply by measuring the percentage of the population covered by safe drinking water supply system throughout the country.

B. Data Source

The data for development of this indicator are based on Multiple Indicator Cluster Surveys (MICS) that were the series of assessment conducted by the Ministry of Health in collaboration with UNICEF and WHO.

C. Geographic Area / Population Coverage

The data and the indicator are representative of access to safe drinking water for the population of the Union of Myanmar as a whole.

D. Temporal Coverage

The temporal coverage of the indicator is from 1995 to 2003.

E. Methodology and Frequency of Coverage

The Ministry of Health conducts periodical nationwide assessments of water supply and sanitation. To 2003, four assessments have been carried out in 1995, 1997, 2000 and 2003. The percentage of the population with access to safe drinking water is calculated from the number of household residents connected to various supply sources which are considered safe for drinking water
purposes.

F. Methodology of Data Manipulation

The figures are quoted directly as published by the quoted source and have not been manipulated in any way for the purpose of this indicator development.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

The indicator is indicative of the general coverage of existing water supply systems in terms of numbers of people with access to those supplied sources which are considered to be safe for drinking. However, it does not provide information about how the water supplied by these sources is made safer and meets the drinking water quality standard.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

Reliability of the data is depending on the soundness of methodology applied by the nation-wide assessment which is presently unknown in detail during EPA.

C. Future Work Required (for data level and indicator level)

It is expected that Multiple Indicator Cluster Survey will continue in the future for providing vital health statistics including safe water supply and sanitation coverage. The indicator and the fact sheet should therefore be updated once new and more recent information becomes available from the Ministry of Health.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Percentage of Household Residents with Access to "Safe and Convenient" Drinking Water Supply – 1995-2003

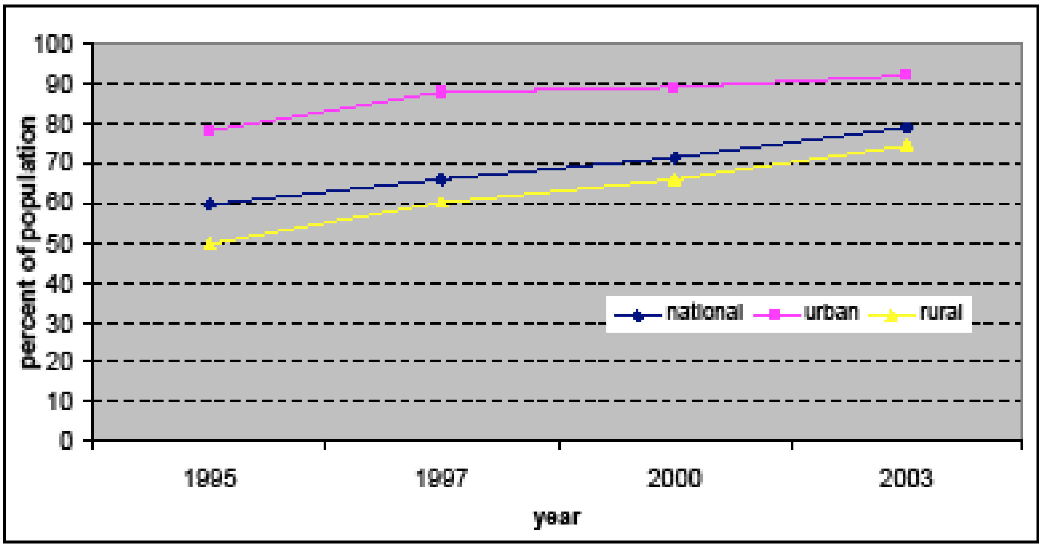


Table 1: Percentage of Household Residents with Access to "Safe and Convenient" Drinking Water Supply – 1995-2003

Region	Percentage			
	1995	1997	2000	2003
National	59.7	66.0	71.5	78.8
Urban	78.1	87.9	89.2	92.1
Rural	49.6	59.9	65.8	74.4

Source: Multiple Indicator Cluster Survey, Ministry of Health, 2003

Figure 2: Percentage of Household Residents by Source of Water Supply – 1995-2003

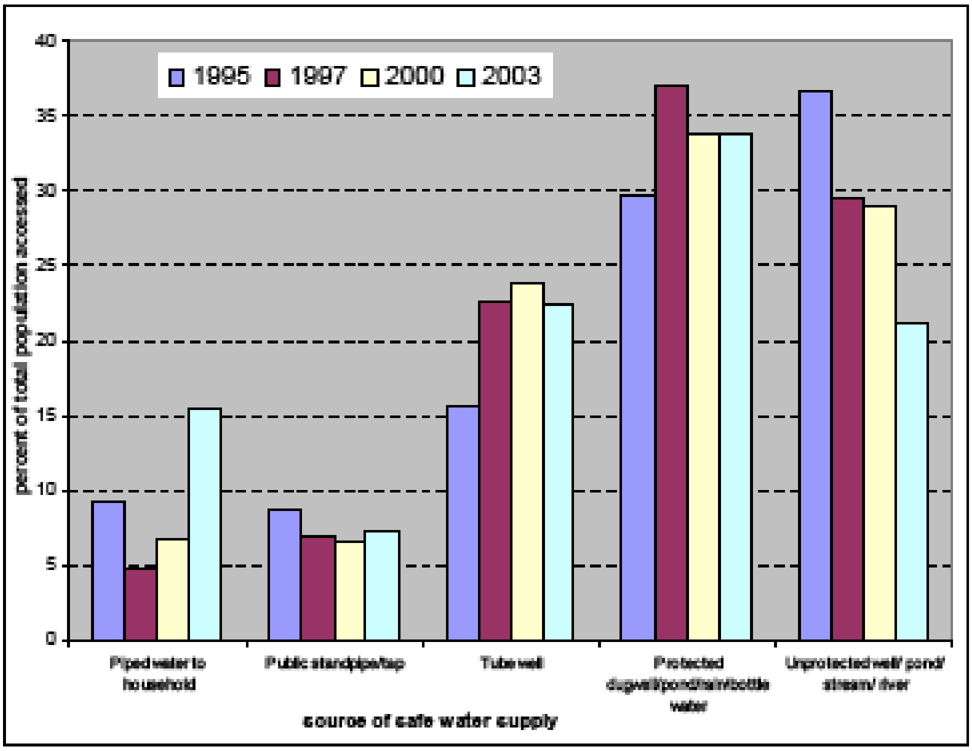


Table 2: Percentage of Household Residents by Source of Water Supply – 1995-2003

Different sources of water supply	Percentage as of Total Population			
	1995	1997	2000	2003
Piped water to household	9.3	4.8	6.7	15.4
Public standpipe/tap	8.8	6.9	6.6	7.3
Tube well	15.6	22.6	23.9	22.4
Protected dug well/pond/rain/bottle water	29.7	37.1	33.7	33.7
Unprotected well/ pond/ stream/ river	36.6	29.6	29.1	21.2

Source: Multiple Indicator Cluster Survey, Ministry of Health, 2003

SUMMARY

A. Policy Reference

1. Purpose:

This indicator aims to understand the extent to which existing water resources are made available for safer drinking use and human consumption.

2. Relevance to Environment Planning and Management:

This is relevant to national health planning for better coverage of safer water supply in reducing the risk of water borne diseases. It is also useful for increasing the efficiency of integrated water resource management for sustainable use of existing water resources.

3. Linkage to Other Indicators:

This indicator is linked to indicators such as Investment in Water Supply and Percentage Change in Population.

4. Targets:

The national health policy sets target on fuller access for all citizens to safe drinking water and it is expected to achieve by implementing the national action plan during the period from 2000/2001 to 2009/2010.

Under the Millennium Development Goals, to which Myanmar is party, the target is to halve, by 2010, the percentage of the population without access to safe potable water.

5. International Environment Treaties:

The Millennium Development Goals are directly relevant in guiding the national policy to improve fuller access of the whole population to safe drinking water.

B. Analysis

As observed in Figure 1, the population access to safe drinking water is improving over time. Within the eight years study period, from 1995 to 2003, coverage of safer water supply increased by 20% nationally to achieve 80% access of the population to safe drinking water by 2003. Improvement had been taking place both in rural and urban areas during this period. Access to safe drinking water in rural areas was merely 50% in 1995 but it had increased to 74.4% in 2003. Likewise, total coverage of safe drinking water supply system in urban areas had increased to 92.1% in 2003 from 78.1% in 1995. (see Table 1).

Table 2 shows the percentage change in the use of different sources that supply safe drinking water. Among them, the use of protected open dug wells and ponds are proportionately highest followed by the use of tube wells. Notably piped water supply connections to households have also increased over time and 15.4% of the total population had access to this source by 2003. The population with water supplied by public stand pipe had slightly decreased from 8.8% to 7.3% during that period. The policy target set for safe drinking water is to have fuller access of all people by year 2010.

As the present level of safe water supply coverage is already 80% with progressive increases, it is considered that the state of water supply for drinking purpose is an improving trend and on average as compared to other GMS countries. (As of 2000, Myanmar (71.5%), Cambodia (30%), (58%), Thailand (80%), Viet Nam (56%) and Yunnan PRC (75%), according to “Asian Development Bank (2004), “Greater Mekong Region – Atlas of the Environment”, Manila, pp:193”.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Population Growth - 1985 to 2015
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	How has population growth affected the proportion of the population with access to safe drinking water?
Priority Concern	Water Resources
Geographic Area	Union of Myanmar
Magnitude & Trend	High and Increasing
Key Message	There will be a population of 62 millions by the year 2015 and improving access to safe drinking water supply will be required for another 20 million people than the safe water supply coverage in 2003. There is a need to improve water supply yearly for 4 million people and it is far above what was annually achieved in the past to improve access of 2.5 million peoples to safe water supply. Therefore, population pressure has been increasing in imposing higher stress on supplying safe drinking water to all.

TECHNICAL INFORMATION

A. Definition

This indicator tracks the increase in total population, both rural and urban areas for the period from 1985 to 2015. It is expressed in thousands of persons per year.

B. Data Source

The Statistical Yearbooks of Central Statistical Organization for the years 1992, 1997 and 2003 are the main sources of the data employed in the development of this indicator.

C. Geographic Area / Population Coverage

The data and the indicator are representative of both rural and urban population growth for the Union of Myanmar as a whole.

D. Temporal Coverage

The temporal coverage of this indicator is for the budget years from 1985 to 2015.

E. Methodology and Frequency of Coverage

The total population of different administrative area of States and Divisions are given in referenced statistical yearbooks for 1985 to 2002 consecutively. The rural and urban populations for those State and Division were only given for 1983 census year.

F. Methodology of Data Manipulation

Ratios of rural and urban population to total population were calculated for all States and Divisions based on 1983 census data. Applying these ratios, rural and urban populations of States and Divisions were further calculated based on State and Division. Total Population figures were given for 1985 to 2002. Linear projections were applied to estimate the population from 2003 to 2015.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

There is an advantage in estimating the total population of rural and urban areas up to the year 2015. However, this is based on the assumption that similar population growth rural and urban population ratios are applicable for all the years, although they are variable annually

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

As the latest population census for the whole country was in 1983, the population given in referenced statistical year books might show greater variation than the actual population. Thus, data employed in this indicator were uncertain in capturing the real situation.

C. Future Work Required (for data level and indicator level)

Am attempt should be made to collect population data closer to the actual situation. Alternatively, the population data collected by the Government Affairs Department and local administrative bodies should be inter-exchangeable with those data from the Department of Population to compare the results and capture the more accurate trend.

Apart from this indicator, other indicators like per capita water consumption should be developed for understanding the pressure on drinking water resources.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Current and Projected Rural and Urban Population – 1985-2015

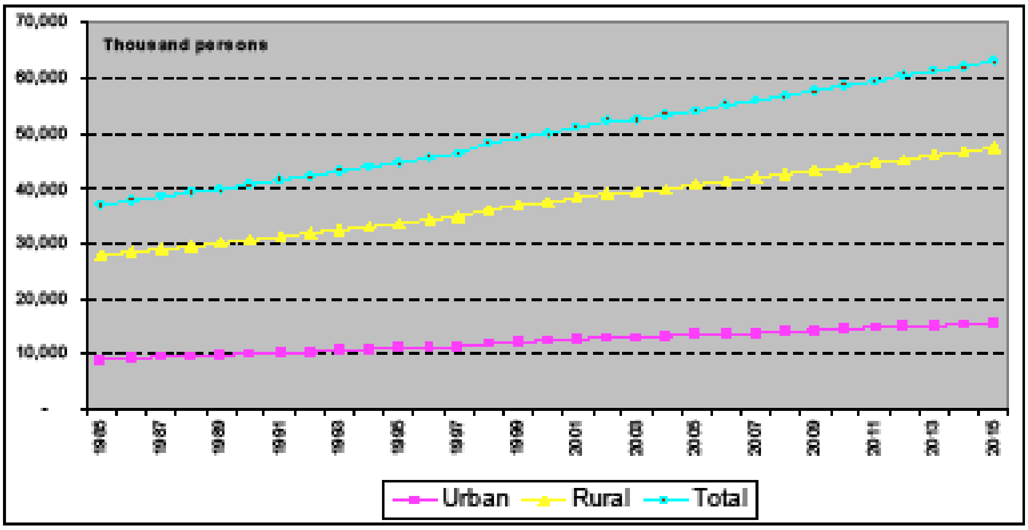


Table 1: Current and Projected Rural and Urban Population – 1985-2015

Year	Urban Population (1000's)	Rural Population (1000's)	Total (1000's)
1985	9,140	27,933	37,073
1986	9,324	28,476	37,800
1987	9,512	29,029	38,541
1988	9,703	29,594	39,297
1989	9,891	30,143	40,034
1990	10,083	30,703	40,786
1991	10,278	31,274	41,552
1992	10,477	31,856	42,333
1993	10,681	32,435	43,116
1994	10,880	33,042	43,922
1995	11,083	33,661	44,744
1996	11,283	34,282	45,565
1997	11,487	34,915	46,402
1998	11,953	36,207	48,160
1999	12,201	36,932	49,133
2000	12,479	37,646	50,125
2001	12,738	38,400	51,138
2002	13,002	39,169	52,171
2003	13,040	39,347	52,387
2004	13,265	40,005	53,270

2005	13,491	40,663	54,154
2006	13,716	41,321	55,037
2007	13,941	41,980	55,921
2008	14,167	42,638	56,804
2009	14,392	43,296	57,688
2010	14,617	43,954	58,571
2011	14,842	44,612	59,455
2012	15,068	45,270	60,338
2013	15,293	45,928	61,221
2014	15,518	46,587	62,105
2015	15,744	47,245	62,988

Source: Statistical Yearbooks, CSO 1992, 1997 & 2003

Table 2a: Estimated Rural Population (000's) by State and Division – 1995-2002

State and Division	1995	1996	1997	1998	1999	2000	2001	2002	Rural Population Ratio
Kachin	901	918	936	977	998	1,019	1,041	1,063	0.779
Kayah	173	177	181	192	198	204	210	216	0.738
Kayin	1,125	1,148	1,170	1,210	1,235	1,261	1,287	1,314	0.834
Chin	379	385	391	398	404	410	416	423	0.854
Sagaing	4,294	4,377	4,462	4,641	4,740	4,667	4,768	4,871	0.861
Tanintharyi	927	948	969	1,011	1,036	1,060	1,085	1,111	0.764
Bago	3,774	3,839	3,904	4,004	4,074	4,144	4,216	4,290	0.805
Magway	3,515	3,580	3,647	3,802	3,882	3,964	4,047	4,132	0.848
Mandalay	4,368	4,457	4,547	4,734	4,839	5,096	5,209	5,324	0.735
Mon	1,604	1,641	1,679	1,746	1,788	1,831	1,874	1,920	0.718
Rakhine	2,149	2,186	2,222	2,309	2,351	2,394	2,438	2,482	0.851
Yangon	1,629	1,655	1,682	1,765	1,804	1,843	1,883	1,924	0.318
Shan	3,531	3,587	3,643	3,740	3,800	3,860	3,921	3,983	0.787
Ayeyarwady	5,292	5,385	5,480	5,678	5,785	5,893	6,004	6,117	0.851
Union Total	33,661	34,282	34,915	36,207	36,932	37,646	38,400	39,169	0.752

Note: Rural population ratio is based on 1983 census.
Source: Statistical Yearbooks, CSO 1992, 1997 & 2003

Table 2b: Estimated Urban Population (000's) by State and Division 1995-2002

State and Division	1995	1996	1997	1998	1999	2000	2001	2002	Urban Population Ratio
Kachin	256	261	266	277	283	289	295	301	0.221
Kayah	61	63	65	69	71	73	75	77	0.263
Kayin	224	228	233	241	246	251	256	261	0.166
Chin	65	66	67	68	69	70	71	72	0.146
Sagaing	691	704	718	746	763	751	767	784	0.139
Tanintharyi	287	293	300	313	320	328	336	344	0.236
Bago	913	928	944	968	985	1,002	1,020	1,037	0.195
Magway	630	642	654	682	696	711	726	741	0.152
Mandalay	1,576	1,608	1,641	1,708	1,746	1,839	1,880	1,922	0.265
Mon	629	643	658	684	700	717	735	752	0.282
Rakhine	375	381	388	403	410	418	425	433	0.149
Yangon	3,497	3,555	3,613	3,791	3,873	3,958	4,044	4,132	0.682
Shan	955	970	986	1,012	1,028	1,044	1,061	1,078	0.213
Ayeyarwady	924	940	956	991	1,009	1,028	1,048	1,067	0.149
Union Total	11,083	11,283	11,487	11,953	12,201	12,479	12,738	13,002	0.248

Note: Rural population ratio is based on 1983 census.

Source: Statistical Yearbooks, CSO 1992, 1997 & 2003

SUMMARY

A. Policy Reference

1. Purpose:

The purpose of the indicator is to see on how likely the population increase is challenging and influencing the mandate of water for all by the year 2015.

2. Relevance to Environment Planning and Management:

The indicator is relevant for adjusting the national health plan and water vision to improve the access of all citizens to safe drinking water in line with the Millennium Development Goals.

3. Linkage to Other Indicators:

This indicator is linked to ‘Percentage of Population with Access to Safe Drinking Water Supply” and “Per capita water consumption”.

B. Analysis

In Figure 1, a linear growth of rural and urban population is observed. As projected in Table 1, the total population by 2015 will be 62 million people and it is an increase of about 16% of the 2005 population within the next decade. Until 2003, the percentage of the population with access to safe drinking water was 80%, equivalent to 42 million people approximately. For the wider access of all people to water supply by 2015, there are 20 millions more people to be covered by improved water supply in forthcoming years. On average, annually improved access to safe water supply should be a minimum of 4 million people by expansion of the water supply infrastructure across the country. For the last eight years from 1995 to 2003, the annual achievement was only 2.5 million people in improving their access to water supply. Therefore, the present level of population growth is above the level of what was annually able to accomplish an improvement of water supply. As population increase in rural areas is higher than that of urban areas, conceivably there will be more stresses in improving rural water supply for all rural people. Accounting for these facts, the population pressure on safe drinking water supply has been high and increasing.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Expenditure on Drinking Water Supply - 1997 to 2003
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	To what extent has expenditure on drinking water supply had an impact on access to safe drinking water?
Priority Concern	Water Resources
Geographic Area	Union of Myanmar
Impact & Trend	Significant and Consistent
Key Message	The real value of expenditure on safe drinking water supply has been consistently increased over time since 1998. As household residents covered by safe drinking water supply increased to 80% of the total population by the year 2003, the response in improving access to safe drinking water is consistent with a significant allocation of more financial resources.

TECHNICAL INFORMATION

A. Definition

This indicator tracks the expenditure made in real terms (at constant prices) by concerned government departments for improving access to safe drinking water supply throughout the country.

B. Data Source

For urban water supply, data were obtained from the Department of Development Affairs (DDA), Mandalay City Development Committee (MCDC) and Yangon City Development Committee (YCDC). For rural water supply, data were obtained from Water Resource Utilization Department (WRUD) and the Department of Development Affairs (DDA).

DDA. 2005. Data related to the development of environmental indicator for national performance assessment. Submission to National Commission for Environmental Affairs, by Department of Development Affairs, Reference Letter No: 282/Nga-07/Sa-Ya-Kha (46) dated 9 February, 2005, Yangon.

YCDC. 2005. Data related to the development of environmental indicator for national performance assessment. Submission to National Commission for Environmental Affairs, by Yangon City Development Committee, Reference Letter No: 109/01 (322)/Sa-tha-ka dated 8 February, 2005, Yangon.

MCDC. 2005. Data related to the development of environmental indicator for national performance assessment. Submission to National Commission for Environmental Affairs, by Mandalay City Development Committee, Reference Letter No: 1001/11/Ya-tha-ya (0234) dated 10 March 2005, Yangon.

WRUD. 2005. Data related to the development of environmental indicator for national performance assessment. Submission to National Commission for Environmental Affairs, by Water Resource
Utilization Department, Ministry of Agriculture and Irrigation, the Government of the Union of Myanmar, Reference Letter No: Sa-ma-ka (4)/280 (055/2005) dated 10 February 2005, Yangon.

C. Geographic Area / Population Coverage

The data and the indicator are representative of all expenditure for water supply for the Union of Myanmar as a whole.

D. Temporal Coverage

Expenditure data utilized for this indicator are for the budget years of 1997-98 to 2002-2003. The budget year is normally started from 1 April of given calendar year and ended at 31 March of the year followed.

E. Methodology and Frequency of Coverage

Annually recorded financial expenditures of concerned departments were the basis for calculating financial investment for safe drinking water supply. This expenditure was given in nominal value at the prevailing price level of the respective budget years.

F. Methodology of Data Manipulation

By using the Consumer Price Index (CPI) of the Central Statistical Organization, real expenditure was calculated at 1997 base year's constant price level. Financial expenditure of DDA and WRUD was summed for the figures of investment in rural water supply, whereas the respective expenditure of DDA, MCDC and YCDC were treated as investment in urban water supply.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

This indicator provides the financial investment of government agencies for safe drinking water supply. Financial investment by private sector and other institutions such as United Nations organizations and international non-governmental organizations were not fully accounted in the total amount of the investment.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

Reliability is high as data were based on actual financial expenditure data of the departments concerned. However, the accuracy of real investment made available for safe drinking water supply will be less as the contribution and investment of the private sector and international organization are not accounted for in the estimation. The robustness of the data also relies on the similarity of the Consumer Price Index (CPI) to the real situation of price inflation.

C. Future Work Required (for data level and indicator level)

Investment data related to private sector and international organization should be integrated into the estimation and percentage of GDP spent on investing for water supply should also be calculated.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Expenditure on Drinking Water Supply – 1997-2003

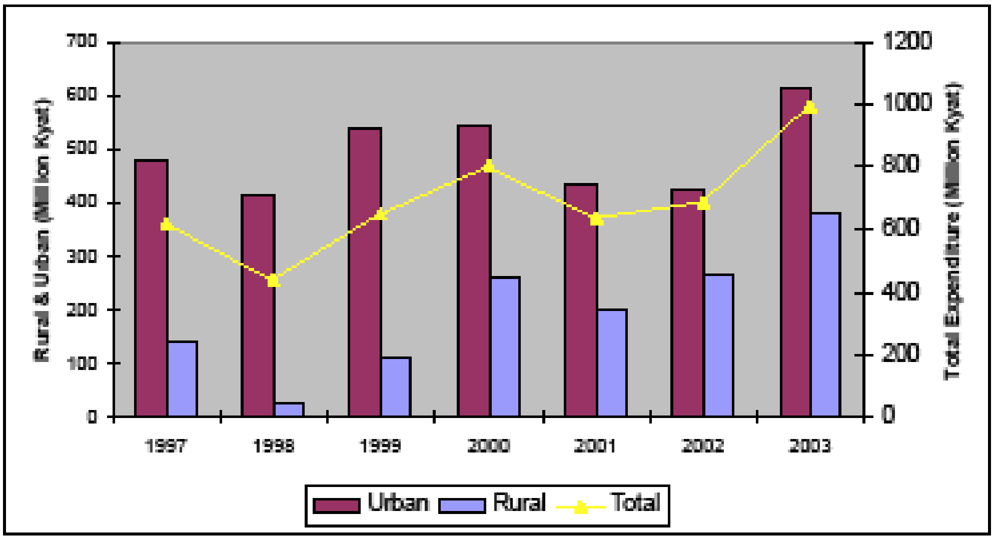


Table 1: Expenditure on Drinking Water Supply – 1997-2003

Year	Investment for Urban Water Supply (Million Kyat)	Investment for Rural Water Supply (Million Kyat)	Total Investment for Safe Drinking Water Supply (Million Kyat)	Consumer Price Index (1997 = 100)
1997	481	139	620	100.00
1998	414	27	440	130.09
1999	538	111	650	150.44
2000	545	258	803	147.85
2001	436	200	635	198.86
2002	425	264	688	314.41
2003	614	380	994	338.62

Source: Compiled from Table 2a and Table 2b, with CPI adjustment

Table 2a: Nominal Value of Expenditure by Department for Rural Water Supply (Million Kyat)

Year	Water Resource Utilization Department	Department of Development Affairs	Total Expenditure
1997	138.51	0.02	138.53
1998	33.96	0.88	34.84
1999	79.66	87.64	167.30
2000	132.05	250.13	382.18
2001	-	397.44	397.44
2002	-	829.76	829.76
2003	-	1,286.41	1,286.41

Source: WRUD (2005) & DDA (2005)

Table 2b: Nominal Value of Expenditure by Department for Urban Water Supply (Million Kyat)

Year	Department of Development Affairs	Mandalay City Development Committee	Yangon City Development Committee	Total
1997	106	76	300	481
1998	99	108	331	538
1999	263	37	510	810
2000	220	110	475	805
2001	245	141	480	866
2002	393	242	699	1,335
2003	1,068	169	841	2,078

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

SUMMARY

A.Policy Reference

1.Purpose:

This indicator analyzes the aspect of financial strengthening on improving the access of people to safe water supply.

2.Relevance to Environment Planning and Management:

This indicator is relevant to National Health Policy and National Health Planning for better coverage of safe drinking water supply in reducing the incidents of water borne diseases.

3.Linkage to Other Indicators:

This indicator is linked to indicators like Expenditure on Overall Environmental Conservation and Management, and per capita expenditure on health care.

4.Targets:

Except for the budgetary framework and plan of Departments concerned, there is no national target set for total investment made available for total improvement in a fuller coverage of water supply.

5.International Environment Treaties:

Millennium Development Goals and International Water Vision are indirectly related to increasing financial resource for improving access to safe water supply.

B.Analysis

By using the consumer price index, the nominal value of expenditure by respected government agencies (as given in Table 2a and 2c) were converted into total investment available for both rural and urban water supply at 1997 constant price level (as given in Table 1). Based on table 1, the trend of real value of total investment in water supply was shown in Figure 1. According to Table 1, the total investment in 2003 increased to 994 million kyat, equivalent to almost 160% of 1997's investment level. More investment was made in urban water supply than in rural water supply. Apparently, a higher increase in the nominal value of investment was made in the years 2001, 2002 and 2003, but a higher rare of inflation caused the real investment value to be lower in 2001 and 2003 than in 2000. However, as observed in Figure 1, real values of total investment for water supply generally showed an upward trend during the period of 1997 to 2003. As the percentage of population with access to safe drinking water increased from 60% to 80% in those years, the performance in improving the status of water resource for drinking is to be rated as a significant and consistent response to this environmental concern.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Irrigated Area as a Percentage of Irrigable Area - 1997 to 2002
Year of Assessment	2005
Type of Indicator	State
Frequently Asked Question (FAQ)	How effectively have national water resources been utilized for agricultural irrigation?
Priority Concern	Water Resources
Geographic Area	Union of Myanmar
State & Trend	Average and Improving
Key Message	Impressively water storage capacity in government dams for agriculture has shown a 27-fold increase since 1988 by constructing more dams and irrigation facilities. However, around 50% of these increased water volumes in those reservoirs were made available for irrigation during 1997 to 2002. Thus the current state of water resource used for agriculture is on average with improving trend.

TECHNICAL INFORMATION

A. Definition

This indicator tracks the efficiency of irrigation dams within the irrigation network. It is expressed as a percentage of irrigated agriculture land to irrigable area of the dams constructed by Government's Irrigation Department.

Irrigated agriculture lands are the occupied areas for cultivation of annual crops under the irrigation of Government dams.

Irrigable areas are the cultivated areas where the irrigation systems of existing dams (government constructed) could supply water to the extent possible for annual crop production.

B. Data Source

The data from the Irrigation Department are used in the development of this indicator.

ID. 2005. Data pertaining to environmental indicator development for national performance assessment. Submission to the National Commission for Environmental Affairs by Irrigation Department, Ministry of Agriculture and Irrigation, the Government of the Union of Myanmar, Reference Letter No: 1868/201 Sa-Ma-Ka dated 8 February, 2005, Yangon.

C. Geographic Area / Population Coverage

The data and the indicator are representative of the irrigated area of the Union of Myanmar as a whole.

D. Temporal Coverage

The data employed for the construction of this indicator covers the period from 1997 to 2002.

E. Methodology and Frequency of Coverage

Data were based on the Statistics of the Irrigation Department. Consecutively they cover six budget years which normally start on 1 April of a given calendar year and end on 31 March of the following year.

F. Methodology of Data Manipulation

In calculating the ratio, the irrigated area is divided by the irrigable area of respective years and it is expressed as the percentage of total irrigable area.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

This indicator provides the observable trend of the supply of water resources from constructed dams to cultivated land within the existing irrigation system and network. However, the data are only for government constructed dams and do not include dams constructed and owned by the community and private sector.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

The robustness of the indicator value is dependent on the accuracy of the data for the actual irrigated area, which is difficult to collect in the field for all irrigation systems.

C. Future Work Required (for data level and indicator level)

The indicator should also calculate irrigated ratio for private irrigation system, which is not covered by this indicator for the time being. In addition, annually irrigated water volume should be further calculated based on this data set for understanding the nature of water consumption, shortage and sufficiency for agriculture use.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Ratio of Irrigated Area to Irrigable Area - 1997/98 to 2002/03

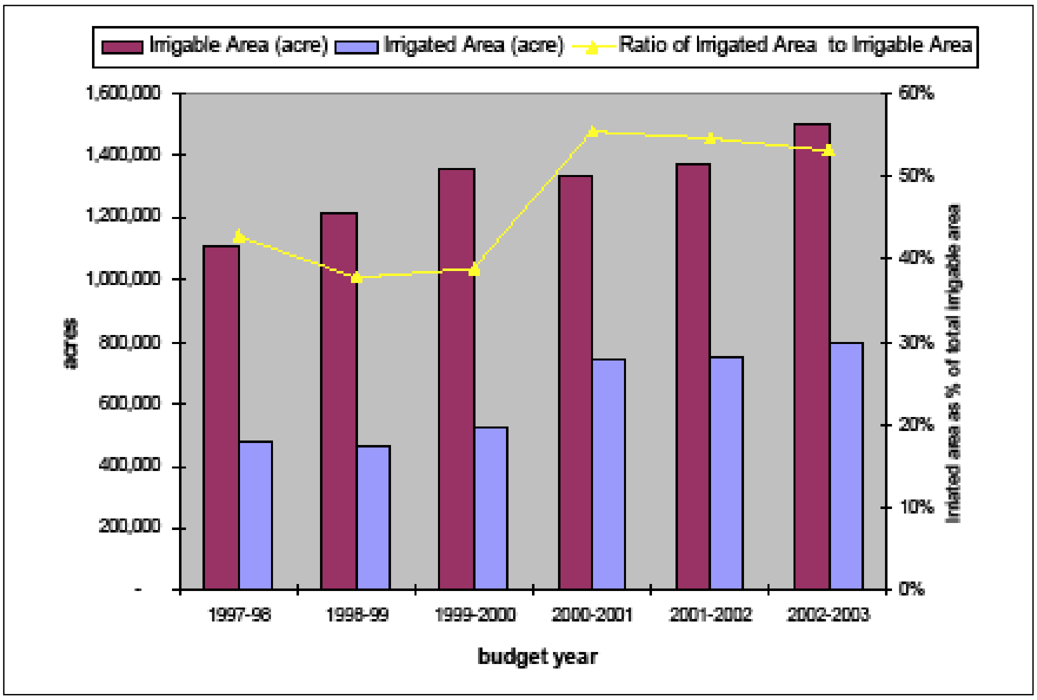


Table 1: Ratio of Irrigated Area to Irrigable Area – 1997/98 to 2002/03

Year	Irrigable Area (acres)	Irrigated Area (acres)	Ratio of Irrigated to Irrigable Area
1997-98	1,107,000	474,185	43%
1998-99	1,210,000	457,449	38%
1999-2000	1,358,000	527,784	39%
2000-2001	1,332,000	739,466	56%
2001-2002	1,375,000	750,476	55%
2002-2003	1,498,000	794,724	53%

Source: Irrigation Department – ID (2005)

Figure 2: Maximum Storage Capacity of Water Volume in Government Dams

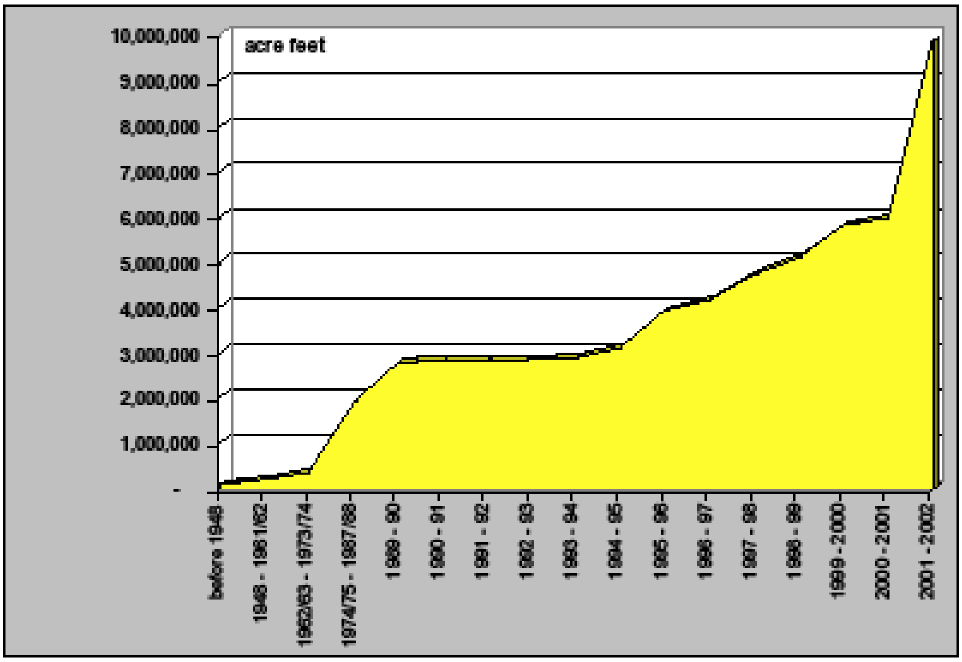


Table 2: Maximum Storage Capacity of Water Volume in Government Dams

Period	No. of Dams	Available Water Volume (Acre Feet)
before 1948	10	78,744
1948 - 1961/62	31	188,675
1962/63 - 1973/74	52	363,404
1974/75 - 1987/88	65	1,894,672
1989 - 90	67	2,778,772
1990 - 91	70	2,802,219
1991 - 92	74	2,812,059
1992 - 93	80	2,828,311
1993 - 94	88	2,881,422
1994 - 95	97	3,095,568
1995 - 96	108	3,913,831
1996 - 97	118	4,160,541
1997 - 98	125	4,717,398
1998 - 99	133	5,097,345
1999 - 2000	143	5,795,906
2000 - 2001	151	5,948,313
2001 - 2002	163	9,847,113

Source: Irrigation Department – ID (2005)

SUMMARY

A. Policy Reference

1. Purpose:

The purpose of this indicator is to measure the efficiency of the current irrigation system in making water resource available for agriculture use.

2. Relevance to Environment Planning and Management:

The indicator is useful for planning and management of water resources effectively for irrigation purpose .It is also relevant to land use planning for sustainable agriculture development.

3. Linkage to Other Indicators:

None specific.

4. Targets:

Once dams are constructed, it is expected that all irrigable areas within their established irrigation networks are to be irrigated fully for agriculture purpose as planned and designed. Therefore, the target related to this indicator is an irrigated area of 100% of the total irrigable area.

B. Analysis

Figure 1 presents the observable trend of irrigation coverage within the established irrigation system and network. Irrigated farming area as a percentage of total irrigable area has increased during the period from 1997 to 2002. It indicates the increased coverage in effective irrigated area under the existing irrigation system of the Irrigation Department. The data revealed that the ratio of irrigated area was only 43% of the total irrigable area in 1997 and it declined to 38% and 39% in 1998 and 1999 respectively. However, the situation improved from 2000 to 2002 by increasing the coverage of irrigated area to above 50%.

In fact, there has been a strong policy support and commitment in increasing water availability for agriculture since 1989. As a result, the numbers of dams constructed have been increased and storage capacity of water for agriculture has also been impressively increased. By the end of the budget year 2001-2002, the maximum capacity of water storage in government dams was almost 10 million acre feet and it was 27 times higher than before 1989 (Table 2 and Figure 2). Alongside its increase in water availability, it is equally important that water should be conveyed from dam to all irrigable area as planned for efficient and effective utilization of the water resource for agriculture.

However, the efficiency of water supply from the dam is dependent on many factors such as annual precipitation received, better maintenance of canal and off-take structure, minimizing water leakage, balancing water demand by suitable cropping system, and farmers' participation in water distribution, maintenance and management. Failure in one of these factors might be associated with lesser irrigation coverage.

Despite the irrigated farming area as a percentage of total irrigable area showing an increase during the years from 1998 to 2000, it has been leveling around 50% since 2000. Thus the current state of water resource for agriculture is on average with a stabilizing trend in terms of managing agriculture water use efficiently.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Irrigated Crop Sown Area - 1985 to 2002
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	What is the level of stress caused by irrigated annual cropping on the efficient use of agriculture water?
Priority Concern	Water Resources
Geographic Area	Union of Myanmar
Magnitude & Trend	High and Steady
Key Message	The irrigated area accumulated by multiple cropping doubled from 3 to 6 million acres during the period from 1985 to 2002. More than 70% of these areas were sown for paddy for which water consumption is high. There is a causal link between a stress to supply water for all irrigable areas and increasing acreage of irrigated crop sown area, especially multiple cropping of paddy. As the trend in encouraging the multiple cropping of the paddy is to be continued, the pressure on efficient water use for agriculture will remain high and steady at present and in the future.

TECHNICAL INFORMATION

A. Definition

This indicator tracks the growth in the total crop sown areas under irrigation. Crop sown area is defined as the sum of all cultivated land areas that is subjected to multiple cropping within an agriculture calendar. The agriculture water demand of the crop sown area gives a measure of the total volume of water required to meet the irrigation needs of all the crops that are sown/grown over a piece of land. It is expressed as thousand acres per year.

B. Data Source

The Statistical Yearbook for the year 2003 of Central Statistical Organization is the main source for the data employed in the development of this indicator.

C. Geographic Area / Population Coverage

The indicator represents the situation of crop-sown area under irrigation across the whole country.

D. Temporal Coverage

Temporal coverage of this indicator is for the budget years from 1985 to 2002.

E. Methodology and Frequency of Coverage

The total irrigated area under annual crop multiplication was given for all circumstances under any types of irrigation systems either government or private. For the earlier period, data were only represented for the years 1985 and 1990 as it was compiled at five yearly intervals.

F. Methodology of Data Manipulation

The percentage of annually irrigated paddy sown area is calculated based on the total crop sown area of the respective budget year.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

The indicator provides the comparable trend of increased intensity of cropping under improved irrigation as well as the likelihood of increased water demand by crop sown, particularly growing paddy. An indicative value is given for all crop-sown areas under the irrigation systems of both government (Irrigation Department and Water Resource Utilization Department) and private sector. It only generalized the scenario in analyzing the causal link of this indicator to "State indicator, which focused on the efficiency in conveying the agriculture water from government constructed dams to all irrigable areas within established irrigation networks.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

There is a possibility of error at the data level since the compilation of the crop-sown area is dependent on manual methods of data collection at the field level.

C. Future Work Required (for data level and indicator level)

Data should be separately collected for the crop-sown area affected by different irrigation schemes under the Irrigation Department and Water Resource Utilization Department in order to analyze the different conditions. The average volume of water consumed by annually sown crops should also be calculated for better irrigation management in adjusting the crop-water requirement.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Irrigated Crop Sown Area and Percentage of Irrigated Paddy Sown Area

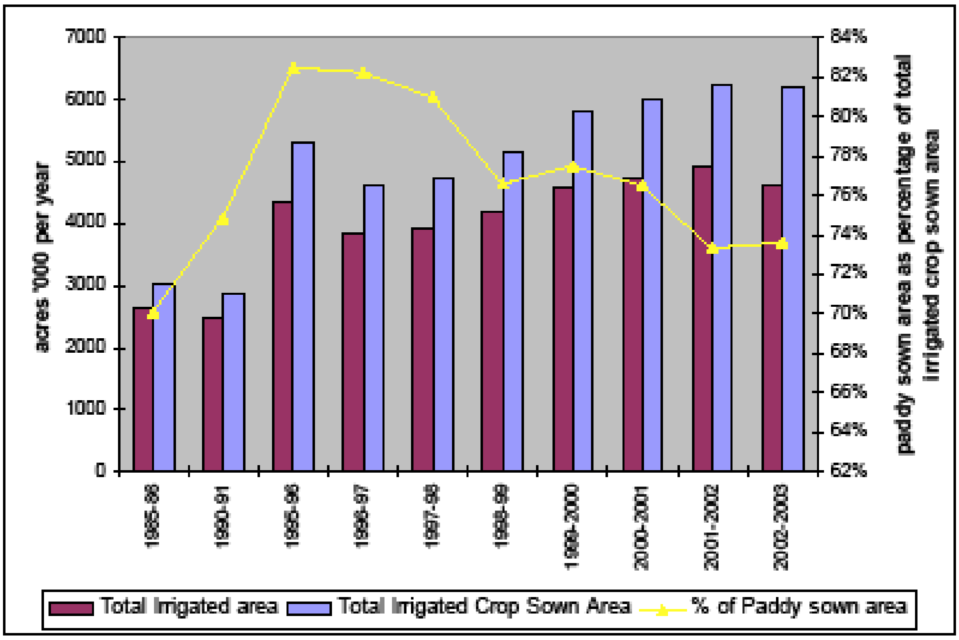


Table 1: Irrigated Crop Sown Area (thousand acres) and Percentage of Irrigated Paddy Sown Area

Year	Total Irrigated Area	Total Irrigated Crop Sown Area	Irrigated Paddy Sown Area	Irrigated Sown Area of Other Food Crop	Irrigated Sown Area of Other Non Food Crop	% Paddy Sown Area
1985-86	2,616	3,024	2,119	890	15	70%
1990-91	2,479	2,871	2,148	707	17	75%
1995-96	4,341	5,292	4,365	908	19	82%
1996-97	3,846	4,610	3,793	796	21	82%
1997-98	3,933	4,750	3,848	867	35	81%
1998-99	4,182	5,140	3,937	1,175	28	77%
1999-00	4,550	5,799	4,493	1,274	32	77%
2000-01	4,720	6,021	4,609	1,381	31	77%
2001-02	4,906	6,239	4,578	1,629	32	73%
2002-03	4,619	6,198	4,559	1,609	31	74%

Source: Statistical Yearbook, CSO 2003

SUMMARY

A.Policy Reference

1.Purpose:

The purpose of this indicator is to capture the tendency in level of demand on agriculture water by type of crop sown and irrigated area accumulated by annual crop multiplication.

2.Relevance to Environment Planning and Management:

This is relevant for better management in supplying water for irrigation efficiently and effectively to all irrigable areas within established network.

3.Linkage to Other Indicators:

This indicator is linked to indicators such as “the ratio of irrigated area to all irrigable area” and “the percentage of irrigated area over total agriculture land”.

B.Analysis

As observed in Figure 1, there is an upward trend of irrigated crop-sown area during the studied period. Although total irrigated crop-sown area in 1990 was lower than that of 1985, the irrigated area accumulated by annual crop multiplication has been expanded significantly from 1995. By 2002, it reached 6.2 million acres approximately, an almost two fold increase since the early 1990s (Table 1). The total area affected by irrigation also increased as well during the same period. Obviously, this was due to significant increases in the number of dams constructed after the country adopted the open market economy since 1988 and the national policy focused on tapping the water resource potential for agriculture. It was also found that the ratio of irrigated crop-sown area to irrigated area was gradually higher and almost 134% in 2002 by indicating the higher cropping intensity with increasing use of available water. The available water was essentially used for growing paddy for which the crop-water requirement is higher than for other crops-In conjunction with a policy of self-sufficiency of rice locally; an attempt has been made to multiple crop of paddy as much as possible within a given cropping calendar.

The water requirement for successful paddy growing is as high as 5 acre feet per acre of paddy field and the estimated water consumption in 2002-2003 was around 23 million acre feet for 4.5 million acres of paddy growing area across the country. As the irrigated area under the government’s irrigation system was about one third of total irrigated area of the whole country, probably 7.6 million acre feet of agriculture water are required for irrigating paddy-growing areas under the government’s irrigation scheme in which two agencies, namely; Water Resource Utilization Department and Irrigation Department, are involved. For irrigation department alone, the best-estimated water consumption by paddy will not be less as 5 million acres feet as irrigation coverage by the Water Resource Utilization Department was lesser than 40% of total irrigated area under the government scheme in 2001-2002.

Maximum capacity of water storage in the dams of Irrigation Department is approximately 10 million acre feet and water consumption by paddy was already above 50% of water available from existing infrastructure. Taking into account the possible variations in annual precipitation, maintenance of irrigation network and over utilization of irrigated water, this consumption level might be higher in certain circumstances. In this situation, current acreage of irrigated paddy sown area has already created a stress with higher water consumption unable to irrigate all irrigable areas within the established network. Therefore, the efficiency of irrigation is very much influenced by increasing acreage of paddy-sown area. In other words, the more the paddy was sown, the lesser the irrigable areas were irrigated. According to Table 1, total sown acre for paddy under irrigation throughout the country was above 80% of total irrigated crop sown area for years 1995, 1996 and 1997. However, this decreased to below 80% in later years and the percentage of irrigated paddy sown area for 2002 was 74%. As it is observed that the ratio of irrigated area to irrigable area was around 50% since the year 2000, the decline in percentage of irrigated paddy sown acre stabilized the trend of irrigation efficiency. Nevertheless, the trend in encouraging the multiple cropping of paddy is to be continued and the level of stress by irrigated crop sown area for efficient use of agriculture water is going to be higher as usual in the future. Thus, this indicator is rated as High and Steady.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION

Indicator ID	
Indicator Name	Expenditure on Irrigation Management - 1992 to 2004
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	How has expenditure on irrigation management improved efficiency in agriculture water management?
Priority Concern	Water Resources
Geographic Area	Union of Myanmar
Impact & Trend	On Average and Consistent
Key Message	At 1992 constant price level, the real value of expenditure on irrigation management has been consistently increased since 2000 and the level of spending in 2004 is as high as 200% of the 1992 level. As slightly over the half of the total irrigable area could be irrigated so far as shown in the "state" indicator, increased expenditure in irrigation management has only made a modest improvement in the average efficiency of agriculture water utilization.

TECHNICAL INFORMATION

A. Definition

This indicator tracks the expenditure for irrigation management by the Irrigation Department (ID). It is expressed in millions kyat per annum. Expenditure on irrigation management includes all the money spent for personnel, operational and maintenance, administration, surveying, research and training, whereas expenditures on irrigation development tracks the cost of constructing dams and irrigation networks.

B. Data Source

The data utilized for the construction of this indicator originate from the Irrigation Department of the Ministry of Agriculture.

ID. 2005. Data pertaining to environmental indicator development for national performance assessment. Submission to National Commission for Environmental Affairs by Irrigation Department, Ministry of Agriculture and Irrigation, the Government of the Union of Myanmar, Reference Letter No:1868/201 Sa-Ma-Ka, dated 8 February 2005, Yangon.

C. Geographic Area / Population Coverage

The data and the indicator are representative of most major irrigation management expenditures for the Union of Myanmar as a whole.

D. Temporal Coverage

The indicator is based on expenditure figures for government fiscal years 1992-1993 to 2004-2005. The fiscal or budget year begins on 1 April and ends on 31March.

E. Methodology and Frequency of Coverage

Annual expenditure is differentiated by the different nature of the expenditure items including personnel, operation and maintenance, administration, survey and investigation, research and training and dam construction.

F. Methodology of Data Manipulation

Investment for agriculture water supply is calculated by summing the expenditure incurred for dam construction and irrigation management. Expenditure incurred in Irrigation Management was based on the financial expenditure of the Irrigation Department spent on Personnel, Operation and Maintenance, Surveying, Research and Training and Administration. The cost of dam construction is treated as the cost of irrigation development. The Consumer Price Index of the Central Statistical Organization was used for estimating real value of the expenditure at the constant price of 1992 base year.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

This indicator is helpful in examining the rationale of financing better irrigation management which is equally important as irrigation development in order to maintain the efficiency in water distribution
and supply as planned and designed. Due to the lack of data, this only indicates the financial response of the Irrigation Department for irrigation efficiency and it does not address the situation of other irrigation systems under the Water Resource Utilization Department and Private sector.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

Reliability is high as the data were based on actual financial expenditure reports of the department concerned.

C. Future Work Required (for data level and indicator level)

Data related to the irrigation management of Water Resource Utilization Department should be also integrated in the analysis.

Figure 1: Expenditure on Irrigation Management at 1992 Constant Prices - 1992-2004

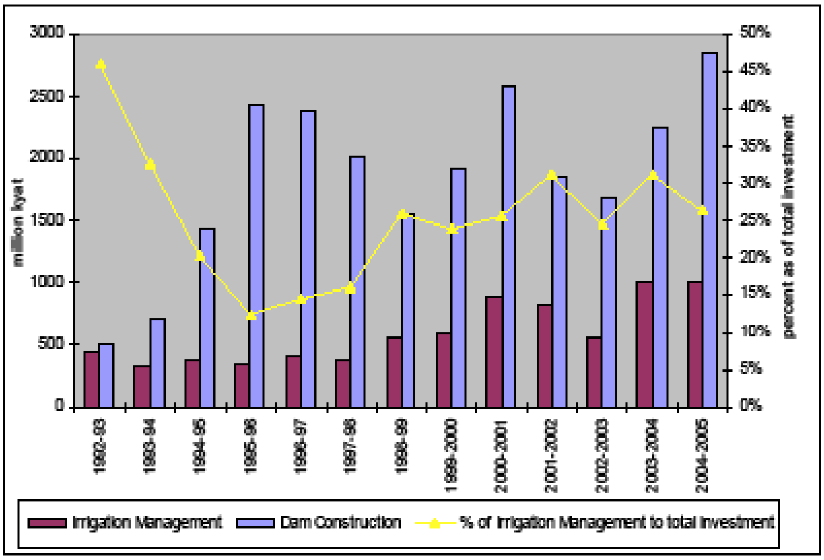


Table 1a: Expenditure on Irrigation Management at 1992 Constant Price as Percentage of Total Investment for Agriculture Water Supply by Irrigation Department

Year	Irrigation Management (Million Kyat)	Dam Construction (Million Kyat)	Total Investment in Agriculture Water Supply (Million Kyat)	Consumer Price Index (1992 =100)	Percentage of expenditure on Irrigation Management to total investment
1992-93	443	520	962	100	46%
1993-94	334	693	1,028	134	33%
1994-95	365	1,439	1,804	164	20%
1995-96	344	2,428	2,772	199	12%
1996-97	406	2,384	2,790	239	15%
1997-98	383	2,020	2,403	245	16%
1998-99	549	1,561	2,109	319	26%
1999-00	600	1,918	2,519	369	24%
2000-01	893	2,591	3,484	363	26%
2001-02	830	1,839	2,669	488	31%
2002-03	545	1,680	2,224	772	24%
2003-04	1,013	2,241	3,253	831	31%
2004-05	1,010	2,837	3,847	964	26%

Source: Irrigation Department, ID (2005)

Table 1b: Nominal Value of Total Investment in Agriculture Water Supply by Irrigation Department (Million Kyat) - 1992/93 to 2004/05

Year	Irrigation Management Million Kyat (a)	Dam Construction (or) Irrigation Development Million Kyat	Total Investment in Irrigation for Agriculture Million Kyat
1992-93	443	520	962
1993-94	447	926	1,373
1994-95	597	2,353	2,950
1995-96	686	4,838	5,524
1996-97	970	5,702	6,672
1997-98	941	4,956	5,897
1998-99	1,751	4,982	6,733
1999-00	2,216	7,082	9,298
2000-01	3,240	9,403	12,643
2001-02	4,050	8,975	13,025
2002-03	4,204	12,959	17,163
2003-04	8,415	18,620	27,036
2004-05	9,734	27,358	37,092

Note: (a) is total expenditure of Table 1c.

Source: Irrigation Department, ID (2005)

Table 1c: Nominal Value of Total Expenditure on Irrigation Management by Irrigation Department (Million Kyat) - 1992/93 to 2004/05

Year	Personnel	Operation and Maintenance	Administration	Survey & Investigation	Research and Training	Total Expenditure
1992-93	110	281	42	4	6	443
1993-94	146	247	41	5	7	447
1994-95	150	371	58	9	9	597
1995-96	155	415	84	17	15	686
1996-97	165	685	93	15	13	970
1997-98	169	501	249	10	12	941
1998-99	172	1,040	506	20	13	1,751
1999-00	172	1,348	635	45	17	2,216
2000-01	754	1,678	730	30	49	3,240
2001-02	761	2,466	766	30	28	4,050
2002-03	776	2,589	764	40	35	4,204
2003-04	786	6,473	897	192	68	8,415
2004-05	1,651	6,823	1,100	100	60	9,734

Source: Irrigation Department, ID (2005)

SUMMARY

A. Policy Reference

1. Purpose:

This indicator serves to analyze the relationship between financial allocation for irrigation management and the efficiency in irrigation for better water supply and coverage.

2. Relevance to Environment Planning and Management:

The indicator is relevant to local agriculture development and cropping management for rationale use of water resource and irrigation efficiency. As careless development in irrigation is strongly affecting fresh water biodiversity and fishery resources, this indicator is useful in focusing attention on the need for effective natural resource management and environmental conservation.

3. Linkage to Other Indicators:

This indicator is linked to indicators like Expenditure on Environmental Management and Land Degradation in the sense of flood control by constructed dams and weirs.

B. Analysis

Based on the data of Table 1a, Figure 1 illustrates the trends of expenditure on irrigation management, dam construction and percentage of expenditure on irrigation management to overall investment of Irrigation Department for agriculture water supply. Tables 1b and 1c were supportive data for deriving the expenditure on irrigation management at the 1992 constant price, as given in Table 1. As shown in Figure 1, there was again a rising trend of irrigation management expenditure following its decline from 1992 to 1997. By the budget year of 2004-05, the current level of spending on irrigation management was as high as 200% of the 1992 level. It is observed that proportionately financial allocation was made more available for improvement in irrigation management, alongside the sharper increases in investment for construction of new dams. During the period from 1992 to 2004, the percentage of expenditure for irrigation management of the total investment of the Irrigation Department for agriculture water supply has fluctuated ranging from 12% to 45% (see Table 1). To increase the irrigated area, it appears that attempts made to expand irrigation by constructing new dams are more important than improving the efficiency of the existing irrigation system.

As the irrigated area as a percentage of the total irrigable area oscillated around 50% since 2000, little improvement could be made by this level of expenditure increase for better efficiency in expansion of irrigation coverage within the established irrigation facility and network. There is still considerable scope for improving and approaching the 100% efficiency target so that the current level of response to selected environmental concern is on average with consistent trend in managing the agriculture water resource effectively and efficiently.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Percentage Solid Waste Collected in Yangon City - 1983 to 2004
Year of Assessment	2005
Type of Indicator	State
Frequently Asked Question (FAQ)	How much of the generated waste in Yangon city is being collected?
Priority Concern	Inadequate Solid Waste Management
Geographic Area	Union of Myanmar
State & Trend	Relatively Poor and Stabilizing
Key Message	The rate of solid waste collection increased in Yangon City from 54% in 2000 to 80% in 2004 whereas it declined from 28% in 1998 to 24% in 2003 for all urban areas of the whole country, except Yangon and Mandalay cities. With the mixture of progress, data uncertainty and the need for meeting the policy target of "Green and Clean City", it is considered that the performance on selected environmental concern is stabilizing at an unspectacular collection rate. As collection rates of other GMS's countries are higher than that of Myanmar, the level of solid waste collection is relatively poor.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track the volume of solid waste collected daily by official means from the point of production such as residential area, communal dump and market. This is compared with total estimated municipal solid waste generated and the unit of the measurement is given as a percentage. Municipal solid waste is defined as "non gaseous and non-liquid waste that result from the daily activities of community's residential and commercial sector within the given administrative urban area.

B. Data Source

The following are sources of information for the data employed in this indicator:

YCDC. 2005. Data related to environmental indicator development. Submission of Pollution Control and Cleansing Department/Yangon City Development Committee to National Commission for Environmental Affairs. Reference Letter No.109/01(322)/Sa-tha-ka, Dated 8 February 2005 Yangon.

Yamauchi, Hisashi. and Sato, Shinsuke. 2001. Related solid waste data of Yangon City for 2000. Daw Khin Win; Quoted in "Final Report on Planning and Techniques for Solid Waste Disposal in Yangon City, the Union of Myanmar", Japan International Cooperation Agency (JICA) and Yangon City Development Committee (YCDC), Yangon.

Khin Maung. 1995. Solid Waste Management at the City of Yangon for Sustained Urban Development. Technical paper presented in National Conference on Environmental Management organized by National Commission for Environmental Affairs (NCEA) in cooperation with Hanns Seidel Foundation – 28-30 August 1995, NCEA/HSF DOC.No.15, Yangon.

Solid waste collection data of State and Division were extracted from the annual progress reports of the Department of Development Affairs for 1998 and 2003.

C. Geographic Area / Population Coverage

Solid waste data for Yangon capital is for the population living in the townships within the administrative area of Yangon city. Data coverage for States and Divisions is only for those administrative areas of urban townships within respective States and Divisions. The waste data for Yangon and Mandalay cities are not included in State-wide and Division-wide urban solid waste management data.

D. Temporal Coverage

For solid waste management in Yangon, the temporal coverage of the data is for four representative years during the period 1983 to 2004. The representative years within this period are 1983, 1990, 2000 and 2004. For solid waste disposal for urban area of States and Divisions, data only cover two years, 1998 and 2003.

E. Methodology and Frequency of Coverage

Solid waste disposal in Yangon for different representative years were based on different sources that had different methodology in estimating it as described below:

• 2004 waste collection data was according to an estimation made by concerned agency (PCCD/YCCD) based on the compilation of operational records.

• 2000 waste collection data was according to an estimation made by concerned agency (PCCD/YCCD) based on their special study undertaken on solid waste management with the assistance of Japanese International Coordination Agency

• 1983 and 1990 Disposal data was derived from "official report of U Khin Maung, former head of PCCD/YCDC." (see below section)

Solid waste collection for urban areas of States and Divisions were based on the compilation of monthly progress reports submitted by township's DDA to head office of DDA in Yangon. From the reports received, data were only derived for 1998 and 2003.

F. Methodology of Data Manipulation

The percentage of solid waste collection was based on the ratio of solid waste collected to total solid waste generated. In the case of Yangon city, the total amount of waste generated for 1983 and 1990 was calculated by multiplying the city population of those periods by per capita solid waste generation, which was derived from the available data set, as explained in the fact sheet for "Solid Waste Generation". By the same token, the same method was applied for estimating solid waste generation for urban areas of States and Divisions. As data for solid waste collection of both Yangon city and States and Divisions were available from respective reports, they were directly used for calculating the percentage of solid waste collection.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

The indicator provides the trend of solid waste management in Yangon City for the past 20 year period. In addition, the trend of solid waste management in all urban areas other than Yangon and Mandalay cities is comparable amongst the States and Divisions for the two different time frames between 1998 and 2003 to improve further. These data for solid waste management for the whole country can provide a general for understanding of the current state. However, interpolated data for solid waste generation based on these assumptions might be limited for revealing the real situation.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

The reliability of the indicative value is overwhelmed by the accuracy of the estimated population figures and per capita solid waste generation. As there are higher gaps and differences in estimated population figures of various sources, the inaccuracy of the indicative value might be higher. Robustness of secondary data for solid waste collection is also dependent on the soundness of the waste monitoring system and data management of the respective authorities, which is unknown at the time when Environmental Performance Assessment (EPA), was carried out.

C. Future Work Required (for data level and indicator level)

For the sake of higher accuracy in the indicative value, obtaining the real figures of population data is essential. Strong and systematic solid waste monitoring will be required in collecting the data regularly for the amounts of solid waste collected, disposed, recycled and treated by various means.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Percentage of Solid Waste Collection in Capital Yangon

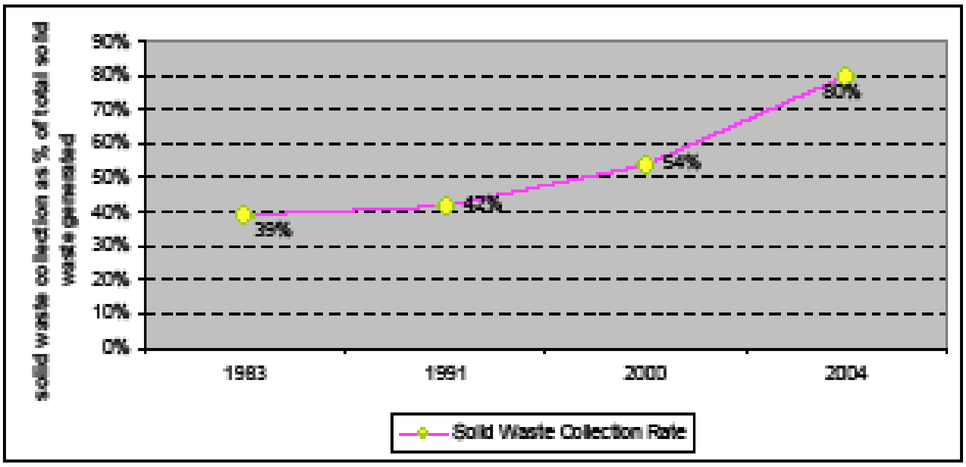


Table 1a: Solid Waste Collection and Disposal at Capital Yangon

Year	Solid Waste Generated (ton/day)	Solid Waste Collected & Disposed (ton/day)	% of Disposed waste to total generated waste
1983	1,018 a	400 b	39%
1991	1,346 c	564 b	42%
2000 d	1,457	787	54%
2003/04 e	1,435	1,150	80%

(a) – estimated based on per capita waste generation equal to 1991 level

(b) – Khin Maung (1995), Published Departmental Paper of Yangon City Development Committee

(c) – interpolated data based on Khin Maung (1995)

(d) – JICA & YCDC (2001), Unpublished Study Report on Planning and Techniques for Solid Waste Disposal in Yangon City

(e) – YCDC official data submittal to NCEA, Ref.No:100/01(322)/Sa-Tha-Ka, Dated February 8, 2005

Source: YCDC (2005), JICA & YCDC quoted in Yamauchi, Hisashi. and Sato, Shinsuke. (2001) and Khin Maung (1997)

Table 1b: Supplemental Data Related to Solid Waste Management in Capital Yangon

Solid Waste Management	Year 2003/04
Total Waste Generated (ton/day)	1435
Total Waste Collected & Disposed	1150
Percent of wasted disposed as of total waste generated	80%
Total waste by uncontrolled landfill (ton/day)	1149.5
Percent of landfill operation as of total waste disposed	99.96%
Total incinerated waste (ton/day)	0.5
Percent of incinerated waste as of total waste disposed	0.04%
Estimated waste recycled (ton/day)	143
Percent of solid waste recycled as of total waste generated	10%

Source: YCDC (2005)

Figure 2: Percentage of Solid Waste Collection and Disposal At Urban Area of State and Division (without Capital Yangon and Mandalay City)

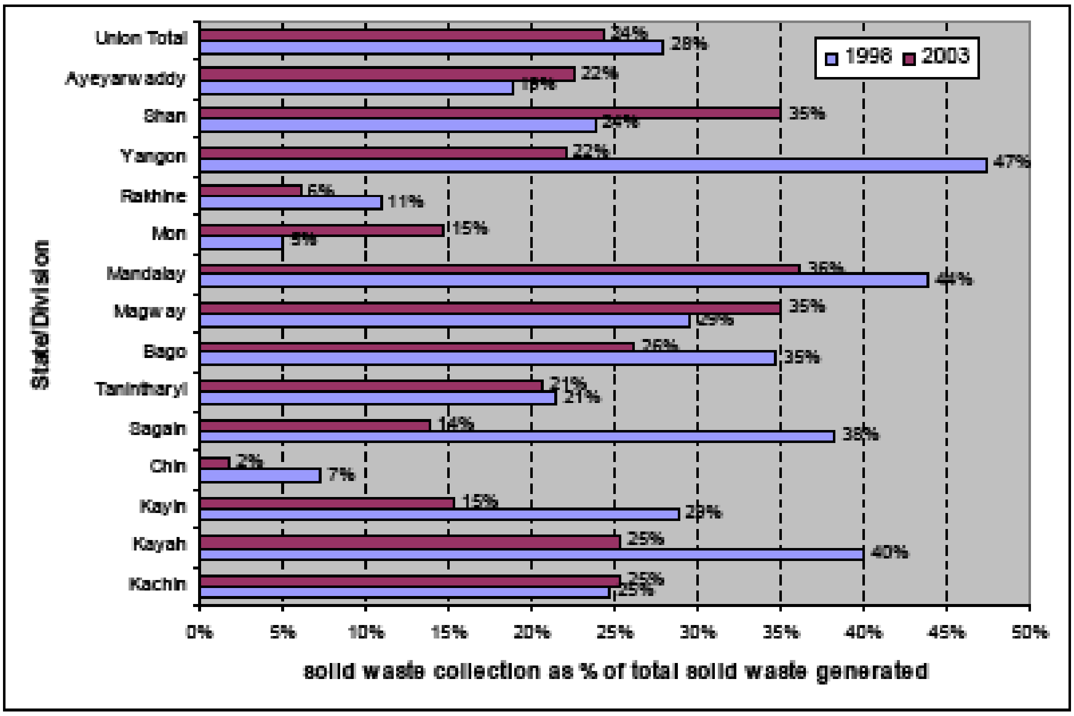


Table 2: Solid Waste Collection in Urban Area of State and Division (without Capital Yangon and Mandalay City)

States & Divisions	Waste Generated (ton/year)		Waste Disposed (ton/year)		Waste Disposal %	
	1998	2003	1998	2003	1998	2003
Kachin	38,735	47,919	9,575	12,125	25%	25%
Kayah	7,251	8,678	2,900	2,200	40%	25%
Kayin	24,831	31,704	7,142	4,846	29%	15%
Chin	10,310	12,137	750	218	7%	2%
Sagain	101,042	113,205	38,656	15,647	38%	14%
Tanintharyi	59,733	70,204	12,829	14,444	21%	21%
Bago	137,159	151,294	47,642	39,487	35%	26%
Magway	75,713	84,616	22,333	29,615	29%	35%
Mandalay	108,206	130,561	47,409	47,172	44%	36%
Mon	84,873	95,990	4,279	14,049	5%	15%
Rakhine	56,589	63,697	6,120	3,831	11%	6%
Yangon	69,349	88,138	32,886	19,402	47%	22%
Shan	135,336	162,100	32,134	56,728	24%	35%
Ayeyarwaddy	123,296	135,548	23,105	30,450	19%	22%
Union Total	1,032,423	1,195,791	287,759	290,213	28%	24%

Source: Annual Reports of Department of Development Affairs - DDA (1998 & 2003)

SUMMARY

A. Policy Reference

1. Purpose:

The purpose of this indicator is to examine the current level of solid waste management and its efficiency in managing the urban environment.

2. Relevance to Environment Planning and Management:

This is relevant for improving or maintaining of the efficient services in urban solid waste management. In the context of the National Health policy, this indicator is useful for showing the reduction of environmental health risk and associated impacts on public health. This is also important aspect for sustainable urban development planning and management.

3. Linkage to Other Indicators:

The indicator is linked to other social, economic and environmental indicators such as Waste generation, Waste recycling, Environmental Protection expenditure and Green House Gases Emission from Solid Waste.

4. Targets:

There are no quantitative target set for this indicator. However the campaign of "Green and Garbage Free City" prescribes a qualitative target for the best achievement in solid waste collection and disposal.

B. Analysis

From the data available as shown in Table 1a and Figure 1, it is observed that the total volume of solid waste daily collected in Yangon Capital were 400 tons/day in 1983, 564 tons/day in 1990, 787 tons/day in 2002 and 1150 tons/day in 2003-2004. As total solid waste daily generated were 1018 tons/day, 1346 tons/day, 1457 tons/day and 1435 tons/day respectively, the percentage of solid waste disposed was calculated as 39% in 1983, 42% in 1991, 54% in 2000 and 80% in 2003. Although it is not perfect, solid waste management in Yangon has been gradually making progress in better collection. In fact, this is an average rate for the whole city and the actual percentage of solid waste collection varies from one sub-urban unit to another – for example, the collection rate is higher in down-town area while it might be lower in sub-urban and satellite townships.

Currently, the collected wastes are hauled into waste dumping sites, which are located in the surroundings of the city. These sites are known to be for uncontrolled dumping but recent data from PCCD/YCDC has indicated that almost 99.96% of total amount of transported waste are daily land filled. It is also reported that half a ton per day of waste, particularly from hospitals, is incinerated equivalent to 0.04% of total disposal (see Table 1b). Due to data deficiency, the actual percentage of recycling from solid waste could not be verified but it is estimated that at least 10% of total solid waste generated are collected by private collectors and used for production of raw materials for cottage industries in Yangon.

From the annual report of the Department of Development Affairs, the amounts of municipal waste collected annually were given for urban areas of all State and Division, except for Yangon and Mandalay Capital, in Table 2. It was found that 9 out of 14 states and divisions have lower collection rates in 2003 in comparison to 1989. Improved collection rates were only observed in Magwe Division, Shan State, Mon Division and Ayeyarwady Division. The situation in Kachin State and Tanintharyi Division was unchanged. For the whole country, the percentage of solid waste collection in 2003 has decreased to 24% from 28% of 1998 (see Figure 2).

From these figures for Yangon Capital and State and Division, there is definitely a need to improve the current level of solid waste management for better collection and disposal as well as for systematic and sanitary treatment of the waste collected. With the mixture of progress in solid waste disposal and the need of quality assurance in treating collected waste, it is appropriate to remark that the State of solid waste management in Myanmar is stabilizing in general. Owing to the fact that solid waste collection in other GMS countries is found to be almost 100 % in Bangkok (Thailand) and 76% in the major cities of Viet Nam, the level of solid waste collection in Myanmar is considered to be relatively poor. However, improvement in data collection and analysis is required for generating systematic and consistent technical information related to solid waste management in order of understanding the real "State" of the sector concerned.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Municipal Solid Waste Generated in Yangon City - 1983 to 2004
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	What is the magnitude and trend of solid waste generated in Yangon Municipality?
Priority Concern	Inadequate Solid Waste Management
Geographic Area	Union of Myanmar
Magnitude & Trend	Medium and Steady
Key Message	By 2003/2004, the daily amount of solid waste generated in Yangon City was about 1435 tons per day and 6% higher than that of the 1991 level but slightly lower than that of 2000. Therefore, solid waste generation is steady in Myanmar and the level of pressure is medium as the 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.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track the amount of solid waste generated per person per day (per capita solid waste generated) as well as the daily amount of municipal solid waste generated in Yangon. Municipal solid waste is defined as “non gaseous and non-liquid waste that result from the daily activities of community’s residential and commercial sector within the given administrative urban area”. The generation of municipal solid waste is derived from the production of waste on a weight basis at the point of production. It is measured in Tons per day. For per capita solid waste generated the unit of measurement in kilogram per person per day.

B. Data Source

The following are sources of data for development of this indicator:

Population Related Data

Immigration and Manpower Department.1986. Rangoon City – 1983 Population Census. Ministry of Home and Religious Affairs, the Socialist Republic of the Union of Burma, Rangoon.

DOP.2005. Amendment of Population Data in EPA Report. Submission of Department of Population to National Commission for Environmental Affairs, Reference Letter No: 300/15 (0011)/ La-Pa-Na Dated 31 October 2005, Yangon.

CSO. 2002. Statistical Yearbook 2002. Central Statistical Organization, the Government of the Union of Myanmar, Yangon.

Solid Waste Related Data

YCDC. 2005. Data related to environmental indicator development for national performance assessment. Submission to NCEA by Pollution Control and Cleansing Department of Yangon City Development Committee, Reference Letter No: 109/01(322)/Sa-Tha-Ka dated 8 February 2005 Yangon.

Khin Maung. 1995. Solid Waste Management at the City of Yangon for Sustained Urban Development. Technical paper presented in National Conference on Environmental Management organized by National Commission for Environmental Affairs (NCEA) in cooperation with Hanns Seidel Foundation – 28-30 August 1995, NCEA/HSF DOC.No.15, Yangon.

Yamauchi, Hisashi. and Sato, Shinsuke. 2001. Related solid waste data of Yangon City for 2000, Daw Khin Win; Quoted in “Final Report on Planning and Techniques for Solid Waste Disposal in Yangon City, the Union of Myanmar”, Japan International Cooperation Agency (JICA) and Yangon City Development Committee (YCDC), Yangon

C. Geographic Area / Population Coverage

The indicator data is focused on solid waste generation in the capital city of Yangon; however the fact sheet includes supplemental data for waste generation for the Union of Myanmar as a whole.

D. Temporal Coverage

For Yangon city, waste generation data is for the period 1983-84 to 2003/04. For State and Division waste generation, solid waste generation in 1998 is compared with that of 2003.

E. Methodology and Frequency of Coverage

In the case of Yangon Capital, existing data only allows for the analysis of situations in four different years 1983, 1991, 2000 and 2003-04 within 20 years interval from 1983/84 to 2003/04. The rate of solid waste generation and daily-generated amount for budget year 2003 and 2004 were according to the official estimation made by concerned government department, Pollution Control and Cleansing

Department (PCCD) of Yangon City Development Committee (YCDC), based on their sampling data and owned analysis. For 2000, generation rate and total daily amount were directly from a previous report made by YCDC together with Japan International Cooperation Agency (JICA) for the study of "Planning and Technique for Solid Waste Management in Yangon. For 1991 and 1983, the rate of solid waste generation was calculated as stated below in "Data Manipulation" based on data obtained from published data of U Khin Maung, former head of PCCD/YCDC. When calculation was made for estimating the annual amount of solid waste generated in State and Division, the situations of Yangon and Mandalay Cities were excluded. Their situation is not comparable with the data obtained from Department of Development Affairs, which is an agency responsible for solid waste management in urban areas of all State and Division other than those cities. The population figures, which are crucial for calculating solid waste generation, are obtained from many sources using different methodology and frequency of coverage. Yangon city population for 1983 is excerpted from the national census report and data for 1991, 2000 and 2003/04 were based on data of Department of Population (DOP). Urban Populations of State and Division (without Yangon and Mandalay City Population) are also obtained from estimations by the DOP.

F.Methodology of Data Manipulation

From the report of Khin Maung (1995), the rate of solid waste generation for 1991 was calculated by tracing back data available for the percentage of daily collection and total collected amount of solid waste. An assumption was made for 1983 that the rate of solid waste generation was same as that of 1991. The calculation was not made for 2000 and 2003/04 as data were available from the concerned department and report.

For estimating the solid waste generation rate of State and Division, the rate of per capita solid waste generation for the 2000 level of Yangon Capital was used as referenced data. Adjustment was then made for each State and Division by discounting the referenced rate with the differences/ variations they have in monthly average household expenditure, which is hereby assumed as a basic determinant for the level of household garbage daily produced, compared to the level of Yangon Capital.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

This indicator is useful in determining the workload and nature of solid waste management to be tackled effectively and efficiently for sustainable urban environment. However, it is expensive and difficult to measure. Seasonal variation may also exist in waste density and volume due to the effect of differences in storage method and change in moisture content.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

As many assumptions were utilized in developing this indicative value, its reliability will be subject to a closer degree of association of these assumptions to the real situation, which is currently unknown due to a lack of basic data. The robustness of the data will be enhanced when the following conditions are met:

Time series data of waste generation collected by PCCD/YCDC has been maintained punctually and improved statistically for several years. Actual population figures have been known for suburban areas of studied Towns and Capitals.

C.Future Work Required (for data level and indicator level)

Time series data should be maintained by the concerned department for statistically improving the data consistency and relevancy as far as solid waste generation rate is concerned. If data could be analyzed for the suburban areas or various urban centers, this will be helpful for realizing the nature of complexity in waste generation by different activities. The composition of generated waste should be also studied punctually from time to time in order to understand the relationship between the waste generated and the change of consumption patterns. This will be helpful for developing further strategy on waste minimization and waste collection method. Collaboration should be also made among the concerned agencies for consolidating the official figures of the urban population, not only for the purpose of solid waste management but also for other purposes of sustainable urban development.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Municipal Solid Waste Generated in Yangon City 1983-2004

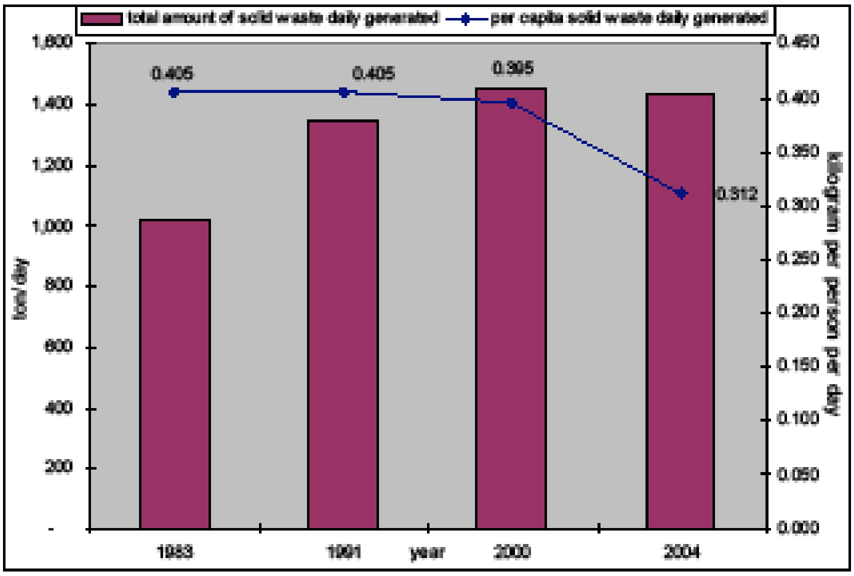


Table 1a: Daily Generated Solid Waste by Type in Yangon City

Particular	1983	1991	2000	2003/04
Per Capita Solid Waste Generation - Kg/person/day	0.405	0.405	0.395	0.312
Households waste generated - ton/day	1,018	1,206	895	n.a.
Commercial waste generated - ton/day	n.a.	n.a.	167	n.a.
Market waste generated - ton/day	n.a.	20	216	n.a.
Street waste generated - ton/day	n.a.	n.a.	85	n.a.
Other wastes unspecified & generated - ton/day	n.a.	120	94	n.a.
Total amount of solid waste generated - ton/day	1,018	1,346	1,457	1,435

Note: YCDC = Yangon City Development Committee, JICA = Japanese International Cooperation Agency, n.a. = not available

• Data for the years 2000 and 2003-2004 were directly quoted from JICA & YCDC Study, and data provided by YCDC to National Commission for Environmental Affairs (NCEA) for environmental indicator development.

• Data for 1991 and 1983 were derived based on YCDC quoted in Khan Muang (1995). It was assumed that there were same rates of Per capita solid waste generation for 1983 and 1991. Total amount of solid waste daily generated was calculated by multiplying per capita solid waste generation into urban population of respective years – 2.51 million (1983) and 2.98 million (1991).

Source: Immigration and Manpower Department (1986), YCDC quoted in Khan Muang (1995), Dawn Khan Win quoted in Yamauchi, Hibachi & Sato, Shinseki (2001), YCDC (2005) and DOP (2005)

Table 1b: Calculated Solid Waste Generation Rate from Available Data for 1991

No	Township	District	Amount of Solid Waste Collection in 1991 (ton/day)	Collected Solid Waste As % of Daily Generation	solid waste generation in 1991 kg/day	Urban Population in 1991	Per capita generation kg/cap/day
1	Thingangyun	East	9	13%	69,231	230,101	0.30
2	North Oak-kalapa	East	6	8%	75,000	226,317	0.33
3	South Oak-kalapa	East	21	unknown	21,000	217,263-	unknown
4	South Dagon	East		no service	unknown	-	unknown
5	North Dagon	East		no service	unknown	-	unknown
6	East Dagon	East		no service	unknown	-	unknown
7	Thaketa	East	4	6%	66,667	228,830	0.29
8	Dawbon	East	9	unknown	9,000	59,233	unknown
9	Mingalar	East					
10	Tarmwe	East	29	50%	58,000	142,159	0.41
11	Yankin	East	14	unknown	14,000	97,979	
12	Dagon Seikan (E/Dagon)	East		no service	unknown	-	unknown
13	Bo-ta-htaung	East	21	100%	21,000	58,279	0.36
14	Pazundaung	East	20	100%	2,000	46,004	0.43
15	Lanmadaw	West	23	100%	23,000	49,391	0.47
16	Lathar	West	15	100%	15,000	36,825	0.41
17	Pabedan	West	30	100%	30,000	49,700	0.60
18	Kyauk-ta-da	West	28	100%	28,000	44,617	0.63
19	Kamayut	West	19	50%	38,000	89,122	0.43
20	Hlaing	West	16	29%	55,172	203,530	0.27
21	Mayangone	West	15	28%	53,571	180,916	0.30
22	Ahlone	West	9	50%	18,000	61,466	0.29
23	Sanchaung	West	25	75%	33,333	81,643	0.41
24	Dagon	West	12	50%	24,000	42,128	0.57
25	Kyee Myin Daing	West	22	50%	44,000	82,827	0.53
26	Bahan	West	30	50%	60,000	121,050	0.50
27	Seikkan	West	3	unknown	3,000	6,262	unknown
28	Mingalardon	North		no service	unknown	147,759	unknown
29	Hlaing-thar-yar	North		no service	unknown	-	unknown
30	Shwe Pyi Thar	North		unknown	unknown	-	unknown
31	Insein	North	13	19%	68,421	262,346	0.26
32	Dala	South		no service	unknown	64,212	unknown
33	Seikgyi-kha-naung-to	South		no service	unknown	18,247	unknown

	Sum of per capita solid waste daily generation for 20 townships	8.10
	Average rate of waste generation - kg/cap/day in 1990/91	0.405
Note: Per capita solid waste generation rate was backward calculated based on information available for percentage of solid waste collection amount of solid waste daily collected and urban population in respective townships of Yangon City.		

Source: YCDC quoted in Khin Maung (1995), DOP (2005)

Figure 2: Volume of Solid Waste Generated in Urban Area of State & Division – 1998 and 2003 (excluding Yangon and Mandalay City)

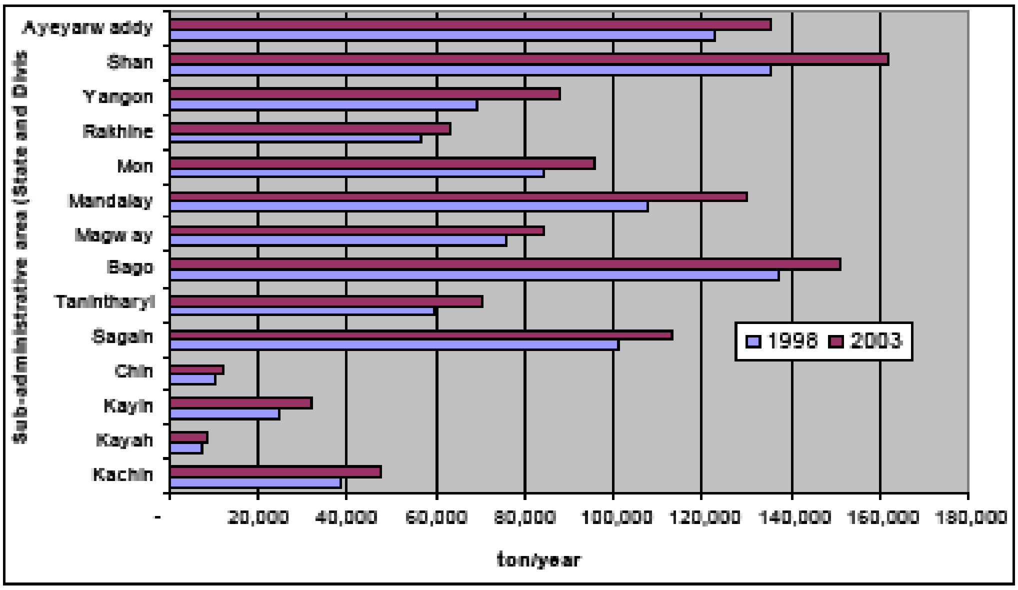


Table 2a: Figure 2: Volume of Solid Waste Generated in Urban Area of State & Division – 1998 and 2003 (excluding Yangon and Mandalay City)

State/Division	Urban Population a		Household Waste Generation		
	1998	2003	Rate b (kg/person/day)	1998 (ton/year)	2003 (ton/year)
Kachin	309,527	382,913	0.343	38,735	47,919
Kayah	81,924	98,043	0.242	7,251	8,678
Kayin	180,353	230,274	0.377	24,831	31,704
Chin	89,223	105,033	0.317	10,310	12,137
Sagain	953,316	1,068,070	0.290	101,042	113,205
Tanintharyi	379,856	446,445	0.431	59,733	70,204
Bago	1,208,730	1,333,291	0.311	137,159	151,294
Magway	835,200	933,412	0.248	75,713	84,616
Mandalay	1,346,590	1,624,789	0.220	108,206	130,561
Mon	827,698	936,119	0.281	84,873	95,990
Rakhine	509,466	573,456	0.304	56,589	63,697
Yangon	481,004	611,324	0.395	69,349	88,138
Shan	1,094,324	1,310,744	0.339	135,336	162,100
Ayeyarwaddy	1,221,413	1,342,780	0.277	123,296	135,548
Union Total	9,518,624	10,996,693		1,032,423	1,195,791

Note:
(a) –.Urban population is received from Department of Population (2005). Yangon and Mandalay City Population are excluded from estimation for Urban Population in Yangon and Mandalay Division
(b) – is meant for per capita solid waste generation as calculated in Table 2b. It is also assumed that there was the same rate of solid waste generation between 1998 and 2003.

Figure 3: Typical Composition of Solid Waste in Capital Yangon 2003/04

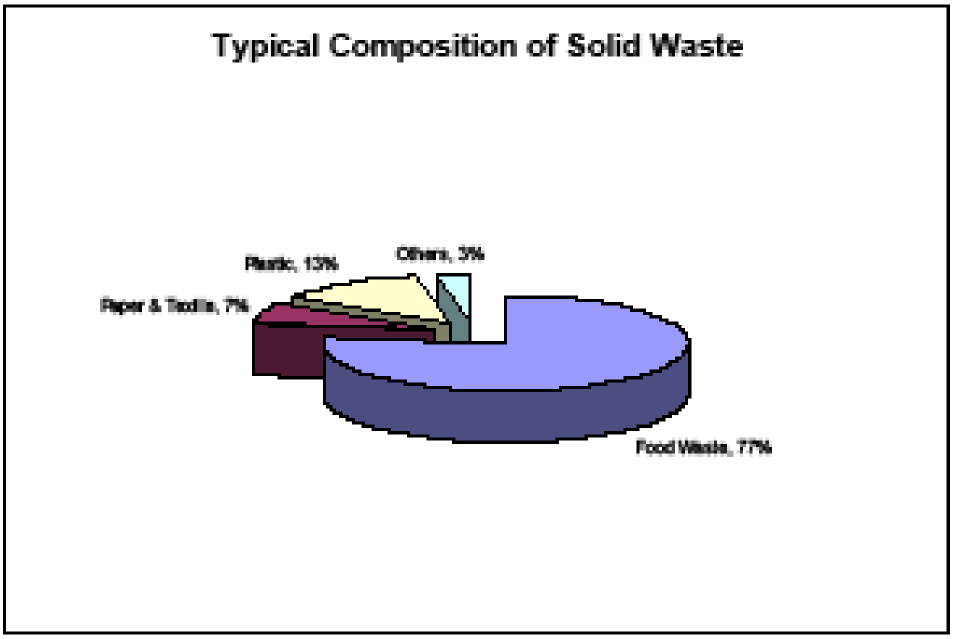


Table 3: Population in Yangon City 1983 to 2003/04

Administrative Districts	1983 (Census)	1991 (DOP)	2000 (DOP)	2003/04 (DOP)
Eastern Yangon	1,212,233	1,437,085	1,942,989	n.a.
Western Yangon	885,271	1,049,477	986,408	n.a.
Northern Yangon	345,959	410,105	817,694	n.a.
Southern Yangon	69,560	82,459	107,348	n.a.
Yangon City Total	2,513,023	2,979,126	3,854,439	4,111,524

Note: n.a. = not available. Census = National Population Census of 1983 quoted in Immigration and Manpower Department (1986), DOP = Department of Population.

Source: Immigration and Manpower Department (1986) and DOP (2005).

SUMMARY

A. Policy Reference

1. Purpose:

The main purpose of this indicator and this fact sheet is to better understand the level of workload that urban authorities are facing in managing solid waste effectively in their municipal area.

2.Relevance to Environment Planning and Management:

Generation of waste as an indicator is intimately linked to the level of economic activity in the country. It is also an indication of the patterns of consumption of raw materials. Wealthier economies tend to produce more waste. The reduction in the volume of waste generated is an indication of changes in consumption patterns with respect to raw materials and increase in recycling and reuse.

3.Linkage to Other Indicators:

This indicator is intimately linked to other socio-economic and environmental indicators especially those related to income-level and economic growth. Those would include; rate of growth of urban population, gross domestic products (GDP) per capita, waste disposal and waste recycling.

4.Targets:

There is currently no quantitative target set in reduction of solid waste generation in Myanmar.

5. International Environment Treaties:

No international agreements exist for reduction in solid waste production.

B. Analysis

From the best available data, the total amount of solid waste daily generated by Yangon Capital and the respective rate of solid waste generation per capita per day are shown in figure 1 and table 1. According to data provided by Pollution Control and Cleansing Department PCCD of Yangon City Development Committee (YCDC) for year 2003/04, the volume of solid waste daily generated has been reduced to 0.312 kg/ person/day from 0.395 kg/person/day in year 2000 and 0.4 kg/person/day in both 1991 and 1983.

It seems that the increases in GDP growth and per capita income during the last decade have not resulted in an increase in the volume of waste generated by a change in the pattern of individual consumption. The recent strenuous effort of PCCD in collecting taxes on domestic waste management might have led urban dwellers to minimize waste generation. Due to the lack of data, these facts and their correlation are not analyzed further in the EPA.

Despite the reduction in per capita waste generation, the total amount of waste daily generated in Yangon Capital has increased as the urban population has grown. Within twenty years, the daily-generated waste amount has increased from 1018 tons per day in 1983 to 1,435 tons per day in 2003/04, an increase of almost 29%l.

As can be observed in Figure 3, typical compositions of solid waste are governed by bio-degradable materials such as paper and textiles (7%), and food refuse (77%). Due to a lack of data, a trend in changes of waste composition could not be observed during the EPA.

An estimation of per capita solid waste generation for State and Division was also given in Table 2b. By using the percentage of the variation in household expenditure level in comparison to the Yangon level, solid waste generation was derived for each and every State and Division based on per capita daily waste generation of Yangon Capital. Then, total amount of municipal solid waste generated per year was calculated in Table 2a for all State and Division excluding data for urban area of Yangon and Mandalay Capitals. As shown in Figure 2, it is observed that Mandalay, Shan, Sagaing, Bago and Ayeyarwady are the areas where the highest volumes of solid waste were generated among the sub-national administrative units of Myanmar. Similar to Yangon Capital, the total amount of solid waste generated by year 2003 is higher than that of year 1998.

As seen in both case of Yangon City and other States and Divisions, the trend of solid waste generation has been steadily increasing and creating consistent pressure on solid waste management. Nevertheless, the level of pressure appears to be medium in comparison with other GMS countries because solid waste generation was found to be 104 tons/day in Vientiane/Lao PDR (1998) and nearly 6000 tons/day in Bangkok (1998).

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Expenditure on Solid Waste Management in Yangon City 1994 – 2004
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	How effectively have financial resources been utilized in improving solid waste management in Yangon?
Priority Concern	Inadequate Solid Waste Management
Geographic Area	Union of Myanmar
Impact & Trend	Average and Consistent
Key Message	At the 1994 constant price level, financial management for solid waste management in Yangon city has been significantly improved within the last ten years in terms of allocating more financial resources (4.5 times the 1994 level) and effort made in collecting more revenue from waste collection and disposal for better financial viability. However, the rate of solid waste collection is still modest level and there is a room to improve its collection, disposal and treatment. Thus, the response to selected environmental concerns is seen to be average by this indicator.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track the amount of expenditure annually spent by Yangon City Development Committee for managing solid waste management effectively in Yangon city. Unit of measurement is the value of money in Kyat at the constant price of 1994's base year.

The expenditure on urban solid waste management is the amount of money spent on the provision of public services for solid waste management by concerned authority, Pollution Control and Cleansing Department of Yangon City Development Committee.

Solid waste management is the generic term for planning, implementation, supervision and monitoring of the activities related to collection, disposal, recycling and treatment of municipal solid waste. The following are definitions for different categories of expenditure.

Capital Investment – this is expenditure incurred for purchasing of heavy machinery, equipment, transportation facility and for developing the sites and premises for waste disposal, dumping, land filling, incineration and treatment.

Waste Operation – this is mostly related to the cost incurred for hiring daily waged labor for waste collection and cleansing the road. The cost spent for fueling of transport facility is also included.

Personnel – this is mainly for the payment of salary and remuneration to permanent staffs appointed for solid waste operation and management

Administration – this is the cost related to running the office and documentation.

Maintenance and other – this is related to the cost of maintaining the facility, equipment and transportation facilities of solid waste management including the money spent for miscellaneous items.The following are definitions for different categories of revenue.

Revenue from household waste – this is the sum of taxes collected from every residential households of the administrative urban area on a monthly basis for collecting household waste.

Revenue from commercial waste – this is the sum of both taxes and charges for collection and disposal of waste from commercial activities and enterprises such as restaurant, shops, hotels and markets.

Revenue from Hospital waste and others - this is the sum of charges for collection of waste from hospital and medical clinic. The charges for special collections requested by customers are also included.

B. Data Source

The overall budget and revenue data for 1994 to 1999 were received from a previous report from a joint study done by the Japanese International Cooperation Agency and Pollution Control and Cleansing Department (PCCD) of Yangon City Development Committee. The annual budget/ expenditure with the break down for itemized categories from 2000 to the most recent budget year of 2003-04 were obtained from the reference data submitted by PCCD to the National Commission for Environmental Affairs (NCEA) of Myanmar for the use in EPA exercise. The reference data for consumer price index were based on the National Statistical Yearbooks (1997, 2002) of Central Statistical Organization (CSO) of Myanmar. City Population data were obtained from Department of Population (Ref:300/15(0011)/La-Pa-Na dated October 31 2005).

C. Geographic Area / Population Coverage

The data and the indicator only cover the expenditure of the concerned municipal authority for Yangon City.

D. Temporal Coverage

The figure for total expenditure applies only to the period from 1994 to 1999. The expenditure with break down category applies to the year 2000 to the recent budget year of 2003/2004.

E. Methodology and Frequency of Coverage

The expenditure data are for the period of budget year, which start from 1 April to 31 March of the incoming year. The value of the expenditure is calculated by the prevailing price level of the respective budget year.

F. Methodology of Data Manipulation

The expenditure is converted into nominal value by using the 1994 constant price level which was derived from the reference data of CSO's consumer price index based on the 1985-86 constant price level. Net cash flow was also calculated by subtracting the total expenditure from the total revenue of respective years.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

The indicator provides the scenario of financial resource actually available and committed for solid waste management over time by taking into consideration its inflated value. When it is compared with the amount of revenue generated from solid waste management, financial viability could be analyzed for efficiency and adequacy of urban solid waste management in the long-term. However, the data do not support fully for the analysis of expenditure incurred for important operations of solid waste collection, disposal, transportation and treatment. As data are only available for Yangon city, it limits the understanding of the overall national responses to solid waste management throughout the country.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

Since the data are compiled from precise information of financial reports, their accuracy and reliability is considered to be high.

C.Future Work Required (for data level and indicator level)

For comprehensive analysis, the data for Yangon City should be broken down into important solid waste management operations such as waste collection, disposal, transportation and treatment. The data from the Department of Development Affairs should be also collected for the expenditure incurred by respective township municipal authorities across all States and Divisions.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1a: Annual Revenue and Expenditure of Solid Waste Management in Capital Yangon at 1994 Constant Price Level (Million Kyat)

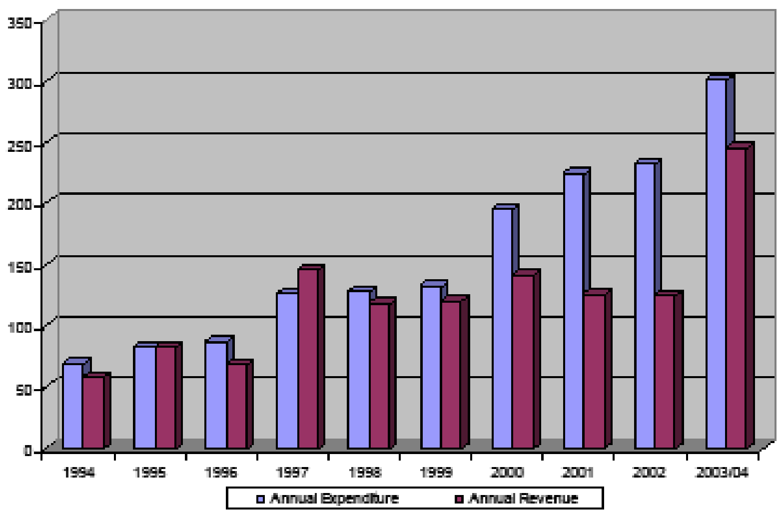


Figure 1b: Level of Financial Subsidy (Net Cash Flow of Expenditure versus Revenue) for Solid Waste Management in Capital Yangon (at 1994 Constant Price Level) (Million Kyat)

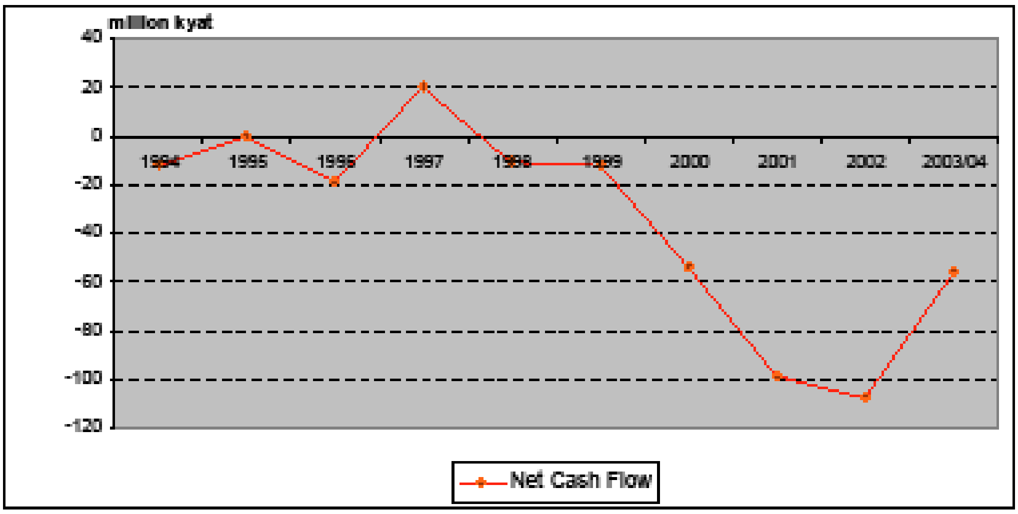


Table 1a. Annual Revenue and Expenditure for Solid Waste Management in Capital Yangon (Million Kyat)

Year	Annual Expenditure	Annual Revenue	Consumer Price Index at 1994 Price Level
1994	69.3	57.5	100.000
1995	100.8	100.7	121.842
1996	126.9	99.7	146.243
1997	189.8	219.6	150.045
1998	250.2	229.8	195.193
1999	299.3	271.5	225.733
2000	433.0	313.0	221.843
2001	668.9	374.2	298.378
2002	1094.9	588.3	471.756
2003/04	1208.9	983.6	401.519

Source: Yangon City Development Committee (2005), Statistical Yearbooks 1997 and 2002

Table 1b. Annual Revenue and Expenditure of Solid Waste Management in Capital Yangon at 1994 Constant Price Level (Million Kyat)

Year	Annual Expenditure	Annual Revenue	Net Cash Flow
1994	69.3	57.5	-11.8
1995	82.7	82.6	0.0
1996	86.8	68.2	-18.6
1997	126.5	146.4	19.9
1998	128.2	117.8	-10.4
1999	132.6	120.3	-12.3
2000	195.2	141.1	-54.1
2001	224.2	125.4	-98.8
2002	232.1	124.7	-107.4
2003/04	301.1	245.0	-56.1

Source: Yangon City Development Committee (2005)

Figure 2a: Percentage Change in Expenditure and Revenue to Year 2000 Level

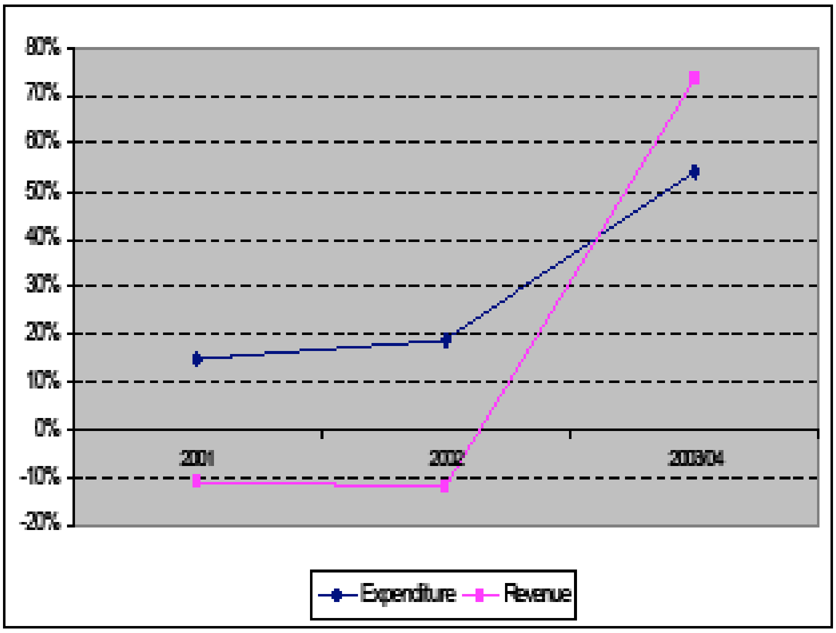


Figure 2b: Itemized Expenditure in Solid Waste Management of Capital Yangon (at 1994 Constant Price Level – Million Kyat)

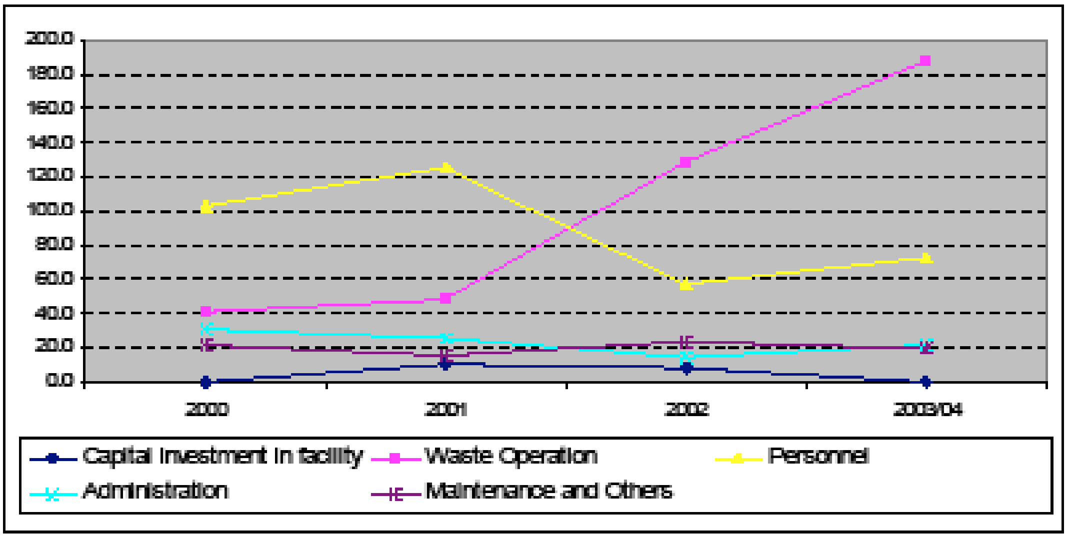


Table 2a: Itemized Expenditure on Solid Waste Management in Capital Yangon (at 1994 Constant Price Level - Million Kyat)

No.	Expenditure Item	2000	2001	2002	2003/04
A	Capital investment in facility	0.0	9.9	8.6	0.0
B	Waste Operation	40.3	47.8	128.6	187.4
C	Personnel	103.1	125.9	57.4	72.9
D	Administration	30.7	25.4	14.2	21.0
E	Maintenance and Others	21.0	15.3	23.2	19.8
F	Total Expenditure	195.2	224.2	232.1	301.1
G	Percent changed as of year 2000 level	100%	15%	19%	54%

Source: Yangon City Development Committee (2005)

Table 2b: Itemized Expenditure on Solid Waste Management in Capital Yangon (Million Kyat)

No.	Expenditure Item	2000	2001	2002	2003/04
A	Capital investment in facility	0	29.45	40.75	0
B	Waste Operation	89.44	142.7	606.81	752.46
C	Personnel	228.83	375.56	270.87	292.68
D	Administration	68.1	75.65	67.01	84.21
E	Maintenance and Others	46.63	45.54	109.43	79.51
	Total Expenditure	433	668.9	1094.87	1208.86

Source: Yangon City Development Committee (2005)

Table 2c: Revenue by Sources from Solid Waste Management in Capital Yangon (at 1994 Constant Price Level – Million Kyat)

No.	Revenue Item	2000	2001	2002	2003/04
A	Household Waste (1.0 - 2.-0 Kyat/day)	43.5	31.7	20.9	24.9
B	Commercial Waste (200 - 225000 Kyat/,month)	69.1	57.3	73.8	166.4
C	Hospital Waste (600 - 150000 Kyat/month)	n.a.	4.2	2.8	3.4
D	Others	28.6	32.2	27.3	50.3
E	Total Revenue	141.1	125.4	124.7	245.0
F	Percent changed as of year 2000 level	100%	-11%	-12%	74%

Source: Yangon City Development Committee (2005)

Figure 2b: Revenue by sources in Solid Waste Management of Capital Yangon (at 1994 Constant Price Level – Million Kyat)

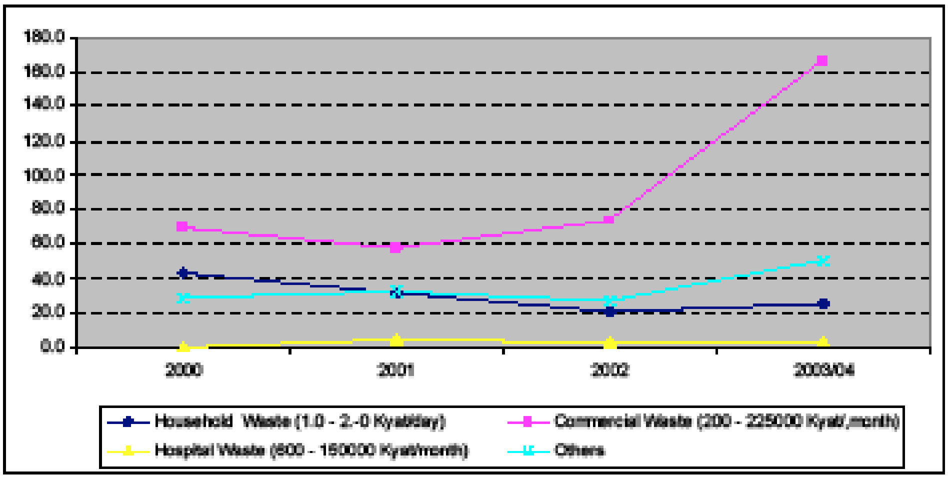


Table 2d: Revenue by Sources from Solid Waste Management in Capital Yangon (Million Kyat)

No.	Revenue Item	2000	2001	2002	2003/04
A	Household Waste (1.0 - 2.-0 Kyat/ day)	96.42	94.64	98.43	99.81
B	Commercial Waste (200 - 225000 Kyat/,month)	153.19	170.99	348.17	668.15
C	Hospital Waste (600 - 150000 Kyat/ month)	n.a.	12.41	13.01	13.85
D	Others	63.36	96.18	128.69	201.81
	Total Revenue	312.97	374.22	588.3	983.62

Source: Yangon City Development Committee (2005)

Table 3: Cost Recovery and Subsidiary on Per Unit Solid Waste Collected

No.	Description	2000	2001	2002	2003/04
A	Total Revenue	312.97	374.22	588.30	983.62
B	Total Expenditure	433.00	668.90	1094.87	1208.86
C	Net Financial Flow	-120.03	-294.68	-506.57	-225.24
D	Consumer Price Index at Year 1994 Constant Price	221.843	298.378	471.756	401.519
E	Net Financial Flow at Year 1994 Constant Price	-54.106	-98.761	-107.380	-56.097
F	Total collected and disposed solid waste (ton/year)	142,400	n.a.	n.a.	419,750
G	Subsidiary cost per collected waste (kyat/ton)	(379.96)	n.a.	n.a.	(133.64)

Source: Yangon City Development Committee (2005)

Table 4. Level of Solid Waste Management in Capital Yangon

No.	Particular	1983	1990	2000	2003/04
A	Total City Population	2,513,023	2,921,521	3,854,439	4,111,524
B	Total solid waste collected (ton/day)	400	564	787	1150
C	No of sanitation worker for manual waste collection	1700	4170	3266	4,469
D	No of urban dwellers per sanitation worker (persons)	1,478	701	1,180	1029
E	Solid waste to be handled by one worker (ton/worker/day)	0.235	0.135	0.241	0.257
F	Maximum Waste Handling Capacity by Facility (ton/day)	450	800	979	1150

Source: Yangon City Development Committee quoted in Khin Maung (1995), Yamauchi, Hisashi. and Sato, Shinsuke. (2001), Yangon City Development Committee (2005), and DOP (2005)

SUMMARY

A.Policy Reference

1.Purpose:

The main purpose of this indicator is to give an indication of the type and level of service that the city authority provides for waste management and the relative importance that it attaches to waste management in relation to other services. It is also an indication of the efficiency of the waste
collection services.

2.Relevance to Environment Planning and Management:

This is an important factor in determining the commitment toward sustainable urban development and improving environmental safety net of citizens in accordance with the national health policy. If waste is not handled properly, there is a significant level of deterioration in public health and the living environment which results in a loss in productivity and reduced economic output.

3.Linkage to Other Indicators:

This indicator is linked to GDP per capita, other environmental protection expenditure, and those associated with the generation, disposal, and recycling of waste.

B.Analysis

Although there is no quantifiable policy target set for solid waste management in Myanmar, the overriding statement of the goal for "Green City and Free Garbage" may well serve as a target to keep the best service of solid waste management by the concerned authority. How far commitments have been made in terms of allocating financial resources to achieve this goal has been the focus of this EPA for reviewing the performance related to solid waste management. Because of data deficiency, only Yangon has been studied.

The nominal value of annual expenditure and revenue were available for the period from 1994 to the budget year of 2003/2004 (Table 1a) and they were converted into the nominal value at the 1994 constant price level by using the consumer price index of Central Statistical Organization. As observed in Table 1b, financial allocation has been annually made more available to solid waste management in Yangon Capital. Total expenditure for 1994 was merely 69 million kyats but it reached to 300 million kyats in 2003. It is almost four and half fold higher than the expenditure level of 1994. An especially sharper increase of budget expenditure occurred after year 2000. In the mean time, the level of revenue annually collected has been raised from 58 million kyats in 1994 to 245 million kyats in 2003, although there were slightly fluctuations in some years during the same period. It indicates the increased efficiency in the collection of revenue by the concerned department of PCCD/YCDC in recent years. Therefore, as shown in Figure 2a, revenue collected in 2003 is 74% higher than that of 2000 level whereas gradual rises of expenditure in comparison to the 2000 level were 15% in 2001, 19% in 2002 and 54% in 2003. By keeping the trend of revenue above the expenditure, the best expectation would be that financial subsidiary for solid waste management could be reduced to an acceptable level for enhancing the capacity of the concerned agency to manage solid waste adequately. This will be an important aspect for financial viability of solid waste management because subsidizing all the time as observed in figure 1b may be disadvantageous to the management resources in the long term.

The nature of expenditure is further analyzed in the EPA with the data available for the expenditure incurred for the various cost items during the period of 2000 to 2003/04 budget year. As of the 1994 constant price level (as shown in Table 2a), the operation cost for waste handling (labor wages for collection and disposal) had been constantly increasing while the administrative cost was almost stable without much change and personnel cost for permanent technical and operational staffs has declined. There was no capital expenditure incurred for infrastructure development and facility improvement in year 2000 and 2003/04. Only a few million kyats had been spent for this purpose in 2001 and 2002. In other words, total expenditure has been mostly incurred for waste collection and the cost of waste treatment was minimal. As the preferred trend should reverse this situation, more investment should be made available to solid waste management for reducing the environmental impact from solid waste. However, it should be recognized that increased spending on reinforcing the work force for improving efficiency in waste collection has been made by recruiting more staff to 4,469 employees in year 2003, whereas the total number of employed sanitary wage staff were 1700, 4170 and 3266 persons for 1983, 1990 and 2000 respectively (Table 4).However, it has not helped to reduce the work load of each sanitary worker for better efficiency in manual collection of waste, although the number of urban residents per one labor becomes less in recent years. The minimal amount of solid waste one waste collector has to handle daily was 0.257 tons in 2003/04 in comparison to 0.235 tons in 1983, 0.135 tons in 1990 and 0.241 tons in 2000.From the data available, the revenue by sources at the 1994 constant price level was given for year 2000 to 2003/04 in Table 2c. There are four main sources of revenue; namely - (a) revenue from collection of household waste at the rate ranging from 1 to 2 kyat per day, (b) revenue from collection of commercial waste at the rate ranging from 200 to 225,000 kyat per month,

(c) revenue from collection of hospital waste at a rate ranging from 600 to 150,000 kyat per month, and (d) revenue from other sources. As observed in Figure 2b, outstanding performance has been seen in the collection of revenue from commercial waste collection and disposal with the sharper rise of revenue amount at a nominal price level to 245 million kyats in 2003/04 from 141 million kyats in 2000. With the due diligence of the concerned authority (PCCD/YCDC), improvement in revenue generation has reduced the financial burden of subsidizing solid waste management to 56 million kyats in 2003 from 107 million kyats in 2002. In comparison, a subsidy of only 134 kyats per ton of collected waste was required by the year 2003, in comparison to 380 kyats per ton in 2000.In summary the response over environmental concern in inadequate solid waste management has improved in recent year in terms of allocating more financial resources and enhancing financial viability conducive to increased solid waste collection rate. Therefore, there is a consistent trend in responding to selected environmental concerns, although the level of performance is rankedaverage as the present rate of solid waste collection is at a modest level and there is room to improve further in the collection and sanitary treatment of collected and disposed wastes.

Greater Mekong Subregion **Indicator Fact Sheet**	
DATABASE INFORMATION	
Indicator ID	
Indicator Name	TSP Concentrations in Yangon City 1998 - 2000
Year of Assessment	2005
Type of Indicator	State
Frequently Asked Question (FAQ)	What is the level of air pollution in urban areas created by motor vehicles?
Priority Concern	Mobile Source Air Pollution
Geographic Area	Union of Myanmar
State & Trend	Relatively Poor with Undetermined Trend
Key Message	From different research studies for different temporal coverage, the concentration of Total Suspended Particulate (TSP) matter was higher in Yangon than the WHO standard. The same situation was also observed in the measurement of Lead (Pb) and SO2. Therefore, the “State of mobile source air pollution” in Yangon city is relatively poor. However, the trend of this indicator is not observable as there is a lack of data and no measurement on a regular basis.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track the level of ambient air concentration in Yangon city in terms of measuring the concentration of Total Suspended Particulate (TSP) matter.
Ambient air concentration is, by general definition, the concentration of a hazardous pollutants or radioactive material in the atmosphere measured at remote locations, as against being directly measured from the point of release. It is here specific to the measurement of:
• Sulfur dioxide (a pollutant when fossil fuels containing sulfur are burned),
• Lead (a product of combustion from motor vehicles using leaded gasoline)
• Total Suspended Particulate Matter – TSP (fine solid and liquid particles dispersed in the atmosphere from combustion processes, industrial activities, or natural sources and small enough to be inhaled and affect the respiratory tract).
The measurements are given in microgram per cubic meter (μ/m3) for TSP and Lead. For SO^2, parts per million (ppm) is used in this indicator development.

B. Data Source

A research project of the Department of Atomic Energy under Ministry of Science and Technology undertaken during the period 1998-2000 is the only source for Total Suspended Particulate matter and Pb concentrations in ambient air. The data for SO^2 concentrations were obtained from the postgraduate study of the Chemistry Department, Yangon University.
Wai Zin Oo. 2001. Air Pollution Monitoring Using Nuclear Related Analytical Techniques. Department of Atomic Energy, Ministry of Science and Technology, the Government of the Union of Myanmar, Yangon.
Saw Kalayar. 2000. Sulphur Dioxide in Yangon City Area Near Chaung Wa. M.Sc. Thesis, Department of Chemistry, Yangon University, Yangon.

C. Geographic Area / Population Coverage

Geographically, data has only covered the selected sites of Yangon Capital. For the measurement of TSP and lead concentration, the sites covered by the study are some urban centers and suburban areas of the city where traffic used to be congested. SO^2 was measured in the Chaungma area around Bayintnaung Road, the suburban area of Hlaing township which was near to industrial locations with a high vehicle density of trucks.
Different temporal coverage exist for different air pollutants as follows:
• Sulphur dioxide – from January 1999 to April 2000
• TSP – from 1998 to 1999 and selectively, November 2000
• Lead – from 1997 to 1999

D. Methodology and Frequency of Coverage

By using a nuclear related method of X-ray Fluorescence Analysis Technique, Radiation Monitoring Laboratory of the Department of Atomic Energy measured the mass concentration in aerosols and total suspended particulate matter at selected sites of Yangon city for different temporal coverage as mentioned earlier.
In measuring SO^2, the following methods were employed by the research study:
• Toxic Gas Detector (Model – p-81930-04, Cole – Parmer International, USA)
• Hydrogen Peroxide Method (air sample trapped into impinger and titration in the laboratory)
• Iodine Method (air sample trapped into impinger and titration in the laboratory).
• Fuchsin or Roasaniline Method (air sample trapped into impinger and titration in the lab)

E. Methodology of Data Manipulation

No data manipulation was performed for TSP and lead concentration. Only averaging of the different results by four different laboratory methods for the measurement of SO^2 was done for the monthly average data of 1998 and 1999 in this fact sheet.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

The data and the indicator provide a general indication of air pollution level in the ambient air of Yangon city. Because of different temporal coverage and sites for measuring air pollutants, it is difficult to collate all the data consistently in analyzing air pollution level in Yangon city. In addition, shorter temporal coverage of each research study limits the time trend analysis of the air pollution level.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

By technical supervision and the research methodology employed, each research study for the measurement of different air pollutants had generated reliable results and research findings with relatively higher accuracy. However, vehicle emissions might not necessarily be the sole reason for causing the concentration of TSP matter in Yangon and possibly it might be also linked to the construction industry that was growing contemporarily.

C. Future Work Required (for data level and indicator level)

More systematic and consistent data collection on ambient air concentration for all important parameters of air pollutants is seriously required to monitor the ambient air quality in Major cities, at least Yangon and Mandalay.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1a: Annual Average of Total Suspended Particulate (TSP) Matter in the Capital Yangon

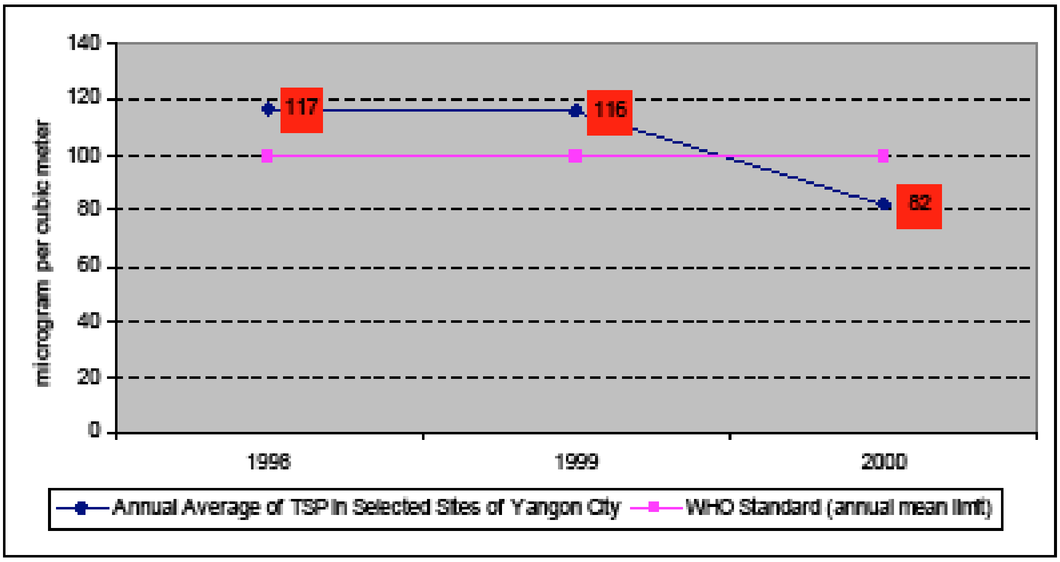


Figure 1b: Average Monthly Total Suspended Air Particulate (TSP) Matter in the Capital Yangon

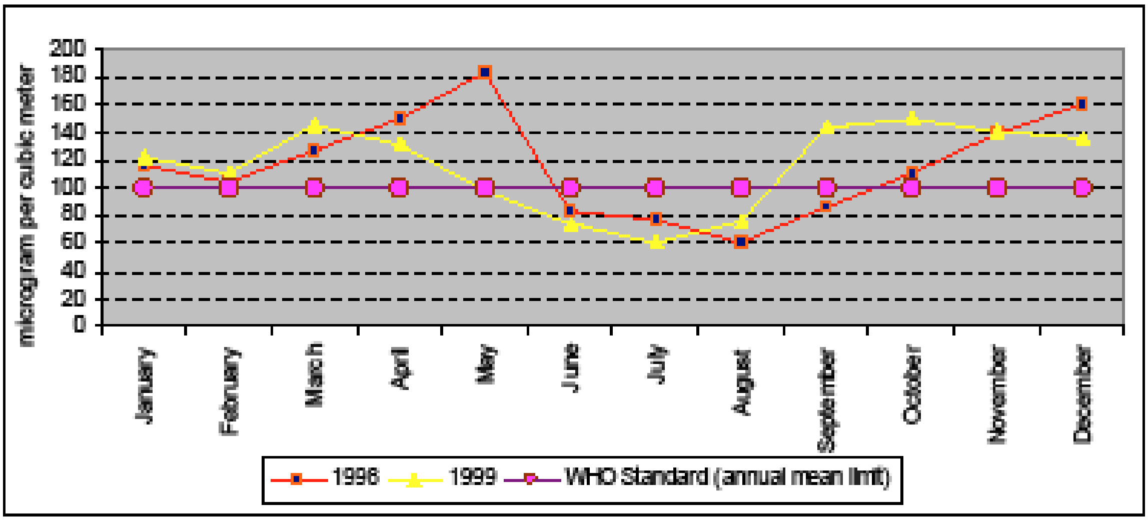


Table 1a: Average Monthly Total Suspended Air Particulates (TSP) in Aerosols in Yangon

Month	1998	1999	2000
January	117	123	-
February	105	111	-
March	128	145	-
April	150	132	-
May	183	99	-
June	84	75	-
July	77	60	-
August	60	76	-
September	87	144	-
October	110	150	-
November	140	141	82
December	160	137	-
Annual Average	117	116	82

Source: Department of Atomic Energy, Ministry of Science and Technology, 2001

Table 1b: Total Suspended Particulate Measurement in Yangon, November, 2000

No	Site for Measuring Air Pollutant	Coarse µg/m^3	Fine µg/m^3	Total Suspended Particulate Matter µg/m^3
1	Thamine	64.28	19.78	84.06
2	Hling thar yar	20.34	7.72	28.06
3	Down-town 31st street	39.00	19.13	58.13
4	South Dagon Industrial Zone	60.30	19.55	79.85
5	Yankin (SITE 1, 2 & 3)	58.83	29.70	88.53
6	Bahna - Shwe Gon Daing – Junction	58.85	30.60	89.45
7	Theinbhyu - Bogyoke Rd. Junction	79.80	39.20	119.00
8	Kanbe - Kabaraye Site 1, 2 & 3	69.54	36.05	105.59
	Average TSP	81.58		

Source: Department of Atomic Energy, Ministry of Science and Technology, 2001

Figure 2: Mass Concentration in Aerosols in the Capital Yangon

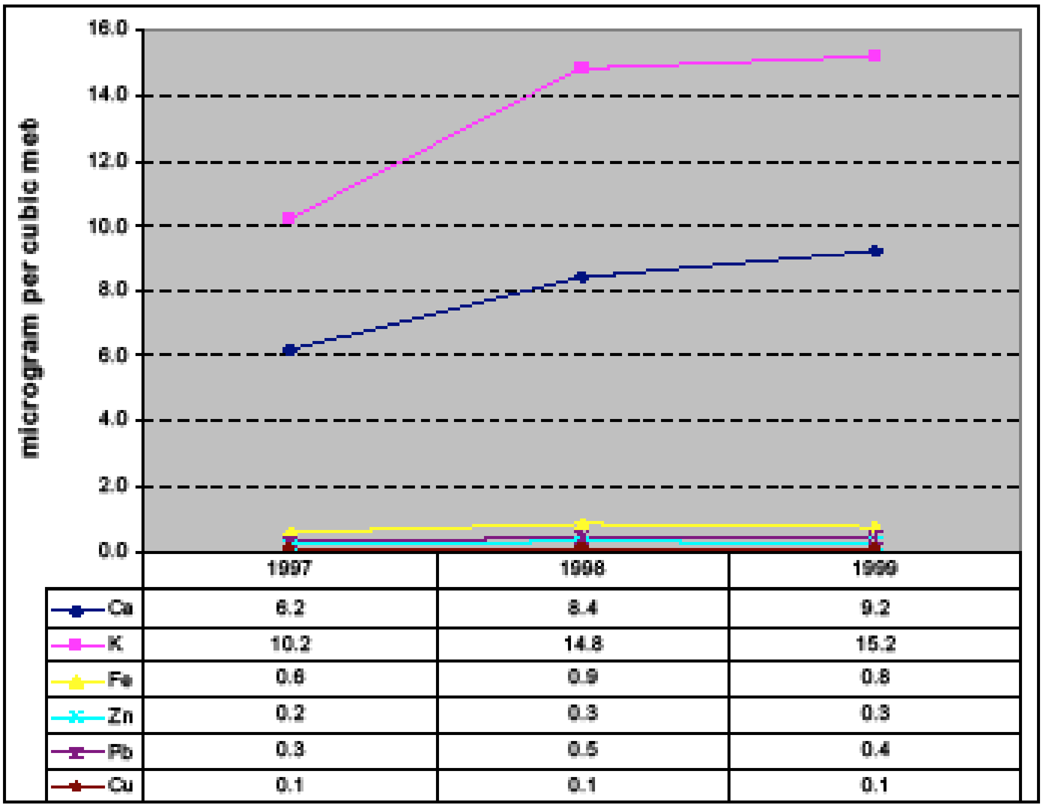


Figure 3: Monthly Average of Sulfur Dioxide Concentration in Selected Sampling Sites in the Capital Yangon

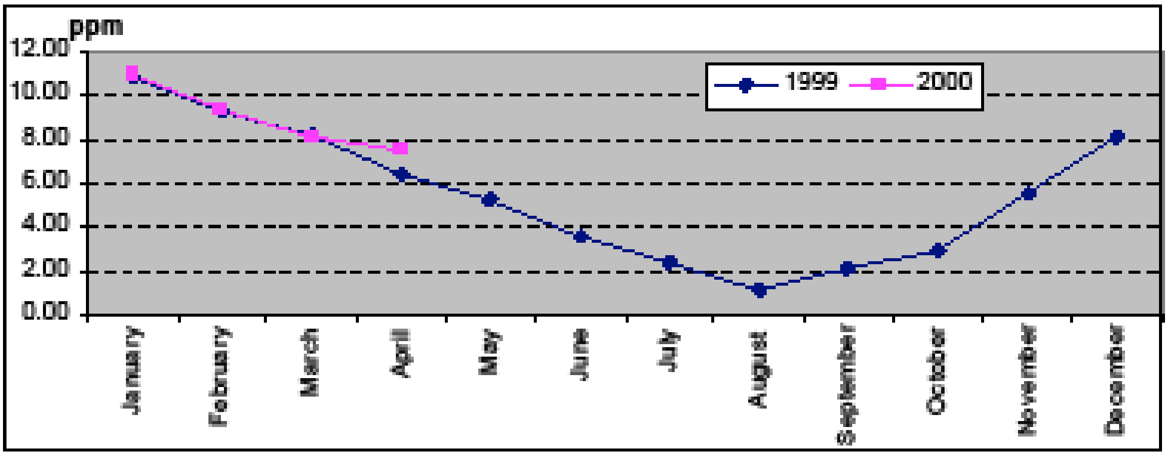


Table2: Monthly Average of Sulfur Dioxide Concentration (microgram per cubic meter) in Selected Sampling Sites in the Capital Yangon

Month	1999	2000
January	10.80	10.91
February	9.21	9.36
March	8.13	8.05
April	6.40	7.46
May	5.24	-
June	3.57	-
July	2.35	-
August	1.04	-
September	2.10	-
October	2.88	-
November	5.48	-
December	8.10	-
Annual Average	5.44	8.94

Source: Saw Kalayar, 2000

SUMMARY

A. Policy Reference

1. Purpose:

The purpose of this indicator is to better understand the ambient air quality of a major city, Yangon, and the nature of air pollution linked to vehicle emission.

2. Relevance to Environment Planning and Management:

This is relevant to monitoring of environmental quality. As the National Health Policy is clearly stated about reducing the environmental health hazard for all citizens, air pollution monitoring and control are essential in improving environmental quality.

3. Linkage to Other Indicators:

This indicator is linked to other indicators such as Car Equivalent Unit, Automotive Fuel Sold/ consumption and Ambient Air Quality of NOx and CO emission.

4. Targets:

No target exists yet as there is no national standard for ambient air quality. However, international standards such as the World Health Organization's (WHO) annual mean limits are applied in comparing the results. According to the "Second ASEAN State of the Environment Report 2000" (published by the ASEAN Secretariat in 2001), WHO's annual mean limits for TSP and SO2 are 100 and 50 microgram per cubic meter respectively.

5. International Environment Treaties:

There is no direct international environmental treaty linking mobile source air pollution for necessary action, however, the "UN Framework on Climate Change Convention" is linked with the monitoring of Greenhouse Gases.

B. Analysis

There is a serious lack of data for determining the situation of mobile source air pollution in the major cities of Myanmar. However, an attempt was made during the EPA to compile the best available data from secondary sources for generalizing the current state of ambient air concentration in Yangon Capital.

According to the data collected from various sampling points of urban center (Botataung Pagoda Road and Kanbe, Kanber Aye Pagoda Road) in 1998, 1999 and 2000, annual average of Total Suspended Particulate matter (TSP) was above the level of the WHO standard of 100 µg/m^3 (see figure 1a). As shown in figure 1b, the level of TSPM was seasonally varied and in general, it was high during mid summer (April and May) and early winter (November and December). A 24 hours average level of TSPM in different sampling points of Yangon capital was given in Table 1b for the period of November 2000 and data reveal that Theinphyu Road, Shwe Gon Daing Junction, Kanber Aye road, Yankin and Thamine junction were the locations where relatively high TSP levels were observed.

From the same source of data, measurement of mass concentration in Aerosols at Yangon Capital were further analyzed. Especially, annual average of lead concentrations in 1997, 1998 and 1999 ranged from 0.3 to 0.5 µg/m3. As the WHO standard is 0.5 to 1 µg/m3 (National Environmental Engineering Research Institute, 1996, pp: 7), it is approaching the acceptable limit. Notably, gradual rises in "Ca" and "K" were observed for all studied years – 1997 to 1999. (See Figure 2)

Data related to SO2 concentration in selected survey sites of suburban residential areas (around Bayint Naung Road, Hlaing Townhship) were also obtained from a postgraduate study at Yangon University. The data were limited for providing a trend line as measurements were only taken for the whole year of 1999 and partially for 2000. Nevertheless, it provides the scenario of seasonal trends in SO2 concentrations. Monthly average concentrations for all methods of measurement were highest during the month of January (10.8 ppm) with a gradual decline to the lowest level of 1.04 ppm in the rainy season (August). The annual average was 5.44 ppm for 1999 which is higher than the acceptable limit – WHO standard for SO2 annual mean limit is 50 $\mu g/m^3$ or 0.02 ppm according to references quoted in 2nd ASEAN State of Environment Report 2000. (See Figure 3 and Table 2).

Taking into consideration the results from the available measurements as far as mobile source air pollution is concerned, ambient air concentration in terms of TSP, Lead and SO^2 approached to above the acceptable limits as standardized by international organizations and neighboring countries. Therefore, the current state of mobile source air pollution in major cities of Myanmar is relatively poor in comparison to the international standard. However, the trend of this indicator is not observable as there is a lack of data deficiency for the regular measurement of ambient air concentrations.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	Car Equivalent Unit per km2 for Major Cities - 1999 to 2004
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	Has air pollution been aggravated by increased vehicle population in major cities?
Priority Concern	Mobile Source Air Pollution
Geographic Area	Union of Myanmar
Magnitude & Trend	Medium and Increasing
Key Message	From 1999 to 2004, total car equivalent unit per square kilometer steadily increased from 1,463 to 1674 units in Yangon and from 545 to 759 units in Mandalay. Net increase in CEU per square kilometer within this period is equivalent to 13% of the 1999 level in Yangon and 39% in Mandalay. Thus, the level of pressure on mobile source air pollution in Myanmar is increasing and medium in terms of the notable increases in vehicular density in major cities.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track the number of Car Equivalent Units within a square kilometer of major urban area in Yangon and Mandalay City.

Car Equivalent Unit (CEU) is the measurement of the different type of vehicles by its engine power and automotive fuel consumption equivalent to a car with normal engine power and average consumption level of automotive fuel. As recommended by the Road Transport Administration Department, default values of multiplier coefficient are used for conversion of different vehicle type to CEU and currently applied values are as below:

- 1 saloon/van (avg. engine capacity – 1500cc) is equal to 1 CEU
- 1 light tuck (avg. engine capacity – 2000cc) is equal to 1.3 CEU
- 1 truck (avg. engine capacity – 4500cc) is equal to 2.5 CEU
- 1 passenger bus (avg. engine capacity – 4500cc) is equal to 2.5 CEU
- 1 motor cycle (avg. engine capacity – 125cc) is equal to 0.2 CEU
- 1 tri-wheel (avg. engine capacity – 800cc)is equal to 0.65 CEU
- 1 trawler-gee (avg. engine capacity – 1000cc) is equal to 1.3 CEU
- 1 (other) vehicle is equal to 2 CEU

Major urban area includes the townships of the city which are the commercially active urban center or the major residential areas adjacent to the urban center.

B.Data Source

Data for total registered car are obtained from the Road Transport Administration Department. The data related to major urban areas of Yangon and Mandalay are based on Yangon City Map of Yangon City Development Committee (2003) and from the source of Mandalay District's Government Affair Department (2004). The Energy Planning Department (EDP) has also provided data related to the total volume of fuel sold (motor spirit and high-speed diesel) for the transportation sector.

EPD. 2005. Energy Data Related to Indicator Development for National Performance Assessment. Submission to National Commission for Environmental Affairs, by Energy Planning Department, Ministry of Energy, the Government of the Union of Myanmar, Ref Letter No: 116/1/G dated 19 April 2005, Yangon

GAD. 2004. Local Data of Mandalay District. Internal document of Mandalay District's Government Affairs Department, Ministry of Home Affairs, the Government of the Union of Myanmar, Mandalay. RTAD. 2005. Data Related to Indicator Development for National Performance Assessment. Submittal to National Commission for Environmental Affairs, by Road Transport Administration Department, Ministry of Transport, the Government of the Union of Myanmar, Ref Letter No: Katha-912/05/13, dated 2 February 2005, Yangon

YCDC. 2003. Township Maps and Data on Yangon City. Yangon City Development Committee, Yangon.

C.Geographic Area / Population Coverage

The data utilized for the construction of this indicator are representative of mobile source pollution for Yangon and Mandalay cities.

D.Temporal Coverage

The temporal coverage of the data applied is an indicator for 1998 to 2004.

E. Methodology and Frequency of Coverage

Total numbers of vehicle registered is acquired from the list of annually registered vehicle at the Road Transport Administration. The data for all states and divisions are summarized by various category of vehicle such as saloon, ban, truck, light truck, passenger bus, tri-wheel, motor cycle, trawler-gee and others. These vehicles were categorized by type of fuel they used such as High Speed Diesel (HSD) and Motor Spirit (MS). However, these data were only available for Yangon and Mandalay Cities.

Automotive fuel sold is a compilation from annual sale record of High Speed Diesel and Motor Spirit by concerned agency of the Energy Planning Department.

F. Methodology of Data Manipulation

By using a multiplier coefficient, different categories of vehicles registered are converted into CEU for both Yangon and Mandalay. As potential emission level of the High Speed Diesel used Vehicle is higher than that of Motor Spirit used Vehicle, a conversion factor is used again in converting Diesel vehicle equivalent to Motor spirit Vehicle. The assumption for the conversion factor using standard practice is that 1 diesel vehicle is equal to 1.2 Motor Spirit vehicles in terms of capacity of consuming energy and emitting smoke. After all vehicles are converted into Motor-Spirit Type Vehicle Equivalent Unit, a further calculation divided CEU by the total extent of the major urban area, which is the sum of the aerial extent of townships considered as major urban areas within Yangon and Mandalay cities according to the definition above.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

The indicator provides an indicative value for determining the level of vehicular density that is comparable from one urban area to another in examining the level of potential risk associated with mobile source air pollution alongside the studied period. However, there are approximately 100,000 departmental vehicles that were not registered under the Road Transport Administration Department. Therefore, the indicative value could not absolutely cover the whole situation. Using the total extent of the major urban area in the calculation may also limit the value for optimal comparison of vehicular density among the areas where the area of the road network may not necessarily be same.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

The indicator is highly reliable and accurate as data used in the indicator are based on an officially precise record of vehicle registration. Robustness will only be affected by the degree of soundness in the assumption of the "conversion coefficient" for CEU.

C. Future Work Required (for data level and indicator level)

Detailed vehicular information such as engine type, age, capacity, accessories for emission control, etc., should be recorded and compiled for all vehicle registered. This will enhance the understanding of the relationship between vehicle density and the associated risk of pollution by emissions.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Car Equivalent Unit Per Square Kilometer of Capital Yangon and Mandalay

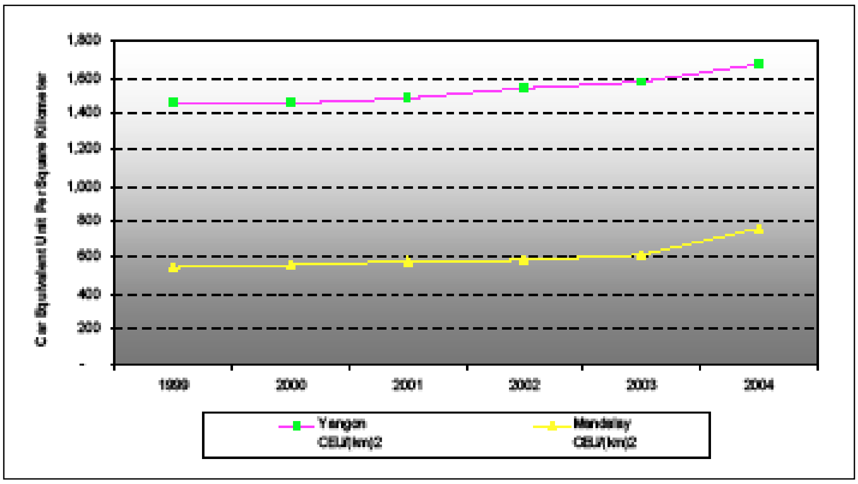


Table 1a: Car Equivalent Unit of Per Unit Urban Area of Capital Yangon and Mandalay

Year	Total CEU in Yangon	Total CEU in Mandalay	Yangon Urban Area (Sq-Km)	Mandalay Urban Area (Sq-Km)	CEU per Sq-Km in Yangon	CEU per Sq-Km in Mandalay
1999	189,907	57,527	129.78	105.57	1,463	545
2000	189,593	58,666	129.78	105.57	1,461	556
2001	192,533	60,804	129.78	105.57	1,484	576
2002	199,655	62,227	129.78	105.57	1,538	589
2003	204,924	64,966	129.78	105.57	1,579	615
2004	217,233	80,139	129.78	105.57	1,674	759

Source: Road Transport Administration Department 2005, Yangon City Development Committee 2003 and Mandalay District's Govern ment Affairs Department 2004.

Table 1b: Total Number of Registered Vehicle in Yangon and Mandalay City (HSD+MS)

Area	Type of Vehicle	1999	2000	2001	2002	2003	2004
Yangon City	Saloon Ban	100,090	101,385	101,725	104,905	110,106	116,441
	Light Truck	13,866	13,747	13,880	14,059	11,706	12,205
	Truck	8,975	8,127	8,260	8,525	8,268	8,694
	Passenger Bus	8,528	9,010	9,405	9,618	9,670	9,930
	Others	4,665	4,761	5,480	6,460	7,159	7,550
	Motorcycle	29,536	23,775	14,643	7,844	3,728	3,476
	Tri-wheel	-	-	-	-	-	-
	Trawler Jeep	67	92	504	1,002	1,896	2,700
	Total	165,727	160,897	153,897	152,413	152,533	160,996
Mandalay City (south/ north)	Saloon Ban	26,162	26,997	28,262	28,339	28,983	27,797
	Light Truck	1,648	2,104	2,201	2,226	2,248	2,232
	Truck	3,559	2,855	2,872	2,849	2,885	2,878
	Passenger Bus	2,047	1,951	1,819	1,740	1,746	1,721
	Others	267	683	767	854	902	930
	Motorcycle	51,654	50,978	52,320	57,428	63,124	139,264
	Tri-wheel	650	503	396	274	251	243
	Trawler Jeep	475	1,124	1,489	1,723	2,073	2,789
	Total	86,462	87,195	90,126	95,433	102,212	177,854

Note: HSD = High Spirit Diesel, MS = Motor Spirit

Source: Road Transport Administration Department, 2005

Table 1c: Total Number of Registered Vehicle in Yangon and Mandalay City (HSD)

Area	Type of Vehicle	1999	2000	2001	2002	2003	2004
Yangon City	Saloon Ban	18,587	19,310	19,988	20,984	24,296	26,611
	Light Truck	7,850	7,806	8,082	8,412	8,570	9,403
	Truck	6,266	5,885	6,079	6,428	7,162	8,101
	Passenger Bus	4,230	5,027	5,550	6,116	7,090	7,403
	Others	4,215	4,315	5,032	6,047	6,704	7,098
	Motorcycle	-	-	-	-	-	-
	Tri-wheel	-	-	-	-	-	-
	Trawler Jeep	67	92	504	962	1,275	2,700
	Total	41,215	42,435	45,235	48,949	55,097	61,316
Mandalay City	Saloon Ban (south/ north)	3,850	4,284	4,483	4,754	5,360	5,617
	Light Truck	1,117	1,513	1,571	1,587	1,629	1,637
	Truck	3,173	2,685	2,718	2,700	2,748	2,744
	Passenger Bus	890	886	883	893	933	935
	Others	218	603	673	755	802	831
	Motorcycle	-	-	-	-	-	-
	Tri-wheel	-	-	-	-	-	-
	Trawler Jeep	475	1,123	1,489	1,723	2,073	2,789
	Total	9,723	11,094	11,817	12,412	13,545	14,553

Note: HSD = High Spirit Diesel

Source: Road Transport Administration Department, 2005

Table 1d: Total Number of Registered Vehicles in Yangon and Mandalay City (MS)

Area	Type of Vehicle	1999	2000	2001	2002	2003	2004
Yangon City	Saloon Ban	81,503	82,075	81,737	83,921	85,810	89,830
	Light Truck	6,016	5,941	5,798	5,647	3,136	2,802
	Truck	2,709	2,242	2,181	2,097	1,106	593
	Passenger Bus	4,298	3,983	3,855	3,502	2,580	2,527
	Others	450	446	448	413	455	452
	Motorcycle	29,536	23,775	14,643	7,844	3,728	3,476
	Tri-wheel	-	-	-	-	-	-
	Trawler Jeep	-	-	-	40	621	-
	Total	124,512	118,462	108,662	103,464	97,436	99,680
Mandalay City (south/ north)	Saloon Ban	22,312	22,713	23,779	23,585	23,623	22,180
	Light Truck	531	591	630	639	619	595
	Truck	386	170	154	149	137	134
	Passenger Bus	1,157	1,065	936	847	813	786
	Others	49	80	94	99	100	99
	Motorcycle	51,654	50,978	52,320	57,428	63,124	139,264
	Tri-wheel	650	503	396	274	251	243
	Trawler Jeep	-	1	-	-	-	-
	Total	76,739	76,101	78,309	83,021	88,667	163,301

Note: MS = Motor Spirit

Source: Road Transport Administration Department, 2005

Table 1e: Car Equivalent Unit of MS Equivalent HSD Vehicle in Yangon and Mandalay City

Area	Type of Vehicle	1999	2000	2001	2002	2003	2004
Yangon City	Saloon Ban	22,304	23,172	23,986	25,181	29,155	31,933
	Light Truck	12,246	12,177	12,608	13,123	13,369	14,669
	Truck	18,798	17,655	18,237	19,284	21,486	24,303
	Passenger Bus	12,690	15,081	16,650	18,348	21,270	22,209
	Others	10,116	10,356	12,077	14,513	16,090	17,035
	Motorcycle	-	-	-	-	-	-
	Tri-wheel	-	-	-	-	-	-
	Trawler Jeep	105	144	786	1,501	1,989	4,212
	Total	76,259	78,585	84,344	91,949	103,359	114,361
Mandalay City Ban (south/ north)	Saloon						
	4,620	5,141	5,380	5,705	6,432	6,740	
	Light Truck	1,743	2,360	2,451	2,476	2,541	2,554
	Truck	9,519	8,055	8,154	8,100	8,244	8,232
	Passenger Bus	2,670	2,658	2,649	2,679	2,799	2,805
	Others	523	1,447	1,615	1,812	1,925	1,994
	Motorcycle	-	-	-	-	-	-
	Tri-wheel	-	-	-	-	-	-
	Trawler Jeep	741	1,752	2,323	2,688	3,234	4,351
	Total	19,816	21,413	22,571	23,459	25,175	26,676

Note: HSD = High Spirit Diesel, MS = Motor Spirit

Source: Road Transport Administration Department, 2005

Table 1f: Car Equivalent Unit of MS Vehicles in Yangon and Mandalay City

Area	Type of Vehicle	1999	2000	2001	2002	2003	2004
Yangon City	Saloon Ban	81,503	82,075	81,737	83,921	85,810	89,830
	Light Truck	7,821	7,723	7,537	7,341	4,077	3,643
	Truck	6,773	5,605	5,453	5,243	2,765	1,483
	Passenger Bus	10,745	9,958	9,638	8,755	6,450	6,318
	Others	900	892	896	826	910	904
	Motorcycle	5,907	4,755	2,929	1,569	746	695
	Tri-wheel	-	-	-	-	-	-
	Trawler Jeep	-	-	-	52	807	-
	Total	113,649	111,008	108,189	107,706	101,565	102,872
Mandalay City (south/ north)	Saloon Ban						
	22,312	22,713	23,779	23,585	23,623	22,180	
	Light Truck	690	768	819	831	805	774
	Truck	965	425	385	373	343	335
	Passenger Bus	2,893	2,663	2,340	2,118	2,033	1,965
	Others	98	160	188	198	200	198
	Motorcycle	10,331	10,196	10,464	11,486	12,625	27,853
	Tri-wheel	423	327	257	178	163	158
	Trawler Jeep	-	1	-	-	-	-
	Total	37,711	37,253	38,232	38,767	39,791	53,462

Note: HSD = High Spirit Diesel, MS = Motor Spirit

Source: Road Transport Administration Department, 2005

Table 1g: Total Car Equivalent Unit of Both MS & HSD Vehicles in Yangon and Mandalay City

Area	Type of Vehicle	1999	2000	2001	2002	2003	2004
Yangon City	Saloon Ban	103,807	105,247	105,723	109,102	114,965	121,763
	Light Truck	20,067	19,901	20,145	20,464	17,446	18,311
	Truck	25,571	23,260	23,690	24,527	24,251	25,786
	Passenger Bus	23,435	25,039	26,288	27,103	27,720	28,527
	Others	11,016	11,248	12,973	15,339	17,000	17,939
	Motorcycle	5,907	4,755	2,929	1,569	746	695
	Tri-wheel	0	0	0	0	0	0
	Trawler Jeep	105	144	786	1553	2796	4212
	Total	189,907	189,593	192,533	199,655	204,924	217,233
Mandalay City (south/ north)	Saloon Ban						
	26,932	27,854	29,159	29,290	30,055	28,920	
	Light Truck	2,433	3,129	3,270	3,306	3,346	3,327
	Truck	10,484	8,480	8,539	8,473	8,587	8,567
	Passenger Bus	5,563	5,321	4,989	4,797	4,832	4,770
	Others	621	1,607	1,803	2,010	2,125	2,192
	Motorcycle	10,331	10,196	10,464	11,486	12,625	27,853
	Tri-wheel	423	327	257	178	163	158
	Trawler Jeep	741	1,753	2,323	2,688	3,234	4,351
	Total	57,527	58,666	60,804	62,227	64,966	80,139

Note: HSD = High Spirit Diesel, MS = Motor Spirit

Source: Road Transport Administration Department, 2005

Table 2a: Major Urban Areas of the Capital Yangon

No.	District	Township	Extent mile^2	Extent km^2	Major Urban Area Km^2
1	East Yangon	Botadaung	0.92	2.38	2.38
2	East Yangon	Dagon/Port	32.97	85.40	
3	East Yangon	Dawpon	1.02	2.64	
4	East Yangon	E/Dagon	35.15	91.03	
5	East Yangon	Mingalataungnyunt	1.96	5.06	5.06
6	East Yangon	N/Dagon	10.15	26.28	
7	East Yangon	N/Okkalapa	10.91	28.26	
8	East Yangon	Pazundaung	0.39	1.01	1.01
9	East Yangon	S/Dagon	30.55	79.11	
10	East Yangon	S/Okkalapa	2.97	7.70	
11	East Yangon	Tamwe	1.85	4.79	4.79
12	East Yangon	Tharketa	5.02	13.01	
13	East Yangon	Thingangyun	4.44	11.50	
14	East Yangon	Yankin	1.94	5.03	5.03
	East Yangon Total		140.24	363.21	18.28
15	Northern Yangon	Hlaingthaya	26.01	67.37	
16	Northern Yangon	Insein	13.52	35.02	
17	Northern Yangon	Mingadon	41.14	106.55	
18	Northern Yangon	Shwepyithar	15.21	39.39	
	Northern Yangon Total		95.88	248.33	29.11
19	South Yangon	Dala	10.93	28.31	
20	South Yangon	Seikkyikanaungto	2.26	5.85	
	South Yangon Total		13.19	34.16	
21	West Yangon	Ahlone	1.40	3.63	3.63
22	West Yangon	Bahan	3.41	8.84	8.84
23	West Yangon	Dagon	4.50	11.65	11.65
24	West Yangon	Hlaing	5.29	13.70	13.70
25	West Yangon	Kamaryut	2.40	6.22	6.22
26	West Yangon	Kyauktada	0.25	0.65	0.65
27	West Yangon	Kyi-myin-daing	2.16	5.59	5.59
28	West Yangon	Lanmadaw	0.54	1.41	1.41
29	West Yangon	Lathar	0.31	0.81	0.81
30	West Yangon	Mayangone	9.78	25.34	25.34
31	West Yangon	Pabedan	0.29	0.76	0.76
32	West Yangon	Sanchaung	0.96	2.47	2.47
33	West Yangon	Seik-kan	0.51	1.32	1.32
	West Yangon Total		31.81	82.39	
	Grand Total		281.12	728.09	129.78

Source: Yangon City Development Committee, 2003

Table 2b: Major Urban Areas of Mandalay

No.	District	Township	MCDC 2003 (Sq-mile)	MCDC 2003 (Sq-km)	Major Urban Area (Sq-km)
1	Mandalay	Aung Myay Thar Zan	11.03	28.57	28.57
2	Mandalay	Chan Aye Thar San	5.05	13.08	13.08
3	Mandalay	Mahar Aung Myay	5.72	14.81	14.81
4	Mandalay	Chan Mya Thar Si	9.07	23.49	23.49
5	Mandalay	Pyi Gyi Ta Gon	9.89	25.61	25.61
	Total	40.76	105.57	105.57	

Source: Mandalay District's Government Affairs Department, 2004

Figure 2: Automotive Fuel Sold in Myanmar

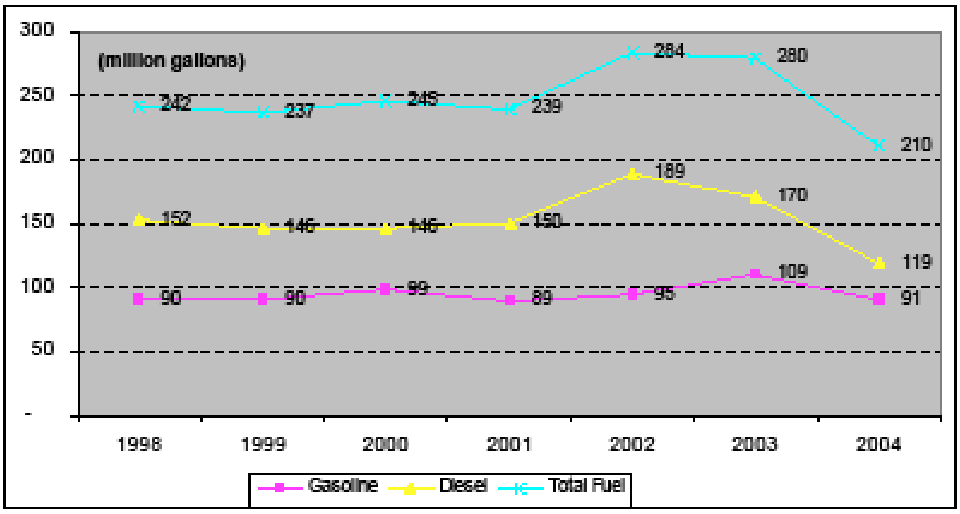


Table 3: Automotive Fuel Sold in Myanmar

Year	Motor Spirit - MS (million gallons)	High Speed Diesel - HSD (million gallons)	Total Fuel (million gallons)
1998	90	152	242
1999	90	146	237
2000	99	146	245
2001	89	150	239
2002	95	189	284
2003	109	170	280
2004	91	119	210

Source: Energy Planning Department 2005

SUMMARY

A. Policy Reference

1. Purpose:

This indicator estimates the level of potential risk that major cities are facing in mobile source air pollution.

2. Relevance to Environment Planning and Management:

The indicator is useful for better urban planning and transportation management in which mobile source air pollution could be well controlled and regulated.

3. Linkage to Other Indicators:

The indicator could be linked to "Automotive Fuel Sold or Consumption", and "Ambient Air Concentration" and "CO2 emission" for better analyzing of atmospheric pollution and global warming.

B. Analysis

Figure 1 provides the trend of Car Equivalent Unit per square kilometer of Yangon and Mandalay Cities, which is based on the equivalent capacity of all vehicles to Motor Spirit type Vehicle in emitting air pollutants. Associated data with figure 1 are given in Table 1a that were derived from following Tables 1b, 1c, 1d, 1e, 1f, and 1g. Major urban areas of Yangon and Mandalay are given in Table 2a and 2b. Data related to automotive fuel sold are given in Table 3 and the trend is illustrated in figure 2.

As shown in Figure 1, trends of vehicular density in term of CEU per square kilometer are stable and rising in both Yangon and Mandalay during the years from 1999 to 2004. In fact, the total numbers of vehicles in Yangon city declined since 2000, though there was a slight increase in 2004 (Table 1b). This decline was only due to a sharper decrease in numbers of the motor spirit type vehicle (Table 1c). However, increases in the number of diesel vehicles during the same period made the total CEU gradually higher in Yangon (Table 1g). In the case of Mandalay, there were continuous increases in the total number of both diesel and motor spirit vehicles from 1999 to 2004, except for a decrease of motor spirit vehicles in 2000 (1d).

As the import of cars was opened in the early 1990s but has been strictly regulated again in late 1990s, only importing high spirit diesel vehicles was common in Yangon after 1999. Meanwhile, many old cars (motor spirit type) were sold out or moved to other parts of the country so that the total number of vehicles was reduced over time in Yangon. In 2004, the government allowed the official registration of the motor cycles that were imported from neighboring countries across the border. This explained the sharper increase in the number of total vehicles in Mandalay in 2004.

Although vehicle population and CEU per square kilometer in both Yangon and Mandalay increased, it is noticeable that volumes of automotive fuel (High Spirit Diesel and Motor Spirit) sold for vehicles, which had an increased trend during the years from 1998 to 2001, has been declining since 2002 (Figure 2). Automotive fuel is sold to the vehicle owner based on a quota set by the government and amount of quota per vehicle is higher in Yangon than in Mandalay. Therefore, the risk of air pollution from mobile source has been greater in Yangon than in Mandalay because of the higher density of CEU per square kilometer and the relatively higher consumption level of automotive fuel.

Within the six year period from 1999 to 2004, the net increase in CEU per square kilometer compared to the 1999 level is 13% in Yangon and 39% in Mandalay. As this magnitude is neither low nor high, the level of pressure on air pollution in major cities of Myanmar is medium with a steadily increasing trend.

Greater Mekong Subregion **Indicator Fact Sheet**	
DATABASE INFORMATION	
Indicator ID	
Indicator Name	Percentage of Vehicles Inspected - 1998 to 2004
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	How effective have vehicular inspections been in regulating the level of pollution from motor vehicles?
Priority Concern	Mobile Source Air Pollution
Geographic Area	Union of Myanmar
Impact & Trend	Low and Intermittent
Key Message	From 1998 to 2004, annually inspected vehicles as a percentage of total vehicles registered in Myanmar have fluctuated within the range of 84 to above 90% at the national level. However, manual inspections on vehicle emission level and lack of national air quality standards and an environmental monitoring institute have compounded the low and intermittent response in controlling vehicle emissions in major cities, although there are increasing levels of air pollutants as seen in the "State" indicator.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track the numbers of vehicles inspected as a percentage of total numbers of vehicle registered in Myanmar. The unit of measurement is given as percentage per annum.

B. Data Source

The Annual record of Road Transport Administration Department is the main source of data for this indicator.

RTAD. 2005. Data Related to Indicator Development for National Performance Assessment. Submission to National Commission for Environmental Affairs, by Road Transport Administration Department, Ministry of Transport, the Government of the Union of Myanmar, Ref Letter No: Katha-912/05/13, dated 2 February 2005, Yangon.

C. Geographic Area / Population Coverage

Data are available for vehicle inspection in all States and Divisions (Sub-administrative area of the country) covering the whole country.

D. Temporal Coverage

The data and the indicator cover the period from 1998 to 2004.

E. Methodology and Frequency of Coverage

The original data provided for the number of total vehicles annually registered and the total number of vehicles annually inspected under the Road Transport Administration Department upon the renewal of the vehicle license.

F. Methodology of Data Manipulation

The percentage of vehicles inspected was calculated from the total number of vehicles registered.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

This indicator provides the trend of vehicular inspection for all sub-administrative units of the country as well as for the whole country. However, it could not further analyze the level of inspection versus type of vehicle and ownership.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

Since data were sourced from annual official records of renewing vehicle license, the reliability and accuracy of the data are high.

C. Future Work Required (for data level and indicator level)

The official record of inspection should be categorized by type of vehicle (in terms of type of petrol used and engine power) and ownership for better analysis. As smoke detecting devices are increasingly used and on-road smoke inspection is undertaken, the number of vehicles failing to meet the inspection standard should be also recorded to be included in the annual report.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: Vehicles Annually Inspected As a Percentage of Total Registered Vehicles

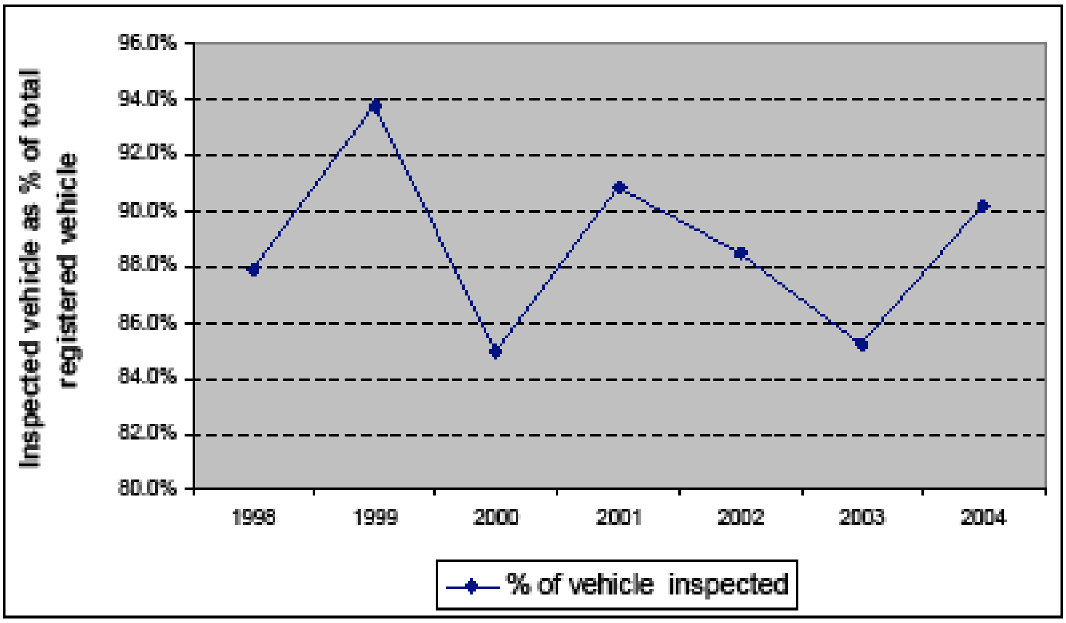


Table 1a: Percentage of Vehicles Annually Inspected

State/Division	1998	1999	2000	2001	2002	2003	2004
Yangon	103.8%	93.6%	97.0%	99.8%	102.7%	95.5%	102.1%
Mandalay	69.4%	72.8%	78.6%	85.1%	85.3%	81.0%	87.6%
Pegu	95.0%	114.6%	86.7%	96.5%	84.6%	80.5%	92.0%
Sagaing	90.7%	92.3%	95.4%	88.4%	79.9%	80.6%	93.6%
Shan	81.9%	140.5%	76.6%	89.1%	84.3%	86.2%	84.4%
Mon	69.7%	76.5%	72.4%	83.5%	77.0%	82.8%	89.3%
Magwe	100.0%	97.4%	100.6%	101.6%	88.6%	83.4%	89.0%
Tanintharyi	52.6%	100.5%	41.4%	67.0%	51.4%	63.5%	72.7%
Ayeyarwaddy	89.5%	87.1%	94.4%	87.3%	74.2%	68.2%	86.5%
Kachin	73.2%	73.4%	64.6%	75.8%	76.5%	71.8%	90.7%
Karin	105.5%	126.8%	76.2%	91.1%	75.3%	76.5%	89.2%
Rakhine	92.6%	98.7%	110.5%	92.7%	88.8%	86.7%	93.7%
Chin	75.5%	108.3%	112.1%	90.8%	107.5%	100.8%	80.9%
Karah	74.6%	107.6%	74.3%	87.4%	78.7%	82.9%	87.2%
Total	87.9%	93.8%	84.9%	90.9%	88.5%	85.2%	90.1%

Source: Road Transport Administration Department , 2005

Figure 2: Number of Vehicles Registered and Inspected

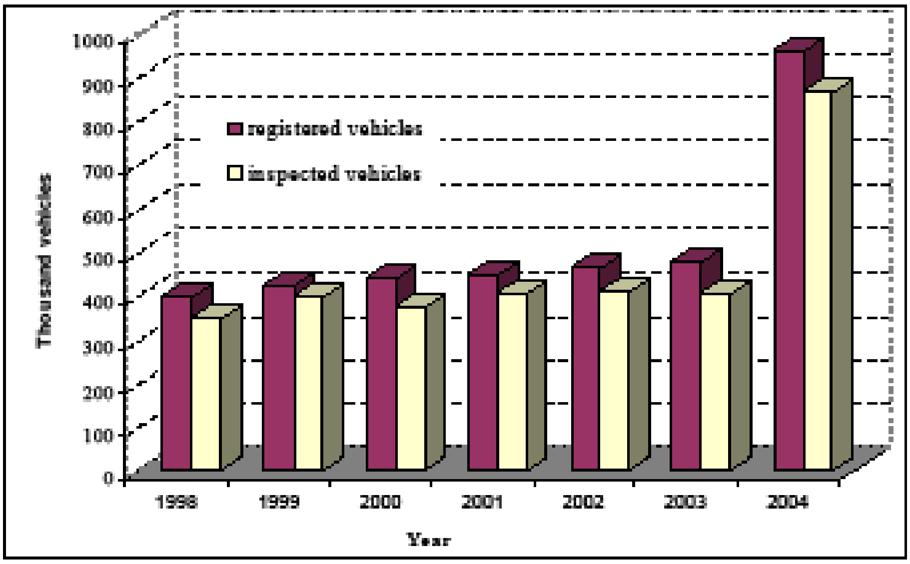


Table 1b: Total Number of Vehicles Annually Registered

State/Division	1998	1999	2000	2001	2002	2003	2004
Yangon	171,550	165,727	160,897	153,897	152,413	152,533	160,996
Mandalay	95,740	104,379	108,285	113,924	121,821	129,686	262,563
Pegu	12,138	16,188	18,044	18,171	19,127	19,524	58,589
Sagaing	15,285	17,208	20,699	24,056	25,581	25,973	99,276
Shan	39,704	46,094	52,150	54,692	59,557	63,245	148,196
Mon	15,225	17,662	16,924	16,300	16,745	16,898	39,887
Magwe	8,836	10,111	11,504	13,116	14,593	15,717	50,232
Tanintharyi	16,832	20,054	20,931	19,581	17,818	16,879	36,716
Ayeyarwaddy	6,249	7,942	9,185	10,549	12,645	13,942	41,182
Kachin	8,977	10,480	11,911	12,141	12,404	12,814	36,333
Karin	3,255	3,783	3,654	3,811	3,774	3,740	11,494
Rakhine	1,857	2,077	2,507	2,766	2,952	3,032	9,398
Chin	335	324	330	336	361	380	886
Karah	1,620	1,929	1,813	1,827	1,901	1,987	4,593
Total	397,603	423,958	438,834	445,167	461,692	476,350	960,341

Source: Road Transport Administration Department , 2005

Table 1c: Total Number of Vehicles Annually Inspected

State/Division	1998	1999	2000	2001	2002	2003	2004
Yangon	178,009	155,087	156,149	153,567	156,599	145,706	164,365
Mandalay	66,469	75,952	85,082	96,967	103,903	105,101	230,084
Pegu	11,535	18,547	15,639	17,529	16,174	15,712	53,930
Sagaing	13,860	15,891	19,748	21,255	20,446	20,932	92,901
Shan	32,505	64,744	39,959	48,729	50,216	54,535	125,065
Mon	10,613	13,517	12,256	13,605	12,896	13,995	35,613
Magwe	8,838	9,846	11,578	13,327	12,929	13,112	44,712
Tanintharyi	8,847	20,149	8,674	13,125	9,166	10,721	26,702
Ayeyarwaddy	5,590	6,914	8,674	9,207	9,380	9,502	35,623
Kachin	6,571	7,689	7,695	9,206	9,483	9,205	32,964
Karin	3,434	4,795	2,784	3,473	2,840	2,860	10,252
Rakhine	1,719	2,051	2,771	2,564	2,622	2,628	8,803
Chin	253	351	370	305	388	383	717
Karah	1,209	2,076	1,347	1,596	1,496	1,647	4,005
Total	349,452	397,609	372,726	404,455	408,538	406,039	865,736

Source: Road Transport Administration Department , 2005

SUMMARY

A. Policy Reference

1. Purpose:

The purpose of this indicator is to understand the level of measures undertaken in regulating the vehicular emissions at the point of source for controlling air pollution from automobiles.

2. Relevance to Environment Planning and Management:

This is relevant to urban environmental planning and management for controlling urban air quality. It is also useful for urban transportation development and management.

3. Linkage to Other Indicators:

The indicator is linked to indicators like "Car Equivalent Unit per Square Kilometer of Major Cities and "Ambient Air Concentration".

4. Targets:

According to the Motor Vehicle Law enacted in 1989, all vehicles in Myanmar are bound to annual inspection and renewal of vehicle license. Otherwise, quotas will not be issued for purchasing petrol from government petrol station, which is the only one source for supplying automotive fuel.

B. Analysis

According to Table 1a, annually inspected vehicles as a percentage of total registered vehicles throughout the country fluctuated within the range of 84% to 90% during the period from 1998 to 2004 (see Figure 1). A wider range of vehicle inspection has been observed in the areas such as Yangon and Mandalay Divisions where around half of total vehicles nation-wide are registered; for example, inspection in Yangon remained above 90% while there was a lower degree of inspection in Mandalay from 70 to 88% during the same period. A higher movement of vehicles from one location to another registration area and change in ownership might be the major reason for the lower percentage of inspection and registration.

Tables 1b and 1c show data related to the calculation of the percentage of vehicle inspections. From these tables, it is notable that the number of vehicles annually registered has been steadily increasing at the national level, although there is some variation in some of the sub-administrative area, States and Divisions. For instance, total vehicles annually registered in Yangon Division have gradually decreased during 1999 to 2003 although increased in 2004. In contrast, Mandalay Division, in the central part of Myanmar, has steadily increased in total registered vehicles since 1998. Until the end of 2004, experienced staff of the Road Transport Administration Department visually inspected the vehicle emissions for the renewal of the vehicle license and only a few digital smoke detectors were introduced in early 2005 for inspection in Yangon. Besides, ASEAN standard on vehicle emissions was recently introduced in Myanmar and is in the l early stage of enforcing the vehicle inspection in accordance with the adopted standard. The lack of national air quality standards and an environmental monitoring institute is also one of the reasons for weakening the tighter control on vehicle emissions. Therefore, these factors have compounded in evaluating the response as low and intermittent in managing the air pollution from mobile sources.

Greater Mekong Subregion **Indicator Fact Sheet**	
DATABASE INFORMATION	
Indicator ID	
Indicator Name	GHGs Emission in CO_2 Equivalent - 1990 to 2005
Year of Assessment	2005
Type of Indicator	Pressure
Frequently Asked Question (FAQ)	What is the level of GHG emissions in Myanmar attributing to Global Warming?
Priority Concern	Climate Change
Geographic Area	Union of Myanmar
Magnitude & Trend	Low but Increasing
Key Message	Total net GHGs emissions in CO_2 equivalent has consistently increased from 41,500 in 1994 to 62,000 Gg in 2005. The agriculture and energy sectors are the major sources for total GHGs emission while the Forestry sector is the major net sink of CO_2. the current emission level (1.1 metric ton per person) is relatively low compared to other GMS countries like Thailand, Yunnan (PRC) and Viet Nam.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track the amount of Green House Gases emissions in Myanmar. Green House Gases are the chemical gases that cause global warming at varying degree depending on their concentration and life horizon in the atmosphere and their heat absorptive capacities. The main GHGs are carbon dioxide (CO^2), methane (CH^4), nitrous oxide ($N2^0$).
Emission of GHGs is the national anthropogenic emissions of carbon dioxide, methane and nitrous oxide. It is measured in gigagrams (Gg) (1 Gg is equal to 1000 metric ton) of CO^2 equivalent in which methane and nitrous oxide are also converted by using Global Warming Potentials (GWP). Emissions of these gases are estimated based on activity data from fuel combustion, fugitive fuel emissions, industrial processes (particular reference to CO^2 emission from Cement production in Myanmar), agriculture, forestry and land use change and waste.

B. Data Source

The Country Report on Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS) for Myanmar is the main source of data employed in the fact sheet. The ALGAS project was a regional project conducted from 1995 to 1998 with funding from the Asian Development Bank, Global Environmental Facility and United Nations Development Programme. Myanmar was covered by the project and the National Commission for Environmental Affairs was the national counterpart agency (NCA) in Myanmar. A National Technical Experts (NTE) team was formed with staff from the Ministry of Agriculture and Irrigation, Ministry of Forestry, Ministry of Electric Power and Ministry of Livestock Breeding and Fishery. NTE closely worked together with the International Consultant for carrying out the national inventory on Green House Gases Emission. An abatement strategy was also part of the study for mitigating measures.
In addition to the ALGAS report, the National Statistical Year Books for 1997 and 2002 were also used for compilation of some data for extrapolation.

C. Geographic Area / Population Coverage

The data and the indicator are indicative of GHG emissions for the Union of Myanmar as a whole.

D. Temporal Coverage

Temporal coverage is from base year 1990 to year 2005.

E. Methodology and Frequency of Coverage

During the ALGAS study, data from various departments and national statistics were utilized in developing base year inventory and thereby forecasting it up to the year 2020 for every decade. By using actual data for 1990, 1991 and 1992, a base year inventory was estimated. For the estimation of years 2000, 2010 and 2020, firstly a projection was made on growth of Gross Domestic Products and Population. Then growth of each sectors contributing to sources and sink of GHGs was interpolated. From this projection, respective values of parameters and variables related to the emission of various GHG were further calculated. Total Net Green House Gases in term of Carbon Dioxide equivalent was summed by the emission values of all GHGs estimated in the study.
Calculations of CO^2 equivalents were based on Global Warming Potentials (GWPs) of 21 for CH^4 and 310 for N^2O. NOx and CO are not included since GWPs have not been developed for these gases.

F Methodology of Data Manipulation

Original data in ALGAS report were only given for base year 1990 and projected years of 2000, 2010 and 2020. For the continuous period of 1990 to 2005, the required data were interpolated from these original data sets with the additional adjustment as necessary and possible as stated below; For Energy Combustion & Fugitive related emissions, data were only given for base year 1990 and year 2020. Based on this figure, an annually increased rate was calculated and straight-line method was employed in filling the data from 1992 to 2005.

For Industrial process related emissions, cement production data were obtained from Statistical Year Books for the period of 1990 to 2005 consecutively. The rate used in estimation of CO2 emission on each ton of cement production is 0.5 ton.

For emissions related to agriculture, forestry and land use, original data were only available for 1990, 2000, 2010 and 2020. Annual increments in emissions were calculated for each 10 year interval and a straight line method was employed for filling the figures in the gap years.

For emission from waste, data was only provided for the 1990 base year. Using projected population figures for 2000 and 2010, the annual incremental rates of emission were derived for each 10 years intervals – first decade from 1991 to 2000 and second decade from 2001 to 2010. With these incremental rates, gap years were filled by the straight line method.

In addition to CO2 equivalent, CO2 emissions alone were also calculated based on the relevant data from gross energy consumption and industrial process (ALGAS report). For the sake of calculating per capita carbon dioxide emission, population data were mainly obtained from Statistical Year books of 1997 and 2002. For those gap years in 2003, 2004 and 2005, an annual population growth rate of 2.02% was used in the estimation.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

This indicator has advantages in comparing the level of GHGs emission among the countries attributing to global warming. However, it does not provide an understanding of the relationship between its absolute value and climate change that the country is presently facing. Besides, this is an extrapolated estimation of GHGs emission and not necessarily the GHGs atmospheric concentration of the country.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

Many technical assumptions were used in the original analysis of ALGAS study for estimating GHGs emission and inventory. There are many uncertainties on per unit GHGs emission rates of related activity for sourcing and sinking these gases. This weakens the robustness of the data; particularly emissions estimated for agriculture, land use and forestry sectors in which greater spatial diversity and ecological complexity have existed. In projections for year 2000, 2010 and 2020 based on 1990 inventory, the reliability of the estimation depends on the projected sectoral growths that were determined by estimated GDP growth rate and projected population. Estimated emission figures for gap years may also have less accuracy because they were derived from ALGAS inventory base year and projected years by straight line method rather than calculating from actual sectoral performance in sourcing and sinking of GHGs alongside its growth changes in respected years.

C. Future Work Required (for data level and indicator level)

As base year inventory on green house gases was established well for year 1990 level, estimations should be further carried out for gap years between 1991 to 2005 by using actual sectoral performance in sourcing and sinking of GHGs instead of the straight line estimation made in this assessment.

Figure 1: GHG Net Emission in CO^2 Equivalent (million tons)

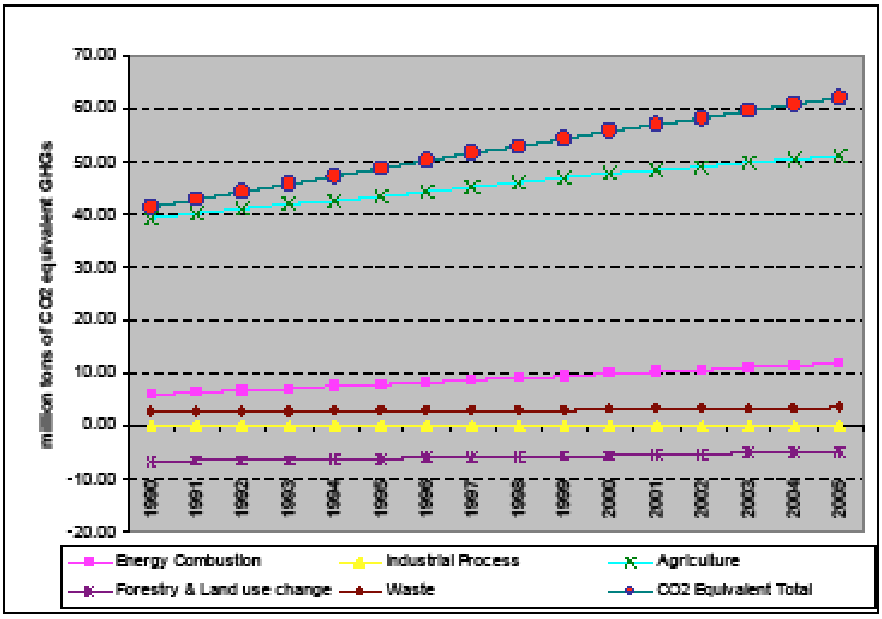


Table 1: Projected Emission of Green House Gases (Million Ton of CO^2 Equivalent)

Year	Energy Combustion & Fugitive	Industrial Process	Agriculture	Forestry & Land use change	Waste	CO^2 Equivalent Total
1990	6.09	0.20	39.20	-6.66	2.69	41.5
1991	6.48	0.22	40.08	-6.54	2.74	43.0
1992	6.87	0.24	40.95	-6.43	2.79	44.4
1993	7.27	0.20	41.82	-6.32	2.84	45.8
1994	7.66	0.25	42.70	-6.20	2.89	47.3
1995	8.06	0.26	43.57	-6.09	2.95	48.7
1996	8.45	0.25	44.44	-5.98	3.00	50.2
1997	8.84	0.24	45.31	-5.87	3.05	51.6
1998	9.24	0.17	46.19	-5.75	3.10	52.9
1999	9.63	0.18	47.06	-5.64	3.15	54.4
2000	10.03	0.21	47.94	-5.52	3.21	55.9
2001	10.42	0.19	48.57	-5.36	3.27	57.1
2002	10.81	0.19	49.20	-5.21	3.32	58.3
2003	11.21	0.19	49.83	-5.05	3.38	59.6
2004	11.60	0.19	50.46	-4.89	3.44	60.8
2005	12.00	0.19	51.09	-4.73	3.50	62.0
2010	13.97	0.18	54.23	-3.94	3.80	68.2
2020	17.91	0.18	62.73	-2.39	4.47	82.9

Source: ALGAS Myanmar Report by ADB/GEF/UNDP/NCEA, 1998

Table 2: Greenhouse Inventory for 1990 Base Year – Gigagram (Gg)

Sources and Sinks	CO_2 Emissions	CO_2 Removals	Net CO_2	CH_4	N_2O	NO_x	CO	CO_2 Equiva-lent	% CO_2 Equiva-lent
Total (Net) National Emissions	67,078.3	72,988	-5,909.8	2,134.11	8.4	71.5	1,119.7	41,500	100
1.All Energy (Fuel Combustion& Fugitive)	3,311.8		33,11.8	119.8	0.8	71.0	1,095.5	6,086.1	14.67
A. Fuel Com-bustion	3,311.8			111,.546	0.8	71.0	1,095.5	5,913.1	
1.Energy and Transformation Industries	1,414.3			0.04	0.005	3.8	0.45	1,416.6	
2.Industry	528.3							528.3	
3.Transport	1,005.0			0.16	0.008	9.87	54.84	1,010.8	
4.Commer-cial institutional	234.16			0.022	0.0008	0.22	0.14	234.87	
5.Residential									
6.Traditional Biomass Burned for Energy				111.31	0.82	56.94	1,040.0	2,591.7	
7.Others (please specify)	130			0.018	0.0011	0.18	0.04	130.72	
B. Fugitive Fuel Emissions				8.24				173.04	
1.Oil and Natural Gas Systems				7.8				163.8	
2.Coal Mining				0.44				9.24	
2.Industrial Pro-cesses	180.44		180.44					180.44	0.43
A. Cement Production	180.44							180.44	
B. Others (please specify)									
3.Agriculture				1,767.7	6.7	0.4478	24.18	39,202	94.47
A. Enteric Fer-mentation				396.22				8,320.6	
B. Manure Management				43.58				915.2	
C. Rice Cultiva-tion				1,327				27,867	
D. Agricultural Soils				NE	6.7	NE	NE	2,077	
E. Prescribed Burning of Savannas				0.88	0.01	0.39	23.17	21.58	

F. Field Burning of Agricultural Residues				0.05	0.0016	0.0578	1.0182	1.54	
G. Others (please specify)									
4.Land use Change and Forestry	63,586	72,988	-9,402	118.67	0.82			-6655.7	16.04
A. Changes in Forest & Other Woody Bio-mass Stocks		46,698							
B. Forest and Grassland Conversion	63,586								
C. Abandon-ment of Man-aged Lands		26,290							
D. On Site Burning of Forest				118.67	0.82				
5.Waste				127.925				2,686.4	6.47
A. Solid Waste Disposal on Land				123.72				2,598.1	
B. Wastewater Treatment				3.25				68.25	
C. Others (please specify)				0.955				20.06	
Bunker Fuel Emissions (if available)									

SUMMARY

A. Policy Reference

1. Purpose:

The purpose of this indicator is to measure the level of major anthropogenic emissions affecting global warming.

2. Relevance to Environment Planning and Management:

Such emissions are largely influenced by a country's energy use and production systems, its industrial structure, its transportation system, its agriculture and forestry sectors and the consumption patterns of the population. Sudden changes in emission levels indicate the system's inefficiency in managing these sectors for maintaining a desirable balance between economic growth and environmental resources and its carrying capacity. Therefore, adaptive environmental planning and management is required to stabilize the emission level as well as to improve the efficiency of related sectors adjusting to overall economic growth toward the sustainable development goals.

3. Linkage to Other Indicators:

This indicator is closely linked to many other socio-economic and environmental indicators, for example, GDP per capita growth rate, annual energy consumption per capita, forest cover, environmental protection expenditure, and expenditure on air pollutions abatement.

4. Targets:

Currently there is no target set for Myanmar to reduce its emission level.

5. International Environment Treaties:

Primarily it relates to The United Nations Framework Convention on Climate Change and Kyoto Protocol.

B. Analysis

As can be observed from Figure 1, net GHG emissions in CO^2 equivalent were estimated at approximately 41,500 Gg in the 1990 base year. These were projected to increase to 55,900 Gg in year 2000, 68,200 Gg in 2010 and 82,900 Gg by 2020. The agriculture sector, mainly from rice cultivation, is 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 is in second place but the magnitude of the emissions is dwarfed by that of the agriculture sector. The burning of fuelwood is the major contributing factor in the energy sector. Emissions from industrial process and waste, both existing and projected, are minimal.

It can also be observed from Table 1 that forestry and land use change is a net sink of GHGs according to 1990 inventory and future projections. In the base year, the net removal was 6,655 Gg but this figure was estimated to decline to 2,400 Gg by 2020. This however was based on a deforestation rate of 218,800 ha per year, through to 2020. The actual deforestation rate in the 1990s was closer to 400,000 ha per year and it is possible that the sink effect may have disappeared but the turn of the new millennium.

It is also noted from the baseline inventory that in terms of pure CO^2 emissions, Myanmar was a net sequester, i.e. the country absorbed more CO2 gases that it generated. The growing stock in the forest and the abandonment of marginal lands compensated for all the CO^2 emissions of all the other sectors. The amounts are also significant. Approximately 67,100 Gg of CO^2 were emitted; approximately 73,000 Gg were removed. The balance of 5,900 Gg is subtracted from the other gases in the CO -equivalent equation. (See Table 2).

Most of the other CO_2-equivalent emissions are the result of rice cultivation. In the 1990 base year, approximately 27,900 Gg of CO^2-equivalent were emissions from rice cultivation in the form of CH4 (methane) gases. 1,327 Gg of methane gases originated from rice cultivation which, translated to CO^2-equivalent (factor is 21), results in 27,900 Gg of CO^2-equivalent gases.
The overall contribution from rice cultivation is unlike that of any of the other GMS countries. There is a valid reason for this. For Myanmar, the rate applied in calculating methane emissions was developed from the results of actual field measurements and the rate is approximately three times the magnitude of what UNFCCC recommends as a default value. The large difference in the rate is partially explained by the use of organic manure applied to the rice crop.
The UNFCCC early estimate on the excess pressure on the planet is in the order of 37 million Gg. That figure can be said to be the excess that the planet cannot withstand without undergoing climate change. Obviously Myanmar's 41,500 Gg share of the excess 37-million Gg problem is marginal. On a per capita basis and using year 2005 estimates and for emissions and population, the ratio is approximately 1.1 metric ton per person.
The current estimated emission level (1.1 metric ton per person) is relatively low comparing to other GMS countries like Thailand, Yunnan (PRC) and Viet Nam; the per capita rate is also low by international standards. However, the trend and the pressure is expected to increase as methane gases from rice cultivation continue to rise and as the CO_2 sink from the growing biomass tdisappears.

Greater Mekong Subregion
Indicator Fact Sheet

DATABASE INFORMATION	
Indicator ID	
Indicator Name	GHG Emission Over Per Unit Value of Gross Domestic Products - 1990 to 2002
Year of Assessment	2005
Type of Indicator	Response
Frequently Asked Question (FAQ)	How efficiently have GHGs emissions being regulated in the pace of GDP growth?
Priority Concern	Climate Change
Geographic Area	Union of Myanmar
Impact & Trend	Non-Comparable with Undetermined Trend
Key Message	GHGs emission per unit of GDP probably declined during the 1990s. The absence of an up-to-date GHG emission inventory makes it impossible to establish a trend and provide a reliable assessment.

TECHNICAL INFORMATION

A. Definition

This indicator attempts to track degree of GHG emission intensity or the amount of green house gases (GHGs) emission for every increase in per unit value of GDP. GHGs Emission Intensity is the ratio that total net emission of Green House Gases (GHG) in CO^2 Equivalent is divided by total value of gross domestic products. It is expressed in Kilogram of CO^2 per Kyat (Kg CO^2/Kyat). GHGs are the chemical gases that cause global warming to a varying degree depending on their concentration and life horizon in the atmosphere and their heat absorptive capacities. The main GHGs are carbon dioxide (CO^2), methane (CH^4), nitrous oxide (N^2O).

GHG emissions are national anthropogenic emissions of CO^2, CH4 and N^2O. They are measured in gigagram (Gg) (1 Gg is equal to 1000 metric ton) of CO^2 equivalent in which methane and nitrous oxide are also converted by using Global Warming Potentials (GWP). Emissions of these gases are estimated based on activity data from fuel combustion, fugitive fuel emissions, industrial processes (particular reference to CO^2 emission from Cement production in Myanmar), agricultur

B. Data Source

The Country Report on Asia Least-Cost Greenhouse Gas Abatement Strategy (ALGAS) for Myanmar is the main source of data employed in the fact sheet. The ALGAS project was a regional project conducted from 1995 to 1998 with the funding of the Asian Development Bank, Global Environmental Facility and United Nations Development Programme. Myanmar was covered by the project and National Commission for Environmental Affairs was the national counterpart agency (NCA) in Myanmar. The National Technical Experts (NTE) team was formed with the staffs from Ministry of Agriculture and Irrigation, Ministry of Forestry, Ministry of Electric Power and Ministry of Livestock Breeding and Fishery. NTEs closely worked together with the international consultant for carrying out the national inventory on Green House Gases Emission. Abatement strategy was also part of the study for mitigating measures.

In addition to the ALGAS report, the National Statistical Year Books for year 1997 and 2002 were also used for the data of Gross Domestic Products.

C. Geographic Area / Population Coverage

The data and the indicator are representative of GHG emissions for the Union of Myanmar as a whole.

D. Temporal Coverage

Temporal coverage is from base year 1990 to year 2002.

E. Methodology and Frequency of Coverage

During the ALGAS study, data from various departments and national statistics were utilized in developing base year inventory and thereby forecasting it up to for 2000, 2010 and 2020. By using actual data for 1990, 1991 and 1992, base year inventory was estimated. For the estimation of year 2000, 2010 and 2020, firstly a projection was made on growth of Gross Domestic Products and Population. Then growth of each sectors contribution to source and sink of GHGs was interpolated. From this projection, respective values of parameters and variables related to the emission of various GHG were further calculated. Net Green House Gases in terms of Carbon Dioxide equivalent was summed by the emission values of all major GHGs estimated in the study. Calculations of CO^2 equivalents were based on Global Warming Potentials (GWPs) of 21 for CH^4 and 310 for N^2O. NOx and CO are not included since GWPs have not been developed for these gases. Energy consumption data were also obtained from the section of energy sector assessment in the ALGAS Myanmar Report. It was originally estimated based on primary energy consumption in traditional energy used, total commercial used and hydro-electricity energy used.
The values of Gross Domestic Products for 1990 to 2001 were given in National Statistical Books of 1997 and 2002. They were calculated at 1985-86 constant price level.

F. Methodology of Data Manipulation

Original data in the ALGAS report were only given for the base year 1990 and projected years 2000, 2010 and 2020. Emission data for gap years for the period of 1990 to 2001 were interpolated from each 10 years interval of original data set by the straight line method. However, data for industrial process were updated with the data from Statistical Year Book, particular reference to cement production. By the same token, energy consumption was also interpolated from the original data set of the ALGAS report. Then total energy consumption and total net GHGs emission in CO^2 equivalent were divided by total values of GDP for the same period for calculation of the respective intensity level. As original data of GDP values for 2001 and 2002 were based on 2000-01 constant producer price level, they were converted into 1985-86 constant price level by using the consumer price index given in CSO 1989, 1993, 1997 and 2003.

QUALITATIVE INFORMATION

A. Strength and Weakness (data level)

The data and the indicator are indicative of the amount of Green House Gases emitted per amount of income generated by the country's economy. This is powerful in understanding the current level of management in mitigating the global warming by reducing its emission level while pursuing the higher economic growth with better distribution simultaneously for sustainable development. However, it should be noted that the value of GDP as a denominator in the calculation is associated with a sensitive fluctuation of price level for all goods and services. If increased GDP value is due to price level increase in related goods and services when they were produced, it is hard to explain the performance level in reducing GHGs with higher productivity and resource utilization. Moreover, annual GDP values available from national statistics are given in the local currency of Kyat and an indicative value of GHGs emission intensity becomes less usable for global and regional comparison.

B. Reliability, Accuracy, Robustness, Uncertainty (data level)

The reliability of data is influenced by the following conditions, which were unlikely to occur during the study done so far in estimation of Green House Gases Emission in Myanmar.

• Capturing the actual growth rate of GDP in real US Dollar terms by using Purchasing Power Parity(PPP).

• Comprehensiveness of secondary sectoral data in line with GDP growth for forecasting the growth of related activity that emits GHGs.

• Comprehensiveness of ecological data (chemical, thermal and nutrient flow) for those diverse ecosystems existing throughout the country to estimate the associated biomass production and rate of GHGs emission from each related activity and performance.

• Soundness of existing technical knowledge and reference to the nature of emission and emission rate associated with various production systems and ecosystem interactions.

C. Future Work Required (for data level and indicator level)

In addition to the improvements undertaken in accordance with the influencing factors suggested in the above section for better accuracy, the recalculation of this indicator could have been closer to the real situation.

SUPPORTING DATA TABLES, GRAPHS AND MAPS

Figure 1: GHG Emission Intensity to Gross Domestic Products

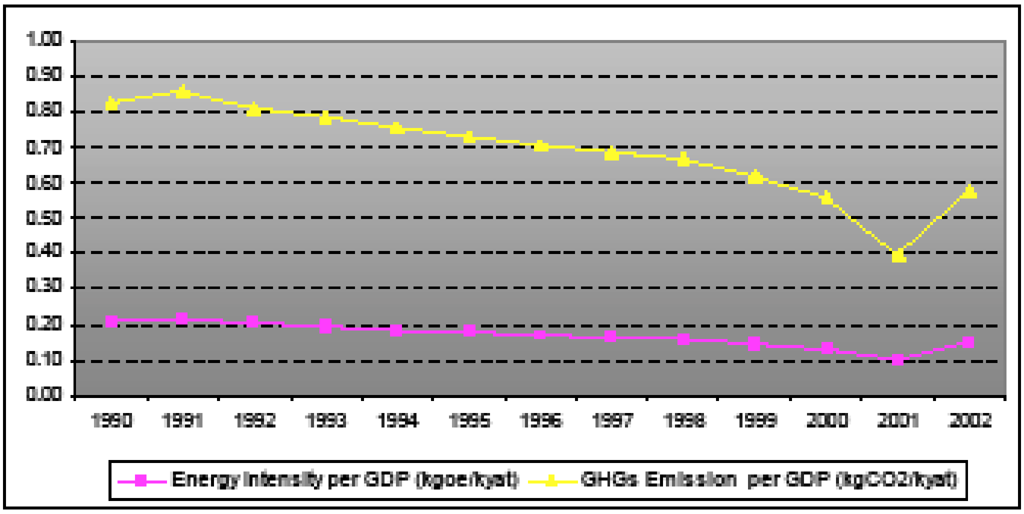


Table 1: Energy Intensity and GHG Emission Intensity to GDP

Year	GDP at 1985-86 Constant Price (million Kyat)**	Gross Energy Consumption (million kgoe)*	GHGsCO2 Equivalent Total Emission (million tonnes)*	Energy Intensity per GDP (kgoe/ kyat)	GHGs Emission per GDP (kg CO2/kyat)
1990	50,260	10,462	41.5	0.21	0.83
1991	49,933	10,727	43.0	0.21	0.86
1992	54,757	10,992	44.4	0.20	0.81
1993	58,064	11,257	45.8	0.19	0.79
1994	62,406	11,522	47.3	0.18	0.76
1995	66,742	11,787	48.7	0.18	0.73
1996	71,042	12,052	50.2	0.17	0.71
1997	75,123	12,317	51.6	0.16	0.69
1998	79,460	12,582	52.9	0.16	0.67
1999	88,157	12,847	54.4	0.15	0.62
2000	100,275	13,113	55.9	0.13	0.56
2001	144,499	14,076	57.1	0.10	0.39
2002	100,533	15,039	58.3	0.15	0.58

Note: * = interpolated from ALGAS Myanmar, 1998, ** = GDP for 2001 and 2002 were given in 2000-01 constant producer price level and converted for the value at 1985-86 constant price level to be consistent with other GDP values. Consumer Price Index given in Statistical Year book of 1989, 1993, 1997 & 2003 were used for estimation

Source: ADB & et al and CSO, 1989, 1993, 1997, 2003

Table 2: Data Employed in ALGAS Study for Projection of GDP Growth Rate and Share of Major Sectors in Relation to Estimated GHGs Emissions

Year	Agriculture (% as of GDP)	Industry (% as of GDP)	Service (% as of GDP)	Others (% as of GDP)	Annual GDP Growth Rate
1990	38.7	8.7	16.5	36.1	2.8 %
1995	37.1	9.4	18.0	35.5	6.9 %
2000	35.6	10.1	17.3	37.0	6.2 %
2005	34.0	10.8	18.1	37.0	6.5 %
2010	32.6	11.5	18.5	37.4	6.8 %
2015	31.1	12.2	18.9	37.8	7.1 %
2020	29.6	12.9	19.3	38.2	7.4 %

Source: ADB & et al, 1998

SUMMARY

A. Policy Reference

1. Purpose:

This indicator is useful for assessing the efficiency of performance in boosting the national income in relation to the reduction in green house gases emitted.

2. Relevance to Environment Planning and Management:

This indicative value is relevant in readjusting of currently level of performance in both economic and environmental management for improving efficiency in reducing its emission level as well as in striving to attain desirable economic growth and income.

3. Linkage to Other Indicators:

For a comprehensive understanding and analysis, this indicator could be used together with such indicators as GDP per capita growth rate, per capita rate of GHGs emission, GHGs emission per total energy consumption and environmental protection expenditure.

4. Targets:

Currently there is no target relevant to this indicator.

5. International Environment Treaties:

Primarily it relates to The United Nations Framework Convention on Climate Change and Kyoto Protocol.

B. Analysis

From Figure 1, it has been found that the combination of the two trends has been associated with the indicative value of GHG emission per unit value of GDP given in Table 1. It was a steadily descending trend during the period of 1990 to 2000 but fell markedly in 2001 and increased in 2002. The rapid decrease in the value of the indicator in the year 2001 appears to reflect an unexpected increase 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% - see Table 2) rather than necessarily demonstrating a suddenly improving performance by GHG emitters. This increase illustrates one of the pitfalls of relaying on assumed rather than actual values of indicators assessing performance.

In general, a steadily descending trend of the indicator value is desirable as it suggests that the energy potentially giving rise to 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 (post-1990) estimates of GHG emissions makes it impossible to say with confidence what the recent trend has been.

CASE STUDY 1

ENVIRONMENTAL PERFORMANCE ASSESSMENT IN MANDALAY CITY

Background

1. Mandalay is in the central region of Myanmar located at 21°58' N 96°04'E, 716 km north of Yangon Capital. The city is bordered by the Ayeyarwaddy River at the west and connected to all parts of the country all year round by a transportation network. Mandalay is the capital of Mandalay Division and the second largest city in Myanmar. Because of its strategic location, Mandalay is economically active and fast becoming a major commercial and communication center with border trade routes to the People's Republic of China (PRC) and India. Since Myanmar's adoption of a market economy in 1988, Mandalay has seen rapid urbanization. Urban population has grown from 722,235 in 1994 to 875,252 in 2005 at a rate of 2.3 % per year (Mandalay's Immigration and National Registration Department, 2005) and urban area to 117 square kilometer (km2) (Tun Kyi, U 2004). The municipal area of the city consists of five administrative townships: Aung Myay Tharzan, Chan Aye Tharzan, Maha Aung Mye, Chan Mya Tharzi and Pyi Gyi Tagon. Two industrial zones have been established at the southern urban fringe of Mandalay City and approximately 1,131 factories, workshops and cottage industries are operating and providing employment to 11,412 persons (Mandalay's District Peace and Development Council, 2005).

2. This rapid urbanization in Mandalay city has led to increasing urban environmental concerns including solid waste, air pollution, water pollution and sustainable use of water resources. There are two main reasons for selecting Mandalay city as the case study:

i) To raise awareness on environmental issues affecting Mandalay at local and national level in the National Commission for Environmental Affairs (NCEA), and
ii) To initiate the process of environmental performance assessment (EPA) at the local level, introducing the concept, technique and methodology of EPA to the urban environmental authority of Mandalay City Development Committee (MCDC).

3. The case study team comprised of the following members, collaborating with the authority of MCDC, particularly with technical staff of the Water and Sanitation Department. The team

[1] In the old capital of Burmese King, there is a palace surrounded by a moat and water from the moat was used in the past as a main source of water (drinking and domestic use) for urban dwellers. Some parts of township still rely on moat water for domestic use. Moat water is replenished by water coming from Sedawgyi Dam.
[2] Project was built with a loan from ADB ($15 million) and OPEC ($7 million) with the government investment of MK323.135 million, (WSD/MCDC, 2005b).
[3] WSD/MCDC is a key authority for managing the urban water supply in Mandalay city with major responsibilities for (1) formulation of water supply policies, (2) preparing, allocating and controlling the budget for water supply, (3) supplying enough clean water to meet water demand, (4) controlling water quality, (5) billing and collection of water charges, (6) functioning and maintaining the existing water supply system, (7) formulation and execution of plans for improvement including extension of the existing water supply system and facilities, and (8) procuring pumps, pipes, equipments and materials supporting to water supply system. (Tun Kyi, U 2004)

Map 1: Mandalay City

conducted local visits in Mandalay City during the period of 17-24 July 2005.

i) Daw Yin Yin Lay, Joint Secretary and Director of National Commission for Envi ronmental Affairs, National Focal Point of SEF II Project and Team leader of National Technical Reviewer Team
ii) Dr. Than Htut, Deputy Director, Occupational Health Unit, Department of Health and Technical Reviewer of National Technical Reviewer Team
iii) U Win Myo Thu, Domestic Consultant, Environmental Issues, SEF II Project
iv) U Maung Maung Than, Domestic Consultant, Environmental Database, SEF II Project
v) Daw Ye Ye Htwe, Head of Branch, National Commission for Environmental Affairs
vi) U Kyaw San Naing, Head of Branch, National Commission for Environmental Affairs
vii) U Aung Aung Lay, Head of Branch, National Commission for Environmental Affairs

4. Sustainable use of water resources has been selected as the environmental concern for the case study. As a signatory country to the Millennium Development Goals (MDG), it is also justifiable to examine the current performance at local level in realizing the national policy target of supplying safe drinking water to all citizens by the year 2015.

2. Environmental Performance Assessment - Sustainable Use of Water Resource in Mandalay City

2.1. Context

5. Water is supplied in Mandalay city mainly by a network of piped water supply system, private wells and moat water . The piped water supply system was constructed during the period 1983 to 1992 under the project Mandalay Water Supply Project, co-financed by ADB, OPEC and Myanmar Economic Bank . The water source for the piped water supply system is ground water mainly drawn from tube well pumping stations along the banks of the Ayeyarwaddy River. The water drawn is conveyed to reservoir at No.1 Booster Pumping Station (BSP1) for distribution by a network of pipes. Originally, 19 high yielding tube wells (16 inches diameter and average depth of 450 feet) were constructed during the ADB funded project and the average pumping capacity of each tube well was approximately about 50,000 imperial gallons per hour. After ADB project, Water and Sanitation Department of Mandalay City Development Committee (WSD/MCDC) has been continuing to invest in subsequent years for improving and expanding the piped water supply system. To date, there are 32 tube wells with different pumping capacity in sourcing water to a distribution network of an existing system (WSD/MCDC 2005a) . However, the chlorination facility has not been functioning and some water losses have been noted during inspection of water meters.

6. As only 60% of the city area is covered by the current piped water supply network (Tun Kyi, U 2004), residents living outside of existing pipe network have to rely on water sourced from tube wells dug by WSD/MCDC and international donor projects. There is no centralized water supply system for industrial water use and factory owners have to tap ground water through their own resources. In general, available water quality data suggests that water from tube wells is safe for drinking.

2.2. State (Water Resource)

7. A JICA study (2002-03) revealed that ground water abstraction in Mandalay city was 170,000 cubic meters (m^3) per day against the 100,000 m3 per day of natural recharge, leading to overex ploitation of ground water at rate 1.7 times higher than the level of water replenishment (JICA 2003, pp: 2-136). It further suggests that the maximum pumping rate should not exceed 2 times the natural recharge rate and private wells should be restricted in the natural recharge area. JICA's study finding is also consistent with that of the 1997 UN study about severe water scarcity in Mandalay city. The study indicated that total water withdrawal (including agriculture, domestic and industrial use) is 106 % of available wa ter resource It has been found that water resources are severely strained even if water

[4] There are 28 tube wells with a pumping capacity of 45,000 gallons per hour. All of them except one tube well are functioning in pumping up the water for supply. Additionally there are 2 tube wells of 40,000 gallons per hour pumping capacity and another 2 tube wells of 35,000 gallons per hour pumping capacity.
[5] According to a field study carried out by the Japanese International Cooperation Agency in 2003 (JICA, 2003)

withdrawal is just above 40% of available water resource; the situation in Mandalay city is thus already critical (Zaw Win, 2004 quoted in Irrigation Department 2005).

8. The indicator 'Percentage of Total Urban Population with Access to Piped Water Supply' is selected for determining the state of safe water supply in Mandalay city. Water supply data were primarily sourced from WSD/MCDC whereas population data were obtained from Immigration and National Registration Department of Mandalay District. Temporal coverage is from 1994 to 2003.

Indicator: Percentage of Total Urban Population with Access to Piped Water Supply 1994-2003

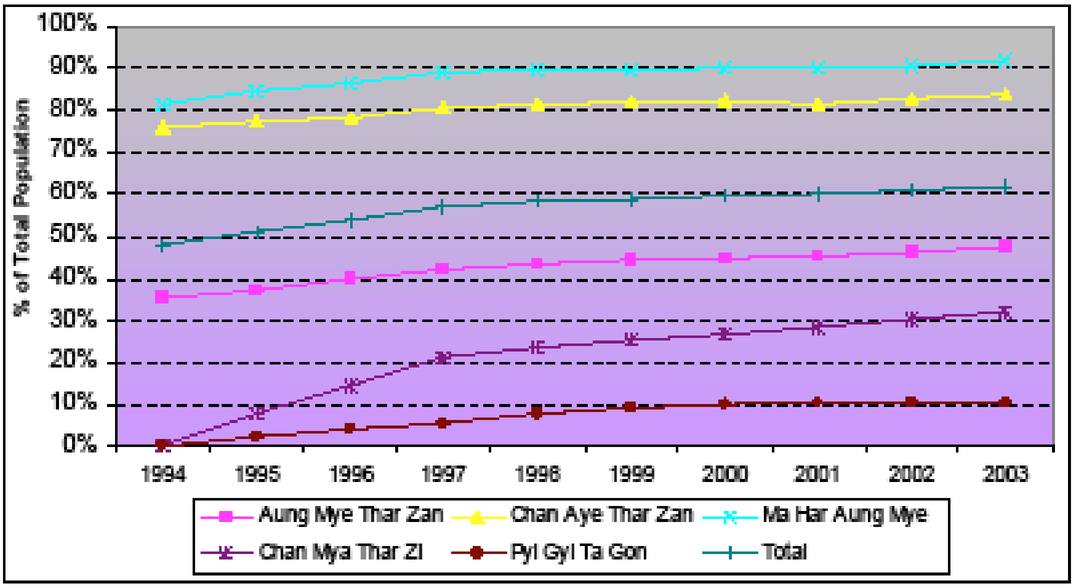
9. This indicator tracks total urban population coverage of current piped water supply in Mandalay city. The population serviced by piped water supply was estimated by multiplying the total number of water meters installed in the city by the number of persons benefiting from each water distribution outlet at which water meter is installed. The assumption was made that on average, one water distribution outlet would be supplying water to eight water users. Data on this indicator is given in Annex 1 and the percentage population coverage by piped water supply is shown in Figure 1.

10. The target was to supply piped water to over 90% of total residents living in the 4 old townships by 1988. This serves as the target for assessment in this EPA to evaluate the performance of improved access to safe drinking water.

11. As seen in Annex 1a, total water meters in stalled in Mandalay city have gradually increased from 43,183 in 1994 to 65,413 in 2003. Accordingly, the total population served has grown from 345,464 in 1994 to 523,304 in 2003 (see Annex 1b). Hence, approximately 77% of the planned target of access to safe water supply by the year 2000 was met in 2003.

12. Figure 1 also shows that the target of 90% population coverage by piped water supply are met or approached only in Chan Aye Thar Zan and Mahar Aung Mye townships and only modestly achieved in Aung Mye Thar Zan and Chan Aye Thar Zi townships with populations of 47% and 32% of the total township population respectively,

Figure 1: Percentage of Total Population with Access to a Piped Water Supply System



[6] These newly demarcated townships (after 1988) consist of the major urban areas of old townships, namely South East and South West townships.
[7] This township consists of former North West Township's areas.
[8] Some part of the former South East Township has recently appeared as a major area of the new satellite township of Chan Mya Tharzi.

in 2003. In the case of Aung Mye Tharzi, the local residents are still relying on moat water supply as an alternative. In the newly established satellite township of Pyi Gyi Tagon, only 11% of total township population has access to a piped water supply as technically it is less feasible for extending the piping network in this township.

13. The overall population with access to a piped water supply in Mandalay city is 62% of the total city population. The population with access to either moat water supply or water supply from tube wells developed by WSD/MCDC in other township areas unconnected to existing piped water supply system, are not included.

14. During the case study, attempts were made to calculate the per capita volume of water available from piped water supply system as a supplementary indicator for understanding the level of people with access to a sufficient quantity of water for their daily requirements. According to JICA's 2002 study, the volume of daily water supplied by piped water systems for consumption is 18.282 million per day. At a service population of 510,064 in 2002 (see Annex 1b), per capita availability of piped water was found to be 36 gallons per person per day approximately. Given that 30 gallons of water per person per day is sufficient for daily consumption in Mandalay city (Tun Kyi, U 2005), the present per capita water volume available from piped water supply (as of 2002) is above the basic minimum need level, though it might have been declined over time. Due to a lack of data, the trend for this indicator could not be established.

Suggested Rating: Average and Stabilizing

Justification: Access to safe piped water supply in Mandalay city has been steadily improving with an average of service population of 62% of the total city population having such access, against a target of 90% population. More needs to be done to improve this access.

2.3. Pressure (Water Resource)

Indicator: Percentage Deficit in Groundwater Abstraction for Daily Water Supply 1996 - 2003

15. Improved access to safe water supply is dependent upon the availability of raw water. Groundwater is a vital resource for water supply. The percentage deficit in groundwater

Table 1: Deficit of Ground Water Abstraction for Daily Water Supply

Year	Maximum Water Yield (Million gallons per day) (a)	Daily Water Production (Million gallons per day) (b)	Daily Water deficit (Million gallons per day) (c)	% of Water Deficit (d)
1996	22.7	19.8	2.88	12.7%
1997	24.8	21.6	3.24	13.0%
1998	27.0	21.6	5.40	20.0%
1999	29.2	23.4	5.76	19.8%
2000	29.2	23.4	5.76	19.8%
2001	31.1	25.0	6.08	19.6%
2002	31.1	25.0	6.08	19.6%
2003	33.0	26.2	6.80	20.6%

Note: (a) = maximum water yield is calculated based on the assumption that groundwater is abstracted by pumping up all service tube wells on 24 hours service. (b) = daily water production is calculated based on daily operational record of tube wells of WSD/MCDC. (c) = Water deficit is obtained from the subtraction of daily water production from the maximum water yield that can be potentially abstracted on 24 hour a day basis as designed by established piped water supply system. (d) = water deficit as a percentage of total maximum yield.

Source: WSD/MCDC (2005a)

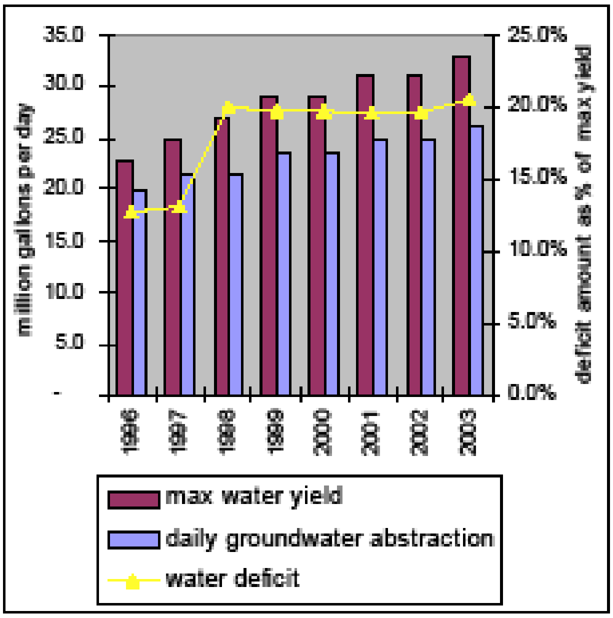
abstraction for daily water supply needs is selected as the 'pressure' indicator, particularly within the service area of piped water supply network.

16. This indicator tracks the existing level of water deficit as a percentage of the estimated volume of maximum water yield that could be abstracted from all service tube wells on 24 hours a day service. Water deficit was calculated by subtracting the actual water volume of daily production from the total estimated water volume of maximum yield. Then, it was divided by the maximum yield to calculate the percentage deficit. All data employed in this indicator were obtained from daily records of WSD/MCDC for the period 1996 to 2003.

17. As seen in Table 1 and Figure 2, water deficit has increased imposing pressure on daily water supply, rising from 2.88 million gallons per day in 1998 to 6.8 million gallons per day in 2003. Key factors for this deficit include (i) insufficient electricity supply for pumping up the service tube wells continuously; (ii) reduced mechanical capacity for water pumps and (iii) declining groundwater resources.

18. As overexploitation has been reported by various studies (JICA and UN), there might be a lower groundwater level in the aquifer and water pumps are unable to pump up the water at design capacity. Given that groundwater resources of Mandalay city are dependent upon natural recharge from the Ayeyarwaddy River and upper watershed (JICA, 2003 pp: 2-136), associated environmental degradation of these sources are also contributing to the declining groundwater level in Mandalay city. The situation might be also be aggravated if there is uncontrolled excessive pumping rate of private tube wells in natural recharge areas.

Figure 2: Water Deficit for Water Supply



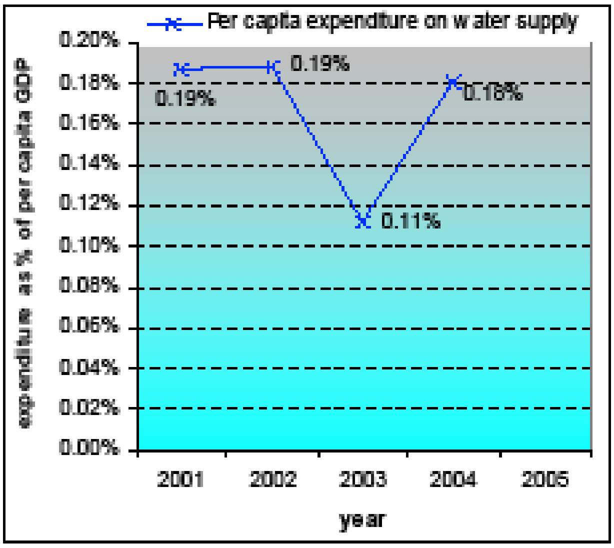
Source: WSD/MCDC 2005a

Table 2: Expenditure on Water Supply by WSD/MCDC in Mandalay City

Year	Annual Expenditure on Water Supply (Kyat)	City Population	Expenditure per person on Water Supply (Kyat/person)	Per capita GDP (Kyat/person)	Expenditure per person on water suply as % of per capita GDP
2001 - 02	141,002,695	821,914	172	91,795	0.19%
2002 - 03	242,343,185	837,685	289	154,132	0.19%
2003 - 04	168,657,025	842,330	200	179,177	0.11%
2004 - 05	352,383,865	856,264	412	227,848	0.18%

Source: WSD/MCDC 2005a, MNPD 2005, MIMNRD 2005

Figure 3: Expenditure Per Person on Water Supply as % of Per capita GDP in Mandalay



Source: WSD/MCDC 2005a, MNPD 2005, MIMNRD 2005

Suggested Rating: High and increasing

Justification: As of 2003, water shortage was at 20.6% of potential maximum yield having risen from 12.7 % in 1996. Declining groundwater resources is a key factor in this growing shortage and the trend seems to be worsening.

2.4. Response (Water Resource)

Indicator: Expenditure Per Person on Water Supply as a Percentage of Per Capita GDP 1996-2003

19. With growing population, more effort is required in extending and expanding water supply facilities and related infrastructure to improve access to safe drinking water. This is a matter of allocating more financial resources over time. Hence the indicator chosen is ‘expenditure per person on water supply as a percentage of per capita GDP’.

20. This indicator tracks financial availability for improving water supply in Mandalay city in terms of annual spending level of WSD/MCDC on a per capita basis compared to per capita gross domestic product (GDP) of Mandalay district (most of the townships in this district are part of Mandalay municipal areas). The unit of this indicator is given as percentage of expenditure on water supply (kyat/person) over per capita GDP value. Data for expenditure on water supply were obtained from WSD/MCDC, while official data for per capita GDP value are provided by the National Planning Department of Mandalay district.

21. Population data have to be based on official population statistics of Immigration and National Registration Department of Mandalay district for the period from 2001-2002 budget years to 2004-2005 budget years.

22. As observed in Table 2, expenditure on water supply has been increasing since 2001/2002. On a per capita basis, expenditure per person is found to be MK172 in 2001 and gradually increasing to MK289 and 412 respectively in 2002 and 2004. The spending level fell in 2003 compared to the previous year of 2002. Per capita GDP value has also increased from 91,795 to MK227,848 over the period from 2001 to 2004; resulting in a decline in expenditure per person on water supply from 0.19% of per capita GDP in 2001 to 0.11% in 2003 and 0.18% in 2004.

23. Thus, Figure 3 illustrates the declining trend of expenditure on water supply as a percentage of Mandalay GDP. As a total annual expenditure of WSD/MCDC also included of the expenses of other activity like infrastructure development for water pollution control and treatment facility, the actual amount of financial resource available for improving water supply might be slightly lower than the calculation made here.

Suggested Rating: Low and Sporadic

Justification: Current spending levels on water supply at lower than one percent of per capita GDP is relatively low. A declining trend of expenditure indicates sporadic response in improving people's access to safer drinking water supply.

3. Conclusion

24. Access to safe water 24. Access to safe water supply in Mandalay city has reached over 60% of the total population. However, it is notable that only 2 out of the total 5 administrative townships within the municipal area of Mandalay city are able to supply safe water to 90% o the total township population as planned. Besides, only 77% of the planned target in improving people's access to safe piped water supply was achieved by the year 2003/2004. The population has been increasing by 2.3% per year resulting in a water deficit in daily water production for sufficient supply.

25. According to health statistics, the lower access to safe piped drinking water supply in Pyi Gyi Tagon Township has been associated with the trend (as seen in Figure 4) of a relatively higher prevalence of water borne diseases, which include Diarrhea, Dysentery, Para Typhoid and Viral Hepatitis. No significant sign of a declining trend in the average prevalence of these diseases is observed within the period 2001 to 2004 (Department of Health, 2005).

26. A consumer satisfaction survey that was carried out by JICA's study in 2001 revealed that satisfaction with the current piped water supply system was found with 60% and 70% of the total respondents in Aung Mye Tharzan and Chan Aye Tharzan respectively, while it was 80% in Mahar Aung Mye and Chan Mya Tharzi (JICA 2003, pp:2-46). This indicates the need for improvement of performance in supplying safe water supply to water users.

27. The existing level of financial allocation to increasing water supply networks is very low, especially for a growing population. Substantial financial resources will be required for achieving the goal of complete access to safe water in the Mandalay city.

28. Total revenue from water supply at 1994 constant price level is given in Table 3 and it indicates the decline of revenue level from MK65.19 million in 1995 to MK42.43 million in 2004. Total investment in piped water supply system was $22 million with an annual depreciation cost could be roughly $1 million per year for a 20-year service life of the system. At government official exchange rate of MK450 for one Foreign Exchange Certificate (1 US $) (JICA, 2003), this will be equivalent to MK450 million. If so, the current annual revenue level is ten times lower than annual depreciation of the existing water infrastructure. This weakens the financial recovery of the existing water supply system and consequently it affects the sustainable

use of water resources. Illegal use of piped water is highlighted by JICA's study and measures will be needed to improve the efficiency of the whole system. Subsidy policy on water charging should be accordingly reviewed and changed as necessary. Commissioning of feasibility studies will be also required for promoting the private sector's investment in urban water supply and developing an alternative source of water supply rather relying on groundwater, which is already under threat from overexploitation.

Suggested Rating: I Star

Justification: Increased population and water shortage has threatened the availability of safe water supply. Limited financial capacity makes the management of water resource challenging for realizing the national goal of improving citizens' access to safer water supply on a sustainable basis.

29. As this case study was carried out for the main purposes of introducing EPA and initiating its process at Mandalay city, the following suggestions are made for future conduct of EPA.

i) An effort should be made to improve the data employed in this case study as they were collected and analyzed within the limitation of available time. There might be a data discrepancy on water production, distribution and supply. Financial data should be examined again for including all direct and indirect cost and income of water supply i.e. water charges on international hotels are not included in the analysis here.

ii) A future EPA should also include other environmental concerns of inadequate solid waste management, mobile source air pollution and inland water pollution. It needs to consider that appropriate policy targets are set for managing the urban environment; for example, policy targets for future population coverage for water supply; effluent BOD level for discharging industrial and domestic water to natural water bodies; appropriate car equivalent units etc.

iii) Mandalay City Development Committee (MCDC) will remain the leading authority for future conduct of EPA in Mandalay city. For wider technical and social coverage, it will be also necessary to form an EPA team comprising of resource persons from other government agencies, university, private firms and local NGOs. It should also seek an opportunity to establish an information center for compiling available environmental information and baseline data. There should be collaboration with the National Commissions for Environ mental Affairs for conducting EPAs in future.

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Annex 1a: No of Water Meters Installed in Townships of Mandalay City

Year	Aung Mye Thar Zan	Chan Aye Thar Zan	Ma Har Aung Mye	Chan Mya Thar Zi	Pyi Gyi Ta Gon	Total
1994	8,637	17,273	17,273	-	-	43,183
1995	9,190	17,957	18,232	1,307	116	46,802
1996	10,065	18,593	18,978	2,442	220	50,298
1997	10,843	19,467	19,867	3,687	313	54,177
1998	11,343	20,060	20,285	4,072	440	56,200
1999	11,739	20,658	20,635	4,527	549	58,108
2000	12,075	21,118	21,118	4,860	591	59,762
2001	12,530	21,570	21,631	5,281	628	61,640
2002	13,028	22,175	22,155	5,743	657	63,758
2003	13,459	22,552	22,614	6,115	673	65,413

Source: WSD/MCDC (2005)

Annex 1b: Service Population by Piped Water Supply in Mandalay City

Year	Aung Mye Thar Zan	Chan Aye Thar Zan	Ma Har Aung Mye	Chan Mya Thar Zi	Pyi Gyi Ta Gon	Total
1994	69,093	138,186	138,186	-	-	345,464
1995	73,517	143,658	145,858	10,456	928	374,416
1996	80,517	148,746	151,826	19,536	1,760	402,384
1997	86,741	155,738	158,938	29,496	2,504	433,416
1998	90,741	160,482	162,282	32,576	3,520	449,600
1999	93,909	165,266	165,082	36,216	4,392	464,864
2000	96,597	168,946	168,946	38,880	4,728	478,096
2001	100,237	172,562	173,050	42,248	5,024	493,120
2002	104,221	177,402	177,242	45,944	5,256	510,064
2003	107,669	180,418	180,914	48,920	5,384	523,304

Note: Assumption is made that one water meter may supply water to 8 persons.

Source: WSD/ MCDC (2005)

Annex 1c: Township and Total Population of Mandalay City

Year	Aung Mye Thar Zan	Chan Aye Thar Zan	Ma Har Aung Mye	Chan Mya Thar Zi	Pyi Gyi Ta Gon	Total
1994	194,860	182,161	169,435	132,285	43,494	722,235
1995	198,199	185,841	172,366	134,008	44,246	734,660
1996	201,596	189,595	175,347	135,753	45,012	747,303
1997	205,051	193,425	178,381	137,521	45,790	760,168
1998	208,625	197,332	181,465	138,333	46,582	772,337
1999	212,139	201,318	184,604	142,686	47,387	788,134
2000	215,774	205,385	187,798	144,543	48,207	801,707
2001	220,562	212,447	191,971	147,753	49,181	821,914
2002	225,456	214,593	196,231	151,032	50,373	837,685
2003	226,706	215,783	197,319	151,870	50,652	842,330

Source: NIMNRD (2005)

Annex 1d: Percentage of Total Population with Access to Pipe Water Supply

Year	Aung Mye Thar Zan	Chan Aye Thar Zan	Ma Har Aung Mye	Chan Mya Thar Zi	Pyi Gyi Ta Gon	Total
1994	35%	76%	82%	0%	0%	48%
1995	37%	77%	85%	8%	2%	51%
1996	40%	78%	87%	14%	4%	54%
1997	42%	81%	89%	21%	5%	57%
1998	43%	81%	89%	24%	8%	58%
1999	44%	82%	89%	25%	9%	59%
2000	45%	82%	90%	27%	10%	60%
2001	45%	81%	90%	29%	10%	60%
2002	46%	83%	90%	30%	10%	61%
2003	47%	84%	92%	32%	11%	62%

Source: based on Annex 1b and 1c

Annex 2: Cases of Waterborne Diseases and Their Prevalence Per Thousand Population in Mandalay Year Diarrhea

Year	Diarrhea (no of case)	Dysentery (no of case)	Para Typhoid (no of case)	Viral Hepatitis (no of case)	Total No. of Cases	Population	Prevalence per thousand population
Aung Mye Thar Zan Township							
2001	197	3	0	0	200	220,562	0.9
2002	201	43	1	3	248	225,456	1.1
2003	239	50	0	2	291	226,706	1.3
2004	386	45	0	0	431	230,456	1.9
Chan Aye Thar Zan Township							
2001	381	226	0	2	609	212,447	2.9
2002	260	206	15	0	481	214,593	2.2
2003	332	215	0	0	547	215,783	2.5
2004	400	122	0	0	522	219,352	2.4
Mahar Aung Mye Township							
2001	391	114	0	14	519	191,971	2.7
2002	371	135	0	0	506	196,231	2.6
2003	262	75	0	0	337	197,319	1.7
2004	214	49	0	1	264	200,584	1.3
Chan Mye Thar Zi Township							
2001	186	81	1	8	276	147,753	1.9
2002	211	57	0	1	269	151,032	1.8
2003	117	60	0	0	177	151,870	1.2
2004	235	55	0	0	290	154,382	1.9
Pyi Gyi Tagon Township							
2001	250	84	2	3	339	49,181	6.9
2002	280	114	3	6	403	50373	8.0
2003	314	138	15	10	477	50,652	9.4
2004	333	133	10	1	477	51,490	9.3

Source: Morbidity and Mortality of Disease under National Surveillance in Mandalay Division by township, Department of Health 2005

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CASE STUDY 2

1. BACKGROUND

1. Inle Lake is a well-known tourist attraction in southern Shan Plateau in eastern part of Myanmar known for natural scenic beauty, sociocultural uniqueness and diverse wetland ecosystem. It is the second largest terrestrial lake after Indawgyi lake of Kachin State in the north of the country and located between 20˚18' to 20˚53' North Latitude and 96˚50' to 96˚57' East Longitude (Naing Zaw, 1990, & Khin L.M, 2004). It covers the valley floor of Balu Chaung, a stream outlet leading to Moebye Dam at southern downstream serving as a water source to country's largest hydro-electricity plant, at 2,915 feet above sea level (FCG, 1992). Mountain ranges with peaks reaching 4000 feet above sea level surround the eastern and western parts of the lake and they are dissected by many valleys with streams that are at times torrential. Nine creeks are identified as major water inlets into the lake with the larger watershed area exceeding 6 million acres in 11 administrative townships (SCOILC, 2005). Weather is very pleasant with daytime temperatures ranging from 12 – 24˚ Celsius in December to maximum 21 – 32˚ Celsius in April. Occasionally, there are severe winter cold spells and crop-killing frosts; however, the lake is large enough to ameliorate temperature conditions in the basin. Precipitation exceeds 5 cm/month from April through November and peaks in August with typical rainfall of 20 cm (Myint and Alan, 1999).

2. Inle Lake provides a large area of water bodies adjoining the vegetative shoreline of marsh land at the nearby valley plain and at the bottom of the hills, where habitats are created for seasonally migratory water fowl and birds. Flora and fauna species are diverse , and it is the nesting place of globally endangered Sarus crane (Grus antigone) (personal communication, U Than Htay, 2005). Among the nine endemic fish species (Htay Htay et al., 2002), Inle Carp (Cyprinus carpio intha) locally known as nga-phein is culturally symbolic and important for consumption and household income. For distinct biophysical features and biodiversity endemism, Inle is not only designated as 190th World's Eco-region (Olson et al. 2000 quoted in Htay Htay et al. 2002) but also nominated as one of the freshwater biodiversity hotspots by the World Conservation Monitoring Center (WCMC, 1998).

3. In addition to its ecological importance, the socio-cultural aspects of the local inhabitants in

9 Major creeks of the lake are (1)Thantaung, (2)Ye Pe, (3) In Tein, (4) Nam Latt (5) Shwe Lin Pan (6) Nam Mei Sin (7) Tha le Oo (8) Magyiseik and (9) Magyi Pin

10 According to Steering Committee Of Inle Lake Conservation (SCOILC), the watershed area is spread into Taunggyi (478,609 ac), Kalaw (372,562 ac), Ho Pong (781,159 ac), Pin Laung (827,792 ac), Phe Khong (516,881 acs), Nyaung Shwe (359,300 ac), Pindaya (163,132 ac), Yerp Sout (1,301,197 ac), Si Saing (506, 209 ac), Ywar Ngan (656,618 ac) and Loi Kaw (48,000 ac) townships in two national sub-administrative areas of Shan and Kayah States.

11 Species recorded are 240 birds, 50 fishes, 25 amphibians, 3 turtles, 30 reptiles, and 70 butterflies (FD & WCS, 2005, and Fact Sheet, 2002.

12 This spp is currently listed into vulnerable class by IUCN Red list, IUCN, 2004.

Inle Lake are also unique. The local ethnic people, the Intha, are the majority population residing in the area. Flat-bottomed boats are used for daily commuting and Inthas propel these boats by foot rather than by hand, as a traditional way of rowing. Most people are engaged in fishing.

4. Inthas are adept at hydroponic farming using floating islands of decayed grasses, reeds and marsh plants. The islands (locally known as yechan) are typically about 2 meter (m) wide and 40 m long, but may be as large as 8 m by 100 m. Silt and clay alluvium from the Lake Bottom and weeds such as water hyacinth are used to augment the structure and fertility of these islands. By trimming these islands annually, Inthas continue floating gardening year-round by growing vegetables. As water is abundant for irrigation and organic matter is naturally enriched in the islands, floating gardening is very productive and economically beneficial. In recent years, a high yield variety of tomato was introduced from Thailand and Inle has become a major production area of tomatoes, supplying the whole country.

5. Apart from fishing and hydroponics farming, textile cottage industries in the villages are also a key driver for the local economy and employment. The tourist industry is also booming in Inle Lake and tourist infrastructure such as hotels and resorts are being constructed. Inle has become a hub of socio-economic activity and an area of tremendous ecological value in the Southern Shan State.

2. ENVIRONMENTAL CONCERN AND LOCAL INITIATIVE FOR INLE LAKE CONSERVATION

6. Increasing economic activities have raised environmental issues in Inle Lake. Due to rapid deforestation and slash and burn cultivation in the adjacent watershed, soil erosion is accelerating and transporting sediments to the lake. Combined with domestic effluent and increased use of fertilizer in floating gardens, sedimentation results in increasing the nutrient uploading in the lake leading to Eutrophication (FD, 2001). The lake was 23 km long and 11 m wide in 1967 and had shrunk to 11 km long and 5 km wide in 1996 (Khin Thant, 1967 and Thi Dar Win, 1996 quoted in Myint and Alan, 1999). Land reclamation for settlement and paddy cultivation are also reasons for the loss of the lake area. Moreover, household waste, effluent and increased uses of chemical in cottage industry and tomato cultivation are causes of the decline in water quality causing concerns about increased prevalence of water borne diseases (personal communication with local resident, 2005).

7. The Government however has paid attention to conservation. Inle Wetland Wildlife Sanctuary (IWWS) was established by Forest Department in 1985 and watershed conservation initiated by UN funded projects in late 1980s. Since 1992, under the guidance of the head of the State, policies have been laid down in reinforcing the conservation efforts by means of

- law prohibiting expansion of human settle ments and floating gardens and controlling slash and burn cultivation and cutting of tree in upland watershed,
- institutional strengthening of key agencies (Forest Department and Irrigation Department) for closer supervision, and
- extensive reforestation and forest protection by Forest Department and removal of sediments and aquatic weed with drainage improvement in the lake by Irrigation Department.

8. For effective monitoring and enhancing coordination among the agencies, Steering Committee of Inle Lake Conservation (SCOILC) has been set up since 1992 and is chaired by the Chairman of the Shan State Peace and Development Council (local authority of Shan State). Steering committee includes 15 different government organizations and State/Division level Officers-In-Charge of those agencies serve as members. Furthermore, township level supervision committees are also formed for supervision of conservation programs.

13 According to a study by Department of Chemistry of Taunggyi University, the water of Inle lake is alkaline (pH ranging from 8.3 to 9.5) and its total hardness is higher than the natural range (90 -100 ppm). Pb, Cu, Cd and Hg were also recorded in the lake water and fish, but concentrations did not exceed the ranges of WHO permissible limits in terms of toxicity (Khin Mu et al., 2004). However, a larger scale of systematic research need to be carried out for determining water quality of Inle Lake because the studies conducted in the past were associated with too limited facilities and sampling size in order to be representative results of the water quality.

Table 1: Progress of Conservation Activities in Inle Lake and Watershed Area

Sr.No	Activity	1992/93 – 1999/00	2000/01 – 2004/05
1.1	Establishment of Forest Reserve (acre)	45,997	697,336
1.2	Natural Forest Management (acre)	4,000	70,000
1.3	Community Forest (acre)	13,792	10,000
1.4	Forest Plantation (acre)	13,940	10,450
1.5	Agroforestry (acre)	224	-
1.6	Multipurpose tree planting (seedling)	-	120,000
1.7	Public Tree Planting (No)	3,680,000	68,600,000
1.8	Contour bund (running feet) - FD	140,000	200,000
1.9	Terrace (acre)	86	-
2.1	Cross sectional Weir (no)	6	-
2.2	Check Dam (no)	92	-
2.3	Drainage Construction (feet)	-	400,000
2.4	Removal of sedimentation (cu-feet)	28,000,000	52,500,000
2.5	Dredging of floating island (acre)	406	750
2.6	Dredging of aquatic weed (acre)	3,431	600
3.1	Distribution of Fruit Tree (seedling)	120,000	690,000
3.2	Contour bunding (acre) - MAS	151	2000

Note: Sr.No 1.1 to 1.9 was implemented by FD – Forest Department while sr.no 2.1 – 2.6 and 3.1 – 3.2 were undertaken by Irrigation Department and Myanmar Agriculture Service (MAS), respectively.

Source: SCOILC (2005), pp:11-12 & 19-20

9. With the objective of preventing Eutrophication and conserving Inle watershed, the steering committee has drawn plans for implementation of integrated conservation activities since 1992. The following is the progress to date of the implementation of these field activities.

10. Recognizing the ecological importance of this area, Inle Lake was selected as case study. National Coordination Committee of SEFII project, which is the National Commission for Environmental Affairs (NCEA), formed a team comprising of the following members for conducting a case study at Inle Lake for two main objectives – (a). Enhancing awareness on national environmental policy and the process of environmental performance assessment (EPA) and (b). Strengthening local initiative by introducing the localized EPA system in response to global environmental concerns in which Myanmar is bounded to Millennium Development Goal (MDG) and United Nations Convention on Biological Diversity (UNCBD).

Team member of Inle Lake Case Study

1. Daw Htwe Nyo Nyo, Deputy Director, National Commission for Environmental Affairs (NCEA) and National Coordinator of SEF II Project
2. Dr.Than Htut, Deputy Director, Occupational Health Unit, Department of Health and Technical Reviewer of National EPA Team of SEF II Project
3. U Myint Thein, Deputy Director, Settlements and Land Records Department (SLRD) and Member of National Coordination Committee of SEF II Project
4. U Soe Win Maung, Assistant Director, Department of Agriculture Planning and Member of National Coordination Committee of SEF II Project.
5. U Win Myo Thu: Domestic consultant for Environmental Issue, SEF II Project
6. U Maung Maung Than: Domestic consultant for Environmental Database, SEF II Project
7. U Sai Than Maung: Head of Branch, National Commission for Environmental Affairs (NCEA)
8. Daw Kyi Kyi Thant: Head of Branch, National Commission for Environmental Affairs (NCEA)

9. U Than Htay: Park Warden of Inle Wetland Wildlife Sanctuary

11. In collaboration with the Steering Committee of Inle Lake Conservation (SCOILC), the case study team led the exercise of prioritizing environmental concern, collecting data and analyzing the findings. The results of the EPA were also presented to the local authority (SCOILC)

3. ENVIRONMENTAL PERFORMANCE ASSESSMENT OF INLE LAKE

12. There are a few environmental issues in Inle Lake and the adjacent watershed including Threat to Biodiversity, Forest Resource, Land Degradation, Water Resource and Inland Water Pollution. Among them, 'Threat to Biodiversity' was selected for conducting a case study because of its global importance and data availability for developing P-S-R indicators.

3.1 State (Threat to Biodiversity)

13. Inle Wetland Wildlife Sanctuary was established to protect the natural habitat of wetland ecosystem of flora and fauna species. In particular, priority was given to protection of migratory bird species and their habitat. Annual changes in migratory bird spp and population are an indicator of the state. 'Average number of birds annually observed in Inle Wetland Area' is chosen as a state indicator. This indicator tracks the variations in the annual average number of the bird population as well as number of bird species annually observed by the bird watching team of Inle Wetland Wildlife Sanctuary (IWWS). Daily routine records of the bird watching team for four consecutive survey years from 2001 to 2004 are main sources of data for developing this indicator and data cover for both migratory and residential species.

Indicator: Average No. of Bird Annually Observed in Inle Wetland Area 2001-2004

14. Monthly estimates of bird population are drawn by the Bird Watching Center (BWC) in Inle Wetland Area through daily observations (Annex 1a to 1d), and frequency of observation made in that particular month (Annex 2a & 2b). The monthly average numbers of the bird population throughout the year are again summed to obtain the annual average number of the observed bird population. From the lists of regular bird watching records, total numbers of bird species observed within a particular year are counted for both migratory and residential species.

15. According to the data compiled in Table 3.1, it appears that annual average numbers of both migratory and residential bird population are increasing throughout the years from 2001 to 2004, although there was a slight fall in 2004 figures compared to 2003. As bird watching was only done for a few months in 2001, the annual average number of the bird population in that year might not be fully represented. An educated guess suggests that the actual observed bird population (migratory spp) might probably be around 5000 in 2001 if the year-round bird population were to be taken into account. Hence, it is reasonable to say that the annual average number of migratory bird population is fluctuating within the range of 5000 to 8000 from 2001 to 2004. A sign of improvement in the environmental situation is possibly indicated by the increasing trend of the bird population as shown in Figure 3.1. However, more systematic studies for a longer period will be required to establish this species enrichment in Inle wetland area. Similar to the bird population, species diversities of migratory and residential birds are also fluctuating as number of species annually observed change in the years studied. However it is notable, from the supplementary figures shown in Annex 3a and 3b, that seasonal patterns of bird population and species diversity (in major bird nesting areas of the lake) follow a consistent stable trend with slight variation during the study period from 2001 to 2004.

14 Village tracts where most of the member villages in respected village tract lie within the location of marshland adjoining with water body and bottom of the adjacent hill partially.

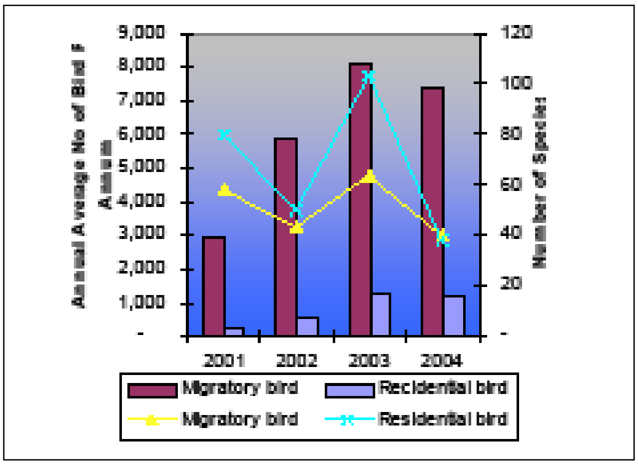
15 Village tracts where most of the member villages in respected village tract are located at the upland hill of Inle Lake and partially with valley plain in some area.

16 Village tracts where most of the member villages in the respective village tract are mainly located, are inside the lake and separate from nearby marshland and upland area.

Table 3.1: Average No of Bird Observed in Inle Wetland Area

Year	Annual Average No Observed		No of Species Observed	
	Migratory bird	Residential bird	Migratory bird	Residential bird
2001	2,909	299	58	80
2002	5,894	538	43	50
2003	8,093	1,243	64	103
2004	7,375	1,170	40	38

Figure 3.1: Average No of Bird Observed in Inle Wetland Area



Source: IWWS (2005)

Suggested Rating: Relatively Good and Stabilizing

Justification: Available data indicate that bird species are still present in a diverse state in terms of number of species annually observed. Observation of globally endangered spp of Sarus crane (Grus antigone) and their nesting place also confirm that the environmental situation of Inle Lake is relatively good. With slight varia tion, the seasonal pattern of bird population and species observation exhibit a stable trend in species diversity.

3.2. Pressure (Threat to Biodiversity)

16. Environmental sustainability of Inle lake has been threatened by habitat loss, water pollution and Eutrophication. An increasing population has compounded the acceleration of the environmental degradation process due to household waste, agricultural activity and cottage industries. Therefore, population density is selected as the 'pressure' indicator. This indicator tracks the change of population per unit area of member village tracts of Inle Lake in Nyaung Shwe Township and the wetland area as a whole. Data from Immigration and National Registration Department of Nyaung Shwe Township is used for development of this indicator and the unit of the indicator is given in population per square mile. Temporal coverage of the indicator is from 1995 to 2005; however, data for 1990 and 1983 are also given for comparison purposes.

Indicator (1): Population Density in Inle Lake 1983-2005

17. In addition to population density of the whole lake, population densities in wetland village tracts, upland village tract and lake's village tracts are given in Table 3.2 for understanding the existing population pressure patterns on lake ecosystem.

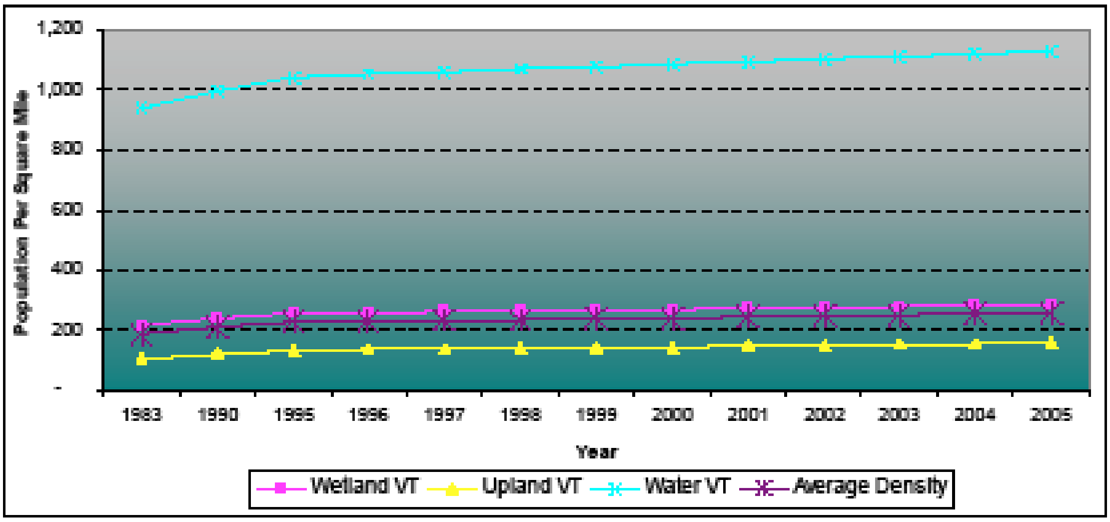
18. As observed in Figure 3.2, population density in Inle lake is gradually increasing. Notably, population density in the lake's village tracts is extremely high (1127 per square mile in 2005) and above the average population density of the whole Inle wetland area (257 per square mile in 2005). Increasing population density in the lake

Table 3.2: Population and Population Density in Inle Lake

Year	Wetland Village Tracts (265 sq-m)		Upland Village Tracts (272 sq-m)		Village Tracts inside Lake (23 sq-m)		The whole area of Inle Lake (560 sq-m)	
	Population	Density	Population	Density	Population	Density	Population	Density
1983	56,916	215	27,448	101	21,169	937	105,533	188
1990	62,871	237	32,427	119	22,541	998	117,839	210
1995	67,101	253	35,866	132	23,516	1041	126,483	226
1996	67,943	256	36,565	134	23,711	1050	128,219	229
1997	68,785	259	37,264	137	23,906	1058	129,955	232
1998	69,627	263	37,963	139	24,100	1067	131,690	235
1999	70,469	266	38,662	142	24,294	1076	133,425	238
2000	71,311	269	39,359	145	24,487	1084	135,157	241
2001	72,152	272	40,056	147	24,680	1093	136,888	244
2002	72,992	275	40,752	150	24,873	1101	138,617	248
2003	73,831	279	41,448	152	25,066	1110	140,345	251
2004	74,670	282	42,139	155	25,259	1118	142,068	254
2005	75,504	285	42,837	157	25,452	1127	143,793	257

Source: Immigration and National Registration Department (2005)

Figure 3.2: Population Density by Type of Village Tract in Inle Lake



Note: Wetland VT = Village Tracts of Wetland Zone, Upland VT = Village Tracts of Upland Zone, Water VT = Village Tracts inside Inle Lake

Source: Immigration and National Registration Department, (2005) area indicates the growing human activity and associated environmental impacts.

19. Population density in wetland village tracts is also found to be high, from 215 to 285 per square mile during the period of 1983 to 2005. It is also slightly higher than the average population density of the whole lake. As people living in both wetland and the lake's village tracts are heavily reliant on livelihood activities such as fishing and floating gardens, the increasing population in these areas is imposing an imbalance on the lake's ecosystem beyond its carrying capacity.

Suggested Rating: High and Increasing

Justification: Population density has been growing at an alarming rate in the villages in the wetland tracts. By 2005, the population density there was four and half fold higher than the average density of the whole lake area (257 per square mile). This compares with the national population density average of 200 per square mile,

Indicator (2): Inle Lake Area As a Percentage of 1990s Total Area – 1990-2003

20. Habitat loss is considered to be one of the pressures on biological diversity of Inle lake. Therefore, area changes of Inle lake are seen as a sign of habitat loss and chosen as the second pressure indicator. This indicator is developed based upon remote sensing and geographical information system (RS/GIS) data of Forest Department with ground verification by experienced local key-informants well versed in local land use. This indicator tracks habitat loss since 1990 in term of changes in the whole area of Inle lake.

21. As shown in Table 3.3, the total area of Inle lake was 58,325 acres in 1990 and has reduced to 56,911 acres in 2000 and 55,857 acres in 2003. This reduction accounts for a 2.4% loss in area from 1990's level to 2000 and 4.2% to 2003 (see Figure 3.3) However, the natural habitat area, which includes the areas of both marshland and open water bodies, did not change and even slightly increased during the same period. This is a positive trend for wildlife protection as marshland and water bodies are important habitats of the species, particularly for migratory and residential birds. However, the quality of this marshland (vegetation density) and water bodies (chemical and physical properties) have not been assessed during the case study. The extent of human settlement and agriculture area (paddy in shore line and floating garden inside of lake) shrank from 33,714 acres in 1990 to 29,209 acres in 2000 and 24,246 acres in 2003; representing a 9468 acre net area loss in settlement and agriculture area of Inle lake in the past 15 years. This change has lead to a gain in natural habitat area (7000 acres) and total exclusion of 2468 acres of land from vicinity of lake (as they appear as separate permanent land forms and are no longer associated with the seasonal inundation pattern of the lake).

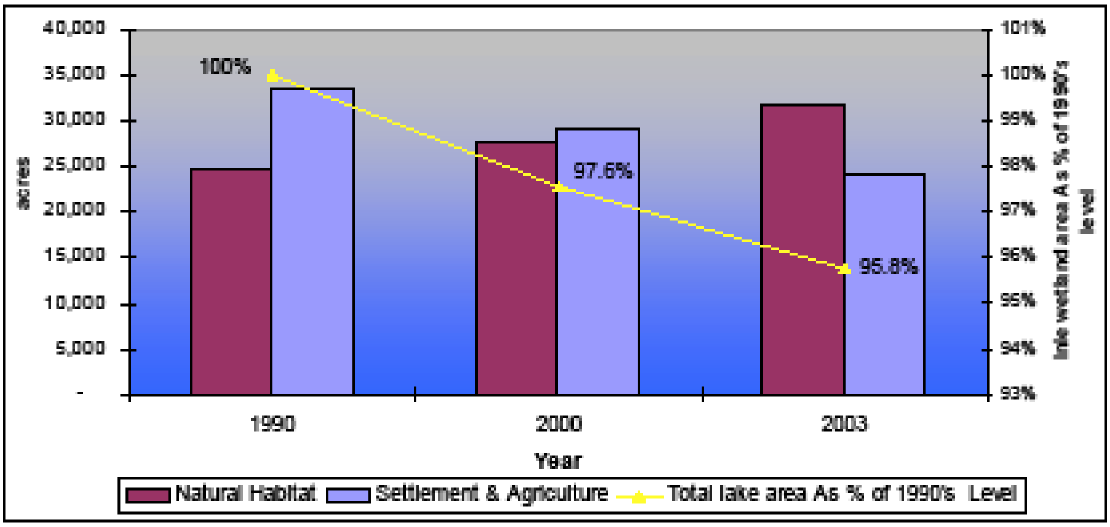
Table 3.3: Change of Natural Habitat and Other Land Use in Inle Area

Year	Natural Habitat Area (Acre)			Settlement & Agriculture Area (Acre)			Total Lake area	
	Open Water	Marsh Land	Sub-total	Floating Garden	Settlement/ Paddy	Sub-total	Acre	As % of 1990's level
1990	12,368	12,242	24,610	9,786	23,929	33,714	58,325	100%
2000	11,734	15,968	27,702	17,186	12,023	29,209	56,911	97.6%
2003	15,289	16,322	31,611	11,067	13,178	24,246	55,857	95.8%

Source: Developed from Remote Sensing Data of Forest Department by Maung Maung Than (2005)

22. From the land use data compiled in Table 3.3, it appears that the law on restricting encroachment into natural habitat areas, is working, as the area of marshland and open water bodies have not been negatively affected. However, the settlement area has gradually reduced due to rise of floating garden within the vicinity of settlement and agricultural land use. In 2000 the settlement area declined to 12,023 acres from 23,929 acres in 1990 while there was a sharp increase in floating garden area from 9,786 acres in 1990 to 17,186 acres. Perhaps, local inhabitants were

Figure 3.3: Inle Lake Area as a Percentage of 1990s Level



Source: Developed from Remote Sensing Data of Forest Department by Maung Maung Than (2005)

converting their residential area for the more productive use of floating gardens. This trend marginally reversed after 2000 because the floating garden area declined to 11,067 acres in 2003 while settlement area increased to 13,178 acres. This might be related to the fact that the exploitation of wild floating islands from marshland by local people for making new floating gardens in their residential area, was tightly controlled and some area of the lake's shore line were earmarked for paddy cultivation under the paddy promotion scheme for local food security. Therefore, land use intensification in the officially demarcated settlement and agriculture area is very high.
On the other hand, although the total extent of natural habitat area remains stable with a slight increase, vegetation density of marshland seems to have deteriorated. As total area of settlement and agriculture land use constitutes 43% of total lake area, higher intensification of socio-economic activity in this vicinity implies the acceleration process of eutrophication and declining water quality, which, in turn, has an adverse impact on environmental stability and biodiversity of the precious wetland ecosystem.

Suggested Rating: High and Increasing

Justification: In the period from 1990 to 2005, 4.2% of total wetland area was lost. The loss accelerated after 2000 because 1.8% of total land was lost within the 3 years (2000 – 2003), equivalent to 0.6 % per annum. This is two and half times higher than the rate of loss registered during the period 1990 to 2000 of only 0.24% per annum.

3.3. Response (Threat to Biodiversity)

23. The earlier response for biodiversity conservation in Inle lake to provide complete legal protection by notifying the lake area as wildlife sanctuary has since 1992 been extended to the adjacent watershed as well. Efforts have been made to strengthen the institutional capacity, extending the reforestation and soil conservation activities and improved law enforcement. As discussed earlier, prevention of encroachment into natural habitat area seems successful because the total extent of marshland and water bodies remains intact. However, destructive human activities are still reported such as man-made fire, illegal bird poaching and illicit exploitation and transportation of floating island for agriculture. To manage

17 As of 2002/2003, the estimated national population was 52.17 million (CSO, 2003) and the total extent of the country is 261,228 square miles (CSO and DAP, 1999) so that the average population density for the whole country is calculated at 199.7 persons per square mile.

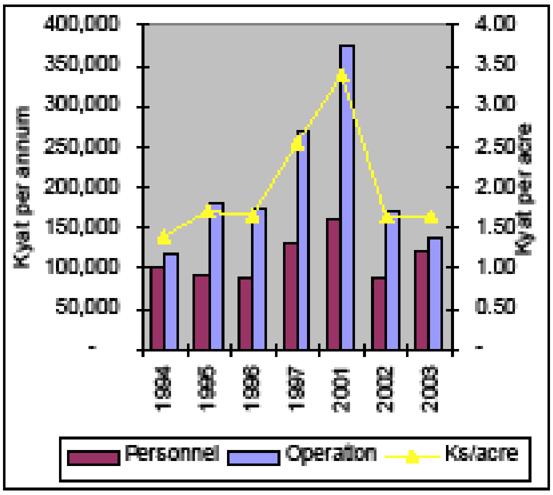
Table 3.4: Actual and Inflation Adjusted Annual Expenditure for Wildlife Conservation in Inle Wetland Area

Year	Expenditure on Personnel (Kyat)		Expenditure on Operation (Kyat)		Total Expenditure (Kyat)		Expenditure Per Acre Kyat/Acre	CPI
	Annual Amount	CPI Adjusted	Annual Amount	CPI Adjusted	Annual Amount	CPI Adjusted		
1994	166,633	101,883	192,062	117,431	358,695	219,313	1.38	163.55
1995	179,531	90,091	358,618	179,960	538,149	270,051	1.70	199.28
1996	212,346	88,779	418,629	175,023	630,975	263,801	1.66	239.19
1997	323,082	131,653	662,803	270,087	985,885	401,740	2.53	245.40
2001	784,309	160,716	1,825,940	374,162	2,610,249	534,878	3.37	488.01
2002	685,782	88,881	1,305,181	169,158	1,990,963	258,039	1.63	771.57
2003	1,144,429	120,524	1,305,425	137,479	2,449,854	258,003	1.63	949.55

Note: CPI = Consumer Price Index based on National Statistical Year Book, 2003

Source: IWWS (2005), CSO 2003

Table 3 .4: CPI Adjusted Expenditure on Wildlife Conservation in Inle Wetland Area



Source: IWWS (2005)

these issues, effective wildlife protection and conservation is required, for raising environmental awareness and education, patrolling and guarding, monitoring of species and habitat status, and promotion of community based nature conservation. In this respect, financial expenditure on wildlife conservation is selected as a response indicator to examine the capacity of financial resource made available for the pursuit of effective wildlife conservation. Annual financial reports of Inle Wetland Wildlife Sanctuary were the main sources of data for developing this indicator. Temporal coverage of this indicator was from budget year 1994 to 2003, but there are also some data gaps from 1998 to 2000.

Indicator: Financial Expenditure on Wildlife Management 1994-2003

24. This indicator tracks the financial expenditure annually incurred by Inle Wetland Wildlife Sanctuary of Forest Department for managing wildlife protection and conservation activities in Inle lake area. The unit of indicator is Kyat per annum Annual expenditure of IWWS was adjusted by consumer price index (CPI) of National Statistical

Yearbook (2002) for estimating real value of expenditure available on wildlife management.
Table 3.4: Actual and Inflation Adjusted Annual Expenditure for Wildlife Conservation in Inle Wetland Area

25. From the inflation-adjusted figures, it is found that a steady increase in total expenditure on wildlife management has occurred until 2001 but dropped sharply in 2002 and 2003 reaching to a level lower than expenditure in 1995. This affected performance in some operations such as environmental education, species monitoring and patrolling, and fire protection.

26. On an average, per acre expenditure on conservation throughout the study period was around MK1.6 per acre per annum except for the peak years in1997 and 2001.

Suggested Rating: Low and Intermittent

Justification: Financial allocations towards wildlife management have not been stable and actually declined. The current spending level of MK1.66 per acre per annum is not adequate to improve the environmental situation in Inle Lake.

4. Conclusions

27. Inle Lake is rich and diverse in migratory and residential bird species. However, this has been facing pressure of population increase and losses of lake area habitat at an alarming rate since 2000. Concerted efforts have been made in the past in strengthening institutional mechanisms, law enforcement and implementation of reforestation policies, waterway improvement, sedimentation control and species protection. Encroachment into the natural habitat area of Inle Wetland Wildlife Sanctuary has declined and the total extent of marshland and water bodies have not reduced since 1990, although the quality of these resources seemed to have declined under intensified human interventions and eutrophication of the lake. More attention needs to be paid to the reduced quality of the Inle Lake area.

28. One of the greater concerns in environmental stability of Inle Lake is the carrying capacity of the ecosystem under growing population pressure and limited financial resources available for ecological conservation. Even if the financial allocation is increased, there is still a need for developing appropriate strategies and protection measures in reducing the population pressure and diversification of socio-economic activities in the lake whilst still preserving the traditional socioculture value and securing livelihood improvement of people dependent upon the lake ecosystem. The EPA process introduced by SEF II project provides a good initiative in this direction. The following are some suggestions relevant for future conduct of an EPA locally at Inle Lake.

i) Resources should be made available for continuing the present effort in species monitoring of not only migratory and residential birds but also other fauna and flora, especially endemic aquatic weeds and fish species. Technical assistance should be given to Inle Wetland Wildlife Sanctuary's Office for the establishment of systematic databases in order to man age collected species data efficiently in spe cies monitoring as well as in environmental education material development.

ii) Future EPAs should seek the use of compre hensive RS/GIS application. Not only should the extent of different land use be assessed but also the vegetation density and condition of different land uses should be examined.

iii) Population density was developed for different locations of village tracts to examine the nature of population pressure that might be spatially varied. The categorization of village tracts into different land classes should be further improved. Any discrepancy in population data among government agencies should be reconciled.

iv) Deforestation in the upper watershed is one of the major threats to eutrophication of Inle Lake, so indicators like change in forest cover of adjacent watershed should also be developed. Likewise, an attempt should also be made to record the sedimentation rate on a regular basis.

v) Other environmental concerns like land degradation, sustainable use of water resource for drinking purpose, inland water pollution, toxic contamination and inadequate solid waste management are also relevant for the conduct of EPA in future.

vi) Steering Committee of Inle Lake Conservation is a likely candidate for conducting future EPA as it has been a local authority in setting policy and monitoring performance. Important technical agencies are also members of this committee and could provide assistance in the conduct of an EPA. For example, 'Settlements and Land Records Department of Shan State' has facility and skills in information management and this is useful for development of an environmental database. Nevertheless, capacity building of all stakeholders is required for raising environmental awareness and efficiency in the future conduct of EPA.

vii) Collaboration should be extended and strengthened between SCOILC and Taunggyi University as additional technical resources from the research work in the university can be very useful. If possible, Inle Resource Center should be established for pooling all resources and information available for environmental research, education and conservation initiative. Linkage should be also made with the National Commission for Environmental Affairs (NCEA) and NGOs, which are working in the Inle Lake area.

Suggested Rating: 2 Stars

Justification: Biodiversity of Inle Lake is relatively stable and conservation initiatives are already in place. The policy objective of wildlife management in protecting natural habitats seems to have been met. Increasing pressure and limited resources pose a challenge to the current efforts. Taking into account these limitations, the recent performance in relation to the threats to Inle Lake's ecosystem and its biodiversity seems to be moderately encouraging.

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Annex 1a: Total No of Bird Observed in Bird Watching Center (BWC), Inle Wetland for Year 2001

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Little Grebe	0	0	0	0	0	0	0	0	0	0	1	0
R	Little Cormorant	0	0	0	18	0	0	36	0	0	0	2	2
R	Indian Shag	0	0	0	30	34	0	0	0	0	616	462	81
R	Purple Heron	0	0	0	1	0	0	1	0	0	0	0	6
M	Grey Heron	0	0	0	0	5	0	0	0	0	8	0	7
R	Indian Pond Heron	0	0	0	4	1	0	0	0	0	10	23	6
R	Little Egret	0	0	0	115	351	0	34	0	0	5	1	1
R	Intermediate Egret	0	0	0	5	77	0	1	0	0	24	14	20
R	Cattle Egret	0	0	0	26	7	0	0	0	0	0	0	0
M	Yellow Bitterns	0	0	0	0	0	0	5	0	0	0	0	0
M	Spot-billed Duck	0	0	0	1232	1751	0	0	0	0	1628	787	331
M	Cotton Pygmy-Goose	0	0	0	0	121	0	0	0	0	0	0	0
M	Northern Pintail	0	0	0	0	0	0	0	0	0	0	30	0
M	Lesser Whistling Duck	0	0	0	4465	12123	0	2	0	0	2516	204	5844
M	Common Teal	0	0	0	0	0	0	0	0	0	0	18	3
M	Eurasian Wigeon	0	0	0	0	0	0	0	0	0	0	600	50
M	Garganey	0	0	0	0	0	0	0	0	0	0	0	1
M	Ruddy Shelduck	0	0	0	0	0	0	0	0	0	0	0	1
M	Watercock	0	0	0	0	0	0	0	0	0	0	0	1
M	Ferruginous Pochard	0	0	0	0	0	0	0	0	0	0	0	432
M	Asian Openbill Stork	0	0	0	30	1	0	0	0	0	0	0	0
M	Pheasant-tailed Jacana	0	0	0	633	1817	0	0	0	0	0	0	0
M	Bronze-winged Jacana	0	0	0	0	126	0	0	0	0	0	0	0
R	Common Moorhen	0	0	0	0	2	0	0	0	0	0	0	19
R	Purple Swamphen	0	0	0	29	289	0	0	0	0	23	10	5
M	Common Coot	0	0	0	0	0	0	0	0	0	0	0	8

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Common Snipe	0	0	0	183	0	0	0	0	0	3	0	4
M	Brown-headed Gull	0	0	0	0	0	0	0	0	0	0	3033	341
M	Herring Gull	0	0	0	0	0	0	0	0	0	0	0	11
R	Common Kingfisher	0	0	0	0	0	0	0	0	0	0	14	6
R	White-throated Kingfisher	0	0	0	0	0	0	4	0	0	0	1	3
M	Black - winged Stilt	0	0	0	1560	73	0	0	0	0	0	0	10
R	Blue-tailed Bee-eater	0	0	0	0	0	0	3	0	0	0	0	0
R	Black Kite	0	0	0	2	1	0	0	0	0	0	9	7
R	Brahminy Kite	0	0	0	0	0	0	0	0	0	0	0	9
R	Black-shouldered Kite	0	0	0	0	2	0	3	0	0	0	1	0
R	White Wagtail	0	0	0	7	5	0	0	0	0	19	17	6
R	Yellow Wagtail	0	0	0	50	0	0	0	0	0	0	1	0
R	Greater Coucal	0	0	0	2	6	0	11	0	0	5	12	8
R	Black Drongo	0	0	0	11	5	0	0	0	0	33	12	5
R	House Crow	0	0	0	0	2	0	4	0	0	0	0	38
R	Jerdon's Bushchat	0	0	0	0	0	0	0	0	0	0	0	1
R	Pied Bushchat	0	0	0	0	0	0	0	0	0	0	0	1
R	Baya Weaver	0	0	0	0	0	0	1	0	0	0	0	0
R	Brown Prinia	0	0	0	0	0	0	1	0	0	0	0	0
M	Cinnamon Bittern	0	0	0	0	0	0	4	0	0	0	0	0
M	Black Bittern	0	0	0	0	0	0	3	0	0	0	0	0
M	Chinese Pond Heron	0	0	0	0	0	0	5	0	0	0	3	0
M1	Unknow (Black Duck)	0	0	0	0	0	0	0	0	0	0	4	0
Total	Population Observed				8403	16799		118			4890	5259	7268

Source: IWWS (2005)

Annex 1b: Total No of Bird Observed in Bird Watching Center (BWC), Inle Wetland for Year 2002

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Little Grebe	0	0	0	0	9	0	0	0	0	0	0	0
R	Little Cormorant	233	117	0	54	3	0	39	170	471	230	2	815
R	Indian Shag	112	327	239	44	22	28	12	120	258	117	124	16
R	Purple Heron	9	32	4	11	5	1	1	2	4	9	4	19
M	Grey Heron	9	149	76	0	0	0	0	0	0	50	0	4
R	Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	3	0	0
R	Indian Pond Heron	2	0	0	1	0	10	2	24	17	33	9	66
R	Little Egret	0	0	1	6	4	8	4	0	1	0	3	0
R	Intermediate Egret	31	30	27	28	53	0	5	1	15	11	28	44
M	Yellow Bittern	0	0	0	0	1	0	12	45	16	1	0	2
M	Spot-billed Duck	890	2521	978	1132	155	23	221	6	1479	2292	3146	4304
M	Cotton Pygmy-Goose	4	0	50	19	0	0	77	0	0	0	0	12
M	Northern Pintail	9	2062	1297	0	0	0	0	0	0	2	74	693
M	Lesser Whistling Duck	94	1096	1000	5263	1767	0	25	88	126	4061	6627	6200
M	Common Teal	0	0	0	0	20	0	0	0	0	0	0	616
M	Garganey	921	3966	2597	0	0	0	0	0	600	3786	4635	12500
M	Ruddy Shelduck	0	1	12	27	0	0	0	0	0	0	10	234
M	Ferruginous Pochard	907	1173	594	14	0	0	0	0	0	580	2991	2466
M	Baer's Pochard	113	70	31	0	0	0	0	0	0	6	0	0

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Falcated Teal	0	0	0	0	0	0	0	0	0	0	0	216
M	Pheas-ant-tailed Jacana	2	107	41	66	26	0	6	0	5	3	8	485
R	Common Moorhen	48	97	85	132	49	18	40	0	0	75	89	911
R	Purple Sw-amphen	0	0	0	1	6	13	1	7	12	35	13	348
M	Common Coot	2	0	0	0	0	0	0	0	0	0	8	207
M	Marsh Sand-piper	0	0	0	0	0	0	0	0	0	0	0	41
M	Common Snipe	0	4	16	20	0	0	0	0	0	28	12	7
M	Brown-headed Gull	2439	2054	1520	21	22	0	0	0	0	17	440	5835
M	Herring Gull	11	15	22	0	0	0	13	0	0	0	0	2
R	Common Kingfisher	11	0	6	1	0	0	0	10	11	16	6	16
R	White-throated Kingfisher	1	2	1	0	0	0	0	32	12	30	8	16
M	Black-winged Stilt	0	2334	3472	4200	9	0	0	14	0	0	0	0
R	Green Bee-eater	0	0	0	0	0	1	21	14	22	0	0	0
R	Black Kite	11	5	3	0	0	0	0	0	1	3	3	0
R	Brahimy Kite	9	11	2	7	0	0	0	0	0	19	11	57
R	Black-shoul-dered Kite	1	0	1	0	0	0	1	0	0	3	3	3
R	White Wagtail	10	12	2	0	0	0	0	0	10	18	26	16
R	Yellow Wagtail	2	0	0	1	0	0	0	0	1	0	4	60
R	Greater Coucal	12	17	5	32	16	4	24	34	21	21	8	18
R	Black Drongo	16	6	7	42	0	0	0	0	4	119	9	76

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R	Red-whiskered Bulbul	0	0	0	0	0	0	0	0	3	0	0	0
R	Jerdon's Bushchat	0	0	0	0	0	0	0	0	0	0	0	5
R	Common Myna	0	0	0	0	0	0	8	9	8	9	0	0
R	White-vented Myna	0	0	0	0	0	0	0	38	0	0	0	0
R	Barn Swallow	0	0	27	54	0	0	12	80	63	1745	2	574
R	House Crow	0	0	0	0	0	0	49	69	2	14	0	32
M	Cin-namon Bittern	0	0	0	0	1	0	8	5	0	0	0	0
R	Common Stonechat	7	13	17	2	0	0	0	1	6	19	3	30
M	Black Bit-tern	0	0	0	1	0	0	0	3	0	0	0	0
R	Scaly-breasted Munia	0	0	0	0	0	0	24	38	0	1	0	2
M	Green Sand-piper	0	0	0	0	0	0	0	0	0	0	20	7
M	Indian Skimmer	0	0	0	0	0	0	0	0	0	0	0	18
M	Bar-headed Goose	0	0	0	0	0	0	0	0	0	0	0	2
M	Common Shelduck	0	0	0	0	0	0	0	0	0	0	0	2
M1	Red-crested Pochard	0	1	1	0	0	0	0	0	0	0	0	4
M	Common Sand-piper	0	0	0	0	0	0	0	0	0	0	0	12
M	Ruddy-breasted Crake	0	0	0	0	0	0	0	0	0	0	0	9
M1	Pratincole	0	0	0	0	0	0	0	0	0	0	0	11
R	Comb Duck	6	0	0	0	0	0	0	0	0	0	0	0
M	Common Pochard	0	85	41	0	0	0	0	0	0	0	0	0

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Gadwall	0	5	0	0	0	0	0	0	0	0	0	0
R	Blur-tailed Bee-eater	0	0	0	0	0	0	29	109	47	3	0	0
R	Red-wattled Lapwing	0	0	0	0	0	0	0	0	0	2	0	0
R	Long-tailed Shrike	0	0	0	0	0	0	0	0	0	0	1	1
M	Great Black-headed Gull	0	0	1	0	0	0	0	0	0	0	0	0
M1	Unknown Black Duck	0	0	0	0	0	0	0	0	0	1	0	0
	Total	5922	16312	12176	11179	2168	106	634	919	3215	13362	18327	37014

Source: IWWS (2005)

Annex 1b: Total No of Bird Observed in Bird Watching Center (BWC), Inle Wetland for Year 2002

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Little Grebe	0	0	0	0	9	0	0	0	0	0	0	0
R	Little Cormorant	233	117	0	54	3	0	39	170	471	230	2	815
R	Indian Shag	112	327	239	44	22	28	12	120	258	117	124	16
R	Purple Heron	9	32	4	11	5	1	1	2	4	9	4	19
M	Grey Heron	9	149	76	0	0	0	0	0	0	50	0	4
R	Black-crowned Night Heron	0	0	0	0	0	0	0	0	0	3	0	0
R	Indian Pond Heron	2	0	0	1	0	10	2	24	17	33	9	66
R	Little Egret	0	0	1	6	4	8	4	0	1	0	3	0
R	Intermediate Egret	31	30	27	28	53	0	5	1	15	11	28	44
M	Yellow Bittern	0	0	0	0	1	0	12	45	16	1	0	2
M	Spot-billed Duck	890	2521	978	1132	155	23		6	1479	2292	3146	4304
M	Cotton Pygmy-Goose	4	0	50	19	0	0	77	0	0	0	0	12
M	Northern Pintail	9	2062	1297	0	0	0	0	0	0	2	74	693
M	Lesser Whistling Duck	94	1096	1000	5263	1767	0	25	88	126	4061	6627	6200
M	Common Teal	0	0	0	0	20	0	0	0	0	0	0	616
M	Garganey	921	3966	2597	0	0	0	0	0	600	3786	4635	12500
M	Ruddy Shelduck	0	1	12	27	0	0	0	0	0	0	10	234
M	Ferruginous Pochard	907	1173	594	14	0	0	0	0	0	580	2991	2466
M	Baer's Pochard	113	70	31	0	0	0	0	0	0	6	0	0
M	Falcated Teal	0	0	0	0	0	0	0	0	0	0	0	216

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Pheas-ant-tailed Jacana	2	107	41	66	26	0	6	0	5	3	8	485
R	Common Moorhen	48	97	85	132	49	18	40	0	0	75	89	911
R	Purple Sw-amphen	0	0	0	1	6	13	1	7	12	35	13	348
M	Common Coot	2	0	0	0	0	0	0	0	0	0	8	207
M	Marsh Sandpiper	0	0	0	0	0	0	0	0	0	0	0	41
M	Common Snipe	0	4	16	20	0	0	0	0	0	28	12	7
M	Brown-headed Gull		2054	1520	21	22	0	0	0	0	17	440	5835
M	Herring Gull	11	15	22	0	0	0	13	0	0	0	0	2
R	Common Kingfisher	11	0	6	1	0	0	0	10	11	16	6	16
R	White-throated Kingfisher	1	2	1	0	0	0	0	32	12	30	8	16
M	Black-winged Stilt	0	2334	3472	4200	9	0	0	14	0	0	0	0
R	Green Bee-eater	0	0	0	0	0	1	21	14	22	0	0	0
R	Black Kite	11	5	3	0	0	0	0	0	1	3	3	0
R	Brahimy Kite	9	11	2	7	0	0	0	0	0	19	11	57
R	Black-shoul-dered Kite	1	0	1	0	0	0	1	0	0	3	3	3
R	White Wagtail	10	12	2	0	0	0	0	0	10	18	26	16
R	Yellow Wagtail	2	0	0	1	0	0	0	0	1	0	4	60
R	Greater Coucal	12	17	5	32	16	4	24	34	21	21	8	18
R	Black Drongo	16	6	7	42	0	0	0	0	4	119	9	76
R	Red-whiskered Bulbul	0	0	0	0	0	0	0	0	3	0	0	0

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R	Jerdon's Bushchat	0	0	0	0	0	0	0	0	0	0	0	5
R	Common Myna	0	0	0	0	0	0	8	9	8	9	0	0
R	White-vented Myna	0	0	0	0	0	0	0	38	0	0	0	0
R	Barn Swallow	0	0	27	54	0	0	12	80	63	1745	2	574
R	House Crow	0	0	0	0	0	0	49	69	2	14	0	32
M	Cin-namon Bittern	0	0	0	0	1	0	8	5	0	0	0	0
R	Common Stonechat	7	13	17	2	0	0	0	1	6	19	3	30
M	Black Bittern	0	0	0	1	0	0	0	3	0	0	0	0
R	Scaly-breasted Munia	0	0	0	0	0	0	24	38	0	1	0	2
M	Green Sandpiper	0	0	0	0	0	0	0	0	0	0	20	7
M	Indian Skimmer	0	0	0	0	0	0	0	0	0	0	0	18
M	Bar-headed Goose	0	0	0	0	0	0	0	0	0	0	0	2
M	Common Shelduck	0	0	0	0	0	0	0	0	0	0	0	2
M1	Red-crested Pochard	0	1	1	0	0	0	0	0	0	0	0	4
M	Common Sandpiper	0	0	0	0	0	0	0	0	0	0	0	12
M	Ruddy-breasted Crake	0	0	0	0	0	0	0	0	0	0	0	9
M1	Pratincole	0	0	0	0	0	0	0	0	0	0	0	11
R	Comb Duck	6	0	0	0	0	0	0	0	0	0	0	0
M	Common Pochard	0	85	41	0	0	0	0	0	0	0	0	0
M	Gadwall	0	5	0	0	0	0	0	0	0	0	0	0
R	Blur-tailed Bee-eater	0	0	0	0	0	0	29	109	47	3	0	0

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R	Red-wattled Lapwing	0	0	0	0	0	0	0	0	0	2	0	0
R	Long-tailed Shrike	0	0	0	0	0	0	0	0	0	0	1	1
M	Great Black-headed Gull	0	0	1	0	0	0	0	0	0	0	0	0
M1	Unknown Black Duck	0	0	0	0	0	0	0	0	0	1	0	0
	Total	5922	16312	12176	11179	2168	106	634	919	3215	13362	18327	37014

Source: IWWS (2005)

Annex 1c: Total No of Bird Observed in Bird Watching Center (BWC), Inle Wetland for Year 2003

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Little grebe	0	0	0	0	0	104	1	28	0	0	0	5
R	Little car-morant	80	155	188	323	159	494	1084	1566		1038	1432	519
R	Indian shag	0	0	0	0	7	0	0	2	3	0	0	0
R	Purple heron	18	45	13	5	15	19	11	13	21	17	17	23
M	Grey heron	8	24	2	0	0	0	2	0	0	28	10	1
R	Night heron	0	0	0	0	0	0	0	0	4	0	6	0
R	In-dian pond heron	0	0	0	0	10	2	26	39	60	10	0	0
M	Yellow bittern	0	0	0	0	23	54	60	55	30	4	0	0
M	Black biitern	0	0	0	0	2	18	5	8	0	1	0	0
M	Cinanmon bittern	0	0	0	0	20	23	43	19	2	0	0	0
R	Little Egret	0	0	0	35	11	87	70	10	7	5	1	0
R	Intermedi-ate egret	38	61	41	185	216	359	29	33	22	1	21	29
R	Cattle egret	0	0	0	0	5	27	114	14	9	7	0	0
M	Spot-billed duck	6601	5132	2600	2229	500	923	349	144	257	2371	4893	4320
M	Northern pintail	11391	7880	489	0	1	1020	5	0	0	0	3003	2469
M	Lesser whistling duck	6950	9240	2495	3915	2056	0	594	440	585	5364	3826	2600
M	Gad wall	0	31	28	0	0	0	0	0	0	0	267	235
M	Common teal	0	30	27	0	0	0	0	0	0	0	0	4
M	Eurasian wigeon	45	211	138	0	0	0	0	0	0	42	313	720
M	Garganey	6110	3090	2665	0	0	0	0	0	0	1863	6457	5323
M	Mallard	6	19	0	0	0	0	0	0	0	0	12	5
M	Ruddy Shelduck	78	0	12	15	0	6	0	0	0	0	19	19
M	Common shelduck	0	0	0	0	0	0	0	0	0	0	8	2

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Fur-ruginous Pochard	2585	1923	493	2	0	0	0	0	0	0	677	673
M	Barer's Pochard	36	65	24	0	0	0	0	0	0	0	27	3
M	Common Pochard	0	0	0	0	0	0	0	0	0	0	4	34
M	Falcated teal	0	37	0	0	0	0	0	0	0	0	0	6
M	Northern shoveler	0	62	19	0	0	0	21	0	0	0	60	256
M	Cotton pygmy-goose	0	80	0	0	213	771	220	15	0	0	0	0
M	Bar headed goose	0	0	0	0	274	0	0	0	0	0	0	3
M	Pheas-ant tailed jacana	614	1568	984	784	0	61	8	0	0	3	186	295
R	Common morhen	313	694	333	328	136	10	1	1	0	25	275	295
R	purple sw-amphen	64	47	37	30	26	27	2	22	40	37	50	57
M	black/ common coot	10	3	0	0	0	0	0	0	0	1	6105	3500
M	Ruddy breasted crake	15	17	0	0	0	0	0	0	0	0	18	15
M	Marsh sandpiper	38	25	66	59	0	0	0	0	0	0	0	0
M	Common sand piper	0	0	0	0	0	0	0	0	0	0	0	0
M	Green sand piper	378	2579	1415	297	0	0	0	0	0	3	10	75
M	Spotted-redshank	8	0	0	0	0	0	0	0	0	0	0	0
M	common red shank	47	199	0	0	0	0	0	0	0	0	0	0
M	western curlew	0	2	0	0	0	0	0	0	0	0	0	1
M	common snipe	0	0	0	0	0	0	0	0	0	0	1	0
M	brown headed gull	1821	834	1230	109	0	0	0	0	0	26	2782	4967
M	herring gull	0	0	0	0	0	0	0	0	0	0	0	2

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Indian skimmer	0	2	0	0	16	0	0	0	0	0	0	0
M	black winged stilt	435	3833	2550	10050	0	0	0	0	0	2	0	253
R	common king fisher	0	6	6	0	0	0	2	2	21	45	29	16
R	white throated king fisher	0	26	4	0	0	12	29	24	23	15	16	13
R	green bee eater	0	0	0	0	0	100	130	187	65	0	0	0
R	blue tailed bee eater	0	0	0	0	0	228	125	0	196	0	0	0
R	black kite	0	9	0	0	0	3	0	0	1	1	0	0
R	Brahminy kite	0	15	1	0	0	12	0	0	0	1	0	4
R	black shoulder kite	0	1	2	3	5	0	4	5	12	21	0	0
M	Pine har-rier	0	0	0	0	0	0	0	0	0	2	0	0
R	eastern marsh harrier	0	0	0	0	0	0	0	0	1	0	27	30
M	western marsh harrier	0	31	37	15	0	0	0	0	11	7	24	27
R	white wagtail	0	7	7	8	0	0	0	0	3	32	25	23
R	yellow wagtail	0	9	7	2262	0	0	0	0	0	3	6	7
R	citrine wagtail	0	43	27	9	0	0	0	0	0	0	0	0
R	common myna	0	2	7	0	2	28	0	0	0	23	0	0
R	white vented myna	0	0	0	0	0	0	0	0	0	0	10	0
R	collored myna	0	0	0	0	0	0	126	0	0	0	0	0
R	greater coucal	0	31	15	9	21	42	28	45	9	24	16	11
R	lesser coucal	0	0	0	0	1	24	31	13	25	20	0	0
R	jerdon's bushchat	0	0	0	0	0	0	9	0	0	0	0	0
R	common stone chat	0	34	21	1	0	0	0	0	23	33	36	18

Type	Spp Common name	Observed Population (No)											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
R	Pine bushchat	0	0	0	0	0	0	0	0	0	10	1	0
R	black drongo	0	53	29	35	1	10	0	0	40	123	114	32
R	house crow	0	37	16	3	39	0	0	0	6	0	83	107
R	red-whis-kered bulbul	0	0	0	13	0	0	0	0	0	0	0	0
R	barn swal-low	0	285	39	24	538	114	239	288	2704	472	258	340
R	wired tailed swallow	0	0	0	0	0	0	0	0	60	2	3	2
R	house sparrow	0	0	0	0	87	0	0	0	0	0	0	0
R	long tail shrike	0	0	0	0	0	0	0	0	0	5	1	0
R	brown shrike	0	1	0	0	0	0	0	0	0	0	0	0
R	yellow billed prinia	0	0	0	0	0	0	0	0	0	0	0	0
R	grey breasted prinia	0	0	0	0	0	0	0	0	0	0	0	0
R	dusky warbaler	0	4	15	5	0	0	0	0	1	1	17	18
R	ori-enta reed warbaler	0	0	3	0	0	0	0	0	0	0	0	0
R	chestnut capped babbler	0	0	0	0	0	0	21	15	0	9	5	16
M1	Tufted duck	0	0	0	0	0	0	0	0	0	0	93	0
M1	black tern	0	0	0	0	0	0	0	0	88	0	0	0
M1	white wing black tern	0	0	0	0	0	0	0	0	75	0	0	0
M1	clam-orus reed warbaler	0	0	0	0	0	0	4	13	0	0	0	0
M1	Fulvous whistling duck	0	0	0	0	0	0	4	0	0	0	0	0
M1	streaked warbaler	0	0	0	0	0	0	5	68	73	0	0	0

Source: IWWS (2005)

Annex 1d: Total No of Bird Observed in Bird Watching Center (BWC), Inle Wetland for Year 2004

Type	Spp Common name	Observed Population											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Little Grebe	0	0	58	0	0	0	0	0	0	0	0	3
R	Little Cormorant	660	269	191	28	69	176	114	714	895	1529	632	227
R	Purple Heron	0	0	4	0	12	13	3	0	18	10	16	19
M	Grey Heron	9	18	0	0	0	0	0	0	0	2	5	3
R	Black-crowned Night Heron	0	0	0	0	0	0	0	2	22	39	0	0
R	Indian Pond Heron	0	0	0	0	8	7	7	26	14	62	21	22
R	Little Egret	0	1	0	33	8	2	3	8	61	30	0	0
R	Intermediate Egret	20	28	67	116	31	26	38	3	32	71	46	35
R	Cattle Egret	0	0	0	0	18	25	6	0	1	0	0	0
M	Yellow Bittern	0	0	2	9	59	49	53	39	81	11	1	0
M	Spot-billed Duck	2300	936	1825	314	14	45	27	8	438	723	2949	5050
M	Cotton Pygmy-Goose	0	0	6	0	0	0	0	0	0	0	0	0
M	Northern Pintail	450	3	2	0	0	0	0	0	0	0	4213	7600
M	Lesser Whistling Duck	1750	1850	8313	0	0	5	0	0	739	2549	10050	15200
M	Common Teal	11	0	0	0	56	5	0	0	0	0	0	6
M	Eurasian Wigeon	414	179	4	0	0	0	0	0	0	0	270	297
M	Garganey	3350	102	4	0	0	0	0	0	4	2248	7602	11700
M	Ruddy Shelduck	70	1	9	0	0	0	0	0	0	0	18	16
M	Ferruginous Pochard	145	560	303	0	0	0	0	0	0	0	436	889
M	Baer's Pochard	0	0	0	0	0	0	0	0	0	0	2	2
M	Falcated Teal	41	10	0	0	0	0	0	0	0	2	0	0

Type	Spp Common name	Observed Population											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Pheasant-tailed Jacana	1110	523	1089	1188	186	0	1	0	0	1	390	119
R	Common Moorhen	104	27	66	101	68	0	0	0	0	2	2	60
R	Purple Swamphen	31	11	116	735	89	17	23	16	27	44	43	23
M	Common Coot	297	500	0	0	0	0	0	0	0	1	7985	29200
M	Brown-headed Gull	2050	1571	10	0	0	0	0	0	0	0	1934	5524
M	Herring Gull	0	0	0	0	0	0	0	0	0	6	3	1
R	Common Kingfisher	0	0	1	0	0	0	2	7	27	23	20	21
R	White-throated Kingfisher	0	0	0	0	1	16	21	12	31	35	34	26
M	Black-winged Stilt	1250	1690	3432	2839	1	0	0	0	0	0	0	31
R	Blue-tailed Bee-eater	0	0	0	0	6			69	118	0	0	0
R	Black-shouldered Kite	0	0	0	0	0	9	13	7	12	5	1	0
R	White Wagtail	0	0	9	4	0	0	0	0	9	28	32	25
R	Greater Coucal	0	0	0	22	26	45	29	15	11	23	21	18
R	Black Drongo	0	0	20	64	1	0	0	1	15	114	69	33
R	Common Myna	0	0	0	7	17	8	66	0	0	15	0	0
R	White-vented Myna	0	0	0	6	0	0	0	0	0	150	0	0
R	Streaked (Baya) Weaver	0	0	0	0	0	0	0	0	3	2	0	0
R	Barn Swallow	0	0	0	4110	495		76	2800	648	1673	678	3125
R	House Crow	0	0	0	6	8	0	0	0	0	0	41	2
M	Cinnamon Bittern	0	0	0	0	19	13	43	12	26	0	0	0
R	Common Stonechat	0	0	5	2	0	0	0	0	24	39	55	38
M	Black Bittern	0	0	0	0	7	2	1	0	1	0	0	0

Type	Spp Common name	Observed Population											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Green Sandpiper	196	0	0	51	0	0	0	0	0	0	1	22
R	Long-tailed Shrike	0	0	0	0	0	0	0	0	2	2	0	0
M	Common Shelduck	0	0	0	o	0	0	0	0	0	0	12	0
M	Gadwall	34	0	0	o	0	0	0	0	0	0	53	49
M	Wood Sandpiper	0	0	26	o	0	0	0	0	0	0	2	0
R	Eastern Marsh Harrier	0	0	9	7	0	0	0	0	1	12	22	27
M	Common Redshank	0	0	2	4	0	0	0	0	0	0	0	0
R	Chestnut-capped Babbler	0	0	0	14	10	13	0	15	32	91	18	21
M1	Lesser -tree Duck	0	0	0	1235	303	73	71	137	0	0	0	0
M1	House Switt	0	0	0	20	0	0	0	0	0	0	0	0
R	Reed Warbler	0	0	0	0	13	0	0	0	0	0	0	0
M1	White-winged Black Tern	0	0	0	0	7	0	8	0	10	0	0	0
R	Red Rumped Swallow	0	0	0	0	0	0	36	0	0	0	0	0
R	House Sparrow	0	0	0	0	0	0	0	0	2	0	3	0
M	Western Marsh Harrier	0	0	0	0	0	0	0	0	0	5	33	23
R	Dusky Warbler	0	0	0	0	0	0	0	0	0	5	33	23
M1	Red-crested Pochard	0	39	0	0	0	0	0	0	0	0	3	2
M1	Tufted Duck	0	0	0	0	0	0	0	0	0	0	50	30
M	Mallard	6	0	0	0	0	0	0	0	0	0	0	13
M	Northern Shoveler	10	0	0	0	0	0	0	0	0	0	0	79
R	Rock Pigeon	0	0	0	0	0	0	0	0	0	0	0	2
R	Lesser Coucal	0	0	0	0	0	0	0	1	1	0	0	0
R	Indian Shag	0	0	0	0	0	0	0	0	0	1	0	0

Type	Spp Common name	Observed Population											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
M	Bar-headed Goose	8	1	0	0	0	0	0	0	0	0	0	1
M	Common Pochard	46	0	0	0	0	0	0	0	0	0	0	0
M	Ruddy-brested Crake	4	0	0	0	0	0	0	0	0	0	0	0
M	Marsh Sandpiper	91	0	0	0	0	0	0	0	0	0	0	0
	Total	14457	8319	15573	10915	1532	852	794	3892	3305	9553	37799	79607

Source: IWWS (2005)

Annex 2a:Monthly Average No of Migratory and Resident Bird (Bird Watching Center)

No of Frequency Observed Per Month (BWC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	0	0	0	10	23	0	3	0	0	20	26	16
2002	22	21	20	20	14	15	30	29	26	17	17	21
2003	27	25	19	19	20	27	26	27	28	24	24	23
2004	27	26	13	18	27	25	25	17	26	23	25	23

Migratory bird population (BWC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	-	-	-	8,103	16,017	-	19	-	-	4,155	4,680	7,044
2002	5,401	15,643	11,749	10,763	2,010	23	362	161	2,226	10,827	17,971	33,889
2003	37,179	36,917	15,274	17,475	3,105	2,980	1,321	790	1,121	9,717	28,795	25,813
2004	13,642	7,983	15,085	5,660	652	192	204	196	1,299	5,548	36,012	75,860

No of Migratory Spp Observed (BWC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	0	0	0	6	8	0	5	0	0	4	9	14
2002	12	16	17	10	9	1	7	6	5	12	11	25
2003	20	25	18	10	9	8	14	9	8	14	22	26
2004	22	15	15	8	9	7	7	4	7	10	21	24

Monthly Average No of Migratory Bird Observed (BWC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	-	-	-	810	696	-	6	-	-	208	180	440
2002	246	745	587	538	144	2	12	6	86	637	1,057	1,614
2003	1,377	1,477	804	920	155	110	51	29	40	405	1,200	1,122
2004	505	307	1,160	314	24	8	8	12	50	241	1,440	3,298

Residential bird population (BWC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001				300	782		99			735	579	224
2002	521	669	427	416	158	83	272	758	989	2535	356	3125
2003	513	1565	811	3278	1279	1598	2081	2279	5108	1980	2449	1560
2004	815	336	488	5255	880	660	590	3696	2006	4005	1787	3747

No of Residential Spp Observed (BWC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	0	0	0	13	13	0	11	0	0	8	14	18
2002	17	12	15	15	8	8	16	17	21	23	20	21
2003	5	21	20	17	17	18	19	17	25	26	22	19
2004	4	5	9	15	17	15	15	15	23	24	19	18

Monthly Average No of Residential Bird Observed (BWC)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2001	0	0	0	30	34	0	33	0	0	37	22	14
2002	24	32	21	21	11	6	9	26	38	149	21	149
2003	19	63	43	173	64	59	80	84	182	83	102	68
2004	30	13	38	292	33	26	24	217	77	174	71	163

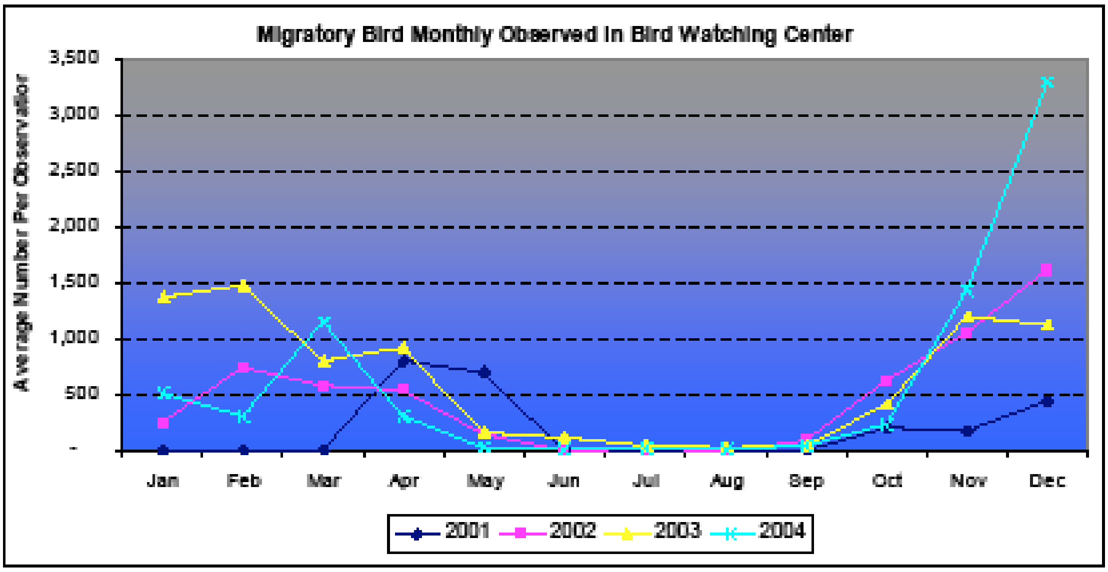
Source: IWWS (2005)

Annex 2b: Annual Average No of Migratory and Resident Birds (Other than in Bird Watching Center)

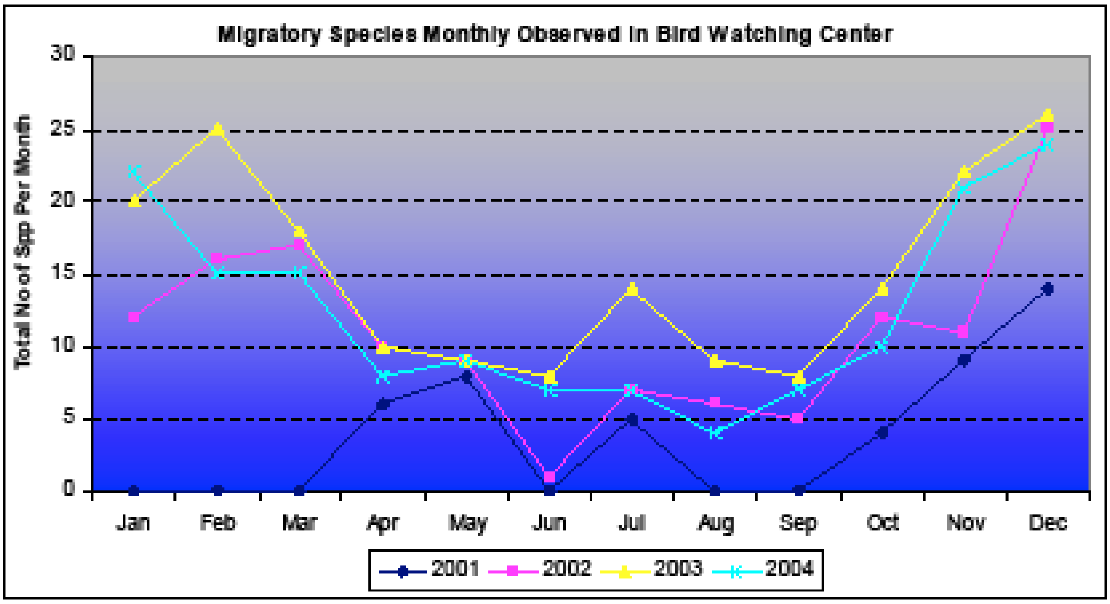
No of Frequency Observed (Other than BWC)				
Year	Inle (Other)	Sagar Lake	Moe Bywe	Hpae Khon
2001	10	25	16	
2002	12			
2003	4	8		1
2004	1			
Total No of Migratory Bird (Other than BWC)				
Year	Inle (Other)	Sagar Lake	Moe Bywe	Hpae Khon
2001	1696	1793	5224	0
2002	2659	0	0	0
2003	99	504	0	315
2004	6	0	0	0
No of Migratory Spp Yearly Observed (Other than BWC)				
Year	Inle (Other)	Sagar Lake	Moe Bywe	Hpae Khon
2001	9	14	10	0
2002	9	0	0	0
2003	3	10	0	6
2004	2	0	0	0
Annual Average No of Migratory Bird Observed (Other than BWC)				
Year	Inle (Other)	Sagar Lake	Moe Bywe	Hpae Khon
2001	170	72	327	
2002	222			
2003	25	63		315
2004	6			
Total No of Resident Bird (Other than BWC)				
Year	Inle (Other)	Sagar Lake	Moe Bywe	Hpae Khon
2001	504	925	668	
2002	382			
2003	387	503		64
2004	12			
No of Resident Spp Yearly Observed (Other than BWC)				
Year	Inle (Other)	Sagar Lake	Moe Bywe	Hpae Khon
2001	19	26	10	
2002	18			
2003	22	29		10
2004	6			
Annual Average No of Resident Bird Observed (Other than BWC)				
Year	Inle (Other)	Sagar Lake	Moe Bywe	Hpae Khon
2001	50	37	42	
2002	32			
2003	97	63		64
2004	12			

Source: IWWS (2005)

Annex 3a



Annex 3b



Annex 4. Population of Village Tract in Inle Wetland (Nyaungshwe Tsp)

Sr No.	Village tract	1983	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1	Banbyin (UP)	2,660	3,255	3,679	3,763	3,847	3,931	4,015	4,099	4,183	4,267	4,351	4,435	4,519
2	Inndan (UP)	1,055	1,376	1,601	1,646	1,691	1,736	1,781	1,826	1,871	1,916	1,961	2,006	2,051
3	Kyauktaing (UP)	1,239	1,694	2,019	2,084	2,149	2,214	2,279	2,344	2,409	2,474	2,539	2,604	2,669
4	Letmayn-gkwe (UP)	1,680	1,827	1,932	1,953	1,974	1,995	2,016	2,036	2,056	2,076	2,096	2,116	2,136
5	Linlan North (UP)	1,594	1,993	2,173	2,221	2,269	2,317	2,365	2,413	2,461	2,509	2,557	2,605	2,653
6	Linlan South (UP)	1,105	1,488	1,758	1,812	1,866	1,920	1,974	2,028	2,082	2,136	2,190	2,244	2,298
7	Lonkan (UP)	1,168	1,598	1,903	1,964	2,025	2,086	2,147	2,208	2,269	2,330	2,391	2,452	2,513
8	Taungche (UP)	4,189	4,448	4,633	4,670	4,707	4,744	4,781	4,818	4,855	4,892	4,929	4,966	5,002
9	Yepu (UP)	1,079	1,240	1,355	1,378	1,401	1,424	1,447	1,470	1,493	1,515	1,537	1,555	1,581
10	Kyepawk-hone (UP)	4,516	5,106	5,526	5,610	5,694	5,778	5,862	5,946	6,030	6,114	6,198	6,282	6,366
11	Tilaw (UP)	4,307	5,329	6,059	6,205	6,351	6,497	6,643	6,788	6,933	7,078	7,223	7,368	7,513
12	Ywatha (UP)	2,856	3,073	3,228	3,259	3,290	3,321	3,352	3,383	3,414	3,445	3,476	3,506	3,536
13	Khaungta-ing (Wet)	2,003	2,339	2,579	2,627	2,675	2,723	2,771	2,819	2,866	2,913	2,960	3,007	3,054
14	Maingthauk (Wet)	4,568	4,890	5,119	5,164	5,209	5,254	5,299	5,344	5,389	5,434	5,479	5,524	5,569
15	Minchaung (Wet)	6,442	7,051	7,486	7,573	7,660	7,747	7,834	7,921	8,008	8,094	8,180	8,266	8,352
16	Naungtaw (Wet)	4,050	4,820	5,370	5,480	5,590	5,700	5,810	5,920	6,030	6,140	6,250	6,360	6,469
17	Pontmu (Wet)	3,606	4,040	4,346	4,407	4,468	4,529	4,590	4,651	4,712	4,773	4,834	4,895	4,956
18	Sakar (Wet)	1,798	2,169	2,434	2,487	2,540	2,593	2,646	2,699	2,752	2,805	2,858	2,911	2,963
19	Taungbogyi (Wet)	2,031	2,402	2,667	2,720	2,773	2,826	2,879	2,932	2,985	3,038	3,090	3,142	3,194
20	Tonle (Wet)	2,669	2,863	2,998	3,025	3,052	3,079	3,106	3,133	3,160	3,187	3,214	3,241	3,268
21	Inntain (Wet)	2,480	2,753	2,944	2,982	3,020	3,058	3,096	3,134	3,172	3,210	3,248	3,286	3,324
22	Maingpyo (Wet)	1,669	1,956	2,158	2,198	2,238	2,278	2,318	2,358	2,398	2,438	2,478	2,518	2,558
23	Kyungyi (Wet)	2,994	3,182	3,317	3,343	3,369	3,395	3,421	3,447	3,473	3,499	3,525	3,551	3,577
24	Nathe (Wet)	3,006	3,461	3,782	3,846	3,910	3,974	4,038	4,102	4,166	4,230	4,294	4,358	4,420

Sr No.	Village tract	1983	1990	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
25	Thabyepin (Wet)	4,499	4,695	4,835	4,863	4,891	4,919	4,947	4,975	5,003	5,031	5,059	5,087	5,115
26	Linkin (Wet)	2,830	3,243	3,536	3,594	3,652	3,710	3,768	3,826	3,884	3,942	4,000	4,058	4,116
27	Nampan (Wet)	3,900	3,992	4,057	4,070	4,083	4,096	4,109	4,122	4,135	4,148	4,161	4,174	4,187
28	Taungtoh (Wet)	3,918	4,142	4,300	4,331	4,362	4,393	4,424	4,455	4,486	4,517	4,548	4,579	4,610
29	Thaleoo (Wet)	4,453	4,873	5,173	5,233	5,293	5,353	5,413	5,473	5,533	5,593	5,653	5,713	5,772
30	Innchan-kela (W)	3,563	3,920	4,175	4,226	4,277	4,327	4,377	4,427	4,477	4,527	4,577	4,627	4,677
31	Innpawk-hon (W)	4,380	4,476	4,541	4,554	4,567	4,580	4,593	4,606	4,619	4,632	4,645	4,658	4,671
32	Innya (W)	3,587	3,825	3,995	4,029	4,063	4,097	4,131	4,165	4,199	4,233	4,267	4,301	4,335
33	Nga-pechaung (W)	2,346	2,423	2,478	2,489	2,500	2,511	2,522	2,532	2,542	2,552	2,562	2,572	2,582
34	Thalay (W)	3,657	3,939	4,139	4,179	4,219	4,259	4,299	4,339	4,379	4,419	4,459	4,499	4,539
35	Ywama (W)	3,636	3,958	4,188	4,234	4,280	4,326	4,372	4,418	4,464	4,510	4,556	4,602	4,648

Source: Nyaungshwe's Immigration and National Registration Department (2005)

Annex 5a: Members of Steering Committee of Inle Lake Conservation

1.	Military Commander and Chairman of Shan State Peace and Development Council	Chair Person
2.	Secretary, Shan State Peace and Development Council	Vice Chairman (1)
3.	Chairman, Taunggyi District Peace and Development Council	Vice Chairman (2)
4.	Commanding Officer, Taunggyi Military Supply Depot	Member
5.	Public Administrator, Government Affairs Department, Southern Shan State	Member
6.	Police Commander, Police Department of Southern Shan State	Member
7.	Director, Immigration and National Registration Department, Southern Shan State	Member
8.	General Manager, Myanmar Agriculture Service, Southern Shan State	Member
9.	General Manager, Myanmar Enterprise for Perennial Crop	Member
10.	Officer In Charge, Settlements and Land Records Department, Southern Shan State	Member
11.	Chief Engineer, Myanmar Electrical Enterprise, Southern Shan State	Member
12.	Director, Department of Development Affairs, Southern Shan State	Member
13.	Director, Department of Agriculture Mechanization, Southern Shan State	Member
14.	Officer In Charge, Fishery Department, Southern Shan State	Member
15.	Secretary, Union of Solidarity and Development Association, Taunggyi Township	Member
16.	Director, Forest Department, Southern Shan State	Secretary (1)
17.	Director, Irrigation Department, Southern Shan State	Secretary (2)

Annex 5b: Members of Township level supervising committee for Inle Lake Conservation

1.	Chairman, Township District Peace and Development Council	Chair Person
2.	Chief of Township Police Department	Member
3.	Staff Officer, Township Immigration and National Registration Department	Member
4.	Staff Officer, Township Irrigation Department	Member
5.	Township Manager, Myanmar Agriculture Service	Member
6.	Staff Officer, Township Settlements and Land Records Department	Member
7.	Township engineer, Myanmar Electrical Enterprise	Member
8.	Township Executive Officer, Department of Development Affairs	Member
9.	Staff Officer, Township level Department of Agriculture Mechanization	Member
10.	Member from Township Union of Solidarity and Development Association	Member
11.	Chairman of Village Tracts Peace and Development Council	Member
12.	Staff Officer, Township Forest Department	Secretary