SUBREGIONAL ENVIRONMENTAL MONITORING AND INFORMATION SYSTEMS PHASE II

T.A. NO. 5899-REG

Report on
Data Collection Status, Processing Capabilities, and Capacity Building Needs in the GMS Countries

and
Capacity Building Plan

Submitted to
Asian Development Bank

By
United Nations Environment Programme
Regional Resource Centre for Asia and the Pacific
Bangkok

January 2002

SUBREGIONAL ENVIRONMENTAL MONITORING AND INFORMATION SYTEMS PHASE II

T.A. No. 5899-REG

Output-3
Report on Data Collection Status, Processing Capabilities, and Capacity Building Needs in the GMS Countries

and
Capacity Building Plan

Submitted to
Asian Development Bank

By
**UNEP Regional Resource Centre
for Asia and the Pacific**

January 2002

Table of Contents

List of Tables

List of Annexes

Presented Papers from Participating Countries and Mekong River Commission

1. Introduction

The Asian Development Bank (ADB) is implementing a Technical Assistance (TA 5899-REG) for the Subregional Environmental Monitoring and Information Systems – Phase II (SEMIS II) in collaboration with the United Nations Environment Programme – Regional Resource Centre for Asia and the Pacific (UNEP RRC.AP). The project is co-financed by ADB (through the Japan Special Fund and the Government of Norway) and the UNEP RRC.AP.

The TA is a follow-up phase of SEMIS I, which was requested by the Greater Mekong Subregion (GMS) countries (Cambodia, Yunnan province of the People's Republic of China, Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam) at the Fourth Meeting of the GMS Working Group on Environment held in Hanoi in March 1998. The GMS Ministerial Meeting held in Manila in September 1998 endorsed the request and the project was approved by ADB on 29 December 1999.

SEMIS Phase I established the groundwork, such as (1) a defined core dataset, (2) a conceptual spatial database design, and (3) technical capacity for the exchange of data, for the sharing of information on environmental and natural resources issues. The overall goal of SEMIS II is to build upon the achievements of SEMIS I to help GMS governments to make informed decisions regarding sustainable development through Integrated Economic and Environmental Development Planning (IEEDP). A key component of informed decision-making is having access to reliable information, including spatial data. The GMS countries are linked geographically and share common environmental problems. Therefore, these countries have a common need to share environmental information in a timely manner.

The key objectives of SEMIS II include:

- Assess the availability of useful and relevant data for planning purposes,

- Increase and strengthen the capacity of national governments to collect and process the information/data,

- Increase the capacity of national governments to make informed decisions regarding development investments relating to sustainable use of natural resources,

- Enhance the ability of GMS national governments to conduct Integrated Economic and Environmental Planning with relevant data, and

- Conduct, store, manipulate and share actual integrated planning information using the data collected in pilot projects for some "Hotspot" areas, such as those identified in TA 5783-REG: Strategic Environmental Framework for the GMS.

2. Objectives and Approach

A key component of informed decision-making is having access to reliable information, including spatial data. The GMS countries, because of their geographic locations, share common environmental problems and therefore have a common need to share environmental information in a timely manner. In this regard, the first necessary step was to have the information on available data and capacity in each participating country.

This report, which presents the outcomes of Work program activities 2.1 and 2.2 (please see project implementation plan), serves as the Output 3 (*Report on current status of data collection and processing capability of participating organization, hardware/software needs, and persons to be trained*) to achieve the SEMIS II key objective 2 (*increase and strengthen the capacity of national Governments to collect and process the information data*).

The specific objectives were to:

1. review the available data/information, specifically those identified as core datasets;

2. assess the capacity strengthening needs for data collection, analysis and processing in each participating country; and

3. plan the capacity building program in terms of nature of training, duration, number of persons to be trained from each country.

The information was gathered from the local agencies and organizations from each participating countries. The priority in collecting the information was given to agencies and organizations that are involved in collecting/generating the core datasets and related themes. A guideline was distributed to each national coordinator on how to collect the information with the purpose to maintain the uniformity of the gathered information from the GMS countries.

3. Findings

Though it was planned that the assessment will be made for the focal/participating agencies only[1], information was collected for all organizations that are involved in environmental data generation in all countries. The current status of data collection/generation and processing capability of participating organization, and the hardware/software and capacity building needs are presented here under.

3.1 Environmental Data Generation

SEMIS I, precursor of current project, identifies 13 core datasets that are frequently required for range of environmental decisions.

Table 1. List of Core Datasets.

Core Datasets	Thematic layer/Geo-referenced Object
• Infrastructure	• Major Roads; Railways; Canals; Pipelines; Major Electric Transmission Lines
• Soil Class (includes slope and terrain)	• Soil Map
• Vegetation Cover	• Forest Cover Map; Grassland/Wetland Map
• Air Quality Measurements	• Locations of Measurement Stations
• Demography	• (linked to Administrative Boundaries)
• Climate Zonation	• Climate (or agroclimatic) Map
• Administrative Boundaries	• Administrative/Census Map; Management/Protected Areas
• Topography	• Elevation Contours; Coastline and Lakes; Rivers
• Land Use	• Land Use Map
• Geology	• Geological map
• Major Harvesting Activities	• (linked to Administrative Boundaries)
• Water Quality Measurements	• Location of Water Sampling Stations
• Soil Analysis Samples	• Locations of Soil Samples

Table 1 presents the list of core dataset and related thematic layers of each core dataset. The list is primarily the spatial data except harvesting activities, which are tabular data to be linked to administrative boundaries GIS data. Besides the list presented in the table, other important data that are required for planning purpose are social and economic data which have been regularly collected in the countries, however different levels of detail depending upon the country. It has also been tried to gather information on such data, which are of social and economic nature, wherever possible.

---

[1] SEMIS II participating agencies are: Department of Natural Resources of Ministry of Environment of Cambodia; National Commission for Environmental Affairs of Myanmar; Science, Technology and Environmental Agency of Lao PDR, Foreign Techno-Economic Cooperation Division of Yunnan Provincial Environmental Protection Bureau of PR China; National Environmental Agency of MOSTE, Vietnam; and Department of Environmental Quality Promotion of MOSTE, Thailand. There is one designated person as national coordinator from each agency to coordinate day-to-day implementation activities. Each national coordinator is supposed to contribute for data collection from his/her home country equivalent to 6 person-months.

3.2 Data Holdings

Lao PDR

The basic thematic layers available in Lao PDR are: infrastructure, land use, topography, forest cover; watershed classification, soil types, and geology ranging from 1:50,000 to 1:1 million scale (Table 2). Some other derived layers are irrigated land, land suitability, and irrigation project's flood extent. Basic and agricultural production statistics are also available. Some of the data, such as forest cover, watershed classification, are available in digital format while rest of the data are in paper format.

Table 2. Available Data and Their Sources in Lao PDR.

S. N.	Theme/Type	Holding Organization	Scale	Format
1	Infrastructure *(specified as base map)*	National Geography Department	Various scales from 1:50K to 1:1,000K	Map/Digital
2	Soil	NAFRI	Various scales	Digital
3	Forest	Department of Forestry	Various scales	Digital
4	Land Use	NAFRI	Various scales	Digital
5	Topographic Map *(Base map)*	National Geography Department	Various scales from 1:50K to 1:1,000K	Map and Digital
			1:500K	Digital
6	Geology	Department of Mine	1:1,000K	Digital
7	Population (Demography)	National Statistic Center		Paper (Report)
8	Administrative Boundary*)*			Digital
	Administrative Units	National Geography Department	Various scales	
	Protected Areas	Department of Forestry		Map
9	Production Statistics. *Agriculture*	Statistic Data Division Department of Planning		Paper (Report)
	Forestry	Department of Forestry/NAFRI		
	Mining	Department of Industry		Report
10	Water Quality	State of Environmental Report		Paper (Report)
11	Air Quality	State of Environmental Report		Paper (Report)
12	Watershed Classification	NAFRI		Map

NAFRI = National Agriculture and Forest Research Institute

Catalogue of Environment Related Databases (included in Annex 1) is available for Lao PDR, which shows that more than 20 Government departments and Lao PDR-based international organizations hold the data. National Agriculture and Forestry Research Institute (NAFRI) of Ministry of Agriculture and Forestry holds majority of the data. Other data holding organizations are National Geography Department; Department of Irrigation; Department of Mine; and Science, Technology and Environment Agency. The National Geography Department is the authority to issue technical instructions and guidelines related to surveying, aerial photography and mapping activities in Lao PDR. *The details on data holding, personnel, equipment and facilities in Lao PDR are given in Annex 1.*

Vietnam

In Vietnam, there are many institutions, in most cases with a functional unit, that are involved in environmental data collection. In relation to SEMIS II core dataset, data layers on infrastructure; transportation; soils; topography; administrative boundary; cadastral; land use; hydro-meteorology; air and water quality monitoring stations; industry; mineral; geology; production data on agriculture and forest, labor, health, and general statistics are available in Vietnam (Table 3). The scale of map layers range from 1:50,000 to 1:1 million scale and are stored in both hardcopy and digital formats. Some of the data on geology, underground water, air and water quality are not yet widely publicized.

Table 3. Available Data and Their Sources in Vietnam.

S. N.	Theme/Type	Holding Organization	Scale	Format
1	Infrastructure			
	Road	Spatial data: maps from	Various scales	Paper amps and
	Railway	General Department of Land		digital data
	Electric Power	Administration (GDLA)		
	Transmission			
	Pipeline	Statistic data: line agencies		
	Dam	and GDLA		
	Port			
	Airport			
2	Soil Class	Ministry of Agriculture and	Various scales	Maps and digital
3	Vegetation Cover	Rural Development, and	from 1:50K to	
		GDLA	1:1,000K	
4	Land Use			
5	Air Quality	NEA, MOSTE	point coordinates with measured parameters	Paper print
6	Topographic Map *Elevation* *Water Boundary* *Water Body*	GDLA	1:50K	Maps and digital
7	Geology	Institute of Information Archives and Museum of Geology	Various scales	Map and digital
8	Population (Demography)	National Committee of Population Planning, DGLA		Paper and digital
9	Climate Zonation			
10	Administrative Boundary *Administration Unit* *Protected Areas*	GDLA, Government Offices		
11	Major Harvesting Activities	Ministry of Agriculture and Rural Development, and GDLA		Yearly Statistic Almanac
12	Water Quality	NEA, MOSTE	point coordinates and measured parameters	Paper print
13	Soil Analysis Sample			

It is likely that more environmental data will be generated in future due to mandatory regulation that requires making use of environmental data. For example, every socio-economic development projects are required to collect environmental data for the preparation of EIA

report. On the other hand, it has been reported that the collected data is often not comprehensive and sometime irrelevant. *The details on data holding, personnel, equipment and facilities in Vietnam are given in Annex 2.*

Cambodia

In the Kingdom of Cambodia, the available environmental data are: protected areas; biodiversity; air and water quality monitoring stations; transportation; industrial; geology; soils; forest cover; land use; topographic maps; fishing lots; administrative boundary (Table 4). The scale range from 1:50,000 to 1:1 million scale and some of them are available in digital format.

Table 4. Available Data and Their Sources in Cambodia.

S. N.	Theme/Type	Holding Organization	Scale	Format
1	Infrastructure			
	Road	MPWT	1:100K	
	Railway	MPWT	1:100K	
	Electric Power Transmission	MIME		
	Pipeline	MPWT		
	Dam	MoWRAM		
	Port	MPWT		
	Airport	MPWT		
2	Soil Class	DoA		
3	Vegetation Cover	DFW	1:250K	Digital
4	Air Quality	DENRAEDM	point coordinates with measured parameters	
5	Land Use	MLMUPC		
6	Topographic Map			
	Elevation	MLMUPC	1:50K	Digital
	Water Boundary	MoWRAM		
	Water Body	MoWRAM		
7	Geology	MIME	1:100K	Digital
8	Population (Demography)	MoP		
9	Climate Zonation			
10	Administrative Boundary			
	Administration Unit	MLMUPC	1:50K	Digital
	Protected Areas	DENRAEDM	1:500K	Digital
11	Major Harvesting Activities	MoP		
12	Water Quality	MoWRAM	point coordinates and measured parameters	
13	Soil Analysis Sample			

DENRAEDM = Department of Natural Resource Assessment and Environmental Data management
DFW = Department of Fishery and Wildlife
DoA = Department of Agriculture
MIME = Ministry of Industry, Mime and Energy
MLMUPC = Ministry of Land Management, Urban Planning and Construction
MoWRAM = Ministry of Water Resource
MPWT = Ministry of Public Work and Transportation
MoP = Ministry of Planning

The major data holding institutions are Ministry of Environment (MOE); Ministry of Public Works and Transport (MPWT); Ministry of Land Management, Urban Planning and Construction (MLMUPC); Ministry of Industry, Mines and Energy (MIME); Ministry of Water Resources and Meteorology (MOWRAM); Ministry of Agriculture, Forestry and Fisheries

(MAFF); and Ministry of Planning (MOP). *The details on data holding, personnel, equipment and facilities in Cambodia are given in Annex 3.*

Myanmar

In Myanmar, different government departments have been involved in routine data generation. The collection of environmental data and information at the national level started after 1990 with the establishment of National Commission for Environmental Affairs (NCEA). Not all core data are available in Myanmar. The available core dataset include: geology; soil; infrastructure; urban centers; industrial zones; land use; topography; cadastral; township boundary (Table 5). Some layers are available in digital format, such as geology soil, urban centers, and industrial zone. The available data range from 1:18,000 to 2 million scales.

The Forest department is the major data holder with relatively more number of trained personnel and computing facilities. Other departments that are generating data are Department of Human Settlement and Housing Development; Yangon City Development Committee; Road Transport Administration Department; Energy Planning Department; Health Department; Department of Meteorology and Hydrology; Central Statistics Organization; Department of Agricultural Planning and Statistics; Relief and Resettlement Department; Immigration and National Registration Department; Geography Department of Yangon University; and Planning Department. *The details on data holding, personnel, equipment and facilities in Myanmar are given in Annex 4.*

Yunnan, PR China

In Yunnan province of PR China, data layers on infrastructure, soil, forest, land use, topography, geology population, and administrative boundaries are held by respective departments. The scales of these layers range from 1:50,000 to 1:500,000. Some of these layers, such as infrastructure, topographic map and administrative boundary exist in digital format. The other data available in paper format are production statistics on agriculture, forestry; locations of water and air quality and the parameters being monitored. *The details on data holding, personnel, equipment and facilities in Yunnan, PR China are given in Annex 5.*

Thailand

The Department of Environmental Quality Promotion (DEQP) is the main data custodian to produce environmental GIS database. DEQP has already produced GIS database for 43 provinces. Land Development Department, Office of Agricultural Economics and Department of Agricultural Extension are other data custodian in the country. Almost all core dataset including thematic layers, identified as SEMIS core data, are available for Thailand. Table 7 presents the available data and respective holding organizations in Thailand.

Most of the datasets range from 1:50,000 to 1:250,000 scale and are in digital format. Road thematic layer is available at the scale of 1:4,000. Besides core dataset, there are plenty of additional and derived products, such as watershed basin and classification, agricultural economic zone, land suitability, drought area, and irrigation area. *The details on data holding, personnel, equipment and facilities in Thailand are given in Annex 6.*

Table 5. Available Data and Their Sources in Myanmar.

S.N.	Theme/Type	Holding Organization	Scale	Format
1	Infrastructure			
	Road	Survey Department	!:50K – 1"=4 mile	Digital and Map
	Railway			
	Gas Pipeline	Myanmar Oil and Gas Enterprise (MOGE)	NA	Paper (Map)
	Electric Power Transmission	Myanmar Electric Power Enterprise		Paper (Report)
	Dam	Irrigation Department		Digital and Paper (Report)
	Port	Myanmar Port Authority		Report
	Airport	Department of Civil Aviation	(point coordinates with description)	Report
2	Soil Class	Myanmar Agriculture Service	1:2 million	Digital
3	Forest	Forest Department	1:50 K 1:250K	Map (out-of-date) Digital
4	Land Use	Forest Department	1:250K 1:50K (selected)	Digital and Map Digital
5	Topographic Map			
	Elevation	Survey Department	1:50K – 1"=4 mile	Map
	Water Boundary (line)	Irrigation Department		Report and Map
	Water Body	Irrigation Department		Report and Digital
6	Geology	Department of Geological Survey and Mineral Exploration	1:50K – 1: 1 million	Paper (Map and Report)
7	Population (Demography)	DHSHD, Department of Population		Report
8	Climate Zonation	MAS	1:2 million	Digital Digital and Report
9	Administrative Boundary			
	Administrative Unit	DHSHD	1:50K (1:18K for project)	Digital
	Protected Areas	Forest Department	?	Digital Text File
10	Production Statistics on Agriculture, Forestry, etc.	Myanmar Agriculture Service		Report
11	Water Quality (from 13 dams)	Irrigation Department		Digital and Report
12	Soil Analysis Sample	Myanmar Agriculture Service		

Remark: DHSHD = Department of Human Settlement and Housing Development

Table 6. Available Data and Their Sources in Yunnan, PR China.

S. N.	Theme/Type	Holding Organization	Scale	Format
1	Infrastructure *(Specific layers not defined)*	Dept. of Surveying and Mapping	1:250K	Digital
		Geography Institute	1:500K	Digital
2	Soil	Department of Agriculture	1:200K	Paper
3	Forest	Department of Forestry	1:50K	Paper
4	Land Use	Department of Land and Resources	1:50K	Paper
5	Topographic Map *(Specific layers not defined*	Department of Surveying and Mapping	1:250K	Digital
		Geography Institute	1:500K	Digital
6	Geology	Department of Land and Resources	1:500K	Paper
7	Population (Demography)	Department of Statistics		Paper (Report)
8	Administrative Boundary *(not define specific themes)*	Department of Surveying and Mapping	1:250K	Digital
9	Production Statistics on Agriculture, Forestry, etc.	Department of Statistics		Paper (Report)
10	Water Quality (from monitoring stations)	Department of Environmental Protection		Paper (Report)
11	Air Quality (from monitoring stations)	Department of Environmental Protection		Paper (Report)

Table 7. Available Data and Their Sources in Thailand.

S. N.	Theme/Type	Holding 1/ Organization	Scale	Format	No. of Dept.2/
1	Infrastructure				
	Road	Royal Survey Department Highway Department	1:50K	Digital	33
	Railway	Royal Survey Department	1:50K	Digital and Map	
	Electric Power Transmission	Metropolitan (and Regional) Electricity Authority	1:4K (BKK)	Digital and Map	
	Pipeline	Metropolitan (and Regional) Water Work Authority	1:4K (BKK)	Digital	
	Dam	Irrigation Department Electricity Generating Authority of Thailand	1:50K	Digital and Map	12
	Port	Port Authority	?	?	
	Airport	Airport Authority of Thailand	(point coordinates)	Map	
2	Soil Class	Land Development Department Agricultural Land Reform Office	1:100K 1:250K	Digital	18
3	Vegetation Cover	Royal Forest Department Land Development Department	1:50K	Digital	14
4	Air Quality	Department of Pollution Control	(point data and measured parameters)	Digital	
5	Land Use	Land Development Department	1:50K	Digital	22
6	Topographic Map				
	Elevation	Royal Survey Department	1:50K	Digital and Map	22
	Water Boundary (line)	Royal Survey Department	1:50K	Digital and Map	18
	Water Body	Irrigation Department Electricity Generating Authority of Thailand	1:50K	Digital and Map	
7	Geology	Department of Mineral Resources	1:50K 1:250K	Digital	16
8	Population (Demography)	Rural Development Department National Statistics Office	(linked to Admin. Boundary)	Digital	
9	Climate Zonation	Meteorological Department	1:250K	Digital	7
10	Administrative Boundary				
	Administration Unit	Department of Administration National Statistics Office	1:50K	Digital	33
	Protected Areas	Royal Forest Department	1:50K	Digital	10

Table 7 (Contd.)

S.N.	Theme/Type	Holding Organization	Scale	Format	No. of Dept.
11	Major Harvesting Activities				
	Agriculture	Office of Agricultural Economics	(linked to Admin.	Report	
		National Statistics Office	Boundary)		
	Forestry	Royal Forest Department		Report	
	Mining Location	Department of Mineral Resources	1:1 million	Map	
12	Water Quality	Department of Pollution Control	(point data and measured	Digital and Report	10
		Irrigation Department	parameters)		
13	Soil Analysis Sample	Land Development Department	(point data and measured	Report	10
		Agricultural Land Reform Office	parameters)		

3.3 Data Distribution Mechanism

Lao PDR

There is no formally established mechanism of data sharing in Lao PDR. The data available to users largely depends on the internal policy and data distribution mechanism of each department. For the Government users, the process is relatively easier to acquire the data if the request is for domestic purpose. The data can be obtained by sending official request to the concerned department. Availability of data and information is limited by the lack of policy that is applicable to all data producers. Most of the departments have their own internal policy. For example, NAFRI holds soil group map in digital format at the scale of 1:250,000 scale which is, however available on request but only at the scale of 1:1 million in hardcopy format.

Vietnam

The environmental data in Vietnam are available in different categories: free publishing and selling; contact-based provision; provision upon request; and restricted provision. In general, population or production statistics are published and easily available for purchase. Topographic , transportation and administrative maps are also available for purchase. Data on soil, current land use and forest cover are available only on specific request.

In some cases, users are not aware about the availability of data because of inadequate publicity. There is no regular communication/coordination between data producer and stakeholders making it difficult to know who is doing what. Other noted constraints of data sharing are incomplete dataset, scattered system of data organization and management, overlapping responsibilities between departments, and lack of guidelines and established mechanism.

Cambodia

In the kingdom of Cambodia, there is also no formal procedure and mechanism for data distribution. Data are made available from many departments mostly on colleague-to-colleague relationship. One reason is there is no inventory/catalogue of existing database for public information due to lack of coordination between departments/organizations. This is eventually causing less demand for use of data and less sharing.

Myanmar

There is no national body for environmental data standards in Myanmar and also no available integrated data catalogue listing the data produced by all the departments/institutions. In the lack of adequate coordination, there is no up-to-date information on what kind of data is being generated in the country, which limits the data sharing. However, data are available for use from different departments with varying range of distribution policies. Some data are restricted for security purposes. Others are available free of charge or with nominal handling charge to government departments and other users too.

A national decentralized network of 15 departments has been established since 1998 to set up the mechanism for information exchange and sharing within the country. The NCEA, which serves as a nodal agency of the network, also serves as the clearing-house for the environmental data. NCEA is making effort to facilitate the coordination between departments for data sharing.

Yunnan, PR China

In Yunnan, PR China, the data held by different government departments/organizations/institutes are available for domestic use only and with corresponding charge.

Thailand

Most of the datasets held by institutions and departments are available through official request. Some statistical data are freely available for downloading while others are available with handling cost. Some security related data are not available for outsiders. For example, topographic maps along the border areas are not available for purchase and public use.

Since there is no up-to-date documentation on the data held by different organizations, sharing is not practiced in the lack of awareness about the existence of data. Geoinformation Science, Technology Development Agency (GISTDA) is trying to complete such documentation.

3.4 Equipment and Facilities for Data Generation

Lao PDR

At least 11 departments are involved in GIS data generation with limited hardware facilities in place. PC ARC/INFO, ARCVIEW, MAPINFO, Autocad are the major GIS software used by these departments. Almost all involved departments are interested in furthering their capacities in environmental data generation and management but lack adequate resources for additional hardware and software procurement.

Vietnam

Information technology has taken significant momentum in Vietnam. Most of the departments/institutions have computing facilities consisting hardware/software, server, etc. Internet facility is available even at province level.

MAPINFO, ARCINFO are common GIS software. FOXPRO, ORACLE are used for database management. Some of the institutions, like Forestry Inventory and Planning Institute are using remote sensing technology to update the forest related data.

Cambodia

The computing facilities in the concerned units of different ministries of Cambodia include hardware (computers, digitizers, scanner, and plotters) and software (PC ARCINFO, ARCINFO, ARCVIEW, ERDAS IMAGINE; SPANS; ATLAS GIS; Multi-SPACE). On the hardware/software part, facilities have to be regularly updated or replaced but limited financial resources within the government systems may not allow doing so. This aspect is always anticipated from the external donor support.

Myanmar

Except some departments, most of the departments have computer facilities though not adequate. Range of GIS and remote sensing software are being used such as ARCINFO, ARCVIEW, Geomedia Professional, TNTMips, GeoComp, PCI, ENVI, ERMAPPER, and ERDAS IMAGINE.

Yunnan, PR China

Most of the departments are equipped with personal computers, printers and scanners. Some of them also have digitizers and plotters. The Government departments, such as environmental protection department; surveying and mapping department; land and resources department; and forest department have GIS/remote sensing software, like ARCINFO, ARCVIEW, ERDAS, and ERMAPPER. Most of the departments have expressed that they want to strengthen their computing facilities with additional hardware and software support.

Thailand

In general, most of the departments working on GIS data generation have adequate hardware including, Personal computers, workstations, digitizer, plotter, etc. Similarly, range of GIS/RS software are being used in the country, such as ARCINFO, ARCVIEW, MAPINFO, ERMAPPER, AUTOCAD, INTERGRAPH, ILWIS, SPAN GIS, PCI, and ENVI. Considering the rapid development in hardware and software technologies, the need for timely upgrade of hardware and software is realized by the concerned departments.

3.5 Trained Personnel

Lao PDR

More than 80% of the total staff actually engaged in GIS data generation and management have obtained some sort of training in GIS and/or remote sensing. However, there is the need for follow-up trainings to the trained staff and basic training to the new staff. It was also found that there is increased interest to get the training in the field of statistical analysis along with the GIS/RS.

Vietnam

With the increased emphasis on information technology, developing human resources by creating more training opportunities is emphasized in Vietnam also. There is no shortage of trained manpower, however regular in-service trainings are still desirable to the personnel involved in data generation and management.

Cambodia

The number of trained personnel in the government sector is relatively small. However, there have been attempt to provide short-term training to more people within the country recently. In general, capacity building, in terms of hardware/software support and more training on GIS/remote sensing, and other data generation and analysis are crucial concerns in Cambodia.

Myanmar

There are trained personnel to carry out day-to-day implementation of the routine activities in each concerned units of the department. The number of trained persons is not enough and there is the need of having more trained people that actually could be involved in environmental data generation and management.

Yunnan, PR China

No specific reports were obtained on trained manpower and training requirements. In general, use of GIS and spatial data generation have not received much emphasis in Yunnan province. It was learnt that Yunnan provincial departments are willing to enhance their capacities with more people trained in environmental data generation, management and analysis. They would welcome any external assistance in this regard.

Thailand

Although several departments have installed GIS facilities to generate environment-related data and for routine work, the proportion of trained personnel in GIS/RS technologies is not adequate. Only few departments, namely Department of Mineral Resources and Land Development Department, indicated of having trained staff. Many departments showed their interest to have people trained in advanced remote sensing and GIS analysis compared to basic remote sensing/GIS application.

4. Capacity Building Plan

The above sections clarify that the GMS country needs rather a massive program on capacity building. Data generation and use for environmental decision making is limited due to inadequate computing facilities in terms of hardware/software/equipments and inadequate trained personnel. In Myanmar, the core data on air and water quality are not collected/created at all because of lack of equipments to establish monitoring stations. So are the cases with computing facilities and appropriate software. Many departments, including the SEMIS II national focal agencies, lack the required amount of hardware/software for full operation.

4.1 Hardware/Software Support

The hardware/software support provided under SEMIS I was reviewed. In SEMIS I, each country (except Thailand) was provided with a suite of hardware and software consisting of: a lap-top computer (Toshiba satellite pro 440CDT, 48 MB RAM, 1.34 GB HDD), and the software, like Windows 95, MS Office, WinZip, McAfee VirusScan, MS Plus, and Winsplit but not remote sensing and GIS software. Due to more advanced state of information technology in Thailand, a webserver and router with LAN connections for six PC workstations was provided instead of laptop computer. While visiting to the GMS countries, it was found that the lap-top computer are still running well. But considering the rapid development in computer technologies, there is the need for upgrading or replacing these computers to accommodate requirements of new version of GIS/RS software to operate. New versions of GIS/RS software may not run satisfactorily in those 486 model laptops. Moreover, there is also the need for additional hardware for the national focal agencies to enhance their data generating capabilities.

In Section 3.4, it is apparent that all the countries, in general, are seeking increased support on hardware/software to adequately speed up the environmental data generation and management. A needs assessment was conducted for only the SEMIS II national focal agencies in the GMS. The compilation of hardware/software needs of each focal agency is presented in Table 8.

An ideal computing facility for spatial data generation, processing and analysis would contain both hardware (computers, digitizers, and plotters) and necessary software for remote sensing and GIS analysis. Under SEMIS II TA, some resources have been set aside towards hardware, software, equipment support to the participating organizations, which is however not adequate to meet the needs reflected in the above table.

Table 8. Hardware and Software Needs of the GMS Focal Agencies.

Detail	Cambodia	Myanmar	Lao PDR	Thailand	Yunnan, China	Vietnam	Total
	Unit	*Unit*	*Unit*	*Unit*	*Unit*	*Unit*	*Unit*
Hardware							
Notebook	1	-	-	1	2	1	5
Desktop PC	1	2	1	1	2 + 1 PC server	-	8
UPS	1	-	1	-	-		2
GPS (Rover)	1			-	-	1	2
Photocamera (GPS camera)	-	-		-	-	1	1
File server	-	-	1	-	-	-	1
Scanner	-	-	1	-	-	-	1
Plotter	-	-	1	-	-	-	1
Software	*No. of license*	*No. of license*	*No. of license*	*No. of license*	*No. of license*	*No. of license*	*No. of license*
PC Arc-Info	1	1	1	-	1	-	4
ArcView with adds-on	1	1	1		1	-	5
ArcView Adds-on only (spatial analyst, 3D, geo-statistical analyst, arcpress)	-	-	-	1	-	-	-
ERDAS IMAGINE	1	1	1	-	1	1	5
ARC-IMS	-	-	-	1	-	-	1

There are number of GIS/RS softwares available from different software vendors. The reason for choosing ESRI (PC ARCINFO, ARCVIEW) and ERDAS (ERDAS IMAGINE) software is that UNEP RRC.AP has a Memorandum of Understanding with these vendors and the software are available in cheaper prices so that minimum hardware and software requirements could be met from the available resources.

After careful scrutinization, the following has been planned to meet part of the needs to be supported from the SEMIS II resources (Table 9). The objective is to support the participating organizations with necessary hardware/software to enhance their capabilities in data collection and analysis. Hence, in most cases, the support package consists of computer (PC and/or laptops) and one set of PC ARCINFO, ARCVIEW and ERDAS IMAGINE software.

Table 9. HW/SW Support Plan under SEMIS-II.

Detail	Cambodia	Myanmar	Lao PDR	Thailand*	Yunnan, China	Vietnam	Total
	Unit	*Unit*	*Unit*	*Unit*	*Unit*	*Unit*	*Unit*
Hardware							
Notebook	1	-	-	-	1	1	*3*
Desktop PC	1	2	2	-	1	-	*6*
GPS (Rover)	-	-	-	-	-	1	*1*
GPS photo camera	-	-	-	-	-	1	*1*
Software	*No. of license*	*No. of license*	*No. of license*	*No. of license*	*No. of license*	*No. of license*	*No. of license*
PC Arc-Info	1	1	1	-	1		*4*
ArcView with (Spatial analyst, 3D analyst)	1	1	1	-	1	-	*4*
ERDAS IMAGINE	1	1	1	-	1	1	*5*

* Thailand is not included for the hardware/software support (TA document, page 8)

4.2 Training

As discussed in Section 3.5, GMS governments are keen to develop their capacity by training more personnel whom can be engaged in environmental data generation and analysis.

According to the original SEMIS II TA paper, it was planned that each national coordinator (total 6 persons for GMS) will be trained in GIS/RS for one month at UNEP RRC.AP as they are supposed to contribute in data collection working at their respective places. Since the GMS countries need more people to be trained, all the SEMIS II national coordinators strongly suggested to include as many person as possible in the training program. Considering the effectiveness of capacity building plan, training more personnel will definitely produce better impact from the project as:

1) there will be more able staff to carry on the job of environmental data generation and management, and

2) there will be continuity in work if any of them happens to transfer from the current position at the focal agency.

The national coordinators are the same personnel who received training during SEMIS I. Considering the need for a follow-up training for the national coordinators, and also to allow other capable staff of the participating agencies to attend the training, it is planned that the one-month training will be curtailed to two-weeks training-cum-internship program as the participants already have some basics of GIS/RS. Although this has additional cost implication compared to the original plan, the training of more personnel (total 12 persons from 6 countries) will have more beneficial impact on the capacity building of the GMS. Each participating agencies are requested to nominate the appropriate persons for the training-cum-internship program.

5. Conclusion and Recommendations

There has been good progress towards the environmental data generation in the GMS countries, however all the countries do not stand at the same level as so far the amount and quality of data is concerned. However, majority data are of geographical nature, other data such as social and economic data have also to be collected and integrated since these data are important for economic and environmental planning purpose.

The generated data are somehow becoming available for public use although there exists no established policy and mechanism of data sharing. An up-to-date inventory of the generated data within the country and the need for data sharing is greatly realized by all concerned to eliminate redundant work between the departments and thereby saving lots of resources that have been invested for data generation. The inventory is very important to create awareness to all stakeholders on what kind of data are being available within the country. The challenge is to establish the coordination between the data producers and an established procedure to allow efficient data sharing to benefit data producers, users and more specifically to allow informed decision making.

There are technical constraints relating to metadata, data standards, and data quality that are hindering the data sharing. In some cases, there are inadequate resources and institutional constraints, such as lack of legal framework, proper policy and guidelines in place; and inadequate trained personnel and equipments. Technological inadequacy, such as internet/intranet facility, is another issue that most of SEMIS II focal agencies have to improve to allow efficient data sharing.

The issues of data sharing should basically be resolved within the national context through the cooperation of data producers and users. There have been some attempts in this regard in some countries, such as Thailand, Vietnam and Cambodia. There should be more efforts within the country to establish a national level data center, which can act as data clearing/ware house. There is also the need of having appropriate policy and guidelines addressing all issues and defining mechanism to allow effective data sharing within the country and eventually within the subregion.

The participating countries lack the capacity to collect, process and analyze the data in terms of hardware/software/equipments and trained manpower. It is however desirable to provide support towards more capacity building with additional equipments and appropriate trainings, the scope of available resources within current SEMIS II is limited to meet the requirements.

Annexes

Include the papers on each country describing details on data holdings, distribution mechanism, and trained manpower

[NOT AVAILABLE IN THIS VERSION,

AVAILABLE IN HARDCOPY FORMAT ONLY]