Strategic Environmental Framework for the Greater Mekong Subregion: Integrating Development and Environment in the Transport and Water Resource Sectors

VOLUME III

GMS Hotspot Profiles

March 2002

SEI STOCKHOLM ENVIRONMENT INSTITUTE
International Institute for Environmental Technology and Management

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PREFACE

The *Strategic Environmental Framework for the Greater Mekong Subregion - TA No. 5783* (the SEF Project*)* was supported by the Asian Development Bank (ADB), with co-financing by the Swiss Agency for Development and Cooperation (SDC). The six countries of the Greater Mekong Subregion (GMS), Cambodia, Lao People's Democratic Republic (Lao PDR), Myanmar, People's Republic of China (PRC), Thailand and Vietnam, participated in the SEF Project through 'Technical Assistance Implementing Agencies' (the national agency responsible for environment or natural resource management) and multi-sectoral national steering committees (comprised of representatives of government agencies responsible for environment, infrastructure development, planning, and others). The SEF Project was implemented with consulting inputs from the Stockholm Environment Institute (SEI), in collaboration with the United Nations Environment Programme Regional Resource Centre for Asia and the Pacific (UNEP RRC.AP) and the Mekong River Commission (MRC).

The aim of the SEF Project was to provide a platform for guiding investment decisions in the transport, water resources development and environmental sectors in the GMS. Its ultimate goal was to ensure these investments are environmentally and socially sustainable. It involved four broad phases:

1. Inception Phase (November 1998 - September 1999);
2. Analysis Phase (October 1999 - July 2000);
3. Production Phase (August 2000 - December 2000);
4. Communication Phase (January 2001- April 2001); and
5. Report Endorsement and Final Production (August 2001-February 2002).

These phases involved a broad range of consultations with a spectrum of stakeholders and decision-makers in the region:

- National planners and ministries who were consulted at various points in the process through the national steering committees and through 18 national and three subregional workshops.
- Non-government organisations (NGOs), who contributed to the knowledge base (e.g. in the identification of hotspots – see Chapter 1) and also to the review and assessment of the outputs.
- Local governments and people, who were consulted in the preparation of the case studies.
- Working Group on Environment (WGE) of the GMS, who gave guidance on and made a professional assessment of the results of the strategic analysis.
- A broad cross-section of international and local experts who acted as Qualified Observers (see *Volume IV: SEF Case Study Reports*), by giving their expert views.
- The Interim Report was placed on the Internet for international review and sent to aid agencies, NGOs, and sectoral experts active in the GMS.
- The first draft SEF report was extensively reviewed and discussed with national decision-makers, scientists, NGOs and other stakeholders in the GMS through a series of six national workshops and a subregional workshop, and the draft was placed on the Internet for international review.
- Internationally recognised environmental assessment and GMS experts were recruited to undertake formal reviews of the SEF report.
- The draft final SEF report was again widely disseminated for comment prior to finalisation.

Key Deliverables

Main Report:	Volume I: Strategic Environmental Framework for the Greater Mekong Subregion Executive Summary
Background Reports:	Volume II: Regional Issues and Emerging Trends: environmental, socio-economic and institutional Volume III: GMS Hotspot Profiles Volume IV: SEF Case Study Reports
Computer Tools:	Prototype SEF 1.0 Software CD ROM (contains all Main Reports, Background Reports and Computer Tools)

All these deliverables will be available on the CD ROM of the SEF 1.0 software.

Overview of Implementation and Monitoring Arrangements

The SEF is meant to support first and foremost improved program planning and implementation under ADB's support for the GMS Program. Therefore, it is envisaged that the ADB will have primary responsibility for supporting SEF implementation and monitoring, at least in the short to medium-term.

There are many other actors for whom the SEF is intended, not least of which are national governments, as well as regional agencies/donors/NGOs. The SEF report suggests roles for all these actors. Through the interest and participation of these other institutions, the SEF may actually be transformed into several different types of strategies depending on their specific needs and roles.

It is important to point out that the SEF should be a living document that is regularly updated to reflect changed conditions and needs. Therefore, while the SEF projects out to a horizon of approximately ten years, updating is envisaged to occur every two years.

Endorsements

After a three-month consultation process following distribution of the draft SEF, formal endorsement was received from each of the six national SEF steering committees. It was also endorsed by UNEP and MRC, institutional partners in the SEF preparation. Most significantly, the SEF was endorsed by the GMS Ministers at a Ministerial Meeting in November 2001. This critical endorsement is expected to open the way to implementation and strengthening of the SEF process by the GMS governments through the GMS Program.

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AIT	Asian institute of Technology
CA	Counterpart Agencies
CDC	Council for Development of Cambodia
CNMC	Cambodian National Mekong Committee
CEFINEA	Centre for Environmental Technology
DEQP	Department of Environmental Quality Promotion (Thailand)
EIA	Environmental Impact Assessment
ENTEC	Environmental Technology Centre
GIS	Geographic Information System
GIS	Geographic Information System
GMS EWIS	GMS Early Warning and Information System
GMS HVAs	GMS Highly Valued Areas
GMS Program	Greater Mekong Subregional Economic Co-operation Program
GMS	Greater Mekong Subregion
GRID	Global Resource Information Database
HVA	Highly Valued Area
HVREs	Highly Valued Resource Ecosystems (term replaced by HVA)
HVSEEs	Highly Valued Social and Environmental Ecosystems (term replaced by HVA)
IEE	Initial Environmental Evaluation
IR	Inception Report
JICA	Japanese International Co-operation Agency
LFA	Logical Framework Analysis
LMB	Lower Mekong Basin (Lao PDR, Thailand, Cambodia, and Vietnam)
MARD	Ministry of Agriculture and Rural Development, Vietnam
MOE	Ministry of Environment (Cambodia)
MRB	Mekong River Basin
MRC	Mekong River Commission
NCEA	National Commission for Environmental Affairs (Myanmar)
NEA	National Environment Agency (Vietnam)
NGO	Non-Governmental Organisations
NNR	National Nature Reserve
NOAA	National Oceanic & Atmospheric Administration
PD	Project Director
PRC	Peoples' Republic of China
QO	Qualified Observer
RETA	Regional Technical Assistance
RMB	Chinese Renminbi
SDC	Swiss Agency for Development and Co-operation
SEF	Strategic Environmental Framework
SIA	Social Impact Assessment
SIERES	Sub-institute of Ecology, Resources & Environmental Studies
STEA	Science, Technology and Environment Agency (Lao PDR)
TA	Technical Assistance
TNC	The Nature Conservancy
UNDP	United Nations Development Programme
UNEPRRC.AP	UNEP Regional Resource Centre for Asia and the Pacific
UNEP	United Nations Environment Programme
VND	Vietnam Dong
VNU-HCMC	Institute for Environment and Resources
WGE	Working Group on Environment

1. GMS HOTSPOTS

1.1 The Hotspot Approach

The identification and analysis of GMS 'hotspots' is one of the key analytical approaches in the SEF Project. For the purposes of this project, a hotspot is defined as:

> (i) a forest, grassland or wetland ecosystem or ecosystem cluster that is relatively intact and functioning well biologically, ***and/or*** an area largely inhabited by indigenous people or other population groups (e.g. poor people) susceptible to damage to their livelihood or social well-being that have been, on the whole, outside the mainstream of development;
>
> ***that***
>
> (ii) is now experiencing high environmental damage *or* is at high risk from environmental damage associated with existing or planned economic development activities, primarily roads and dams.

Hotspots are regions in the GMS at high risk. Risk in this context is defined as the probability of exposure to threats and potential associated damage to ecosystems and/or human well-being. Category (i) in the definition includes the receptors (people or ecosystems) that are exposed to environmental stress, where stress is the pressure exerted by environmental change caused by development activities on people and/or ecosystems. The project has chosen to analyse these several receptor systems because of their high value or vulnerability to damage as result of multiple (and in some instances cumulative) stresses resulting from human activities, notably hydropower and road development.

1.1.1 Why hotspot analysis?

Studies of environmental disasters and long-term regional environmental changes have consistently found that the overwhelming proportion of ecological damage and human loss is highly concentrated in vulnerable ecosystems and communities (Burton et al., 1993; Cuny, 1983; Blaikie et al, 1994). This has been quite evident in the distribution of loss of life to natural disasters globally which shows a continuing decline in wealthy countries and a rapidly rising toll in the poorest countries. Hunger and famine are similarly concentrated in the most vulnerable regions of the poorest countries. Therefore, identifying the regions and peoples at greatest risk from human-induced changes and natural variation and assessing the sources and causes of their vulnerability will help promote more sustainable development. It will also contribute to monitoring and early warning systems for timely interventions in averting or mitigating widespread environmental damage or community disruption.

1.1.2 A Simple Model for Hotspot Analysis

Figure 1.1 describes the conceptual structure of analysis used in this study. Stresses on natural systems and communities arise both from natural variability and human-induced changes, which cause environmental and social damage and perturbations. In this project, the focus is on developmental activities in the form of new hydropower projects and the upgrading or development of new roads. Each of these activities is likely to cause damage – for example, land clearance, land use changes, deforestation, cultural intrusions, and changing accessibility to markets. With a focus on development programs, natural variability

is a contextual issue which we take account of but do not analyse directly. A wide variety of receptor systems can be affected by such changes, and be put at risk. In this study we examine three such receptor systems: highly valued natural areas (as described below), indigenous peoples and other vulnerable social groups (e.g., poverty groups or those dependent upon a simple resources systems such as fisheries). The interaction between multiple stresses (and their magnitude) and multiple vulnerabilities (and their degrees) define the overall level of risk - the intensity of the hotspot.

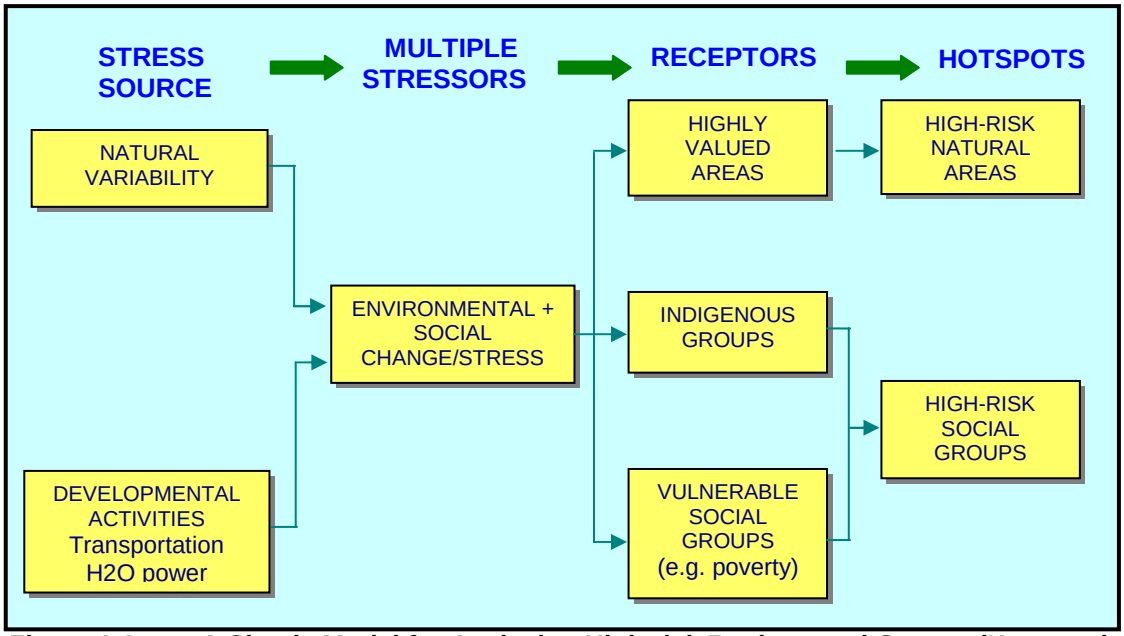

Figure 1.1 A Simple Model for Analysing High-risk Regions and Groups (Hotspots)

There is a dimensionality to vulnerability (and risk) that is considered in this treatment of hotspots. Vulnerability is commonly assumed to have three dimensions:

- exposure: the closer ecosystems or peoples are to developmental stresses, the more they are likely to be affected, and to a greater extent.
- sensitivity: some ecosystems and peoples are more fragile or sensitive to the stresses than others and will therefore suffer more harm from the same level of exposure.
- resilience: once initial damage has occurred, some ecosystems and social groups can recover more rapidly than others.

In this analysis we consider all three dimensions, but principally the first two.

Our focus on environmental stress caused by road development and hydropower in the GMS makes the identification of the stresses – and therefore the hotspots – selective and not comprehensive. In the long run cumulative risk from other development activities and other sectors, (e.g., agriculture) and even natural variability (e.g., drought), also need to be considered to get a more complete picture.

1.1.3 Scope

The SEF project has identified five priority hotspots in the GMS region. These are by no means all the possible hotspots in the GMS, but can serve as examples of an analytical approach towards regional planning that considers multiple stresses and hence integrates risk to both highly valued natural areas and socially vulnerable populations.

Hotspots were identified by using Geographic Information Systems for Participation (GIS-P); a set of new techniques that integrate individual or group perceptions and knowledge of environmental issues into a digital spatial framework (Cinderby, 1999). The advantages of GIS-P information over conventional spatial databases is that it can store and represent an individual's or group's perception of an issue. This approach is increasingly used to enhance the expert understanding of an issue and also to identify information for which there is little conventional data.

The SEF project drew on the knowledge of Qualified Observers as a mechanism to access information in a rapid and efficient manner. Qulaified Observers are recognised experts on GMS issues. The Qualified Observer interviews were primarily conducted by the regional planner and the social expert on the SEF team. Because Qualified Observer knowledge is subjective, we standardised the interviews by using standard key questions and a standard set of background maps and information.

There are several limitations to this hotspot analysis that should be noted:

1. During the hotspot identification process, the Qualified Observers were shown baseline maps that delineated the highly valued natural systems areas more clearly than the location of socially vulnerable groups (poor people and ethnic minorities). In that sense the hotspot identification is based more strongly on ecological criteria than social criteria.
2. We did not attempt to examine those ecosystem services at greatest risk (e.g., fisheries, water supply) nor which ecosystem disruptions might have greatest impacts on life support systems in the region. Nor do we analyse other human receptor systems (e.g., specific communities, the regional economies) that merit attention.
3. Since we do not have direct access to data on community coping systems or long term recovery from environmental perturbations, longer term risk is largely not assessed.

A fuller and more comprehensive hotspots or high risk area analysis would include such considerations. That said, such an agenda of analysis, and what is attempted here, has proved to be a useful mechanism for identifying major issues and potential solutions. It goes well beyond what has been done in most previous studies.

1.1.4 Hotspots and the SEF

The hotspot approach is an integral part of the overall SEF analysis. The hotspot approach has:

- established a definition and concept of hotspots (areas of high-risk) and how they may be identified and mapped, so that their identification can be an on-going process as part of GMS development planning;
- identified and mapped, as part of a consultative process, the major regions at high risk from the chosen developmental activities (roads and dams);
- characterised highly valued natural resources and/or the main vulnerable human populations at risk in the hotspot areas;
- explored the nature and sources of risk in these hotspot areas;
- enabled the SEF Project Team to formulate recommendations for the management of hotspots and also for the GMS as a whole
- enabled the SEF Project Team to suggest improved monitoring and management of development activities in the hotspots so as to reduce the threats involved.

The hotspot approach will help decision-makers to identify future hotspots early in the development planning process, using the SEF 1.0 software (see Annex 1 of *Volume I: Strategic Environmental Framework for the Greater Mekong Subregion*).

1.1.5 Overview of Steps in the Hotspot Approach

The key steps in the hotspot identification were:

1. Defining and conceptualising hotspots.
2. Identifying and mapping hotspots GMS-wide at 1:1,000,000 scale. An initial six hotspots were identified as follows. First, experts[1] were asked to provide information on forest cover, protected areas, and key deltas (Mekong, Red River, Chao Phraya and Irrawaraddy) within the GMS. These were referred to as HVREs, but are now referred to as Highly Vulnerable Areas (HVAs) - see Section 1.2 below. This information was overlain with details of GMS Program and/or national energy/water (hydropower) and transportation projects. The resulting initial hotspots (see Box 1.1) were areas in which the risk zone of the development projects clearly encompassed the mapped ecological data. A GMS-wide map was produced in September 1999 showing the Highly Valued Areas, key projects, and six initial GMS hotspots (Figure 1.2). Detailed maps of each hotspot were also produced (see subsequent chapters).
3. Qualified Observers (QOs) were interviewed to help revise and map the initial hotspots. They were asked to review maps of the Highly Vulnerable Areas and of the development projects described above. They were asked to comment on the mapped ecological data; the stress zones of the projects; and the delimitation of initial hotspots (taking account of potentially affected indigenous peoples and poverty groups). They were also shown a map of the initial hotspots and asked to revise the hotspot boundaries and to add or delete any hotspots. Their comments and suggestions were recorded on a set of overhead transparencies.

BOX 1.1 INITIAL HOTSPOT NOMINATION PROCESS

The initial six hotspots were identified as follows:

A compilation of GMS forest cover, protected areas, and key deltas (Mekong, Red River, Chao Phraya and Irrawaraddy)

+

GMS Program and/or national energy/water (hydropower) and transportation projects

=

Initial Hotspots-the areas in which the zone of impact or influence of the major groupings of the development projects 'overlay' or intersect the mapped ecological data. They are shown in Figure 1.2.

4. The results of the Qualified Observer interview process were then compiled on a new base map, which included suggestions for changes to the hotspot boundaries, suggestions for new hotspots, general comments on the issues within the hotspots, and comments on the information gaps/errors in the identification of projects. The base map was then reviewed in a workshop by the SEF team and key partners. They decided whether to accept/reject the various comments. Given the scope of the SEF project it was decided to select five key hotspots for further analysis. These five Priority GMS Hotspots (see Figure 1.2) are:
    - Priority GMS Hotspot 1: Upper Mekong
    - Priority GMS Hotspot 2: Golden Quadrangle
    - Priority GMS Hotspot 3: Central GMS
    - Priority GMS Hotspot 4: Se San/Se Kong
    - Priority GMS Hotspot 5: Tonle Sap

[1] The experts involved included the project team, as well as UNEP, MRC and ADB staff involved in the project.

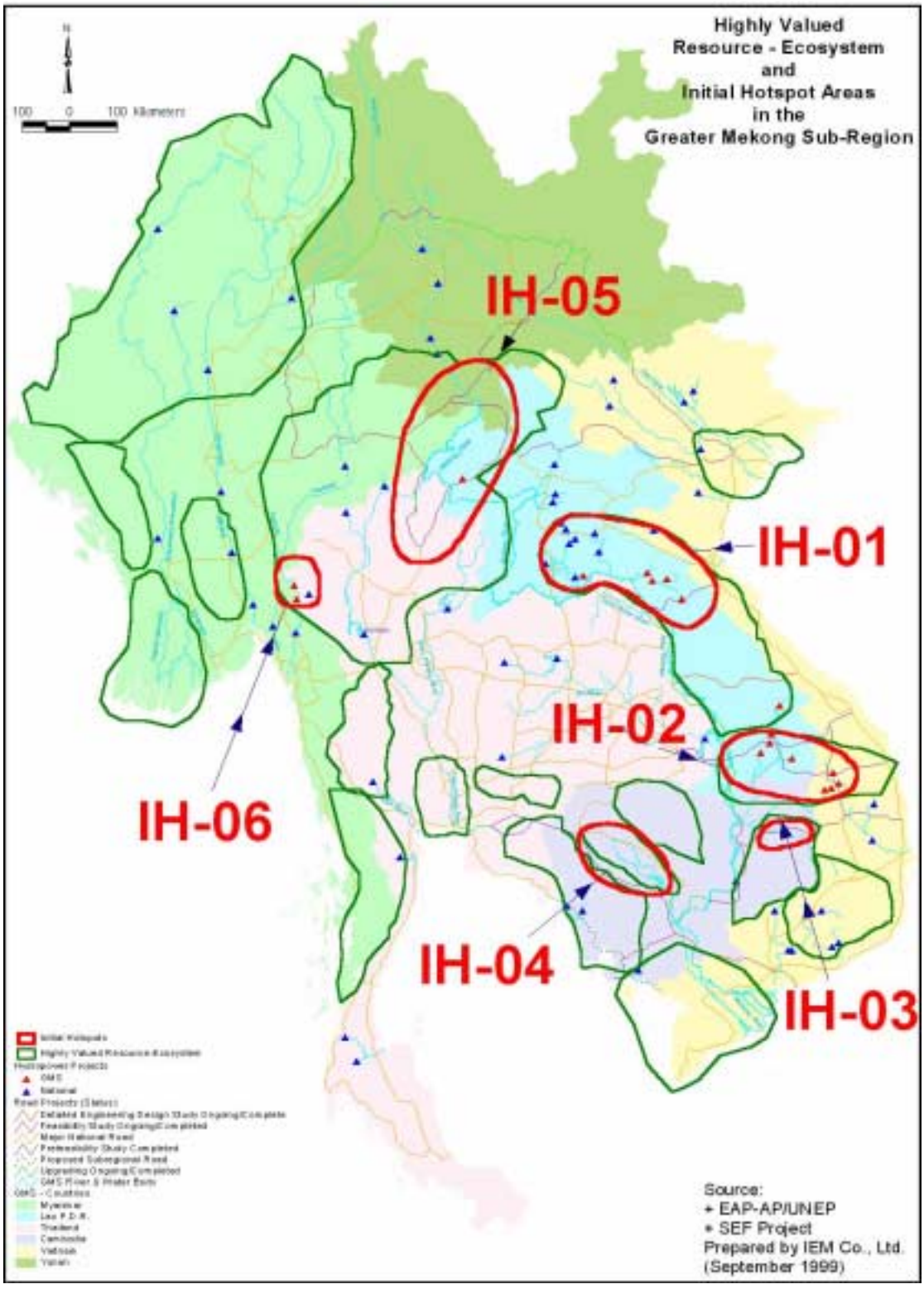

Figure 1.2 Initial GMS Hotspot Map

5. Detailed hotspot data collection was carried out during Qualified Observer interviews and other project missions. This proved insufficient for collecting the amount and level of data required for the analysis so a series of data collection missions were undertaken to complement this data.

Once the hotspots had been identified, the following steps were taken:

- Characterisation of each hotspot, including ranking and valuation.
- Preparation of hotspot profile reports.
- Incorporation of the hotspot profile and GIS outputs (maps and analyses) into the SEF 1.0 software.

These steps are discussed further below.

1.1.6 Highly Valued Areas at Risk

Highly Valued Areas (HVAs) are areas of special environmental significance, and include:

- protected areas;
- areas of outstanding biodiversity;
- forested areas;
- wetlands.

The HVAs have been identified at both a 1:1,000,000 scale and also at a hotspot scale (1:250,000). Since there are gaps and inconsistencies in the GIS data available for various criteria, the HVAs are not comparable across all the GMS countries. Accurate HVAs have only been defined for the area encompassing Cambodia, and lower two-thirds of Lao PDR and Vietnam. This covers the majority of hotspots 3, 4 and 5.

HVAs were classified by their environmental value by experts on the SEF team:

3 = Critical environmental value

2 = High environmental value

1 = Medium environmental value

Table 1.1 presents the HVA data categories and environmental ranking (EVR) system used to produce the 1;1000,000 HVA map. Table 1.2 presents the HVA data categories and EVR system used to produce the 1:250,000 hotspot level analysis.

Table 1.1 Hotspot HVA Data Categories and Environmental Ranking System for 1:1,000,000 Scale

GMS HVA Component	Environmental Value Ranking
BIOPHYSICAL	
Forest Cover[2]	
Lowland Monsoon Forest	3
Lowland Rain Forest	3
Montane Monsoon Forest	3
Montane Rain Forest	3
Degraded Rain Forest	2
Degraded Monsoon Forest	2
Other Forest Categories	1
Wetlands	3
Mangroves	3
Protected Areas	3
Biodiversity[3]	
Critical	3
Acute	2
High	1

Table 1.2 Hotspot HVA Data Categories and Environmental Ranking System for 1:250,000 Scale

GMS HVA Component	Environmental Value Ranking
BIOPHYSICAL	
Forest, Continuous Canopy Cover with High Density[4]	3
Forest, Continuous Canopy Cover Medium Density	2
Forest Mosaic	2
Regrowth (Includes some Stunted Forests)	2
Wood & Scrubland (includes Bamboo)	1
Wetlands	3
Mangroves	3
Protected Areas	3
Biodiversity[5]	
Critical	3
Acute	2
High	1

[2] Forest data from UNEP RRC.AP Landcover 1992.
[3] Biodiversity values were taken from WWF Indochina's Ecoregional Planning for the Forests of the Lower Mekong Workshop, March 2000.
[4] Forest data from Stibig, 1997.
[5] Biodiversity values were taken from WWF Indochina's Ecoregional Planning for the Forests of the Lower Mekong Workshop, March 2000.

Biodiversity values used in the HVA analysis were derived from a workshop held by the WWF Indochina Programme as part of their ecoregional planning process for the forest of the lower Mekong. The workshop brought together over 60 biologists with various expertise in Cambodia, Lao PDR and Vietnam. Although a very rough indicator, this data set takes into account priorities for mammals, birds, reptiles, amphibians, butterflies and vegetation assemblages for Cambodia and the southern two-thirds of Lao PDR and Vietnam. Similar information is not available for other areas in the GMS.

1.2 Analysis of Socially Vulnerable Groups

Many development projects within the GMS are designed to improve living standards and quality of life. Beneficiaries of those projects may, however, be largely different from those who bear associated costs. Costs may take the form of displacement from land and forced resettlement, loss of land and other assets, loss of accustomed livelihood, deterioration in health status, erosion of cultural cohesion, and so on.

One risk with large hydropower and road projects is that the benefits bypass the poor, who nonetheless are forced to bear a large share of non-financial costs. This is because lack of political power and voice is a key feature of poverty, the poor are often not in a position to ensure a fair distribution of costs, e.g., through compensation for economic losses suffered and perhaps other adverse welfare impacts.

Within the GMS countries the poorest people tend to be located in areas where major hydropower and strategic road projects are planned, under construction or already built. While already socially vulnerable (insecure food supply, low rate of literacy, exposure to malaria and other diseases, limited access to markets and other services including information dissemination, insufficient opportunities to influence and take part in decision-making) but nevertheless culturally intact, they are at risk from further impoverishment and marginalisation by hydropower and road projects if special attention (including legislation and policies) is not accorded to reducing or eliminating these risks.

Most of the poorest people in the hotspot areas are indigenous peoples, while many also belong to different ethnic groups who practise different cultivation methods and have different cultural traditions from the dominant culture in their respective countries. An exception is the Tonle Sap hotspot in Cambodia, where a majority are Khmer. The fact that poverty highly correlates with indigenous status and ethnic (minority) background calls for increased attention, caution and readiness (through strategies, policies and programming) by governments and the ADB to deal with issues specifically related to the interests and priorities of these groups.

1.2.1 Mapping Poverty

We surveyed the available socio-economic data for the GMS region. While both the type and the level of detail vary widely across countries, we were able to assemble poverty-related socio-economic indicators at district level for rural areas of half the GMS countries (Cambodia, Lao PDR and Vietnam). In the case of Cambodia, indicators include literacy, access to electricity and access to a supply of clean water. For Lao PDR and Vietnam, a consumption-based poverty measure is used, combined in the latter case with indicators of electricity availability and motorbike ownership. We used the data to generate poverty maps for these countries. For Thailand, province-level poverty indicators are available, but are too highly aggregated to be of much use in identifying vulnerable communities or populations. The Yunnan data were for per capita income by county. In addition, a map of townships targeted for poverty alleviation was also consulted. With respect to ethnic minorities data are available at prefecture level on their proportion in the population.

Whereas, in Cambodia and Vietnam, multiple indicators have been mapped, it is possible to overlay different indicators to determine their extent of overlap in specific districts. Where the overlap is great, the vulnerability of the population is assumed to be high.

With district level socio-economic data, it is possible to identify those populations that are both poor on average and living within the identified hotspot areas. The availability of ethnic minority distribution data would add another layer of information to help in identifying areas of high social vulnerability. Only for Vietnam was this possible, however, at district level. There the dataset employed does permit an identification of districts with the highest proportion of ethnic minorities. These correlate fairly highly with those having the highest incidence of poverty (simple correlation coefficient = 0.54). Overlaying a district-level poverty map with an ethnic minority population map shows significant overlap in the northern and western edges of the Northern Uplands, the western edge of the North Central coast, and the northern part of the Central Highlands. This conclusion is confirmed by the survey of the 1,715 poorest communes (Hanoi, 1998) made by the Vietnamese Government where data on poverty have been collected at commune level. However, it has not been possible to map the information at this level.

1.3 Hotspot Analysis

Having identified the five priority hotspots, the risk to HVAs and socially vulnerable groups from GMS transportation and energy sector projects needed to be assessed within each hotspot.

A map of each hotspot was produced, showing the threats to HVAs and vulnerable people within the hotspot. This was based on:

- the environmental value classification of HVAs within the hotspots, as described in Section 1.1.6;
- the information on social vulnerability of groups within the hotspot (described in Section 1.2);
- the extent and degree of project risk zones (see below).

A GIS overlay of all these evaluations (see below) resulted in a hotspot map that shows the environmental importance of different areas within the hotspot; the risk zones of the projects under consideration; and the varying degrees of threat posed by these projects to the hotspot HVAs and to human populations.

1.3.1 Identifying and Classifying Risk Zones

How did we decide which HVAs and social groups were at risk from existing and planned hydropower and road projects, and the seriousness of that risk?

First we categorised the risk zones of ongoing or proposed GMS and national road projects (Table 1.3) and mapped these for each hotspot. We then overlaid the maps showing the environmental value of the HVAs for each hotspot with the maps showing the risk zones. We then classified this resulting layer as per Tables 1.4 and 1.5. We again mapped the results, in essence showing which are the 'hottest' portions of each hotspot in terms of levels of risk to the environment and social groups. A sample hotspot map (Hotspot 3: Central GMS) is shown in Figure 1.3.

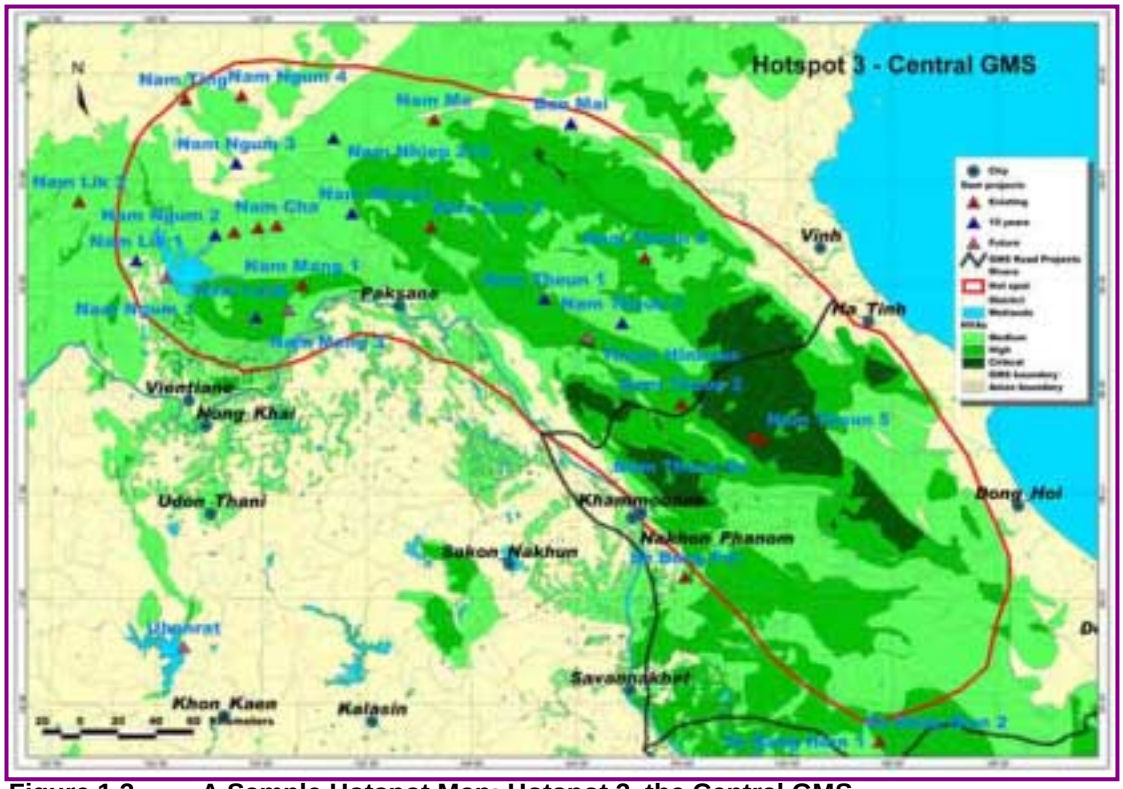

Figure 1.3 A Sample Hotspot Map: Hotspot 3, the Central GMS

Table 1.3 Generic Risk Categorisation in Terms of Environmental Risks, Major Road Projects

Project Type	Risk Zones	Risk Ranking
A). New Roads	3 km perpendicular to average trend of road (highest threat level for intensive exploitation and level)	3
	10 km perpendicular to average trend of road (zone accessible on average in one day by foot)	2
	25 km perpendicular to average trend of road	1
	Special Considerations: River crossings, 1 km perpendicular to average trend of river, both upstream and downstream of crossing	3
B). Existing Roads being upgraded	3 km perpendicular to average trend of road (highest threat level for intensive exploitation and level)	2
	10 km perpendicular to average trend of road (zone accessible on average in one day by foot)	1
	25 km perpendicular to average trend of road	1

Where:

Risk Ranking		Risk Categories
3	=	Very high aggregated environmental risk
2	=	High aggregated environmental risk
1	=	Moderated aggregated environmental risk

Note: In cases where areas have overlapping Risk Zone Categories, the highest risk value ranking shall apply.

Table 1.4 Ranking of High Risk Regions for Natural Systems

HVA Environmental Value Ranking Score	Project Aggregated Environmental Risk		
	Modest	High	Very High
1	MS/MV	HS/MV	VHS/MV
2	MS/HV	HS/HV	VHS/HV
3	MS/VHV	HS/VHV	VHS/VHV

Where each cell reflects a combination of:
Moderate stress (MS) Moderate Value (1) (MV)
High stress (HS) High Value (2) (HV)
Very high stress (VHS) Very high value (3) (VHV)

Table 1.5 Ranking of High-risk Regions for Social Systems

Level of Vulnerability		Level of Estimated Stress		
		Modest	High	Very High
Indigenous Groups:	Remote (marginal) (1)	1	2	3
	Highly Remote (2)	2	4	6
Poverty:	Moderate (1)	1	2	3
	Extreme (2)	2	4	6

In determining level of vulnerability for social groups, two broad criteria are used:

1. Indigenous groups: for these groups, vulnerability is associated with physical remoteness from markets, infrastructure, social services, and cultural insulation (including degree of access to information and participation in decision-making beyond the local community).
2. Poverty status: poverty is assumed to cause social, cultural and economic risks to people, presenting few or no alternatives for improving current livelihood systems.

In Table 1.5, the risk rating is achieved by multiplying the vulnerability score (1-2) with the estimated level of stress (1-3); these give relative but subjective vulnerability scores.

Whilst this analysis has not estimated specific risks, it has provided a baseline overview of the existing environmental and social conditions and an inventory of plans and projects stresses. This provides an 'early warning' of areas within the hotspot where risks might be significant. In the five detailed hotspot characterisations (see subsequent chapters), the magnitude and type of adverse effects that high-risk groups may be subjected to are examined and discussed.

1.4 Hotspot Overviews

The following sections review each of the five GMS priority hotspots identified by the SEF Project. Detailed maps and discussion is provided in the separate hotspot report and the spatial data and information can be accessed and analysed using the SEF 1.0 software.

The focus of the analysis was on identifying receptors and stressors (Figure 1.1) for the hotspots. The analysis has also helped identify and scope strategic issues and fed into the process of formulating recommendations.

1.4.1 Hotspot One: The Upper Mekong

Hotspot one is the Upper Mekong or Lancang River, in Yunnan province of PRC, and the cascade of planned mainstream hydropower projects along its length. The nine proposed and existing projects are considered to be essential by the Government of the People's Republic of China for developing the country's southeast region. However, they also have the potential to permanently alter the hydrology and ecology of the Mekong River and consequently the economy of the GMS. If the GMS is to succeed in its goal of sustained economic development, the GMS countries should coordinate planning to maximise the benefits to the region. In some cases this may not be equivalent to the economic development of the representative countries. The Mekong Cascade hydropower projects may be such a case.

This hotspot contains a rich but increasingly degraded natural resource base, especially forests and wildlife, as well as a diversity of ethnic minorities. It is also pivotal for trade in the GMS because of its proximity to the Economic Quadrangle Development Zone at the intersection of Lao PDR, Myanmar, PRC and Thailand.

The development focus within the hotspot is clearly hydropower, with nine dams planned or already constructed. These include the Manwan Dam (1,250 MW) which was completed in 1996; the Dachaoshan Dam (1,350 MW) which will be operational by 2003; the Xiaowan Dam (4,200 MW) that is expected to begin construction in 2002 or 2003 and begin producing power by 2010; the proposed Jinghong Dam (1,500 MW) which is the subject of feasibility studies being conducted by the Thai and PRC companies that are part of a joint venture to construct the dam and sell power to Thailand's markets; and the Nuozhadu Dam (5,000 MW), currently at the feasibility stage and will probably be in operation in 2017.

Natural resources are protected in a series of three National Nature Reserves, 13 Provincial Nature Reserves and one Geological Reserve within the hotspot. Most of these reserves have been designated to protect forests as well as rare flora and fauna, and they vary in size from over 2,400 km^2 to less than 5 km^2.

There are two areas in the hotspot that have been identified as national level priorities for biodiversity conservation. Within PRC these are Xishuangbanna NNR and Ailao-wuliang Shan NNR (MacKinnon 1996).

The hotspot area is heavily populated, being inhabited by approximately five million people of which nearly half are of different ethnic origins. A number of ethnic groups are restricted to Yunnan, with 25 out of over 50 ethnic groups in PRC being concentrated in this part of the country. However, it remains to be seen how this diversity is to be maintained and how it will adapt to increasing economic development.

Although numerous studies have been conducted along the Mekong in the past 40 years to understand the biophysical situation, there are still many questions that remain unanswered and will need further studies and surveys to clarify. Surveys are needed to improve information collection on water flows, fisheries and ecological processes related to the Lancang basin. A series of initiatives by key actors including MRC, PRC government and others is in fact already underway.

A hydrological model of the entire Mekong basin, based on existing survey data, will be needed to predict the possible effects of the Lancang cascade projects. This model needs to include different development scenarios to inform decision-makers of possible deleterious effects to sensitive areas such as the Tonle Sap, as well as for using in navigation and fisheries decision-making. Such a model is clearly a great technological challenge and should be conducted in cooperation with the government of the PRC, the MRC and a qualified academic institution. The MRC has already done considerable work in this area.

Cumulative results of additional surveys and results from the Mekong Basin Model need to be consolidated and used as the basis for a Cumulative Impact Assessment of the Lancang cascade projects. Special attention should be given to addressing each project, as well as other possible scenarios for scheduling construction.

Above all a mechanism for information sharing needs to be designed and implemented. The most obvious course for this mechanism is to link it to the Mekong Agreement to include the entire basin through a stronger co-operation with the governments of PRC and Myanmar. The Mekong Basin Development Plan activity currently being undertaken by the MRC needs to consider a stronger role for PRC in the process.

1.4.2 Hotspot Two: The Golden Quadrangle

The Golden Quadrangle Hotspot centres on the development of the Chiang Rai to Kunming super-highway, which bisects the hotspot from north to south. Today's Golden Quadrangle area covers the provinces of Chiang Rai, Thailand; Shan State, Myanmar; Bokeo and Luangnamtha provinces, Lao PDR; and southern Yunnan province, PRC. The main feature of the area is its location at a major crossroads in the GMS, an area with a long history of trade and commercial exchange within its borders as well as with the outside world. Thus, contacts and interactions between the local communities, most of them of many different ethnic origins, are not new.

The area is globally renowned for the ethnic diversity of its indigenous peoples, who depend on an increasingly degraded natural resource base.

There are great expectations among the concerned governments, particularly PRC, that opening up this area through the Chiang Rai–Kunming road and other transport investments, will stimulate the economy in all four countries. Some sections of the road have already been built in each country, with other sections at the pre-feasibility and feasibility stages.

However, local communities in the area have benefited the least from current central government development initiatives and thus are among the poorest in each of their respective countries. This suggests the need for careful intervention and close monitoring to avoid unwanted impacts. There is a risk that unless precautions are taken, existing social hazards such as drug abuse and prostitution will increase, and ill-prepared communities will be further impoverished. Special attention has been paid to the Chiang Rai – Kunming road and ADB's potential role in its financing and construction. In light of this involvement the ADB has an opportunity to profit from previous lessons learned in regional road planning and impacts.

Recommendations for this hotspot are primarily linked to the Chiang Rai-Kunming road development. Possible deleterious effects are exacerbated by the region's long history of lawlessness and illegal trade. The area is a global hub for the trade in women, children, narcotics and wildlife. It is obvious that the road project will need to be carefully implemented if these illegal elements are to be suppressed rather than enhanced. Prior to any further construction a much more comprehensive local public consultation is needed. This should then inform the implementation to ensure that affected peoples are substantially better off after project completion.

Previous road projects such as the east-west corridor in Savannakhet, Lao PDR fell far short of predicting the environmental impacts of a large development corridor. This project should try to avoid the mistakes of the past and concentrate on a much large impact area. This is particularly true for the large segment of the road within Lao PDR where the route is the least developed. This impact area assessment should contain at minimum all the districts that the road passes through as well as the protected areas that it bisects.

Past projects have not given sufficient attention to the direct benefits local peoples can derive from infrastructure projects. In considering the Chiang Rai-Kunming road there is a need to plan for including increased access to social services by the local people in the broad project impact area and would include mechanisms like feeder roads and other investments aimed at improving the living standards of the people affected by the project, paying special attention to women and ethnic minorities.

Adhering to global conventions related to trade and labour is of most immediate importance in the region. CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is a prime example. CITES has been signed by every GMS country except Lao PDR. With the Chiang Rai to Kunming highway already playing a major role in regional illegal wildlife trade, it is clear that CITES should be adopted as a basis for regulating this illegal trade. The ADB should make any future loans for transboundary road construction in Lao PDR conditional on the country ratifying CITES (see SEF Report *Volume II*). Similar steps should be taken for the implementation of the International Labor Organisation's Conventions on the movement of people. A critical issue is human rights of migrant labour who have no legal rights in the foreign country and are often exploited.

The Golden Quadrangle is already a centre for illegal activities in the GMS. Clearly there is a need to strengthen capacity for law enforcement in the area. This should specifically target customs officials and border police and provide training, equipment, and capacity-building, with the aim of improved enforcement and decreased corruption.

This hotspot has a number of protected areas that are increasingly subjected to direct pressures. These areas have limited staff, funds, and legal mandates to protect the resources they contain. Of special interest are the only remaining elephant populations left in PRC, which seasonally travel across the border into Lao PDR. The planned road project will bisect the Nam Ha protected area in Lao PDR and come very close to the Xishuanbanna National Nature Reserve in Yunnan. For these areas to survive they should be incorporated into a broader scale land use plan, perhaps in relation to river basin development plans. The road should provide financial retribution to the protected areas to cover the necessary patrolling and enforcement required due to the resultant increased accessibility provided by the road.

1.4.3 Hotspot Three: The Central GMS

The Central GMS Hotspot has been at the centre of the GMS development debate, with 29 built or planned hydropower projects, as well as being a prime corridor for economic development between Thailand and Vietnam. The hotspot includes all of central Lao PDR with smaller parts of Vientiane Municipality, and Vientiane Province, the southern half of Xiengkhuang, the whole of Xaysomboun special zone, Bolikhamsay and Khammouane and the north-eastern part of Savannakhet as well as parts of western Nghe An, Ha Tinh, Quang Binh and Quang Tri provinces in Vietnam.

This area contains some of the most important wilderness areas left in Asia. It supports a series of eight protected areas stretching from the Mekong plain across the Annamite Mountains to the coastal plain of Vietnam. Recent studies have shown that the Annamite Mountains are rich in endemism and of global importance for biodiversity.

Because of the great concentration of existing and planned dams, the area has been subjected to a number of studies during the last 15 years with a special focus since 1995. Compared to the other hotspots, the total number of people is small (not more than 1 million) and the affected people even fewer. The importance of the area is upgraded because of the opportunities associated with hydropower interests. There has been repeated criticism against the lack of outside understanding of local livelihood systems and the low level of local people's involvement. Today the area is relatively well known but there are still major questions about how hydropower can eventually benefit local peoples.

The valuable natural resources and the relatively low population, combined with the opportunities presented by numerous development projects, highlight the opportunities in this area for well-planned sustainable development. This development should concentrate on the conservation of the area's natural resource base and highlight the non-extractive opportunities for income generation that are available.

Whilst this area, especially the Nam Theun and Nam Ngum Basins, are better studied than most other watersheds in the region, current information is still insufficient. For example, the ongoing discussions on fisheries loss and livelihood compensation due to the Theun Hinboun dam require further biological information. With a large number of planned hydropower and road projects associated with these two basins there is a need to better understand the cumulative effects of continued project construction.

As highlighted in the specific interventions for the ADB presented in *Volume I: Stretegic Environmental Framework for the Greater Mekong Subregion*, continued financial support for hydropower construction in these basins should not proceed without a basin development plan. In order to ensure that the basin management plans are adhered to, a management authority will be needed for each major basin. This would be preferential to the situation of competing private interests managing the basin, as currently envisioned.

The current system of protected areas covering the spine of the Annamite Mountains between Lao PDR and Vietnam is of global importance for its biodiversity and ecological functions. These global values should be preserved in a series of connected protected areas and other compatible use zones. Such a system could be financed in the short-term from proceeds from limited hydropower development through electricity sale as well as water use fees. In the longer term eco-tourism and limited sustainable extractive uses such as community forestry or non-timber forest product harvesting could help finance these areas.

1.4.4 Hotspot Four: The Se San and Se Kong Basins

The Se San/Se Kong watershed is the second largest watershed in the Mekong drainage, lying within Lao PDR, Vietnam and Cambodia. The area holds some of the least disturbed forests in the entire GMS. These forests are home to a diverse range of indigenous people. These people in turn are reliant on a rich fishery that includes the Khone Falls area on the lower Mekong, the most productive fishery in Lao PDR.

The area supports a number of globally important protected areas. These include: Dong Hua Sao NBCA, Xe Pian NBCA and Dong Ampham NBCA in Lao PDR, Virachay and Lomphat National Parks in Cambodia and Mom Ray Nature Reserve in Vietnam. These protected areas cover large areas of mixed deciduous forest in the middle elevations, while including lesser amounts of lowland evergreen forest. However, none provide protection to the broad sandy rivers that are unique to the area.

The hotspot is also one of the few remaining areas that still supports an almost complete assemblage of large mammals. The Se San and Se Kong river basins are of high social and environmental value due to their cultural and biological diversity. This diversity is especially valuable along the rivers themselves and the associated riparian communities. The Se San River itself is the only river in the GMS outside of Myanmar that still supports an extensive variety of riverine sandbank dependent birds. These biological values are not sufficiently represented in Lao PDR, Cambodia, or Vietnam's protected area system.

It is these areas that are most at risk from poorly planned hydropower development. The situation in Se Kong/Se San is exacerbated by the transboundary nature of both basins.

There are two major GMS road projects planned for the area, Routes 6 and 9. These will join the GMS through southern Lao PDR and northern Cambodia.

There are twenty-five hydropower projects currently operating, being built or planned for the hotspot. These include: Houay Ho, Se Pian/Se Namnoy, Lower Se San 1, 2, 3, Lower Sre Pok 2, 3, Upper Sre Pok, Prek Liang 1, 2, Upper Se San 4, Se San 3, Yali, Plei Krong, Dak Bla, Nam Kong 1, 2, 3, Huay Lam Phan, Se Katam, Se Kong 3, Se Kaman 1, 2, Xe Xou, and Stung Treng. This list presents all the studied hydropower sites. Whilst the majority will not go ahead for financing reasons, some will certainly proceed.

The Vietnamese part of the hotspot covers the western part of the provinces of Gia Lai and Kon Tum. A majority of the people in this area is indigenous, belonging to groups such as Gia Rai, Bana, and Sedang. The rest of the population are migrated Kinh. Generally, the closer to the border of Lao PDR and Cambodia, the higher the number of ethnic groups.

In Cambodia the hotspot covers small parts of Kratie and Mondul Kiri province, while it covers the greater part of Stung Treng province and the whole of Ratanak Kiri province. As in Vietnam this is also regarded as one of the most remote areas in the country. Beside the Khmer majority group, the two ethnic groups of Gia Rai and Radhe traditionally live in the area.

The major part of the two provinces in southern Lao PDR, Champassak and Attapeu are located within the hotspot. The area is inhabited mainly by indigenous peoples and ethnic groups such as Katu and Bana who generally are known under their own ethnic name (Suay, Taliang, Alak, Ngae, Lawen, Oy, Chieng, Sapuan, Nyahon).

The Se San/Se Kong area has received considerable attention since the Yalli falls incident in March 2000 when the water released from the dam in Vietnam caused floods in Cambodia. A series of studies has been initiated which highlight the complex nature of the transboundary impacts of the proposed development in the Se San and Se Kong basins. However, as in all the hotspots, more information about flows, sedimentation and the ecology of the river basins is needed to inform infrastructure development planning. A hydrological model is an additional planning tool needed to inform decision-makers.

Several versions of hydropower masterplans exist at the national levels both in Vietnam and Cambodia; however, any hydropower development in the basin needs to be guided by a transboundary basin development plan. This could be facilitated by setting up a river basin authority with a transboundary mandate. This authority would oversee the implementation of the basin development plan of the basin.

As with the other hotspots, protected areas are key for the area's sustainable development. In regard to the Se San and Se Kong Basins, the existing system of protected areas play an important role in protecting biodiversity, watershed values and other ecological processes. These protected areas are currently under staffed, under funded and in many cases powerless to enforce any rules within their boundaries. It is imperative that protected areas are included within any comprehensive basin plan and that they are properly staffed, funded and given the legal mandate to protect the resources they contain.

1.4.5 Hotspot Five: The Tonle Sap

The Great Lake of Tonle Sap, Cambodia, is the largest lake in Southeast Asia and one of the most productive freshwater fisheries on the planet. The area has been designated a multiple use area (IUCN IV) by the Government of Cambodia and has been given Biosphere Reserve status by UNESCO. In addition the area is adjacent to the ancient temples of Angkor Wat, a World Heritage site of global cultural importance.

The greater watershed area covers the six provinces of Kompong Chhang, Pursat, Battambang, Kompong Thom, Banteay Meanchey and Siem Reap. The total population of these provinces is 3.4 million, approximately one third of the population of Cambodia. It is estimated that about 340,000 people are living in the immediate area of the lake (MRC/UNDP 1999).

Tonle Sap is hydrologically unique in that water flow reverses seasonally based on the flow of the Mekong River. This unique hydrology makes the entire Tonle Sap ecosystem sensitive to changes in the flow of the Mekong. The most well-known of these is the changes in timing and losses of annual flow which are likely to occur in the future due to hydropower dams on its tributaries or the Mekong mainstream itself. In the very short-term, it is likely that the effect of proposed irrigation projects on the Tonle Sap ecosystem will be more severe than the effect of expected changes in seasonal fluctuations in lake levels from the impact of hydro projects on the Mekong river and tributaries.

The area is also threatened by the increasing local population, which exacerbates the needs for protein consumption leading to potential over harvesting of fish. Another threat is increased use of fertilisers and the resultant runoff into the lake and its tributaries poisoning the fish and the people who live on them.

The flooded forests of the Tonle Sap are an integral part of the ecosystem, providing an area for fish to spawn and providing nesting sites for the largest population of globally threatened water birds left in south-east Asia.

Tonle Sap is an integral part of the Greater Mekong ecosystem. Changes in flows resulting from dam impoundment upstream on the Mekong and its tributaries could have serious impacts on the ecology of the Tonle Sap. There is clearly a need to improve understanding of these processes. The development of a hydrological model could inform decision-makers about the impacts of multiple development scenarios. Such a model should incorporate the Mekong mainstream as well as its main tributaries. Parallel efforts to collect and compile quality data to run the model are needed.

Similar to the management authorities recommended for other basins, a Tonle Sap Management Authority is being discussed by the government of Cambodia, partly to co-ordinate at the national level the activities of the various ministries related to the Tonle Sap. This in part already exists through the establishment of a subcommittee overseen by the Cambodian National Mekong Authority for the Biosphere Reserve. This subcommittee could form the basis of a more extensive body that oversees the entire Tonle Sap basin. The SEF project has looked in more detail at institutional issues related to the Tonle Sap Great Lake in one of its case studies and details are available in *Volume IV* of the SEF reports.

2. UPPER MEKONG GMS HOTSPOT OVERVIEW

2.1 Description

Hotspot one is the Upper Mekong River and the cascade of planned mainstream hydropower projects along its length. These nine proposed projects are considered by the Government of the People's Republic of China as essential to development of the country's Southeast region, but they also have the potential of permanently altering the hydrology of the Mekong River and consequently the GMS.

The area has a rich but increasingly degraded natural resource base, especially forests and wildlife, as well as a diversity of ethnic minorities. It is also pivotal for trade in the GMS because of its proximity to the Economic Quadrangle Development zone at the intersection of Thailand, Lao PDR, Myanmar and China. This zone is discussed in more detail in Chapter Three on Hotspot Two: The Golden Quadrangle.

The development focus within the hotspot is clearly hydropower, with several dams planned or already constructed. These include the Manwan Dam (1,250 MW) which was completed in 1996; the Dachaoshan Dam (1,350 MW) which will be operational by 2003; the Xiaowan Dam (4,200 MW) that is expected to begin construction in 2002 or 2003 and begin producing power by 2010; the proposed Jinghong Dam (1,500 MW) which is subject of feasibility studies being conducted by the Thai and PRC companies that are part of a joint venture to construct the dam and sell power to Thailand's markets; and the Nuozhadu Dam (5,000 MW) currently at feasibility stage and will probably be in operation in 2017.

Natural resources are protected in a series of three National Nature Reserves, 13 Provincial Nature Reserves and one Geological Reserve within the hotspot. There are two areas in the Hotspot that have been identified as national level priorities for biodiversity conservation within China these are Xishuangbanna NNR and Ailao-wuliang Shan NNR (MacKinnon, 1996). The majority of reserves have been designated to protect forests as well as rare flora and fauna, while varying in size from over 2,400 km^2 to less than 5 km^2.

Hotspot one is the most heavily populated of the five priority hotspots being inhabited by approximately Five million people of which nearly half are of different ethnic origins. A number of ethnic groups are restricted to Yunnan with 25 out of over 50 ethnic groups in PR China being concentrated in this part of the country. Thus the ethnic culture is diverse and current policies are encouraging continued diversity. However, it remains to be seen how this diversity is to be maintained and how it will adapt to increasing economic development.

Table 2.1 Upper Mekong Hotspot Summary Characteristics

Location and Size	
Hotspot Area (km^2)	36,614 km^2
Percent of Total Area of GMS Priority Hotspots	15.67 %
Percent of Total Area of GMS	1.58 %
GMS Countries within Hotspot	Yunnan, PR China
Biophysical	
Total Forest Cover[6] (km^2)	Not Available
Percent of total Hotspot Area	Not Available
Wetlands (km^2)	1,237 km^2
Percent of total Hotspot Area	3.38 %
Protected Areas (km^2)	1,552 km^2
Percent of total Hotspot Area	4.24 %
Rare and Endangered Species	Asian Elephant, Green Peafowl, White-cheeked Gibbon, Gaur, many species extirpated.
Socio-economic	
Estimated Population	5 million
Average GDP	US$ 280-350 per capita
Ethnic Minorities Present	Yi, Hani, Yao, Dai, Bulang, Bai, Jinuo, Nu, Hui
Agricultural Land (km^2)	Not Available
Projects	
GMS Hydropower Projects	None
GMS Road Project	None
National Hydropower Projects	Gonggugiao, Xiaowan, Sichiagong, Nuozhadu, Jinhong, Ganlanba, Mengsong
National Road Projects	Rural road upgrades throughout

[6] Contiguous canopy covers with high or medium density (greater than 70 percent forest cover and over 20 percent crown cover with the forest cover).

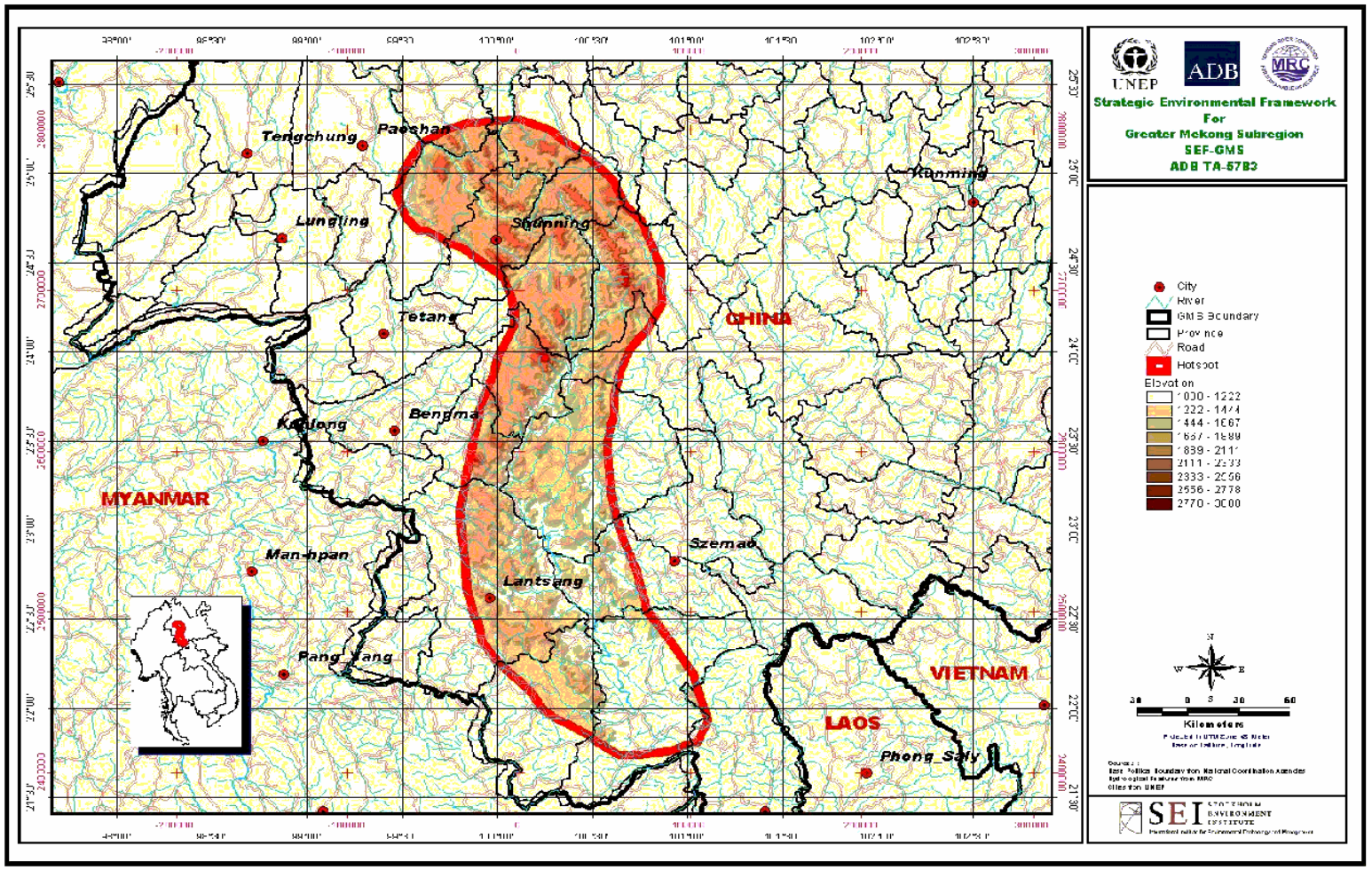

Figure 2.1 Overview Map of Hotspot (including political boundaries, roads, cities and towns)

2.2 Biophysical and Natural Resources

2.2.1 Land Cover

Overall Hotspot one is extremely mountainous with most hillsides largely cleared for agriculture. Forest still persists only in protected areas and on the steepest slopes. Flat lands are used for agriculture and plantations, especially rubber, coffee, and fruit trees.

The project has been unable to obtain any land cover data for the area. UNEP does possess satellite imagery but this is yet to be classified.

2.2.2 Forestry

Forest cover has decreased significantly in Yunnan Province over the past 50 years. A large portion of the Forest cover in Yunnan Province is located in the Mekong Basin, which has approximately 40 percent forest cover. This is primarily limited to protected areas.

In 1998 the national government imposed a logging ban in response to major flooding in the Yangtze basin. Those floods were contributed to deforestation in the upper watershed, primarily within Yunnan Province. This was accompanied by a policy to transfer all land at a slope of 25º or greater from Agriculture to Forestry. The logging ban is only starting to be implemented and so far has met with mixed concerns. The major concerns have included lack of alternatives to agriculture on steep slopes for food and cash income generation and the loss of jobs, fuel wood and cash income from the logging ban, especially in poor villages. Prior to the logging ban commercial and domestic timber extraction had been unsustainable (Xu Jianchu, 2000).

The logging ban has dramatically increased China's need for wood imports, creating a demand that is being felt globally. Within the GMS China is importing increasing amounts of timber from Myanmar, Lao PDR and Cambodia. Each of these countries is currently harvesting at unsustainable levels with Cambodia possibly exhausting its forest estate within the next 10 years. Finding a long-term solution to China's timber needs will be necessary to alleviate forest loss in the other GMS countries.

The project was unable to obtain forest cover data for this hotspot.

2.2.3 Fisheries

The principal threat to fish biodiversity and riverine fish production in the Upper Mekong River hotspot area is mainstream hydrodam development. There is one existing mainstream dam at Manwan. A second is nearing completion (at Dachaoshan, downstream of Manwan), while seven more are planned for the mainstream. In addition, more dams are proposed higher up the mainstream and along the tributaries.

The Mekong mainstream, tributaries and associated lakes are characterised by high fish biodiversity, including a substantial number of endemic species (species flocks in some lakes) (Kottelat and Whitten, 1996; Chu and Chen, 1989; 1990, Li, 1982; and Yang 1991). An environmental assessment study for Manwan and other hydrodams identified new genera and species from the Mekong (Yunnan Institute of Environmental Science, 1993). The upper Mekong ichthyofauna differs substantially from the lower Mekong assemblages occurring in Vietnam and Cambodia, in part due to differing ecological conditions (i.e. cooler water temperature and steeper gradients).

It is not clear from available sources what the level of fish production from the Mekong is. Nominal capture fishery production for the entire Yunnan Province was 19,084 t in 1990

(Yunnan Provincial Science and Technology Commission and Yunnan Institute of Geography, 1993). Indiscriminate fishing has placed a number of rare species at high risk.

The presence of Manwan dam has now effectively segmented the Mekong River into two from a fish ecology perspective. Although post-impoundment studies were not available for examination, it is reasonable to suggest that the Manwan dam likely blocks upstream fish migration, and may be reducing water flows downstream during the dry season (with possible effects as far downstream as Vientiane). The proposed cascade dam development of the Mekong mainstream (further amplified by ancillary tributary dam development) would severely modify the ecology of the river network. A loss of endemic and non-endemic fish species can be expected due to submergence of critical white water habitat and blockage of spawning migrations. Loss of riverine fisheries production would be mitigated to some degree by reservoir formation. Currently, fish production levels are probably depressed due to pulp mill effluent discharge into the river, and apparently also overexploitation.

While mainstream dam development is now only a possible threat to fish biodiversity and production in the lower Mekong River basin, it is a reality in the Upper Mekong. This is a serious issue, which is likely to have transboundary consequences. The planned proliferation of dams in the Upper Mekong presents an extremely high level of risk for irreversible negative impacts on endemic and commercially valuable fish biodiversity.

2.2.4 Protected Areas

There are three National Nature Reserves, 13 Provincial Nature Reserves and one Geological Reserve within the hotspot. There are two areas in the Hotspot that have been identified as national level priorities within China these are the Xishuangbanna NNR and Ailao-Wuliang Shan NNR (MacKinnon, 1996). The majority of reserves have been designated to protect forests as well as rare flora and fauna, while varying in size from over 2,400 km^2 to less than 5 km^2.

The National level nature reserves are:

Gao li gong shan National Nature reserve in Teng Chong, Lu Shui Xian and Bao Shan Shi counties, was established in 1983. It is a very large reserve of 1239 km^2. It is important as a Nature reserve because of its complete vertical forest strata, subtropical evergreen broadleaf forest, alpine coniferous forest, and rare fauna and flora. In a 1996 review of Biodiversity in China it was considered to be in very good condition. The same review suggested that it should be managed as part of the Nujiang-Lancang Jiang Convergence and should be considered as highest priority.

Xishuangbanna National Nature Reserve lies in Jing Hong, Meng Hai and Meng La Xian counties. The reserve is composed of five parcels Mangao, Menglun, Mengla, Shangyong and Mengyang with a total area of 2,418 km^2. It was established in 1981. The reserve is critical to China for supporting the largest remaining areas of tropical evergreen forest ecosystems as well as Asian Elephant and Tiger. Mackinnon et. al. 1996 stated that the forests are rather disturbed and fragmented but still important. They suggest reconstructing forest corridors and strengthening protection particularly of rare evergreen forest formations as well as highlighting the need to develop agroforestry systems in the buffer zone. The reserve has benefited from a long-term support program from WWF and other international organisations including the World Bank through GEF, GTZ and the MacArthur Foundation.

Ailoashan National Nature Reserve is a 504km^2 area of Subtropical moist evergreen broadleaf forest ecosystem for water preservation, The area is important for populations of Concolor Gibbob *Hylobates concolor* and Green Peafowl *Pavo muticus*. Mackinnon et. al. 1996 considered it quite good, although partly degraded in the lowlands. It has been suggested that it be extended to link with Wu Liang Shan reserve to form a single unit. It was

established in 1986 and spans across the counties of Chu Xiong, Shuang Bai, Xing Ping, Jing Dong and Zhen Yuan Xian.

While the provincial nature reserves include: Tian Chi, Yong Guo Shi, Da Xue Shan,Yong De Da Xue Shan, Lin Cang Da Xue Shan, De Dang Hou Shan Shui Yuan Lin, Wei Yuan Jiang, Wang Xian Tai, Jiezihe, Xin Tian, Cai Yang He, Long Shan, Xishuangbanna Banhe and Wu Liang Shan as shown in Table 2-2.

Nan Jian Tu Lin is the only Geological Reserve in the hotspot. It lies in Nan Jian Xian County it was declared protected in 1988 because of its geological formations. It is also quite small being only 5 km^2.

Table 2.2 Protected Areas in the Upper Mekong GMS Priority Hotspot

Name	Area (km^2)	Location (County)	National Category	IUCN Category[7]	YEAR
Gao Li Gong Shan	1,239	Teng Chong, Lu Shui Xian and Bao Shan Shi	National Nature Reserve	IV	1983
Xishuangbanna	2,418	Jing Hong, Meng Hai, Meng La Xian	National Nature Reserve	IV	1981
Ai Loa Shan	504	Chu Xiong, Shuang Bai, Xing Ping, Jing Dong, Zhen Yuan Xian.	National Nature Reserve	IV	1986
Tian Chi	66	Yun Long Xian	Nature Reserve	IV	1983
Yong Guo Shi	7	Yong Ping Xian	Nature Reserve	IV	1988
Nan Jian Tu Lin	5	Nan Jian Xian	Geological Reserve	IV	1988
Wuliang Shan	234	Jing Dong Xian	Nature Reserve	IV	1986
Da Xue Shan	158	Yong De Xian	Nature Reserve	IV	1986
Yong De Da Xue Shan	158	Yong De Xian	Nature Reserve	IV	1986
Lin Cang Da Xue Shan	179	Ling Cang Xian	Nature Reserve	IV	1993,
De Dang Hou Shan Shui Yuan Lin	72	Yong De Xian	Nature Reserve	IV	1990
Wei Yuan Jiang	77	Jing Gu Xian	Nature Reserve	IV	1983
Xin Tian	12	Yuan Jiang Xian	Nature Reserve	IV	1989
Wang Xian Tai	47	Yuan Jiang Xian	Nature Reserve	IV	1989
Jie Zi He	33	Yuan Jiang Xian	Nature Reserve	IV	1989
Cai Yang He	70	Simao Xian	Nature Reserve	IV	1986
Long Shan	5	Mang Lian Xian	Nature Reserve	IV	1986

2.2.5 Biodiversity

Yunnan has the highest biological richness of any province in China. This is due to its complex relief, wide range of climatic conditions, and inaccessibility of much of its mountainous areas. More than half of China's protected mammals and almost half of its protected birds are also found in Yunnan.

[7] See Annex 1 for IUCN protected area categories.

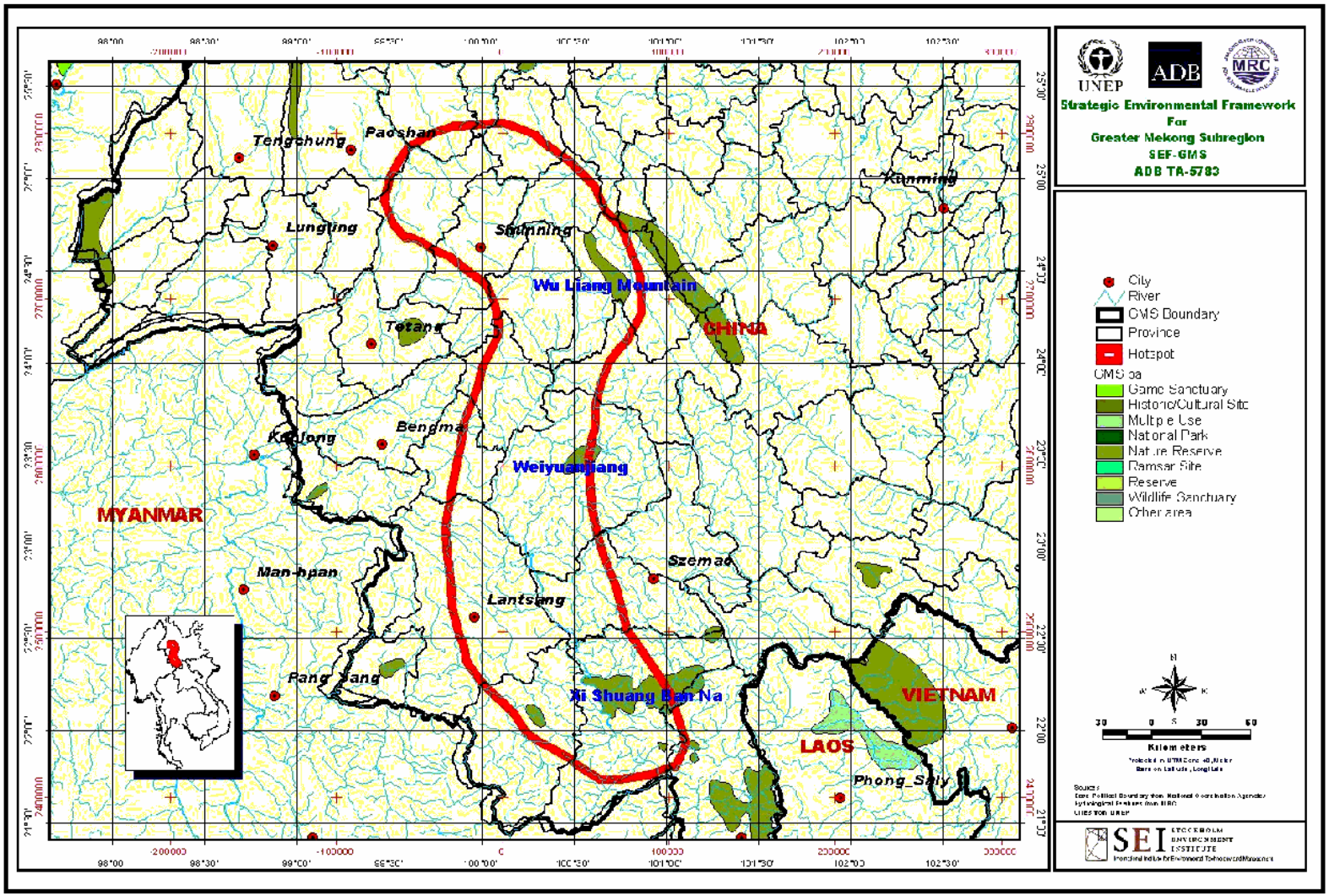

Figure 2.2 Protected Areas in the Upper Mekong GMS Priority Hotspot

These species include Tiger, which is limited to southern Yunnan with less than 20 individuals remaining (Duckworth and Hedges, 1998). Yunnan is also the only province in China where Asian Elephants still exist. They persist in Cangyuan, Jiangchung, Menghai, Jinghong and Mengla counties. Numbers may be as high as 250 but poaching levels are high even with strict penalties, the strictest of which is death.

The Chinese population of Gaur is also concentrated in Yunnan and southeast Tibet with 1995 population estimate being 700-800 animals. In 1980 the species went extinct in Lancang County splitting the population between Xishuangbanna-Simao and Cangyuan (Duckworth and Hedges, 1998).

2.2.6 Water Resources

The Mekong (Lancang Jiang) river north of the hotspot flows in a well defined north-south oriented fault valley, with the Nu Shan mountain range to the west, and the Qingshilang Shan range to the east. The headwaters of the Thanlwin and Irrawaddy (Maykha) rivers are in close proximity in parallel valleys to the west, and the upper Yangtse is to the northwest.

About 10 percent of the Mekong River catchment area are outside of Yunnan Province, in Qinghai Province and in Tibet, and the majority of this area is at high altitude (above 3000 m). The runoff amount from this part of the basin is lower than the average for the whole basin, 330 mm versus 560 mm, because the climate is a continental one, and is not influenced by monsoons. The river flows are snowmelt controlled, with peak floods in May and June. The lowest flows are normally in the February to April period. Exceptionally large floods happen in years with a large snow pack in April, combined with a very warm succession of days during the April-May period.

Where the river enters the hotspot, the mountain trench is less well defined, and the river flows to the south with occasional large 180^{o} loops where mountain obstacles intrude on the valley. The mountains on either side of the valley are high, with peaks as much as 3300-m altitude on the westside, and peaks up to 3200-m altitude on the eastside. Tributary rivers are not large, because the main valley is narrow in the hotspot area, and hence the catchment areas of the tributaries are small. The mainstream river is steep along much of the Yunnan section, with river channel slopes in the range 1.5 percent in the upper part, to 0.8 percent in the middle and lower parts of Yunnan. This range of river gradients is sufficiently large to ensure transport of a very wide range of sediment sizes, ranging from boulders and cobbles, down to gravel, sand and silt.

Concern was expressed in a recent ADB report, that decision-makers do not have adequate access to basic hydrological data (Landcare, 2000). A summary of hydrological information, and a map of gauging stations is given in Landcare, 2000 (Plinston and Daming, 2000). Four stations are listed, Liutongjiang (near the northern border of Yunnan), Juizhou, Gajiu, and Jinghong, near the southern part of the Hotspot. The basin area of the Mekong River approximately doubles over this distance (from 76,700 km^2 to 140,900 km^2). The mean annual discharge increases from 802 m^3/s at Liutongjiang, to 1870 m^3/s at Jinghong. Extreme discharges for these two stations are 4,600 and 12,800 m^3/s for the record maximum flows and 161 and 395 m^3/s for the record minimum flows (Yunnan Institute of Geography, 1993).

These values, quoted from the 1993 report, are based on thirty years of records. This is sufficient to obtain data for strategic planning, but insufficient to ensure the sound design of spillway size. Serious concerns were also raised in the Landcare report about the impact of sedimentation on the life of Manwan reservoir, as a result of continuing and possibly increasing soil erosion in the catchment. The current rate of sedimentation in Manwan may seriously threaten its medium term commercial viability. With the construction and completion of Xiaowan (scheduled for 2010 completion), the sedimentation problem will be transposed upstream to the Xiaowan future reservoir.

2.3 Population

The Langcang River Basin accounts for about 37 percent of the total area of Yunnan Province and covers most of western Yunnan. At the end of 1998, the population of the region was somewhat over 10 million, which constituted nearly 25 percent of the total population of Yunnan (ADB/Landcare, 2000).

However, while the hotspot only covers the lower part of the Basin, it is estimated that not more than 5 million are residing in the area. About half of the population include indigenous peoples such as Yi, Hani, Yao, Dai, Bulang, Bai, Jinuo, Nu, Hui (Bernard & Huteau, 1996).

Primarily covered by high mountains and dominated by (traditionally performed) agricultural production, the Basin is regarded to be at an “early stage of economic development.” (ADB/Landcare, 2000). As a consequence, its productivity and standard of living as captured in GDP/capita is 35 percent below the provincial average and 56 percent below the national norm in 1998.

Population Density data was not available for this hotspot.

2.4 Development Stresses

2.4.1 Transportation

There is an extensive network of roads in the hotspot, several of which bridge the Mekong. No major upgrade plans have been located for these national roads although a certain number of new roads will obviously be needed to support the impending hydro-dam construction. Roads have not been highlighted as a major development in this hotspot but have been discussed in Chapter 3 on the Chiang Rai to Kunming Highway. See map of existing road network (Figure 2.3).

There are no GMS road projects planned in this Hotspot.

2.4.2 Hydropower Projects

One large hydroelectric project, Manwan, is completed and has been in operation since 1996. A second dam, Dachaoshan, is under construction, and will start operation in 2003. There are no GMS funded Dams in this Hotspot

Table 2.3 Existing Hydropower Dams in the Upper Mekong Hotspot

Name of site	Stage of development	Peak Power Output MW	Dam Height m	Reservoir Capacity Mm^3	Predicted annual power output GWh
Manwan	Completed	1,250	126	1060	7,800
Dachaoshan	Under construction. Power production start-up for 2003	1,350	115	884	6,700

Table 2.4 Proposed Mekong (Lancang) Mainstem Dams in the Hotspots

Name of site	Stage of development	Peak Power Output MW	Dam Height m	Reservoir Surface Area Ha	Notes
Xiaowan	Feasibility study in preparation. Construction start for 2001	4,200	290	172,000	
Nozadu	Feasibility study in preparation	5,000	250	144,700	
Jinhong	Feasibility study in preparation. Thai and PRC Joint Venture	1,500	107	149,000	
Gongguo Qiao*	F/S?	750	130	97,300	Immediately upstream of Hotspot
Ganlanba	F/S?	150	10	151,800	
Meng Song	F/S?	600	28	160,000	
Sichia Gang	Pre-F/S	1,100	260	123,000	

A table of dams that are under construction or in the feasibility/pre-feasibility stage is shown above. These are all mainstem dams, except for the ones at Lanping mine (north of the Hotspot), and at Simian paper mill, which are on tributary streams (see GIS Mapping for Hotspot 1). These are small, and their impact on water flows is an order of magnitude smaller than the impact of Manwan dam and reservoir. However the impact of the industrial facilities on Mekong River water quality may be large.

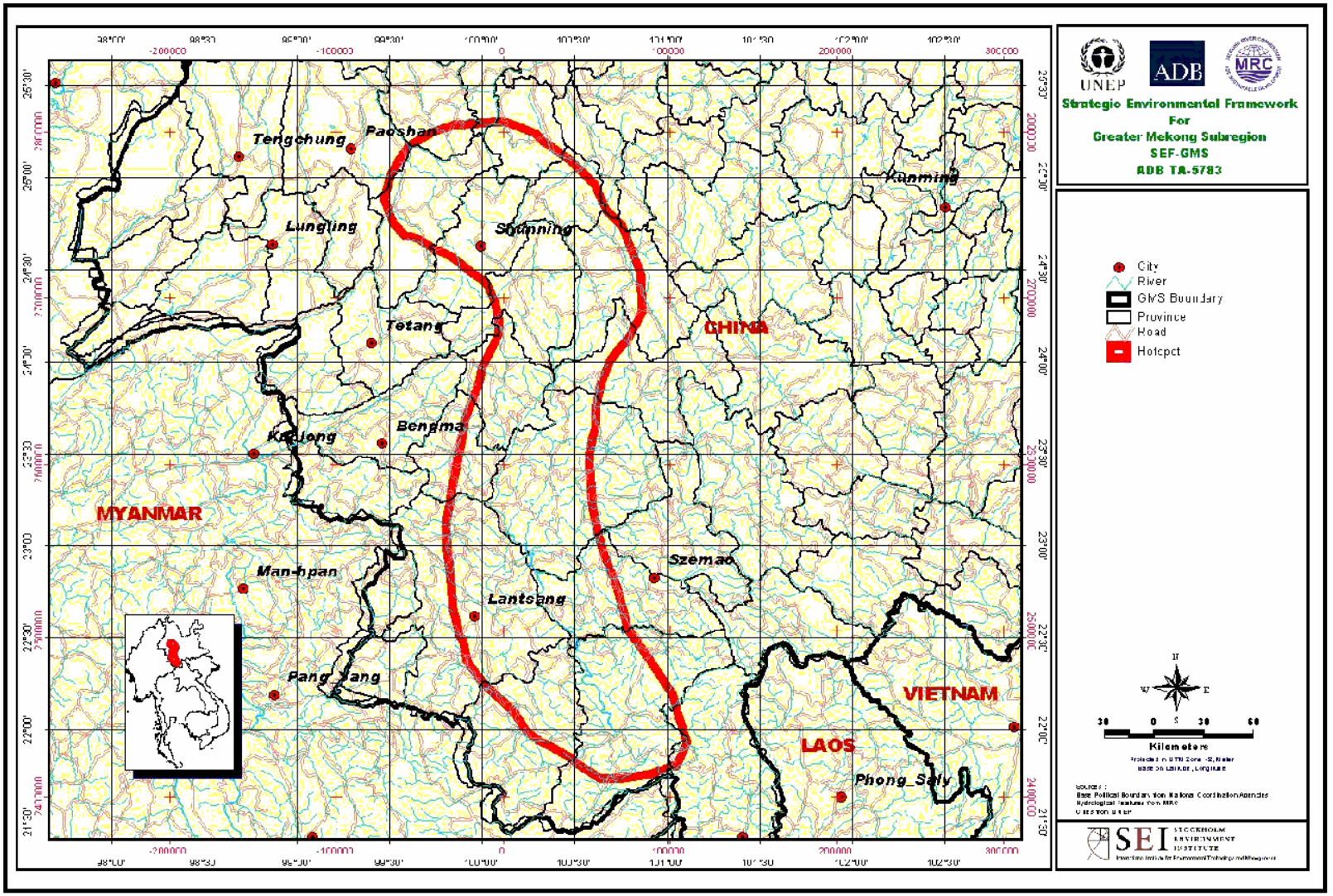

Figure 2.3 Existing Road Network, Upper Mekong Hotspot

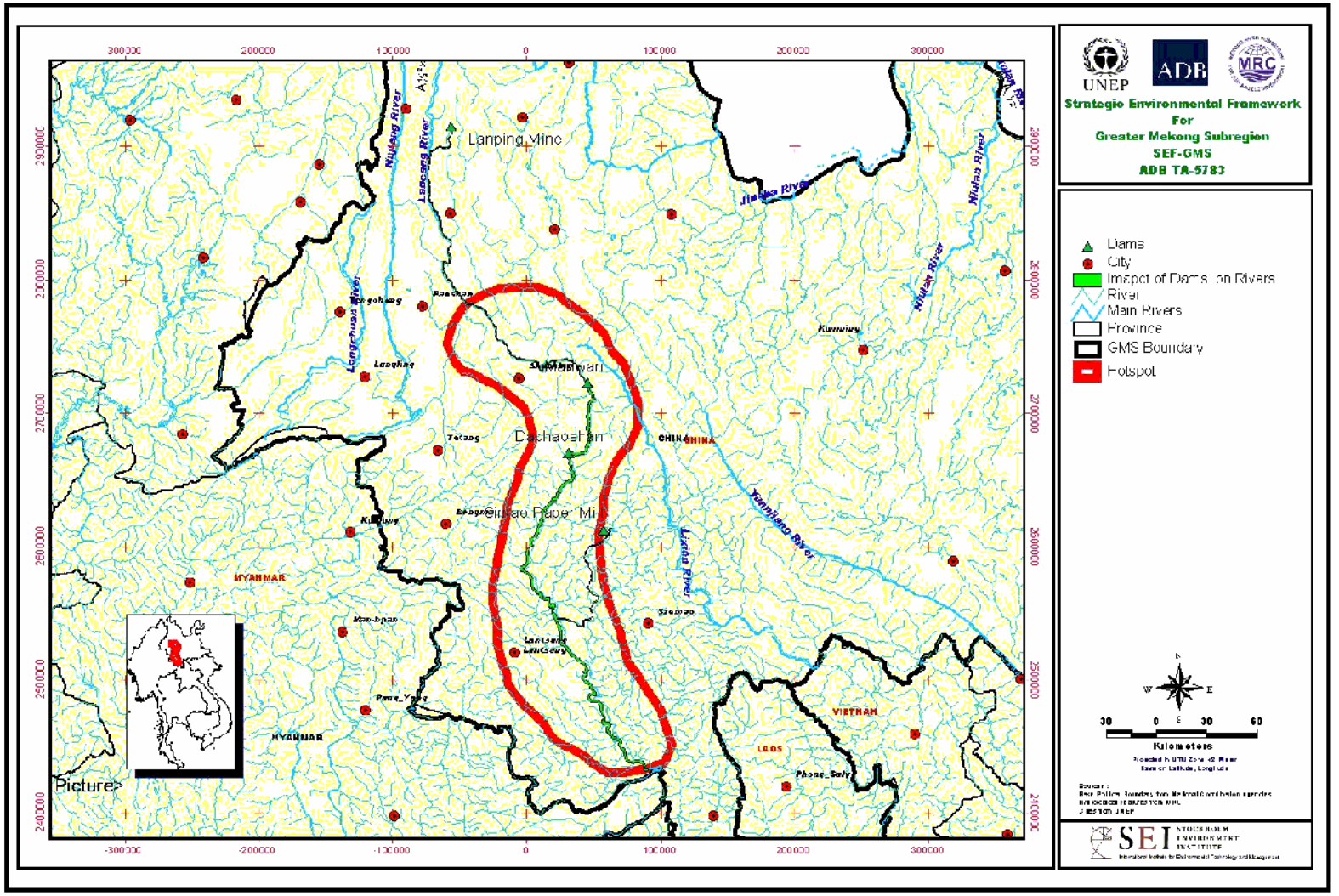

Figure 2.4 Existing Hydropower or Multipurpose Dams in Upper Mekong Hotspot

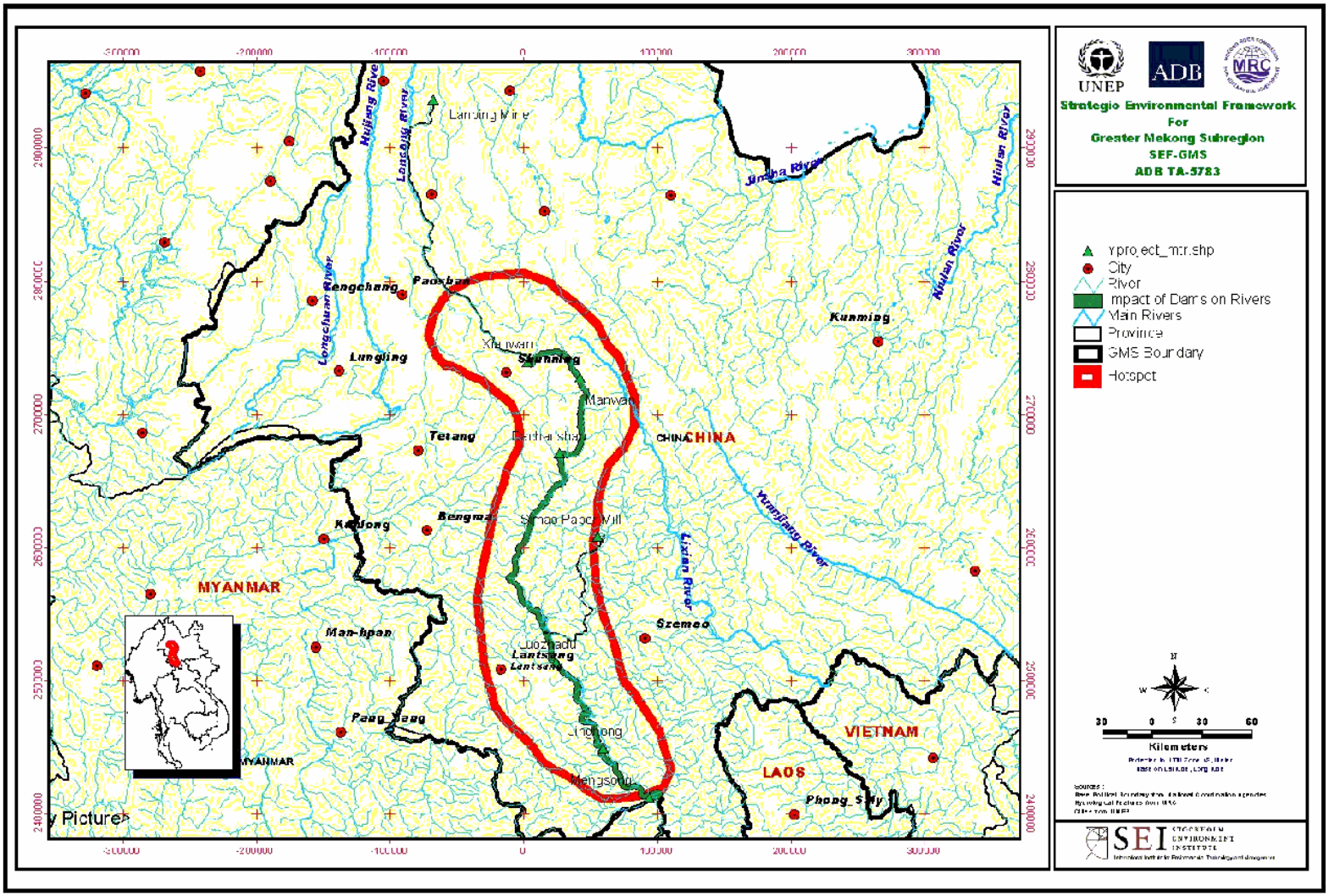

Figure 2.5 Fifteen-Year Hydropower Development, Upper Mekong Hotspot

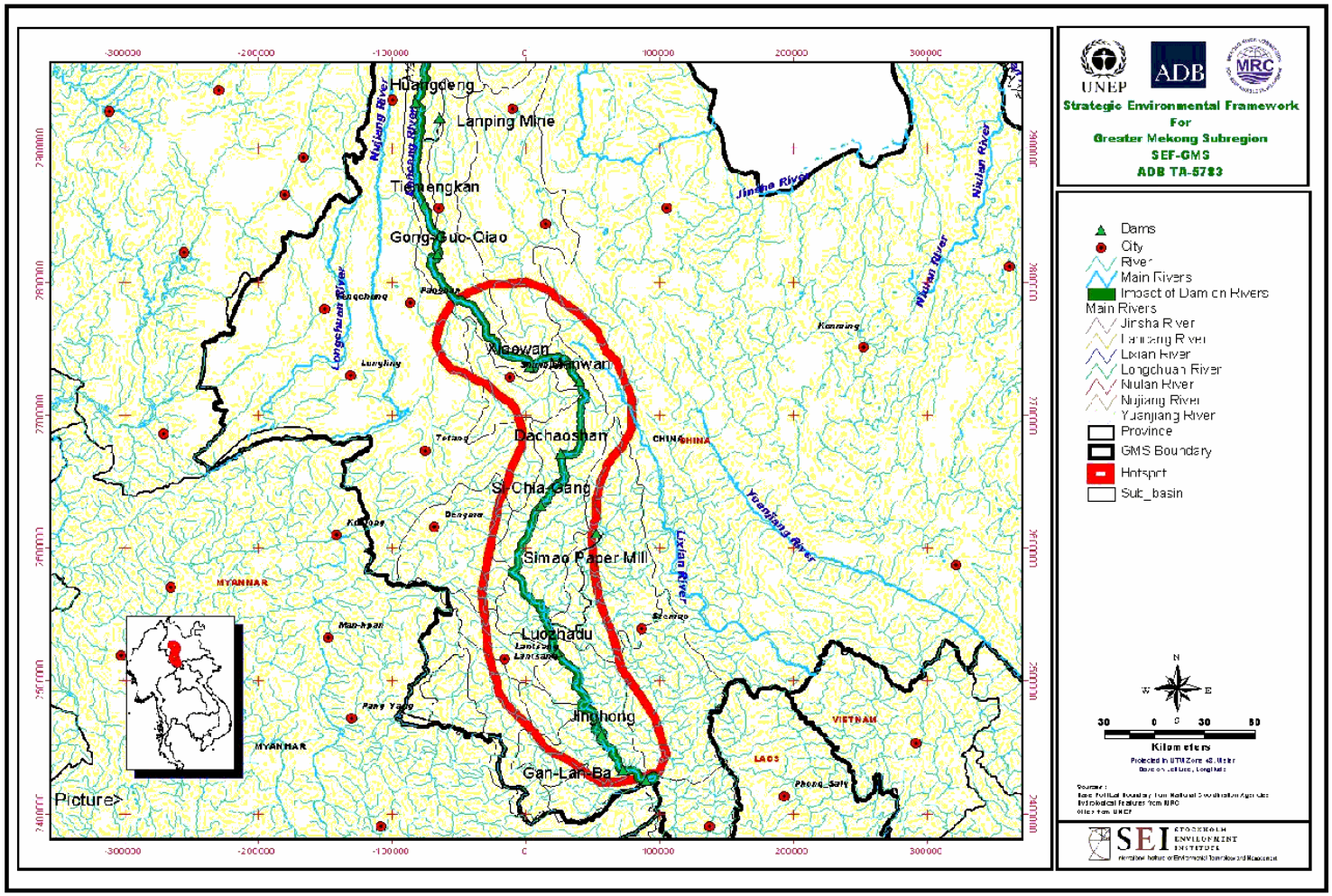

Figure 2.6 Full Hydropower Development in Upper Mekong Hotspot

2.5 Vulnerable Areas and People

The project was unable to acquire data on Forest cover and biodiversity priorities for the Upper Mekong Hotspot . This has rendered the delineation of HVAs impossible and limited the scope of analysis that could be conducted using GIS.

2.5.1 Indigenous Peoples and Vulnerable Groups

The major causes of vulnerability and constraints to development in the upper Mekong Basin as outlined by the Final Report for ADB TA 3139 are:

- Natural conditions are difficult – about 95 percent of the region are mountainous. Relatively few commodity crops dominate the Basin economy, and growth over the period of 1978 to 1998 was much less than in the rest of Yunnan and the PRC.
- Education levels are low: the average number of years in school is 3.5 and 10 percent of the population is considered illiterate.
- Infrastructure is limited and the population scattered in remote areas.
- One million people are considered to be living below or just below the poverty line. Many of these are minority people who because of low education, remoteness, poor natural conditions, poor access to markets and services, benefited very little from the strong growth and increases in standard of living by most people in the PRC and Yunnan over the past twenty years.
- Although there is has been a growth in GDP (tourism and production of plantation crops) it is questionable whether it is sustainable.
- Economic growth has not been distributed evenly within the Basin.

These constraints are also relevant for the hotspot. However, the number of vulnerable groups would be less than one million (ADB/Landcare, 2000).

2.5.2 Livelihood

Primarily covered by high mountains and dominated by subsistence agricultural production, the Basin including the hotspot area is regarded to be at an “early stage of economic development.” As a consequence, its productivity and standard of living as captured in GDP per capita is 35 percent below the provincial average and 56 percent below the national norm in 1998.

The lower Basin is characterised by production of tropical and semi-tropical crops (rubber, tea, sugar, coffee and tropical fruits), growing cross-border trade and cultural links with neighbouring countries and the expanding tourism sector especially in Xishuangbanna.

Experiences of development projects so far reveal that “there is anecdotal evidence that many of the benefits of large investments from hydro dams, large road projects, and airport construction flow out of the Lancang to workers, construction contractors and suppliers of construction materials in Kunming.” (ADB/Landcare, 2000).

2.5.3 Poverty

Figure 2.7 maps poverty at a broad scale based on socio-economic indicators at the county level. It is clear to see that the wealthiest counties are located around the capitol of Kunming and in the far south next to the Mekong River and the other GMS countries.

Unfortunately it was beyond the scope of this study to access why particular counties are rich or poor. Tetang and Lantsang counties both stand out as the poorest counties in southern Yunnan however it is unclear if this is related to lack of resources, ethnic affinity, access to markets or any other of a myriad of reasons for poverty.

We can probably assume that the wealth indicated in the counties along the Mekong river in the far south is linked to trade with GMS countries such as Thailand and to a lesser extent Lao and is therefore highly reliant on the Mekong as a navigation corridor as well as the enhancement of the Chiang Rai to Kunming road which will be discussed in Chapter 3.

2.6 Summary as a High Risk Region

2.6.1 Transportation Projects

The existing system of roads running through Hotspot 1 covers most of the area. In Figure 2.8 these roads are mapped with a 1, 10 and 25 km buffer around them to show the relative impact or footprint of the road. The buffer mapping for Hotspot 1 clearly illustrates that the area has a high level of access. After mapping the 10km buffer for the roads in the hotspot it is clear that there are very few areas less than 10 km from a road and are certainly no areas less that 25 km from a road.

In other hotpsots, we have been able to compare road coverage and access to Highly Valued areas. Unfortunately the data are not available to compile HVAs for Hotspot 1.

We have been able to make a comparison with broad scale poverty data in Figure 2.9. This highlights that access is probably not a limiting factor in development in the area. Such factors have not been identified but could relate to resource availability or distance to market. More detailed studies of the communities and their locations in relation to resources and markets would need to be conducted to answer these questions.

2.6.2 Hydropower Projects

Figure 2.10 illustrates the relation of Hydropower and poverty within Hotspot 1. The full-scale development of Hydropower in the Hotspot has been mapped with the addition of a buffer along the area affected by the projects. The buffer represents approximately 4 km on each side of the river.

The size of 4 km was chosen arbitrarily to highlight the cumulative impacts of successive Hydropower projects.

Without having specific details about each hydropower project and a clearer understanding of the topography of the area a more detailed analysis is impossible. It is clear that the successive projects will amplify changes along the length of the Mekong and the communities that depend on the fisheries and water resources will be negatively effected.

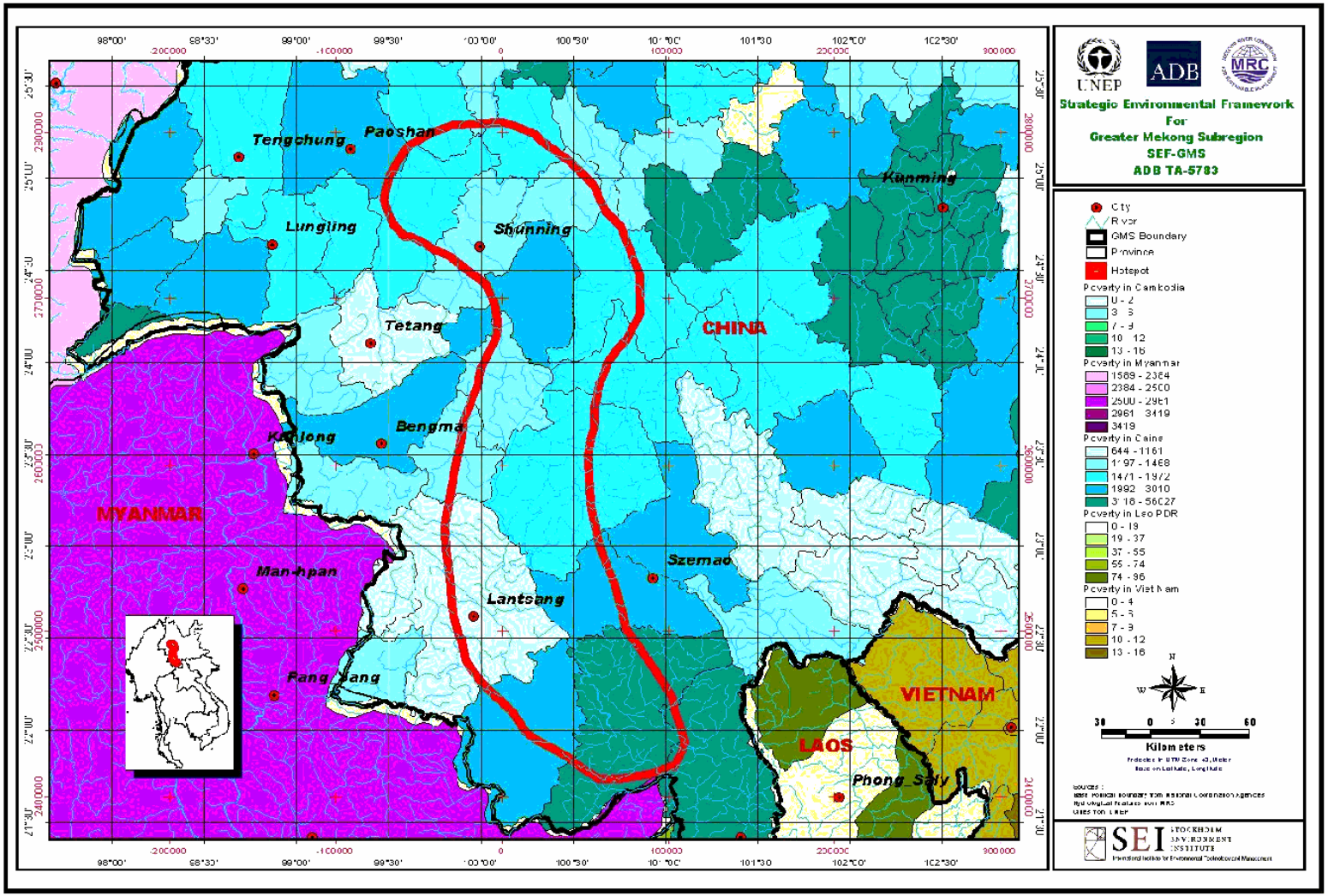

Figure 2.7 Poverty in Upper Mekong Hotspot

2.6.3 Cumulative Risks – Transportation and Hydropower Projects

The cumulative risk of the combined effects of road development and hydro development can only be discussed in relation to broad scale poverty. The majority of the counties adjacent to the Mekong River fall in the middle on the scale of poverty. It is unclear to what extent this income is reliant on the resources of the Mekong. Fisheries levels in china are already relatively low in relation to other GMS countries and access to clean water is not limited to the Mekong.

It is quite likely that the relative wealth of the counties in the far south is correlated with trade to and from GMS countries especially Thailand and Lao PDR. This trade is linked to the Mekong as a transportation corridor, which could be adversely effected by hydropower impoundment. It is unclear how hydro development and navigation enhancement are related in current development planning for the area.

The large number of workers needed for the construction of the Mekong Dam Cascade could provide employment to many local people. However the bulk of skilled workers for the project are likely to come from elsewhere in Yunnan if not from elsewhere in China. As with many dam projects there will be little employment after the dam's construction to maintain the livelihoods of the workers involved in the initial construction.

The Mekong Cascade Dams have the potential to completely change the flows and therefore the productivity and use of the entire Mekong Basin. They should be considered as one of if not the highest priorities in GMS development. There are of even more concern since they are entirely reliant on the Government of PR China to ensure that the potential harmful affects of each project as well as the cumulative impact of all projects do not destroy the livelihoods of the people that rely on the Mekong and its tributaries.

2.7 Strategic Recommendations

It is clear for the GMS to succeed in its goal of sustained economic development that the GMS countries should co-ordinate planning to maximise the benefits to the region. In some cases this may not be equivalent to the economic development of the representative countries. The Mekong Cascade hydropower projects are such a case.

Clarification of the Biophysical Situation – although numerous studies have been conducted along the Mekong in the past forty years there are still many questions that remain unanswered and will need further surveys to answer. The surveys should include improved information collection on water flows, fisheries and ecological processes related to the upper Mekong basin. These surveys should be carried out by the appropriate institutions of the PRC government with co-operation and technical support provided through the MRC.

Mekong Basin Model – building from existing survey data a hydrological model of the entire Mekong basin will be needed to predict the possible effects of the Mekong Cascade Projects. This model should be able to use different development scenarios to inform decision makers of possible deleterious effects to sensitive areas such as the Tonle Sap as well as for use with navigation and fisheries decision-making. Such a model is clearly a great technological challenge and should be conducted in co-operation with the Government of the PRC, the MRC and possibly a qualified academic institution

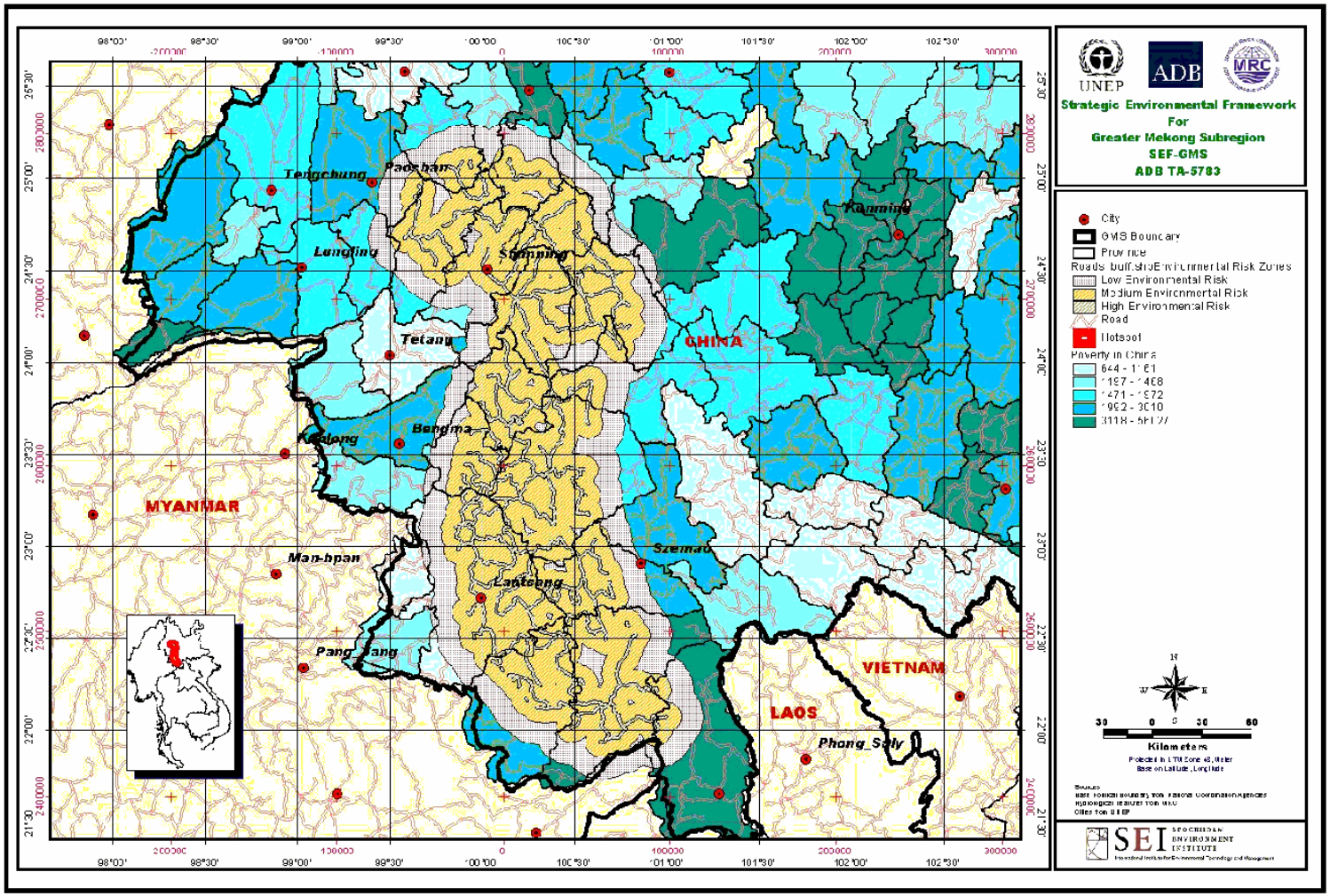

Figure 2.8 Impact Zones, Road Projects, Upper Mekong GMS Priority Hotspot

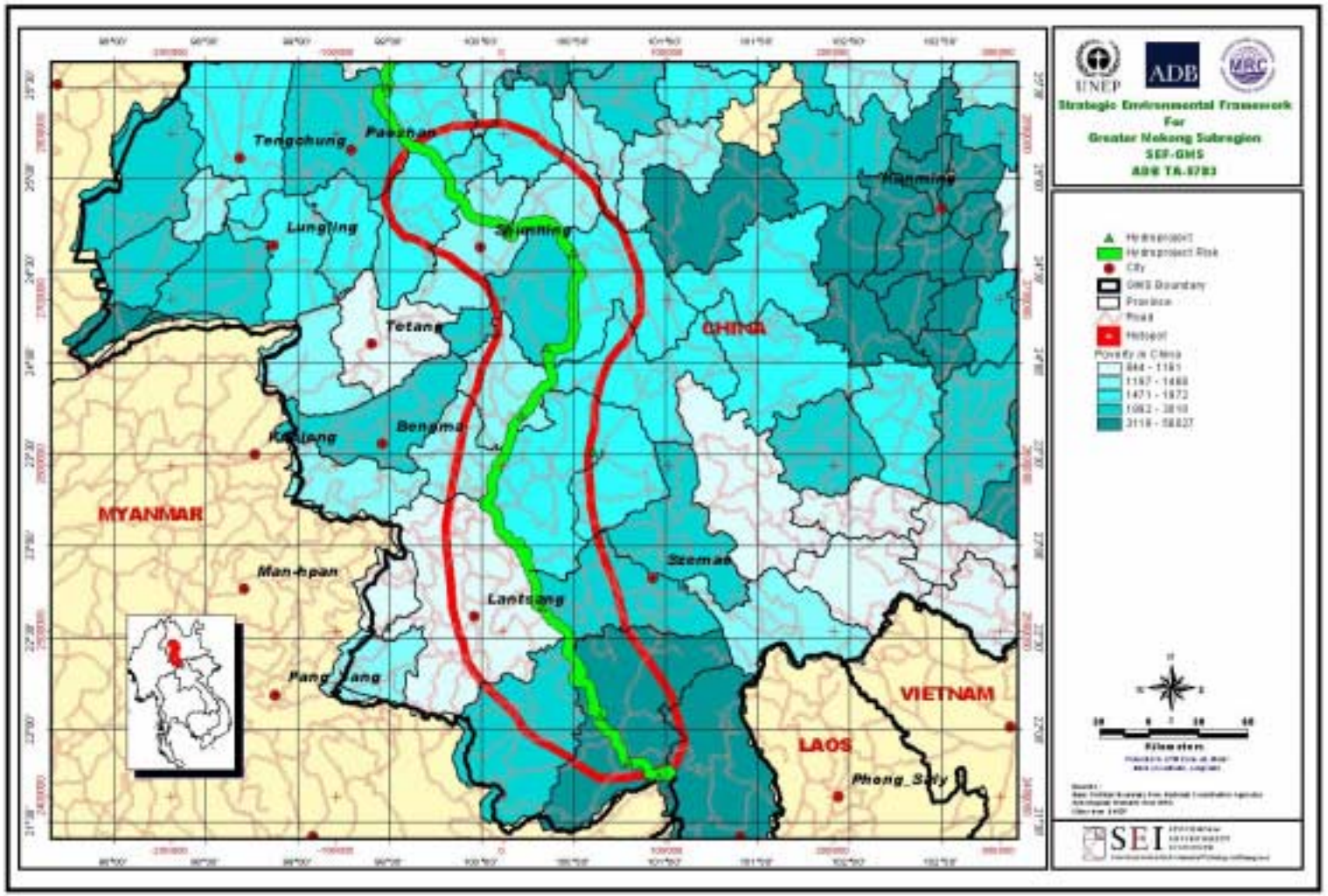

Figure 2.9 Impact Zones, Hydro Projects, Upper Mekong GMS Priority Hotspot (a)

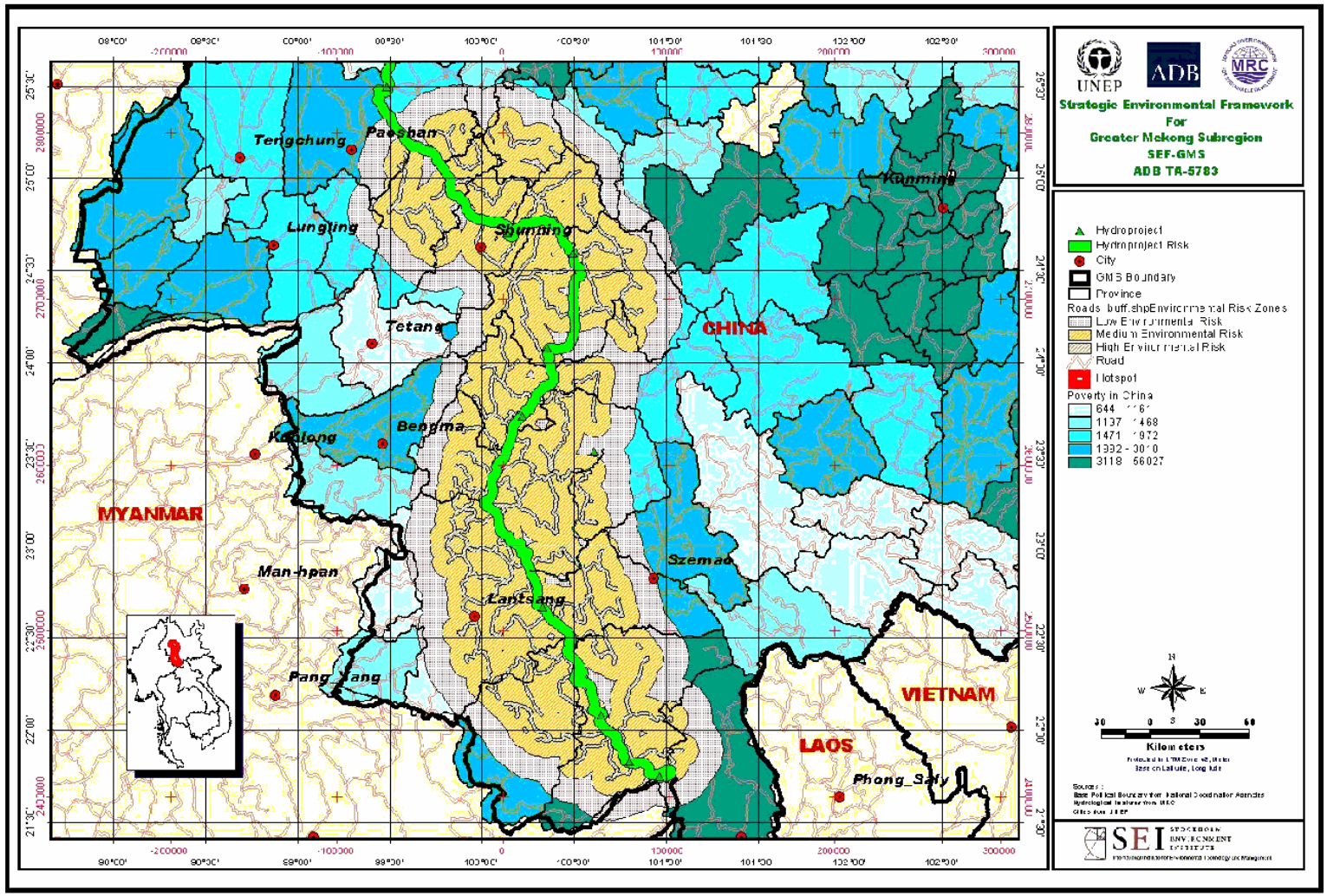

Figure 2.10 Impact Zones, Hydro and Road Projects, Upper Mekong GMS Priority Hotspot

Cumulative Impact Assessment –cumulative results of additional surveys and results from the Mekong Basin Model should be consolidated and used as the basis for a Cumulative Impact Assessment of the Mekong Cascade Projects. Special attention should be made to address each project as well as other possible scenarios for scheduling of construction. These three recommendations should be carried out prior to the construction of the Xiowan Hydropower Project, which is schedule to begin in 2002 or 2003.

Information Sharing Mechanism – in the course of implementing the first three recommendations a mechanism for information sharing should be designed and implemented. The most obvious course for this mechanism is the extension of the Mekong Agreement to include the entire basin through the addition of the governments of PR China and Myanmar.

Mekong Basin Development Plan – the first four recommendations should lead to enough information collection and sharing to be able to produce a comprehensive basin development plan. This is consistent with SEF Principle 5, which states the need for a Basin Development plan on a Mekong tributary before the ADB will consider funding a Hydropower initiative in the Basin. Ideally the overall BDP would consist of the Development plans for each of the Mekong sub-basins. The MRC is currently beginning such an ambitious initiative. For this to succeed the role of China and the entire Mekong basin will need to be considered.

Poverty Alleviation Activities - In addition to the process of improved planning needed to achieve sustainable development in Hotspot One, there is a need to directly improve the livelihoods of residents. It is clear that a more proactive approach to Poverty Alleviation should be initiated. This process should include particular emphasis on: Public Participation, Enhancing access to social services as well as a strategy for local people to share in the benefits of development projects especially women and ethnic minorities.

Stabilise Sedimentation - The Chinese government has already taken steps to limit the effects of siltation on the Manwan Dam. These steps should be commended and further steps should be taken to ensure similar activities for future dam construction.

3. THE GOLDEN QUADRANGLE PRIORITY GMS HOTSPOT OVERVIEW

3.1 Description

The Golden Quadrangle Hotspot centres on the development of the Chiang Rai to Kunming super-highway, which bisects the Hotspot from north to south. The area is globally renowned for the ethnic diversity of its indigenous peoples, which are reliant on an increasingly degraded natural resource base.

Today's Golden Quadrangle area covers the provinces of Chiang Rai, Thailand, Shan State, Myanmar, Bokeo and Luangnamtha Provinces, Lao PDR and southern Yunnan Province, China. The main feature of the area is its location at a major crossroads in the GMS, an area with a long history of trade and commercial exchange within its borders as well as with the outside world. Thus contacts and interactions between the local communities, most of them of many different ethnic origins, are not new.

There are great expectations among the concerned governments that the opening up of this area, through the Chiang Rai – Kunming road and other transport investments, will greatly stimulate the economy in all four countries.

However, given the fact that the local communities in the area have benefited the least from current central government development initiatives and thus are among the poorest in each of there respective countries, suggests the need for a careful intervention and close monitoring to avoid unwanted impacts. There is a risk, that unless precautions are not taken, existing social hazards such as drug abuse and prostitution will rather increase, and further impoverishment of ill-prepared communities will take place.

Special attention has been paid to the Chiang Rai – Kunming road and ADB's potential role in its financing and construction. In light of this involvement the ADB has an opportunity to profit from previous lessons learned in regional road planning and impacts.

Table 3.1 Golden Quadrangle Priority GMS Hotspot Summary Characteristics

Location and Size	
Hotspot Area (km^2)	52,910 km^2
Percent of Total Area of GMS Priority Hotspots	22.56 %
Percent of Total Area of GMS	2.28 %
GMS Countries within Hotspot	China, Lao PDR, Myanmar, Thailand
Area in China	17,116 km^2
Area in Lao PDR	18,444 km^2
Area in Myanmar	10,708 km^2
Area in Thailand	6,640 km^2
Biophysical	
Total Forest Cover[8] (km^2)	Not Available
Percent of total Hotspot Area	Not Available
Wetlands (km^2)	1,852 km^2
Percent of total Hotspot Area	3.5 %
Protected Areas (km^2)	3,684 km^2
Percent of total Hotspot Area	6.96 %
Rare and Endangered Species	Elephant, Gaur, Tiger, Bears, Pheasants, Hornbills and Giant Catfish
Socio-economic	
Estimated Population	3 to 4 million
Average GDP[9]	US$ 250 per capita
Ethnic Minorities Present	Akha, Wa, Hani, Bulang, Jino, Lao, Lue, Kalom, Tai Dam, Yao, Hmong, Khmu, Kwen, Lamet, Panna and Lahu.
Agricultural Land (km^2)	Not Available
Projects	
GMS Hydropower Projects	None
GMS Road Project	Chiang Rai to Kunming Road
National Hydropower Projects	Nam Tha 1
National Road Projects	Rural road upgrades

[8] Contiguous canopy covers with high or medium density (greater than 70 percent forest cover and over 20 percent crown cover with the forest cover).

[9] Human Development in Myanmar, An Internal Report, Prepared by the United Nations Working Group, Yangon, 1998; Human Development Report of Thailand, Final Report, TA 3139-PRC, Policies and Strategies for Sustainable Development of the Lancang River Basin, 2000. ." Final Report. Volume 1 – Main Text; TA 5728 GMS: Chiang Rai – Kunming via Lao PDR; Road Improvement Project, October 1998

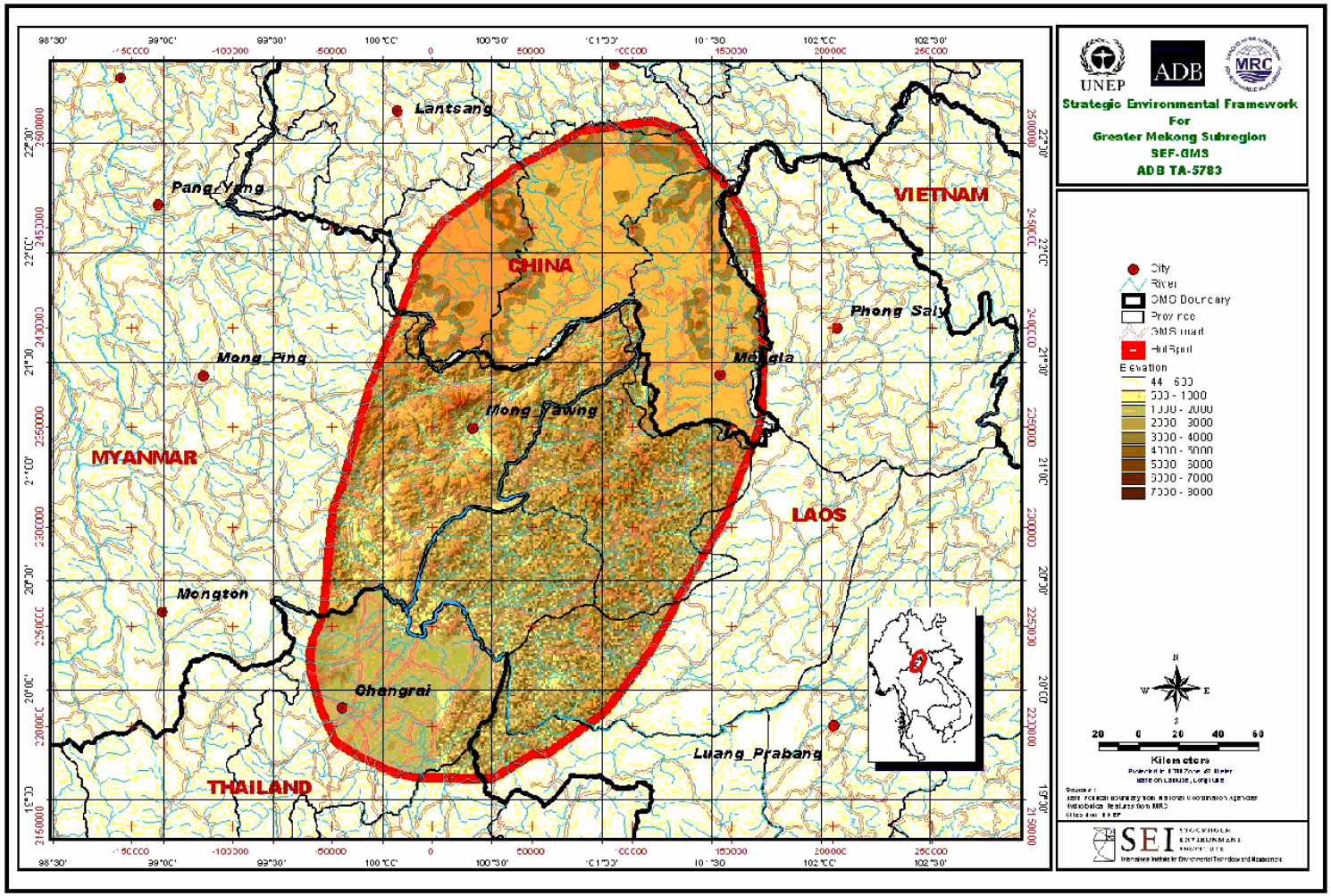

Figure 3.1 Overview Map of Hotspot (including political boundaries, drainage, roads, cities and towns)

3.2 Biophysical and Natural Resources

3.2.1 Land Cover

Land cover data is not available for Yunnan so the following discussion and Table concentrates on land cover in Lao PDR, Thailand and Myanmar as mapped by UNEP in 1992 and 1993. The forest cover in Myanmar and Thailand has not been classified to the same degree as that in Lao PDR causing obviously incorrect changes in forest type across national boundaries. Figure 3.2 also shows the relatively small amounts of fixed agriculture in Lao PDR and Myanmar in comparison to Thailand as well as highlighting the scrubland characteristic of the practice of swidden cultivation found in Northern Lao PDR.

3.2.2 Forestry

Forests in the Golden Triangle have been exploited for centuries. The forests of northern Thailand have been logged extensively; between Chiang Kong and Chiang Rai only small fragments of secondary forest persist. Yunnan Province has large areas of forest, most of it heavily logged; there are also teak, rubber, and tea plantations. Lao PDR still has large areas of mixed deciduous and bamboo forest, although much is part of a swidden agriculture system or has been lost to commercial logging. The forest cover in Xishuangbanna Prefecture alone has been reduced from 55-60 percent four decades ago to 30 percent at present.

Recently enacted government policies and regulations, controlling logging and prohibiting clearing of forestlands, are beginning to take effect, slowing the process of degradation considerably. Timber and non-timber forest products (NTFP), including animals and plants acquired by hunting, fishing, and gathering, make up a large part of Lao PDR and Myanmar's subsistence, domestic, and international economies. The population of Thailand and PR China are less directly reliant on these forest products although they still play an important role in local people's livelihoods.

3.2.3 Fisheries

Hydropower development is the principal threat to fish biodiversity and fisheries production in the Golden Triangle hotspot area. This hotspot area overlaps with the Upper Mekong River hotspot area, and three of the proposed mainstream dams (Jinghong, Ganlanba and Mengsong) have already been considered in the discussion of the latter hotspot. An additional dam (Nam Tha 1) is planned in the Nam Tha tributary in Lao PDR.

The hotspot area probably represents a transitional zone between the lowland warmer-water fish biodiversity of the lower Mekong basin in Vietnam, Cambodia, Thailand and Lao PDR and the upland cooler-water fish fauna of the Upper Mekong in Yunnan and Tibet.

The fish biodiversity and fisheries production issues in this hotspot area are similar to those of the Upper Mekong hotspot area. However, as the Golden Quadrangle area is located downstream of most of the mainstream dam cascade (and tributary dams) proposed for the Upper Mekong and its catchment, it is reasonable to expect that intensive cumulative downstream impacts will be felt in the Golden Quadrangle area. Further downstream of the Golden Quadrangle, the Mekong River will experience hydrological recharge from some of the large tributary basins in Lao PDR and Thailand, so there the impacts of the hydrodam cascade will be less severe. The hydrological stress experienced by the Golden Quadrangle hotspot area may therefore be especially high in comparison to other portions of the Mekong River. This would likely have negative impacts on fish resources locally, and could possibly lead in the long term to a fish fauna 'disjunction' between the lower Mekong and the Upper Mekong River segments.

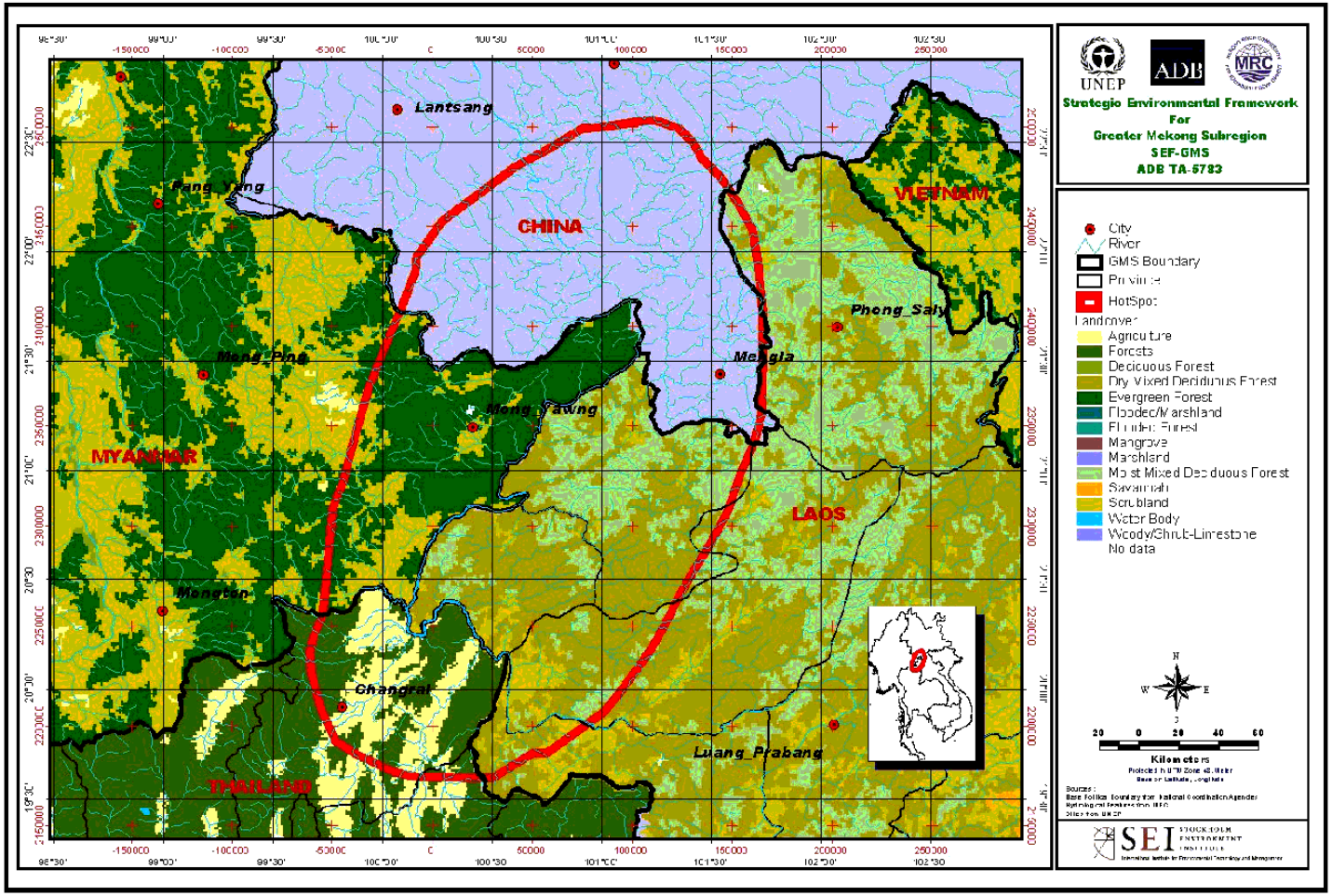

Figure 3.2 Land Cover in the Golden Quadrangle Hotspot

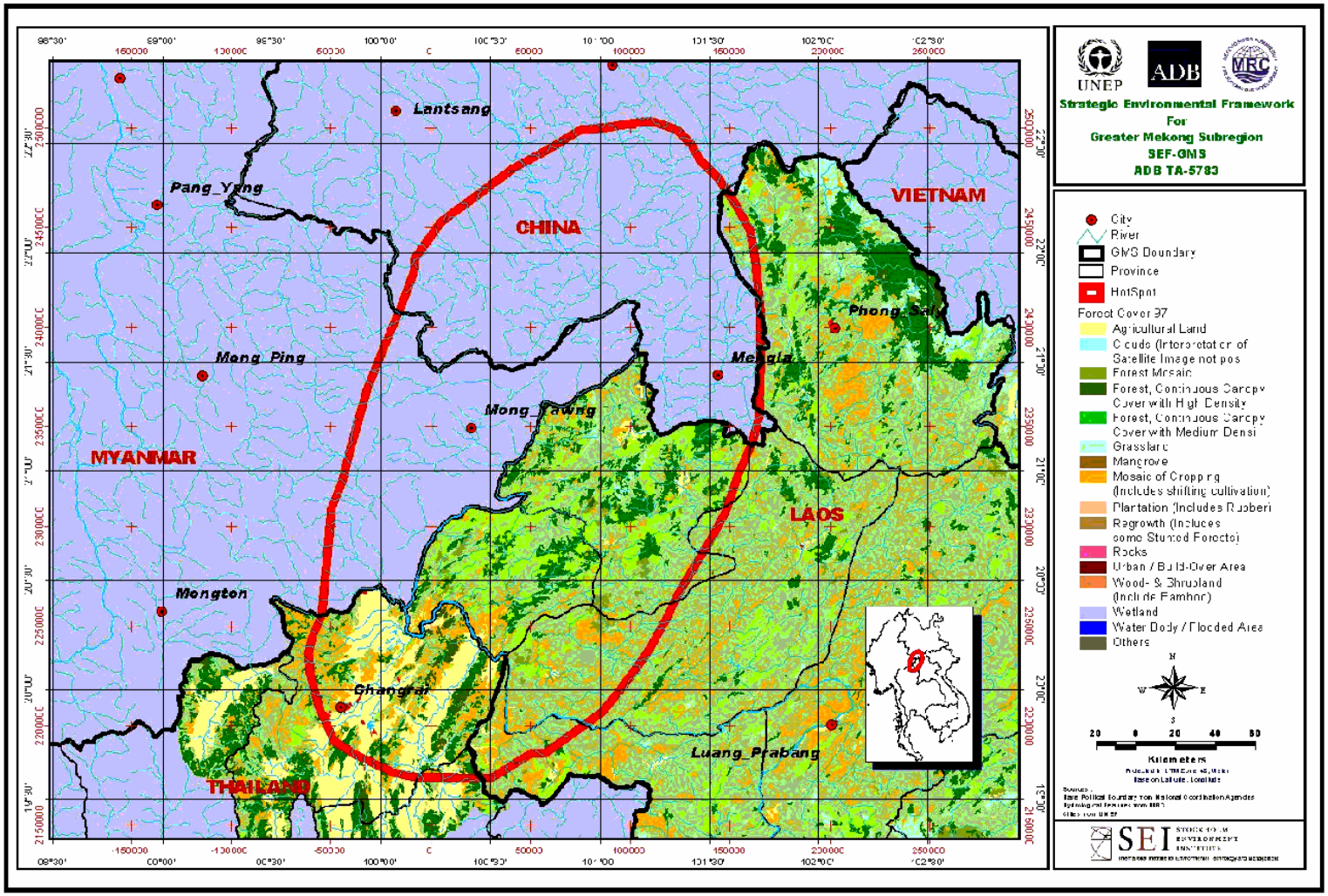

Figure 3.3 Forest Cover in the Golden Quadrangle Hotspot

3.2.4 Protected Areas

The government of Luangnamtha Province have proposed a single National Biodiversity Conservation Area that would encompass the existing Nam Ha NBCA while adding the Nam Ha (west) NBCA as proposed by Berkmueller et. al., 1995 and the Provincial Protected Area of Nam Kong. This amalgamation would create a large NBCA that would link with the Mengla unit of the Xishuanbanna National Nature Reserve. This proposed reserve would protect one of the last remaining populations of Asian Elephant in China and Northern Lao PDR.

Initial surveys in Lao PDR have already identified the presence of a number of threatened wildlife species, including elephants, tigers, leopards, wild dogs, otters, bears, wild cattle, gibbons, and silver pheasants.

Table 3.2 Protected Areas in the Golden Quadrangle Hotspot

Name	Area (ha)	Location	National Category	IUCN Category[10]	Year
Xishuangbanna	241,776	Yunnan	National	IV	1981
Caiyanghe	7,035	Yunnan	Provincial	IV	1986
Nam Ha	Not Available	Lao PDR	NBCA	IV	1993

3.2.5 Biodiversity

The Golden Quadrangle Hotspot is still rich in species of terrestrial fauna, although populations have greatly declined in the past fifty years, particularly large mammal species. The area still supports populations of elephant and wild cattle although the pressure on these populations is very intense. The road will undoubtedly exacerbate the exiting loss to trade and consumption.

3.2.6 Water Resources

This hotspot overlaps Hotspot 1, so some of the information on Mekong River flows discussed in the previous Hotspot section will not be repeated. The Mekong River traverses the Hotspot in a primarily north-south direction, but with occasional big meander loops to the east. Mountains on the east side of the river in China and Lao PDR rise to over 2000 m, and on the west side of the river in China and Myanmar rise to 2600 m at the summit of Loi Pangnao. Steep tributary streams flow to the Mekong mainstem. The largest several of these streams flow in from the west. One of them forms the China-Myanmar border for the last several kilometres, and one of them forms the Myanmar-Thailand border for a short distance. The largest tributary, the Loi, drains the Kyaing Tong area (capital of the Golden Triangle), and flows to the north of Loi Pangnao, before joining the Mekong.

Two large tributaries join the Mekong near the southern edge of the Hotspot. These drain an area of mixed lowlands and mountains, outside the Hotspot, which form the northern tip of Thailand. These are: the Nam Mae Kok, which drains the Chiang Rai area, and meets the Mekong river at the southern end of a large meander loop, and Nam Mae Ing, which has its headwaters in the area around Phayao.

[10] See Annex 1 for IUCN protected area categories.

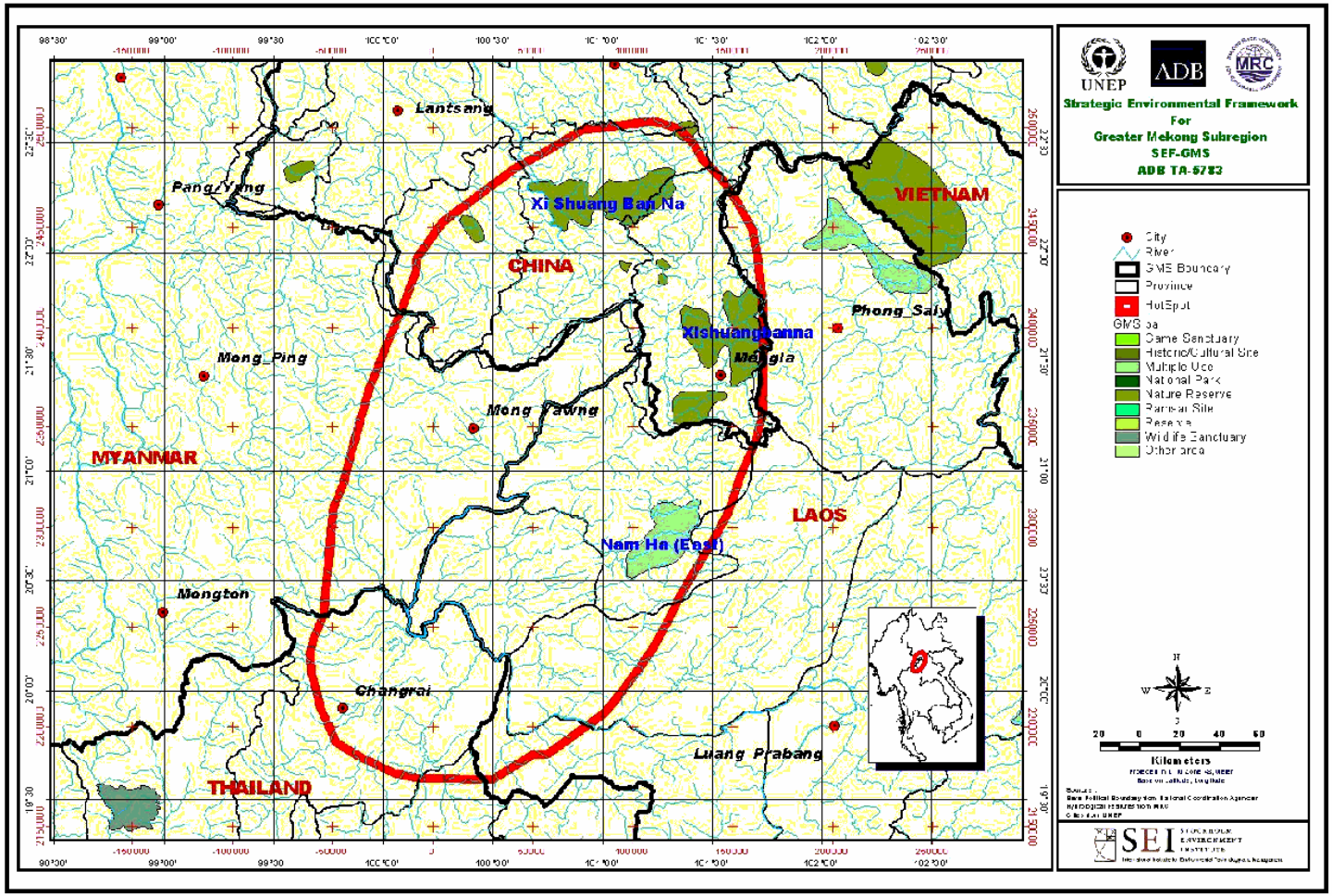

Figure 3.4 Protected Areas in the Golden Quadrangle Hotspot

One of the principal Mekong river gauging stations operated by MRC, the Chiang Saen hydrological gauge, is on the mainstem, just upstream of the confluence with Nam Mae, and several decades of flow gauging information are available.

Navigation is important along this part of the river, as it is presently an important travel route for river passenger and goods traffic from Lao PDR and Thailand to Yunnan. Future excessive lowering of flows, during for example reservoir filling operations for hydro-power projects in Yunnan will have an adverse impact on aquatic life, and on navigation, unless there is an agreement in place about maintenance of reasonable minimum flows. Data from the Chiang Saen hydrological gauging station will be useful in establishing what is the normal range of minimum flows in the mainstem river in this reach, and will provide target flow values that can be brought to the table for negotiations.

The Hotspot will be directly impacted by hydro-electric projects such as the 1500 MW proposed project on the mainstem river, upstream of Jinhong (see 2.4.2). This project will also be inside Hotspot 2. The Nam Tha 1, proposed hydroelectric project in northern Lao PDR (pre-feasibility study indicates 200 MW of peak power production available), will impact the Tha river, a major tributary at the southern edge of the Hotspot.

3.3 Population

Based upon statistics from different sources the provinces in the Golden Quadrangle area would have a population of between 6 and 7 million. A rough estimate would be that about half of that population, or 3 - 4 million people are residing in the core area of the Quadrangle.

Most people here are indigenous belonging to a great variety of different ethnic groups such as Akha, Wa, Hani, Bulang, Jino, Lao, Lue, Kalom, Tai Dam, Yao, Hmong, Khmu, Kwen, Lamet, Panna and Lahu. The variety of the ethnic groups in a comparatively small area is unique and reveals a rich cultural heritage and a relatively well preserved cultural identity and traditional moral (State Planning Committee, 2000, UNDP 1999, Myanmar Government, 2000, ADB/Landcare, 2000).

3.4 Development Stresses

3.4.1 Transportation Projects

Existing Road Network

The are is currently criss-crossed by a number of rural roads. Most of these roads are undergoing some level of upgrading through national projects or from international donor assistance. Recent international donor supported upgrades include the Xieng Kok to Muang Sing road, which was supported by the World Bank as well as ADB assistance to bridge construction along the existing Huay Sai to Boten route. This route will be upgraded for the Chiang-Rai to Kunming economic corridor.

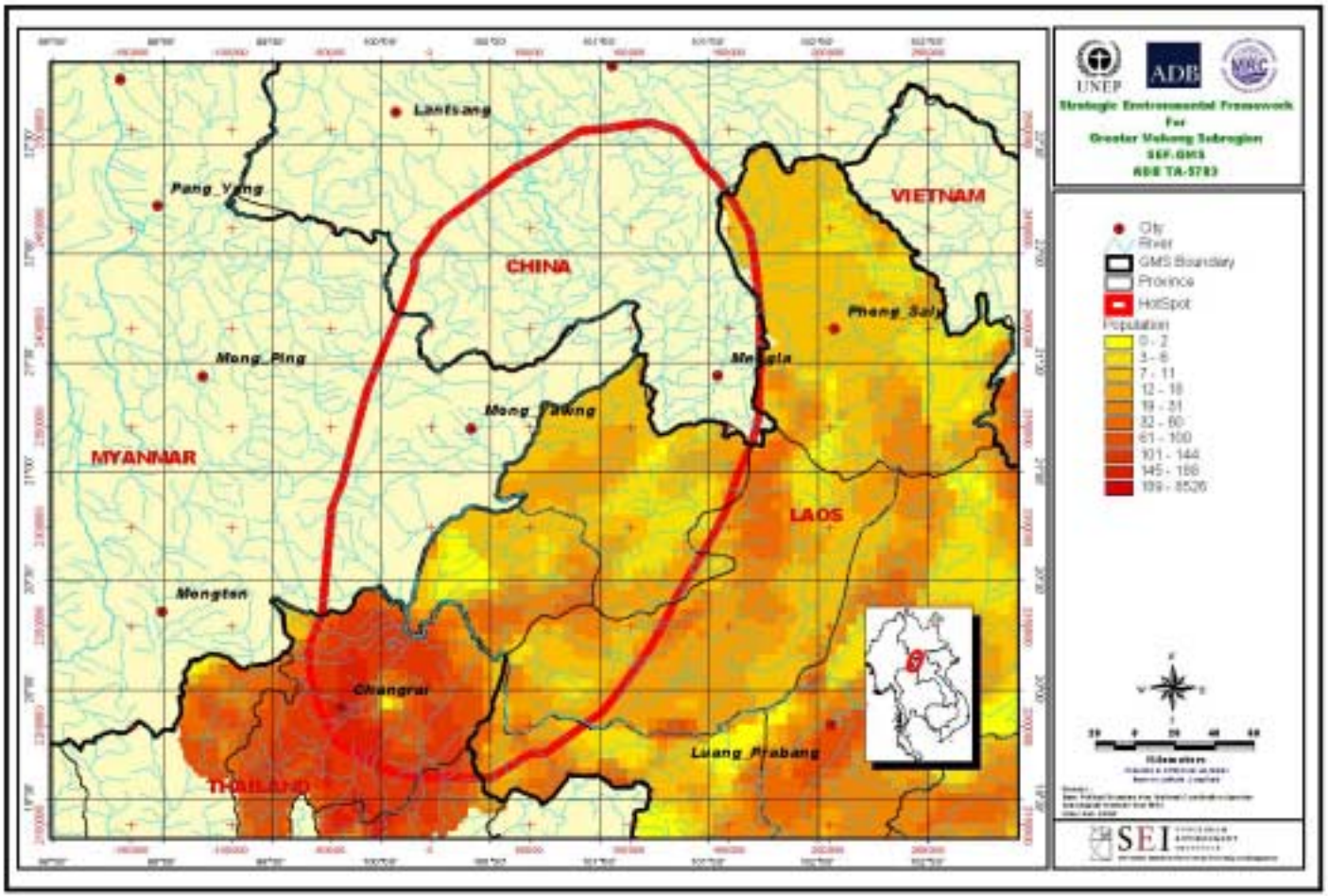

Figure 3.5 Population Density in the Golden Quadrangle Hotspot

Proposed GMS Road Projects and Status

The exact routing of this road is still undecided. An early design suggested that the route would bisect the Xishuanbanna National Nature Reserve. Apparently the routing has been changed to avoid this however it is still not finalised.

Table 3.3 GMS Program Road Projects in the Golden Quadrangle Priority GMS Hotspot

Name	Description	Status
Kunming to Chiang Rai	The project would improve the international north-south road connection between and among Yunnan Province, Lao PDR, and Thailand	In all countries certain segments have been excluded from the project because they have already been completed, are ongoing, or are committed or nearly so.

Proposed National Road Projects and Status

There are numerous rural road upgrades planned for the area but no major new routes.

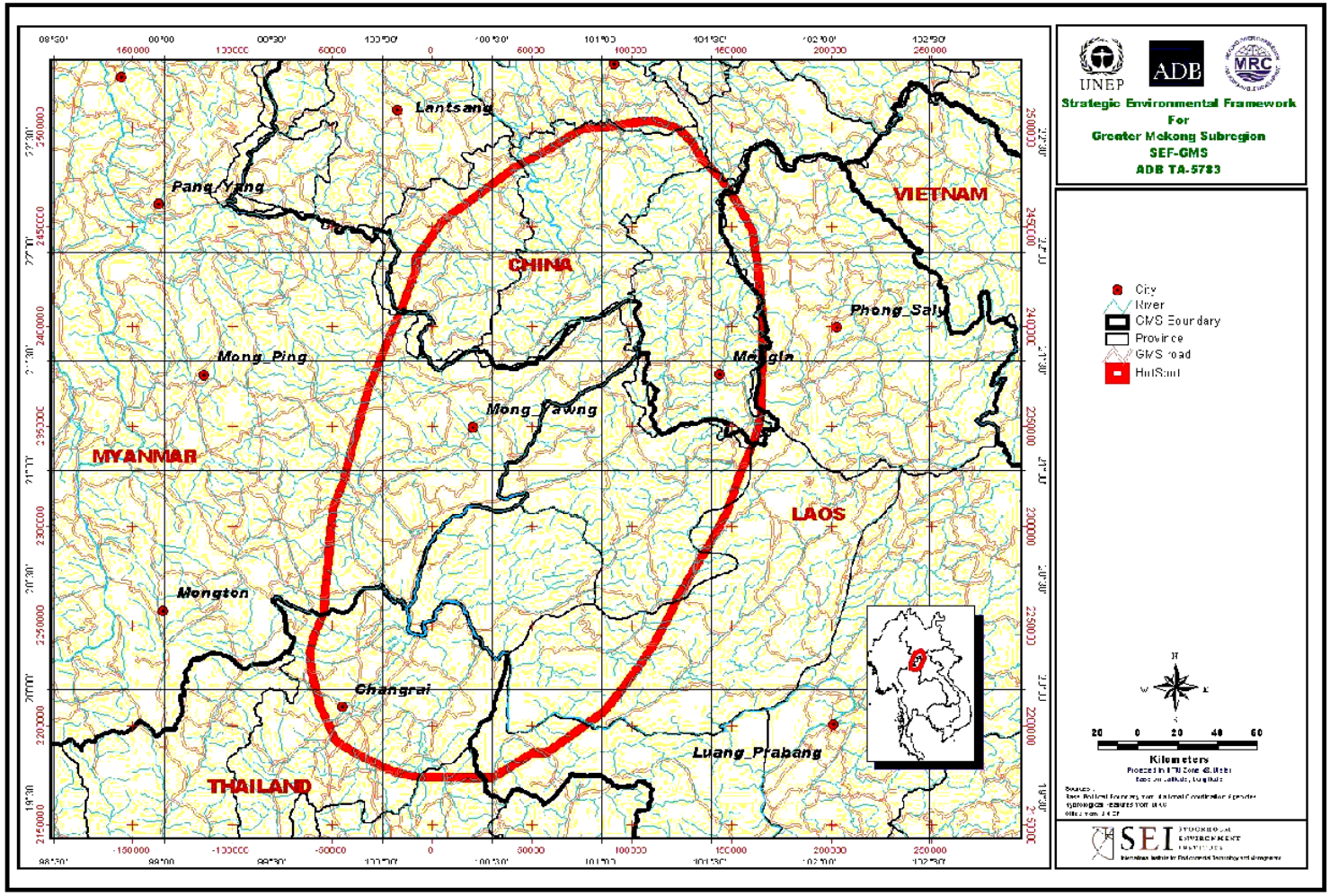

Figure 3.6 Existing Road Network, Golden Quadrangle GMS Priority Hotspot

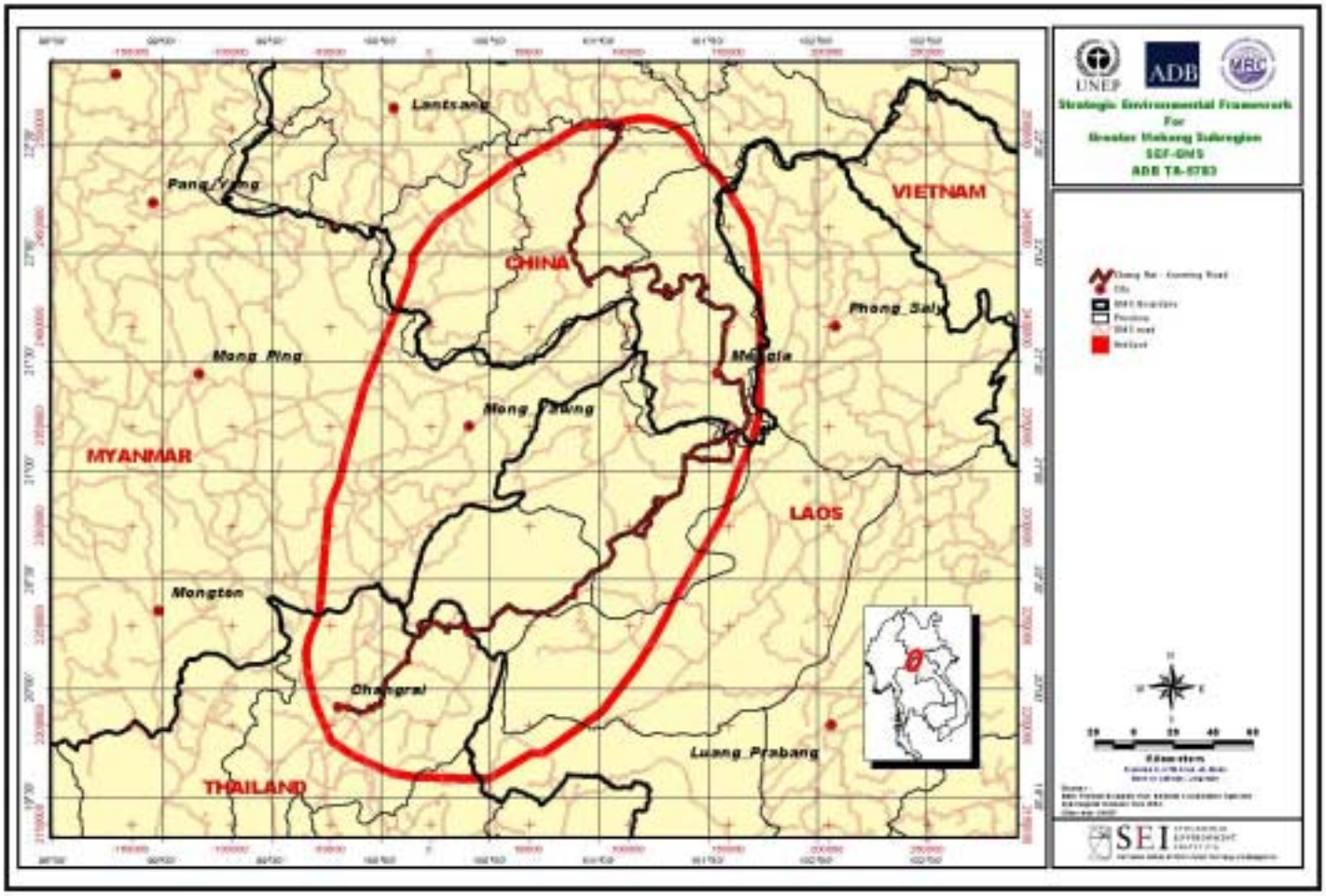

Figure 3.7 GMS Road Projects, Golden Quadrangle GMS Priority Hotspot

3.4.2 Hydropower Projects

The Golden Quadrangle is a comparatively low risk area for hydropower construction. These dams are only touched on here. Hotspots 1, 3 and 4 discuss regional hydropower in more detail.

Existing Dams

There are no existing Hydropower projects in the hotspot. The nearest is the Manwan Dam, which was completed in 1996. It lies on the Mekong mainstem upstream from the Golden Quadrangle Hotspot

Table 3.4 Existing Hydropower or Multipurpose Dams in Golden Quadrangle Hotspot

Name	Stage of development	Peak Power Output MW	Dam Height M	Reservoir Capacity Mm^3	Predicted annual power output GWh
Manwan Dam	Completed and in operation	1,250	126	1060	7,800

Proposed GMS Dams and Status

There are no proposed GMS Hydropower projects in the Hotspot

Proposed National Dams and Status

Table 3.5 Proposed National Hydropower or Multipurpose Dams in Golden Quadrangle Hotspot

Name	Stage of development	Peak Power Output MW	Dam Height M	Reservoir Storage Volume Mm^3	Predicted annual power output GWh
Kaeng Sua ten	The feasibility study was completed in 1985	Irrigated dam	70	1,175	none
Nam Tha 1	MOU signed with Lao PDR government and feasibility and EIA completed	263	N/A	N/A	N/A

3.5 Highly Valued Areas

3.5.1 HVAs in the Golden Quadrangle Hotspot

The data set for Highly-Valued Areas is incomplete for this Hotspot. The use of only a partial set of indicators would be misleading so none has been mapped.

3.5.2 Indigenous Peoples and Other Vulnerable Groups

The majority of the population in the hotspots is classified as indigenous. Given the situation in the Quadrangle (outside the mainstream and now exposed to rapid change), most people could be defined as vulnerable. The exception would be the trading community, of which many are indigenous peoples (e g. Akha in Thailand) who long have had the opportunity to adapt to the demands of a changing society but on their own terms (Evans et. al., 2000).

3.5.3 Livelihood Systems

Beside the long history of trade and transportation by rivers and trails (nowadays existing or planned roads) the area is characterised by its highlands where a great variety of different indigenous peoples are practising swidden agriculture on the hills as well as wet rice cultivation in the valley areas. Other important crops are maize, cassava, and sweet potato. Products with commercial value are chilis, sesame seeds, peanuts, cotton, and planted trees such as rubber, teak and kapok.

The area is also rich in minerals (gold, silver, gems such as sapphires and rubies and coal). It is well known that the people in the area also grow opium as the main basis of income.

Although the major change over the last 15 years is the transition to cash cropping, the setting up of industrial centres and special economic zones along the borders and the opening of cross-border trade between the four countries, this has given little revenue to the rural local communities. A review of existing socio-economic data reveals that the provinces in question, Bokeo, Luongnamtha, Chiang Rai, Shan respectively Simao and Xishuangbanna in Yunnan in 1997 were among the poorest in their respective countries, an estimated GDP per capita of US$ 200-250 (UNWP, 1998; UNDP, 2000; ADB/Lancare, 2000; ADB, 1998).

A clear example where the income goes to other groups than those who originate it, is the opium and heroin trade. According to Hinton in 1993 the value of the heroin trade was US$ 33 million higher that year than that of the value of Thailand's rice export which is a major commodity in the region. Another business, which most often passes over the heads of the local communities, is the timber trade. Yongge reports that in 1996 there were 74 sawmills on the Chinese side of the Myanmar border with a total amount of output of 80 million yuan (about US$ 10 million). Both authors show how the magnitude and value have increased over the last 10 years (Yongge in Evans et. al., 2000).

Another outcome of open doors, increased mobility, and the impoverishment of the rural communities of the area is the booming sex industry taking place mainly in Thailand. Feingold cites Professor Pasuk Phongpaichit, an economist from Chulalongkorn University who specialises in research on corruption and money laundering, who estimates that the income from prostitution and trafficking in women abroad alone exceed the income from drugs and illicit arms trafficking combined (Feingold in Evans et. al., 2000).

Many of these women and girls come from Myanmar and Yunnan while Lao PDR, due to the opening of borders and improved transportation routes "stands poised to become a supplier and transhipper of girls to Thailand" (Fiengold in Evans et. al., 2000). According to Feingold,

"the greatest collective impact is on the upland minority groups of the Thai-Myanmar-China periphery who are disproportionally represented in the trade, and whose cultural and physical survival are most directly threatened".

According to the report "Human Development in Myanmar" some 10,000 adult and child prostitutes from the Shan State work in Chiang Mai alone, while an estimated 20,000 to 30,000 women are reported to be employed in Thai brothels in a state of virtual slavery. Another 10,000 are recruited each year (Fiengold in Evans et. al., 2000).

Although it is difficult to measure the magnitude of the sex trade, it is clear that it has increased over the last decade (Fiengold in Evans et. al., 2000). The sex trade is closely linked to the spreading of HIV/AIDS as is the use of heroine. Heroine use (previously rare among many hill groups) has increased – first through smoking, more recently by injection. Needle-use facilitated the transmission of HIV at the same time as the need for cash pushed more daughters into the sex trade, making them likely to return infected to the villages. (Fiengold in Evans et. al., 2000). In this way, Feingold argues, it is not only the women who are directly threatened but also the areas where they come from.

The provinces of the Golden Quadrangle are still rich both in natural and cultural resources. Nature offers valuable raw material and products in the form of timber, wildlife, gems, minerals etc. as well as tourist attractions. The most significant cultural resource is the ethnically diverse population, whose distinct lifestyles, dress, and craftwork are both inherently valuable and attractive to tourists, as expressed in the final report of the road improvement project from Chiang Rai to Kunming (ADB, 1998).

Opening up the area in form of new and upgraded roads, improved river, rail and air transportation is thus both an opportunity for growth and development but needs also special attention because of its particular environmental and social vulnerability. Further exploitation suggests a careful planning and the participation of the different strata of the people and the different ethnic groups in particular. Not the least it needs much more transboundary co-operation between the concerned countries delegated down to the provincial and district levels.

3.5.4 Poverty

Poverty has been mapped for the Golden quadrangle at a very broadscale. This has been based on county level indicators in Yunnan, district level indicators in Lao PDR and state or province level indicators for Myanmar and Thailand. Poverty can clearly be mapped at much greater detail than it has here but these broad scale indicators should provide an idea of where particularly impoverished areas are.

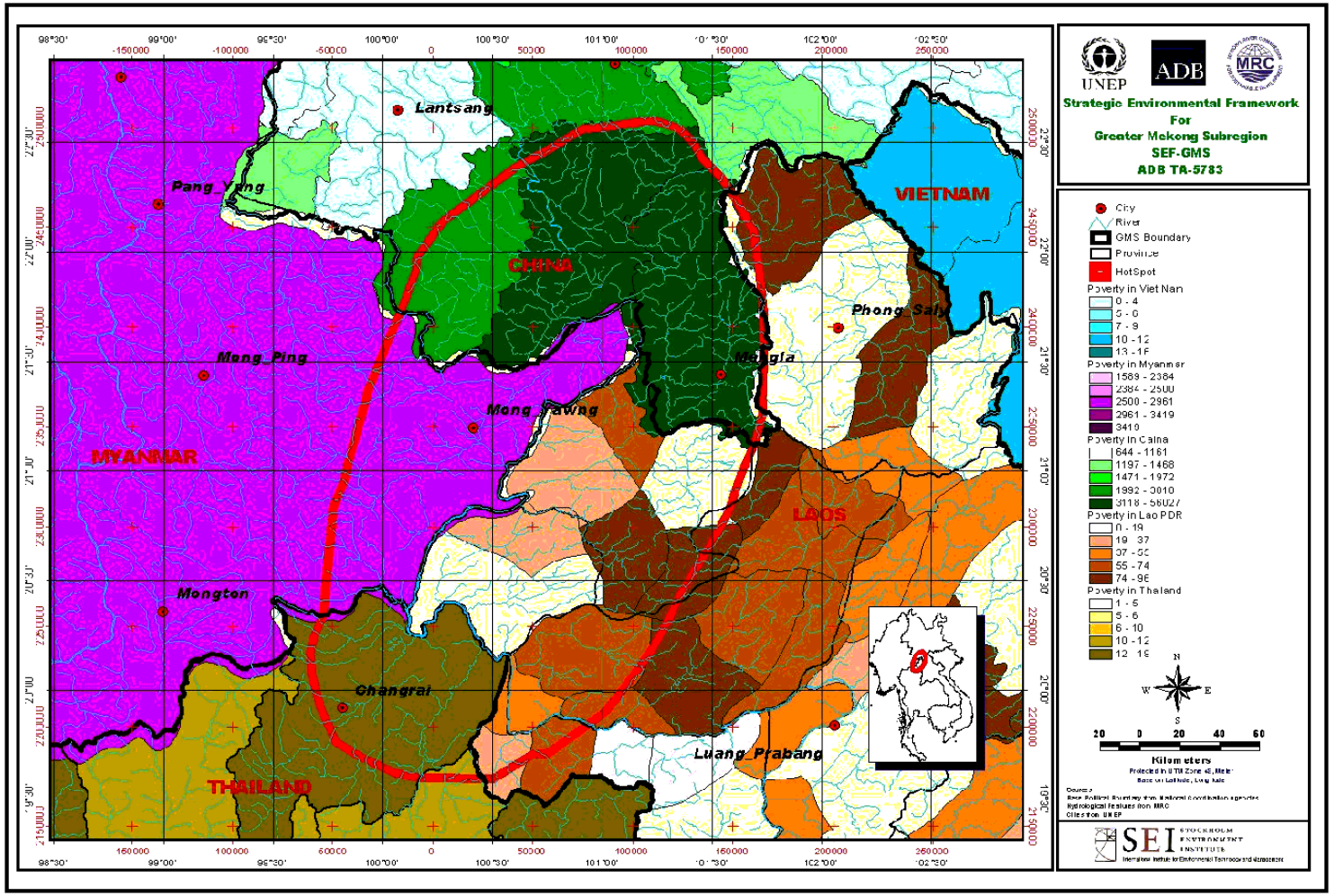

Figure 3.8 Poverty in the Golden Quadrangle Hotspot

3.6 Summary as a High Risk Region

3.6.1 Transportation Projects

The primary roads in the Hotspot have been mapped with a series of three buffers. These buffers cover 1, 10 and 25 km areas in relation to the road. This quickly shows that there are very few areas less than 25km from a road and most areas are within 10km of a road.

As in Hotspot 1 no Highly Valued Areas were mapped but there is a broad scale poverty map to draw some conclusions from. Figure 3.9 shows the road buffers in relation to poverty.

Again since the study has not tried to access the root causes of poverty in the Hotspot it is difficult to ascertain why certain districts are poorer than others are. As shown by the road buffers few of the areas suffer from lack of access at least within 10km or approximately one-day's walk. Future studies are clearly needed to understand the problem of poverty more clearly.

3.6.2 Hydropower Projects

Hydropower although present in the Hotspot has not been seen as a major threat other than exasperating changes in water flow and reducing fish productivity. These issues are discussed in more detail in Hotspot 1, 3, 4 and 5.

3.7 Strategic Recommendations

Recommendations associated with this Hotspot are primarily linked to the Chiang Rai-Kunming road. Hotspot two is unique in that it is the only one of the five to be primarily affected by an economic corridor. Possible deleterious effects are exacerbated by the regions long history of lawlessness and illegal trade. The area is a global hub for the trade in Women, Children, Narcotics and Wildlife. It is obvious that the road project will need to be carefully planned if these illegal elements are to be suppressed rather than enhanced.

Strategy for Public Participation – prior to any further construction a much more comprehensive public participation strategy needs to be developed. This strategy should form the basis of planning to ensure that affected peoples are substantially better off after project completion.

Environmental Impact Assessment should Cover the Full Extent of the Project's Impacts – previous road projects such as the east-west corridor in Savannakhet, Lao PDR fell far short of predicting the Environmental Impacts of a large development corridor. This project should try to avoid the mistakes of the past and concentrate on a much large impact area. This is particularly true for the large segment of the road within Lao PDR where the route is the least developed. This area should contain at minimum all the districts that the road passes through as well as the protected areas that is bisects.

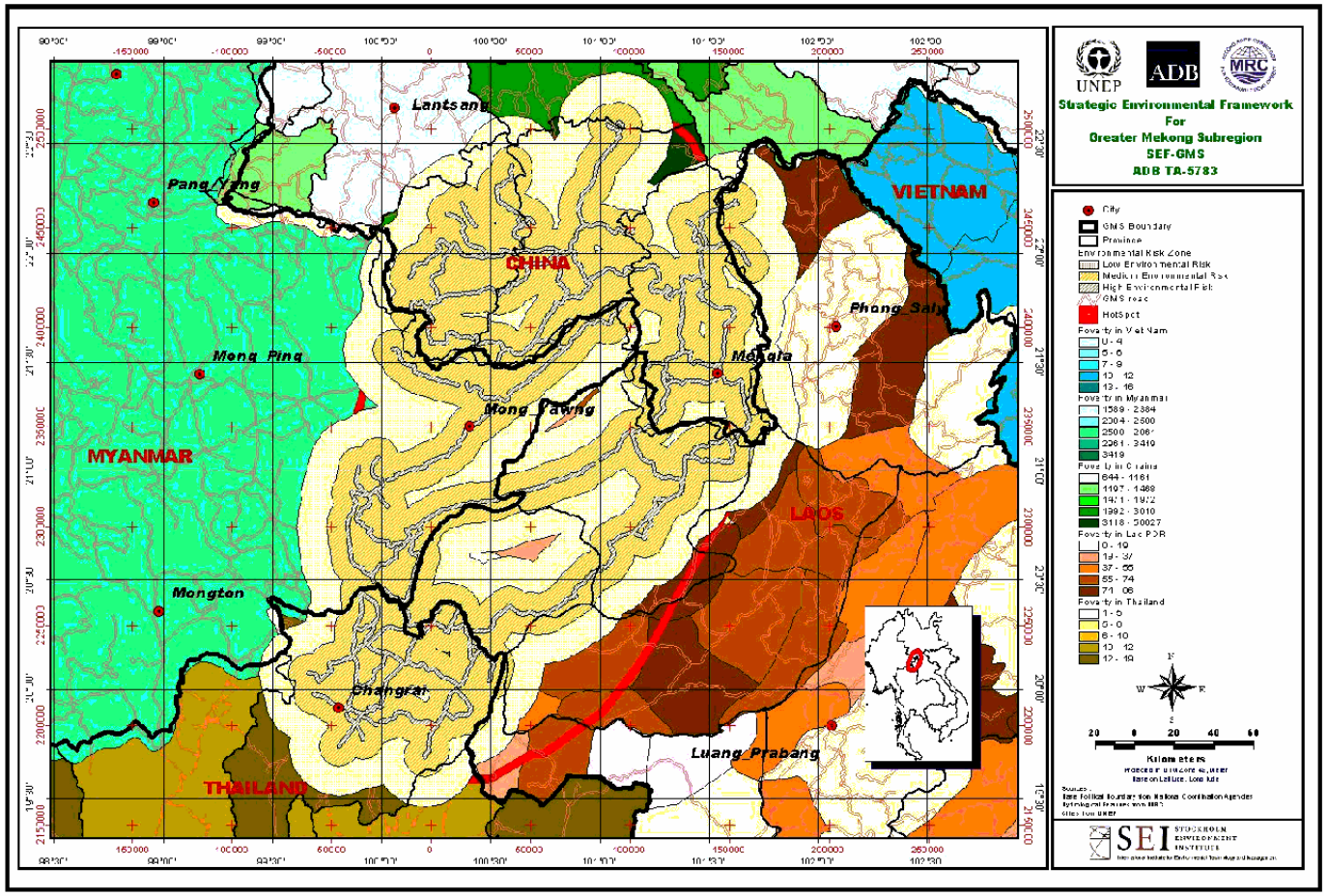

Figure 3.9 Impact Zones of Road Projects in the Golden Quadrangle Hotspot

Insure Clear benefits to Affected Peoples– previous projects have not given sufficient attention to the direct benefits local peoples can derive from infrastructure projects. In considering the Chiang Rai- Kunming road there is a need to plan for including increased access to social services within the planning and execution of the project while ensuring that local peoples share substantially in the benefits of the project, paying special attention to women and ethnic minorities.

Global Conventions as Regional Framework – a common legal understanding is needed in projects of a transboundary nature. This understanding can be found on a number of different subjects in the form of Global Conventions. It is clear that if the GMS is going to develop as a region that this framework should be put in place as soon as possible. In regard to Hotspot Two Global Conventions in relation to Trade and Labor are of the most immediate importance. The Convention on endangered species (CITES) serves as a prime example. CITES has been signed by every GMS country except Lao PDR. With the Chiang-Rai to Kunming highway already playing a major role in regional Wildlife trade it appears clear that CITES should be adopted to form a basis for regulating this illegal trade. The ADB should provide the ascension to CITES as a condition on any future loans concerning transboundary road construction in Lao PDR. Similar steps should be taken for the implementation of the International Labor Organisations Conventions of Labor.

Support for Law Enforcement – with the Golden Quadrangle all ready being a centre for illegal activities in the GMS there will clearly be a need to strengthen capacity for Law Enforcement in the area. This should specifically target Customs Officials and Border Police and provide training, equipment, and capacity building centred towards improved enforcement, decreased corruption and increased moral.

Strengthen Protected Area Systems – The Golden Quadrangle Hotspot has a number of Protected Areas that are increasingly subjected to direct pressures. These areas have limited staff, funds, or legal mandate to protect the resources they contain. Of special interest are the only remaining elephant populations left in China, which seasonal travel across the border into Lao PDR. The planning road project will bisect the Nam Ha protected area in Lao PDR and come very close to the Xishuanbanna National Nature Reserve in Yunnan for these areas to survive they should be incorporated into a broader scale land use plan perhaps in relations to river basin development plans. The road should provide financial retribution to the Protected Areas to cover the necessary patrolling and enforcement required due to the resultant increased accessibility provided by the road.

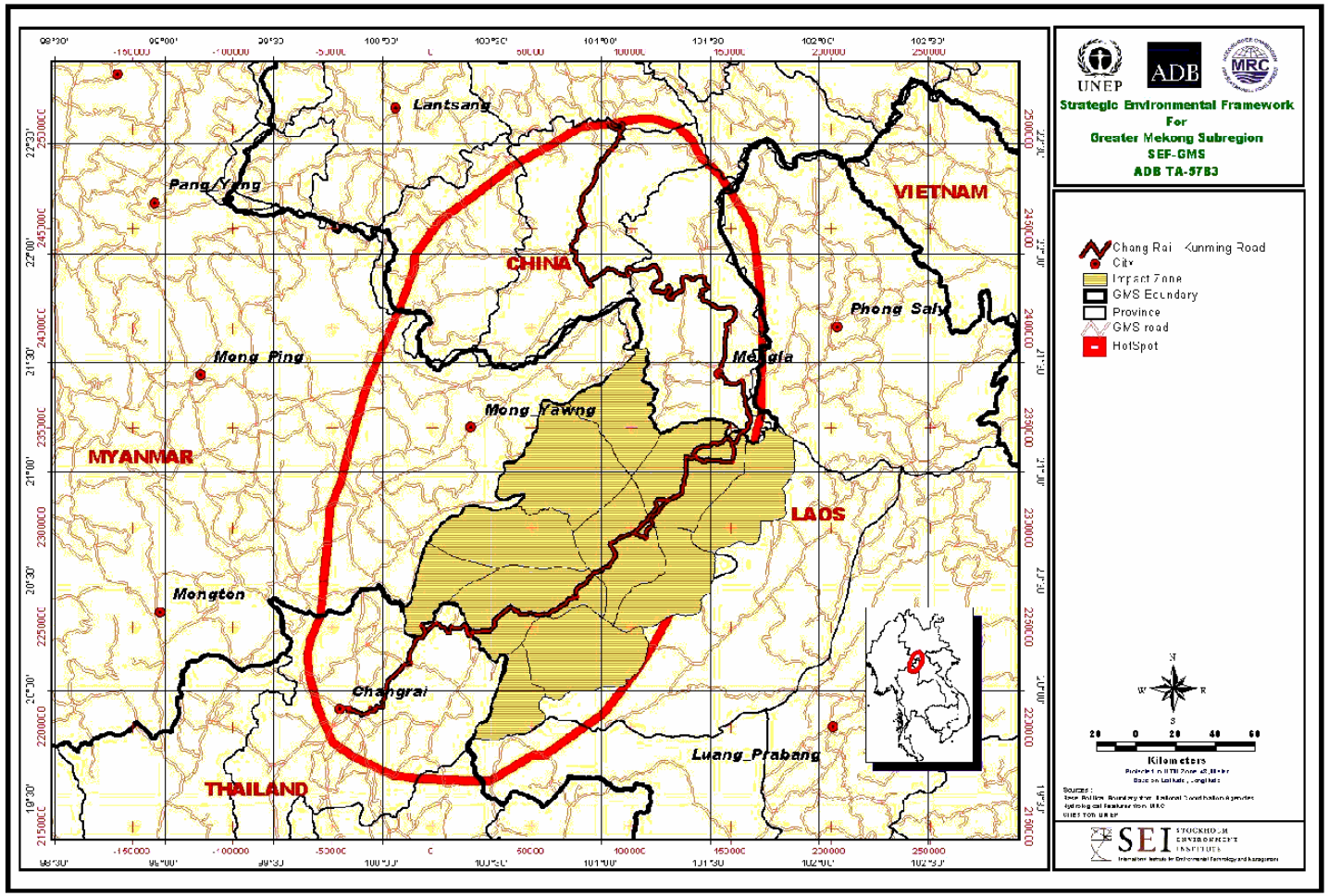

Figure 3.10 Expanded Impact Zone in Lao PDR for Chiang Rai to Kunming Highway

4. CENTRAL GMS PRIORITY GMS HOTSPOT OVERVIEW

4.1 Description

The Central GMS Hotspot has been at the centre of the GMS Development debate with Twenty-nine built or planned Hydropower projects, as well as being a prime corridor for economic development between Thailand and Vietnam.

The area also contains some of the most important wilderness areas left in Asia. Supporting a series of eight protected areas stretching from the Mekong plain across the Annamite Mountains to the coastal plain of Vietnam. Recent studies have shown that the Annamite Mountains are rich in endemism and of global importance for Biodiversity.

The Hotspot includes all of central Lao PDR with smaller parts of Vientiane Municipality, and Vientiane Province, the southern half of Xiengkhuang, the whole of Xaysomboun special zone, Bolikhamsay and Khammouane and the north-eastern part of Savannakhet as well as parts of western Nghe An, Ha Tinh, Quang Binh and Quang Tri Provinces in Vietnam.

Because of the great concentration of existing and planned dams, the area has been subjected to a number of studies during the last 15 years with a special focus since 1995. In relation to the other hotspots, the total number of people is small (not more than 1 million) and the affected people even less. The importance of the area is upgraded because of the opportunities associated with hydropower interests. Criticism against the lack of outside understanding of the livelihood systems and against the low level of local people's participation has repeatedly been highlighted. Today the area is relatively well known but there are still major questions concerning how hydropower can eventually benefit local peoples.

The valuable natural resources and the relatively low population combined with the opportunities presented by numerous development projects, highlight this area's chance for well-planned sustainable development. This development should concentrate on the conservation of the areas natural resource base and highlight the non-extractive opportunities for income generation that are available.

Table 4.1 Central GMS Priority GMS Hotspot Summary Characteristics

Location and Size	
Hotspot Area (km^2)	73,723 km^2
Percent of Total Area of GMS Priority Hotspots	31.56 %
Percent of Total Area of GMS	3.18 %
GMS Countries within Hotspot	Thailand, Lao PDR, Vietnam
Area in Thailand	2,188 km^2
Area in Lao PDR	57,927 km^2
Area in Vietnam	13,608 km^2
Biophysical	
Total Forest Cover[11] (km^2)	29,250 km^2 (excluding Vietnam)
Percent of total Hotspot Area	49% (excluding Vietnam)
Wetlands (km^2)	12 km^2 (excluding Vietnam)
Percent of total Hotspot Area	<0.5% (excluding Vietnam)
Protected Areas (km^2)	15,037 km^2
Percent of total Hotspot Area	25 %
Rare and Endangered Species	Saola, Elephant, Tiger, Wild Cattle, Bears, White-winged Duck, Hornbills, Pheasants, Turtles
Socio-economic	
Estimated Population	800,000 to 1 million[12]
Average GDP	Not Available
Ethnic Minorities Present	Tai, Hmong, Khmu, Tho, Bru, Van Kieu, Ta Oi, Chut
Agricultural Land (km^2)	6,498 km^2(excluding Vietnam)
Projects	
Existing Hydropower Stations	Nam Ngum 1,Theun Hin boun, Nam Leuk
GMS Road Project	None
Planned Hydropower Projects	Nam Theun 2-5a, Nam Mang 1 & 3, Nam Nhiep 1-3, Nam Sane 2, Nam Ngum 2-4, Nam Lik 1, Nam Ting, Nam Bak 1&2, Nam Cha, Nam Mo and Ban Mai
National Road Projects	Route 8a upgrade Route 1 upgrade Thakek to Boualapha

[11] Contiguous canopy covers with high or medium density (greater than 70 percent forest cover and over 20 percent crown cover with the forest cover).

[12] Based upon 1975-2000, 25, Basic Statistics of the Lao PDR, State Planning Committee, Vientiane, 2000.

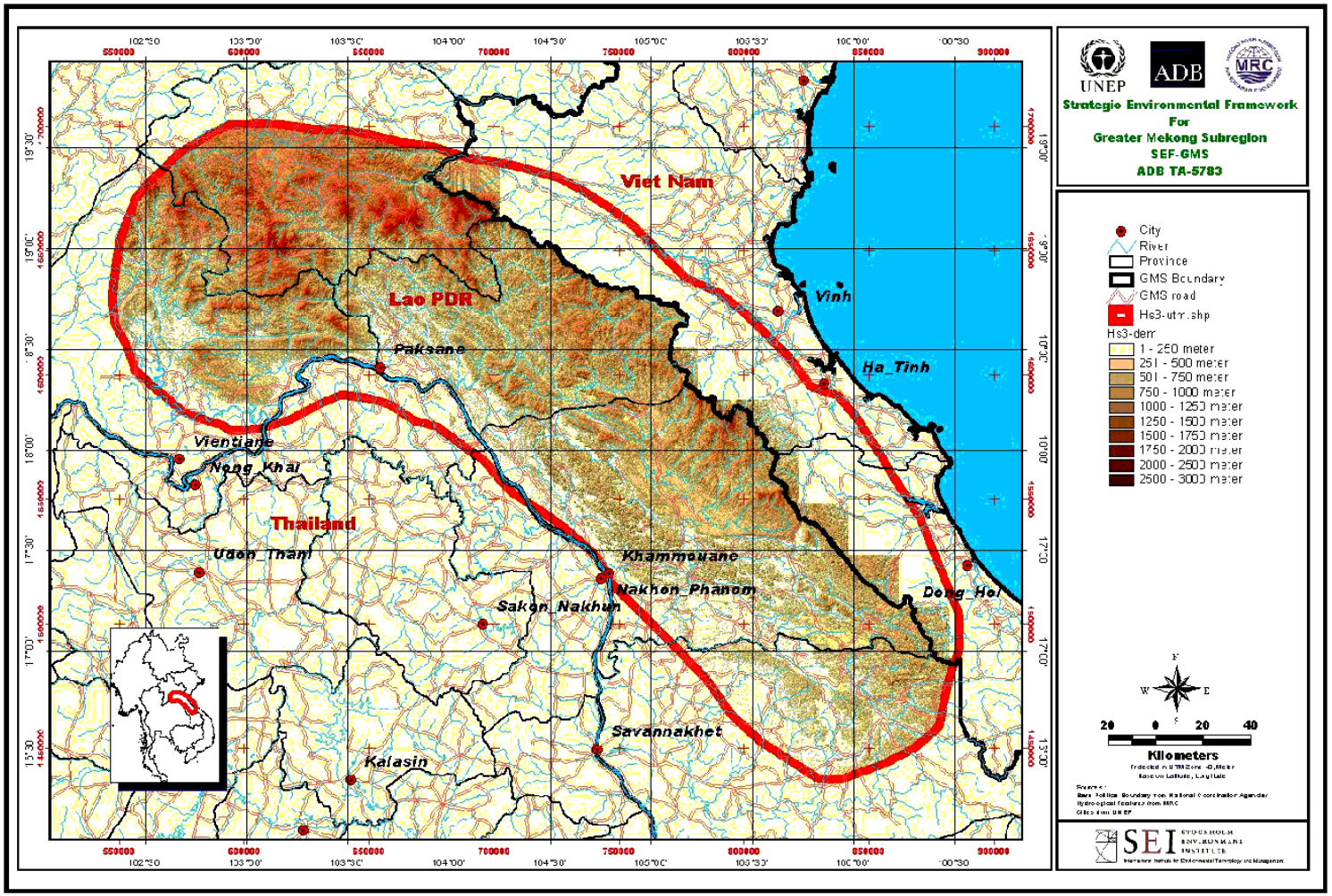

Figure 4.1 Overview Map of Hotspot (including political boundaries, cities and towns)

4.2 Biophysical and Natural Resources

4.2.1 Land Cover

The area is characterised by large areas of Evergreen forest, which are interspersed with several unique land cover types. A long belt of forest associated with limestone karst stretches across the southern end of the Hotspot from the Mekong Plain to the Coastal Plain of Vietnam.

The area also holds the Nakai Plateau, a unique habitat of open pine savannah that has now been heavily degraded by logging activities. In the north west the hotspot holds the large Nam Ngum reservoir and from there agricultural lands, primarily rice paddy, stretch southward the length of the Mekong. The Northern and Western areas of the hotspot are characterised by a mosaic of forest re-growth due to a long history of swidden cultivation by the local residents as well as more recent immigrants from further north in Lao PDR and southern Yunnan.

The forests to the east of the hotspot cover the spine of the Annamite mountains but become increasingly degraded as they reach the densely populated coastal lowlands of Vietnam.

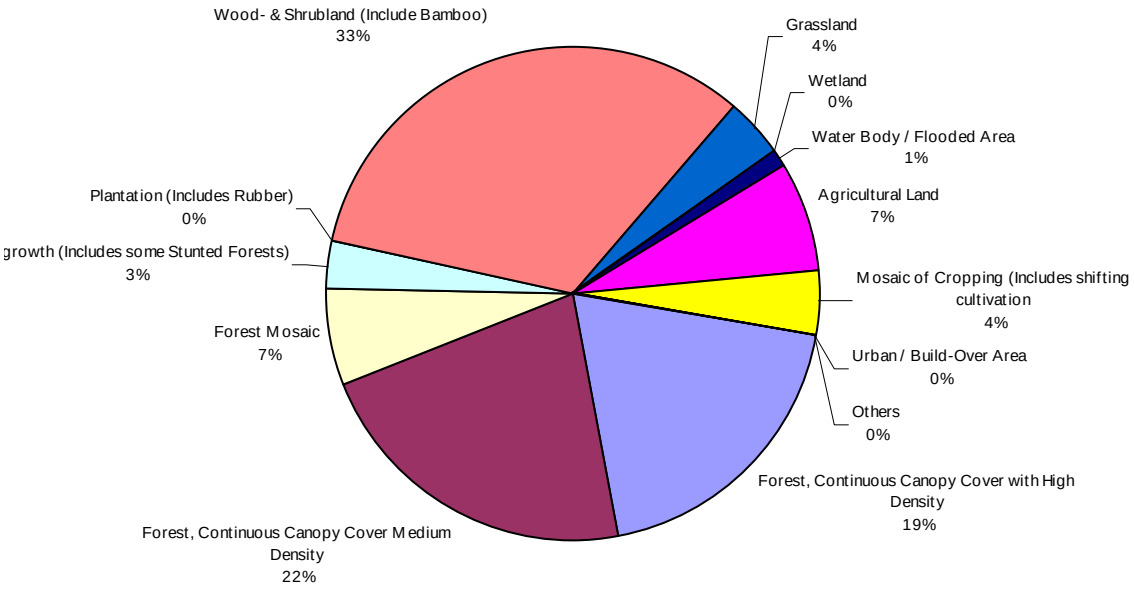

Figure 4.2 Forest and Land Cover in the Central GMS Priority Hotspot (excluding Vietnam)

4.2.2 Forestry

Forestry activities in the Central GMS, in Lao PDR are primarily the mandate of the Mountainous Areas Development Corporation or Bolisat Patthana Khet Phoudoi (BPKP), a military run state company of the Lao PDR government. Logging has been concentrated in the area associated with the inundation of the Nam Theun 2 Hydropower Project as well as road margins and power line routes associated with the Theun Hin Boun Hydropower Project. BPKP, and other Thai and Vietnamese companies have conducted smaller scale logging

operations in Boualapa District, Khammouane Province and Khamkeut District, Bolikhamsai Province.

The Lao PDR is unique in the region in that it does not operate under a concession system but assigns an annual harvesting quota that is not spatially bound or tied to a management plan. This allows for widespread, poorly regulated logging throughout the region.

Some activities associated with Community based timber harvesting have been started in southern Khammouane Province in associated with the World Bank/FINNIDA funded FOMACOP (Forest Management and Conservation Project). This project, which has reached the end of its first stage and is planning an interim phase, experienced considerable success at the onset. However changes in Lao PDR Government policy have reduced the value of the initial results and call into the question the potential for similar initiatives since they currently receive limited political backing.

4.2.3 Fisheries

The most important threat affecting fish biodiversity and fisheries production in the Central GMS hotspot area is hydropower development. Three hydro-dams are currently in operation and more than 20 other dams are planned. Apart from dam construction, some of the hydropower projects also include river diversion. There will be significant impacts on fish biodiversity and riverine fish production from these projects.

The Mekong River tributary watersheds of the Central GMS hotspot area are characterised by extensive upland wetlands and high gradient cool streams that harbour unique fish species assemblages. Fish biodiversity studies indicate that a substantial number of fish species are endemic with restricted distribution, while others are rare elsewhere in the Mekong basin. In addition, many species from the mainstream Mekong River migrate up the tributaries to spawn. The fish biodiversity is of both national and regional importance (Traisawasdichai, 1997; Kottelat, 1996).

Recent studies have been carried out on the downstream impacts of Nam Ngum 1 and Theun-Hinboun hydropower projects. At Nam Ngum 1, discharge water quality is poor, with dissolved oxygen levels being sub-optimal for aquatic life, and occasionally toxic hydrogen sulfide is discharged. A river diversion to increase the affluent flow into the reservoir has decreased water flows downstream of the takeoff. At Theun-Hinboun, decreased downstream flows during the dry season have reduced fish production in the river. Turbidity in the diverted water flow path has increased. Some common problems affect both hydropower projects, including entrainment of fish in turbines and blocking of upstream migration of fish during the breeding season. The upstream effects of dams on the indigenous fish fauna are also substantial. White water rapid zones and wetlands are permanently flooded over and this can result in extirpation of specialised fish species living in these habitats. The reservoirs created by the dams harbour substantial fish faunas and fisheries, but these are not fully equivalent to the lost fish assemblages (Schouten, 1998).

Experiences from these two existing hydropower projects indicates that loss of unique fish biodiversity and depression of riverine fisheries production are the two most likely impacts of hydro-dam development in this hotspot area. Given the large number of dams planned, the full dimensions of their cumulative impact could result in severe degradation of ichthyodiversity. The level of fisheries production from the entire area would be mitigated to some degree by the reservoir fisheries that would be created.

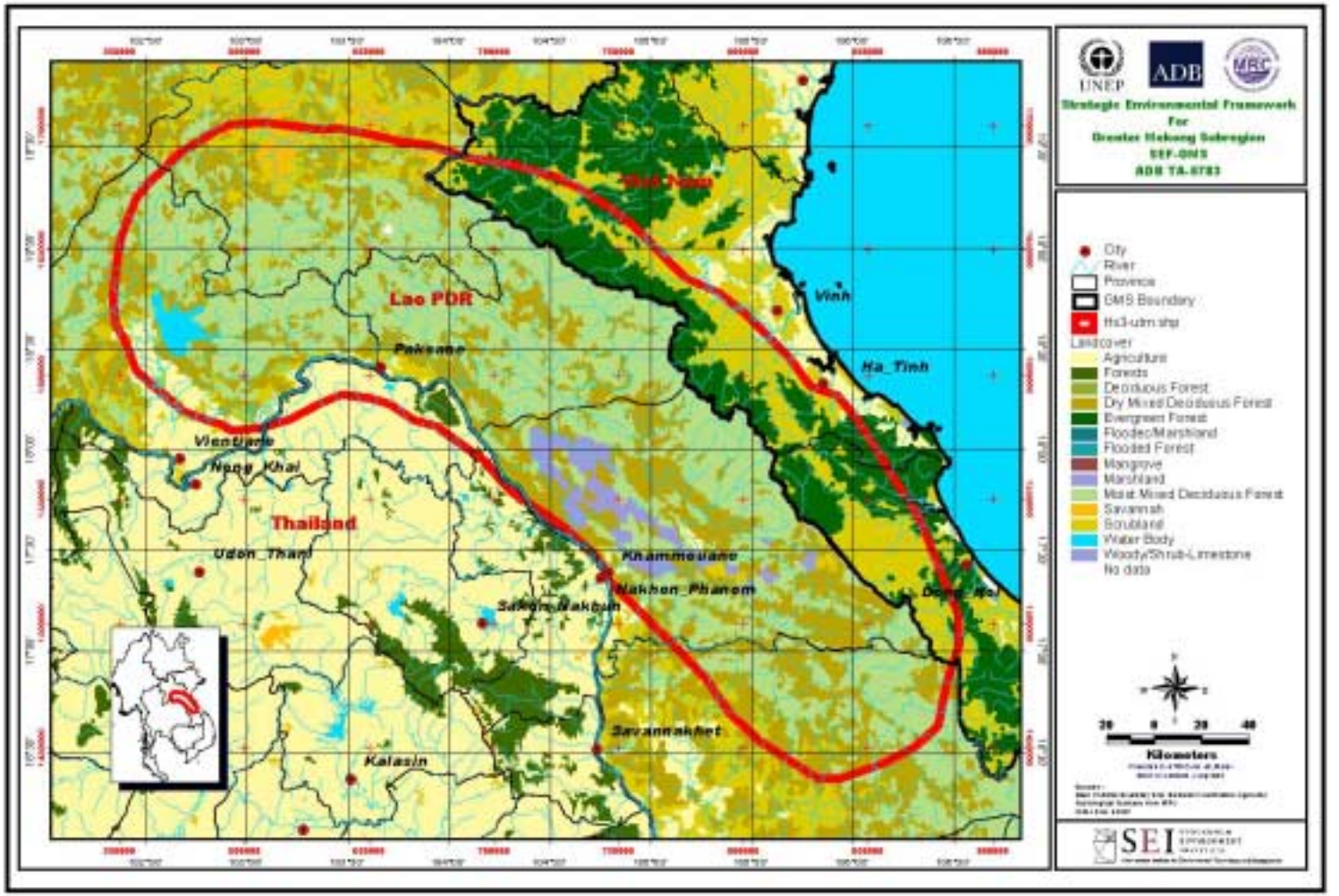

Figure 4.3 Land Cover in the Central GMS Hotspot

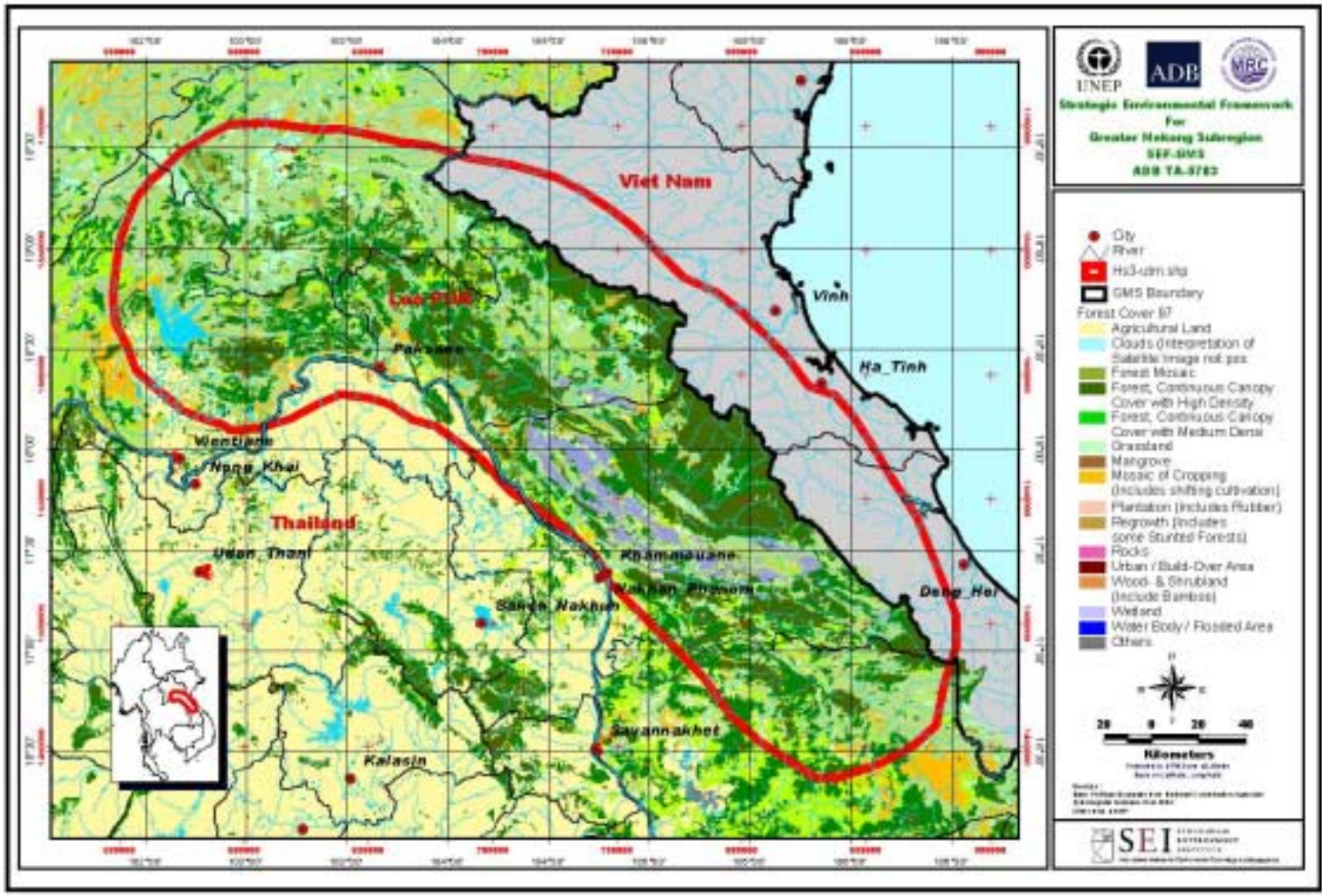

Figure 4.4 Forest Cover in the Central GMS Hotspot

4.2.4 Protected Areas

There are eight protected areas in the Central GMS hotspot, including Nakai - Nam Theun NBCA, Nam Kading NBCA, Phou Hinpoun NBCA, Phou Khao Khoay NBCA, Hin Nam No NBCA in Lao PDR; Vu Quang Nature Reserve, Phong Nha-Ke Bang Nature Reserve, Phu Mat Nature Reserve, Kego Nature Reserve in Vietnam; and Pu Wua Nature Reserve in Thailand (Bermueller, 1995; Wege et. al., 1999).

The area is unique within the GMS for still having habitat links between the protected areas making for one of the regions most valuable wilderness areas. The connectivity of the protected areas in central Lao PDR and Vietnam has been highlighted repeatedly since Berkmueller et. al. 1995. This connectivity could be protected through a series of corridors linking the existing protected areas. Such corridors would link the flagship Nakai - Nam Theun NBCA with the proposed Nam Chuan NBCA to the north, Hin Namno NBCA to the south, and Phou Hinpoun NBCA to the west. Additionally a corridor has been proposed to link between Phou Hinpoun NBCA and the Nam Kading NBCA. Such a network of corridors combined with the existing connections between Nakai Nam Theun and Vu Quang and Hin Namno with Phong Nha would produce the GMS's largest complex of PAs while providing a viable system for long term conservation of the area's unique biodiversity (IUCN, 1998).

Table 4.2 Protected Areas in the Central GMS Hotspot

Name	Area (Km^2)	Location	National PA Category	IUCN PA Category[13]	YEAR
Nakai Nam Theun	3,710	Lao PDR	NBCA	VI	1993
Nam Kading	1,740	Lao PDR	NBCA	VI	1993
Phou Hin Poun	1,580	Lao PDR	NBCA	VI	1993
Phou Khao Khoay	1,390	Lao PDR	NBCA	VI	1993
Hin Nam No	865	Lao PDR	NBCA	VI	1993
Vu Quang	16000	Viet Nam	Nature Reserve	IV	1986
Phong Nha	5000	Vietnam	Nature Reserve	IV	1986
Ke Bang	N/a	Vietnam	Nature Reserve	IV	N/a
Phu Mat	8500	Vietnam	Nature Reserve	IV	1986
Pu Wua	N/a	Thailand	Wildlife Reserve	IV	N/a

[13] See Annex 1 for IUCN protected area categories.

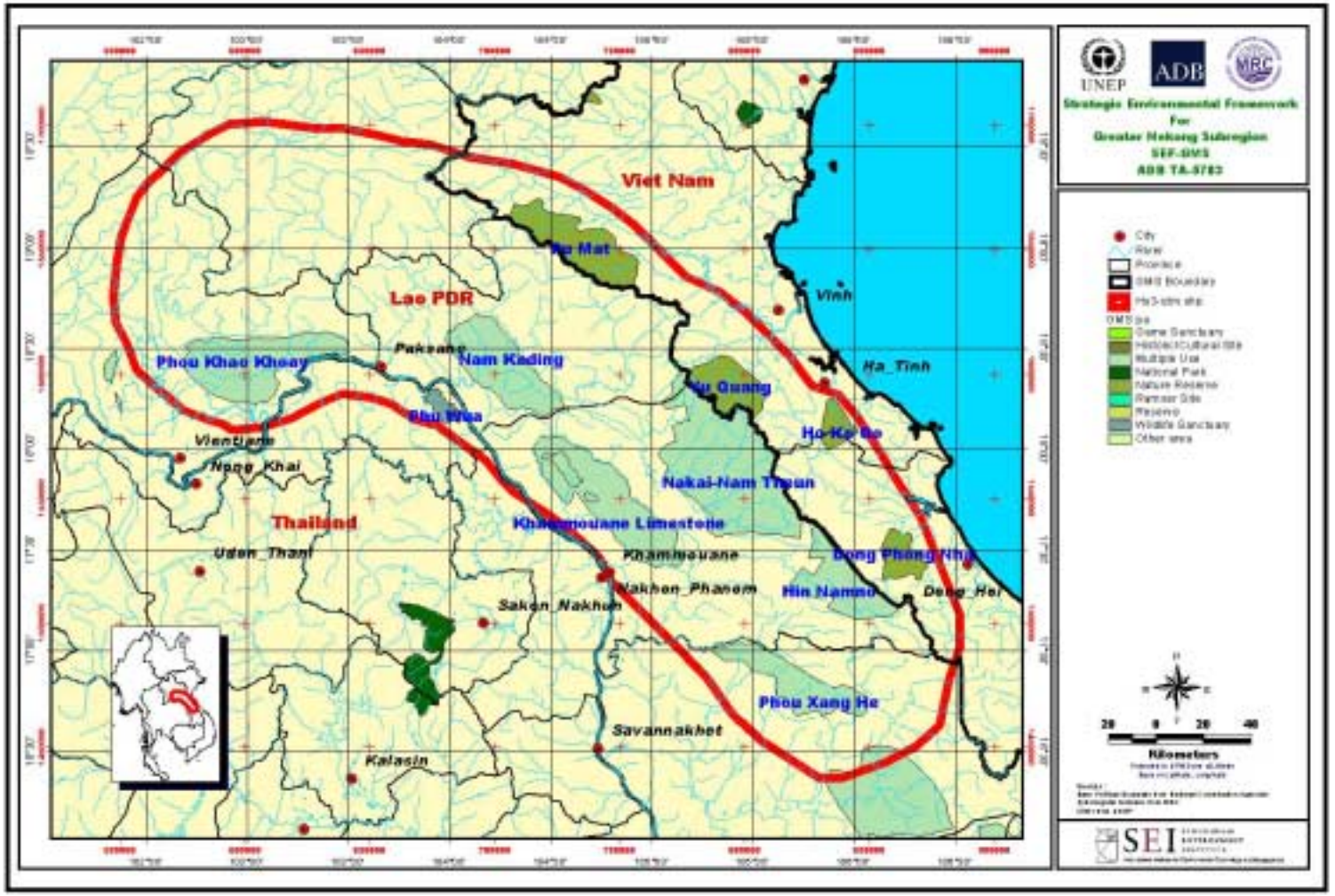

Figure 4.5 Protected Areas in the Central GMS Priority Hotspot

4.2.5 Biodiversity

The Central GMS hotspot has gained international recognition for its important Biodiversity values. Most notable of these values is the recent discovery of three new large mammals to science, the rediscovery of a species previously thought extinct and numerous new species of smaller mammal, especially bats.

The central GMS area has been identified as a Critical Priority by WWF's recent eco-regional analysis of the forest of the Lower Mekong and a portion of the hotspot is considered an Endemic Bird Area as identified by Birdlife International (Statersfield et. al., 1998; Baltzer et. al., 2000).

The Nakai Nam Theun NBCA has been found to hold an incredibly high number of globally threatened species of vertebrate clearly making it one of the highest priorities for conservation in mainland Southeast Asia.

Important species in the area include Tiger, Asian Elephant, Saola, Douc Langurs, White-Cheeked Gibbons, several species of poorly known Muntjac, White-winged Duck, Hornbills, Pheasants, numerous passerines, and several species of freshwater turtle. Although botanical survey coverage is much less complete than zoological, the area has been found to be valuable for a number of endangered conifer species.

The primary threats to wildlife in the area are harvest for the ubiquitous wildlife trade and habitat destruction due to widespread logging and large-scale infrastructure development.

4.2.6 Water Resources

The hotspot spans both sides of the Annamite Mountains. The area includes rivers in Lao PDR that flow to the southwest, into the Mekong River, and other rivers (notably the Song Ca) that flow to the southeast, into the Gulf of Tonkin. Precipitation is controlled partly by the nature of the prevailing wind, and partly by the orientation of the mountain massifs in the hotspot. The northeast (winter) monsoon creates heavy rainfall along slopes with a NE exposure, e.g. the escarpment on the Vietnamese side of the highlands, and the Southwest (summer) monsoon creates heavy rain conditions along slopes with a SW exposure. Peak annual precipitation amounts are sensitive to altitude, and are in the range 2500 to 4000 mm in the mountains of the north-west part of the hotspot, and in the range 1250 to 2500 mm in the south-east part.

Runoff amounts are high, the topography is mountainous, and there is potential for generating significant amounts of hydroelectric power from a very large number of sites. The hotspot is more mountainous in the northwestern part, with many more good sites for potential hydropower production than in the southeastern part. Key river basins for existing and proposed hydroelectric development in the Hotspot are:

Nam Kading/Theun, Nam Hinboun, Nam Mang, Nam Ngum, Nam Ngiep and Nam Sane

These rivers all enter the Mekong River from the north side, in the stretch between Vientiane and Nakhon Panom.

No survey has been done, as far as we are aware of the potential for small and mini hydro generation, which would have the ability to help local and ethnic communities, with minimal environmental damage.

Many medium and large hydroelectric projects have been proposed for the part of the hotspot in Lao PDR, and three projects are in operation, namely

- Nam Ngum, an old project (constructed in 1971) with a very large reservoir

- Theun Hinboun, which has a relatively small reservoir, and is an interbasin diversion project
- Nam Leuk, a small-medium sized project (60 MW) with a relatively small reservoir.
- Preliminary construction work has started at a fourth site, Nam Theun 2, and extensive forest clearing has been done.

The most focus of activity for hydroelectric work in the next 10-year period is on the Theun/Kading river system. Flows are already significantly altered by the interbasin diversion for Theun Hinboun (water is sent out of the river basin, into the Hinboun River). Further modification of flows will happen once the Nam Theun 2 project is built and operating. For the final part of the river immediately upstream of the Mekong confluence, there will be additional flow modification, if and when the Nam Theun 1 project is built. Several of the issues discussed under Hotspot 4 arise, except in many ways the required institutional arrangements should be easier to implement, because the origin of the water, and its control and management are mainly inside one country, Lao PDR.

In Vietnam, a project in the vicinity of Ban La/Ban Mai has been proposed for the Ca river basin. Recently the focus of activities has been at the Ban La site, about 10 km upstream of Cua Rao, and details are reported in the National Hydropower Plan Study for Vietnam (SECO, 2000). This would be a high dam with a relatively large reservoir (45 km^2), causing extensive flooding of valley bottomlands. Previous studies at the Ban Mai site have discouraged development, due to modest economic indicators, and high social and environmental impacts. This dam, if built at Ban La, would be ***very high hazard*** from the dam safety viewpoint, with a very large amount of infrastructure in the Ca valley and Ca estuary at risk. An inundation map for dam break analysis would likely include part, or all of, Vinh.

A second project that is planned but not yet at the feasibility stage is the Nam Mo project in Lao PDR, in the upper Ca River.

4.3 Population

With portions of Vientiane Municipality, Vientiane, Xiengkhuang, Savannakhet Provinces and the whole provinces of Bolikhamsay, Khammouane and Xaysomboun Special Zone in Lao PDR and smaller parts of Nghe An, Ha Tinh, Quang Binh and Quang Tri Provinces in Vietnam, the total population is estimated to be between 800,000 and 1 million people.

A majority of the people is of the Lao PDR ethnic group while other major groups in the area belong to the Tai, Brou, Hmong and Khmu. These groups are also residing on the Vietnamese side of the border as well as the groups of Tho, Van Kieu, and Ta Oi .

Some of the Lao PDR group are migrants having moved into the area during the war and afterwards. Upland groups such as the Hmong have been relocated down to the valleys as part of the Lao PDR government efforts to stop shifting cultivation. Thus the current mixture of ethnic groups is a fairly recent event. Originally these groups may have been distinct ethnic entities with indigenous languages, but at present there is considerable intermarriage and shifting ethnic identities, making it very difficult to differentiate one group from another as, reported by Sparkes from the Nakai Plateau in 1998 (Sparkes pers com). According to the same author all groups are undergoing an increasingly Laoisation, that is integration into the Lao PDR nation state by means of economic interaction, increased mobility, the influx of lowlanders and education and government in the Lao language.

Illiteracy is reported to be very high and health issues are a major concern. The eastern part of the hotspot includes the Nakai-Nam Theun Conservation Area where people have been outside the development mainstream. This is reflected in low literacy rates, especially among women and high infant mortality rates.

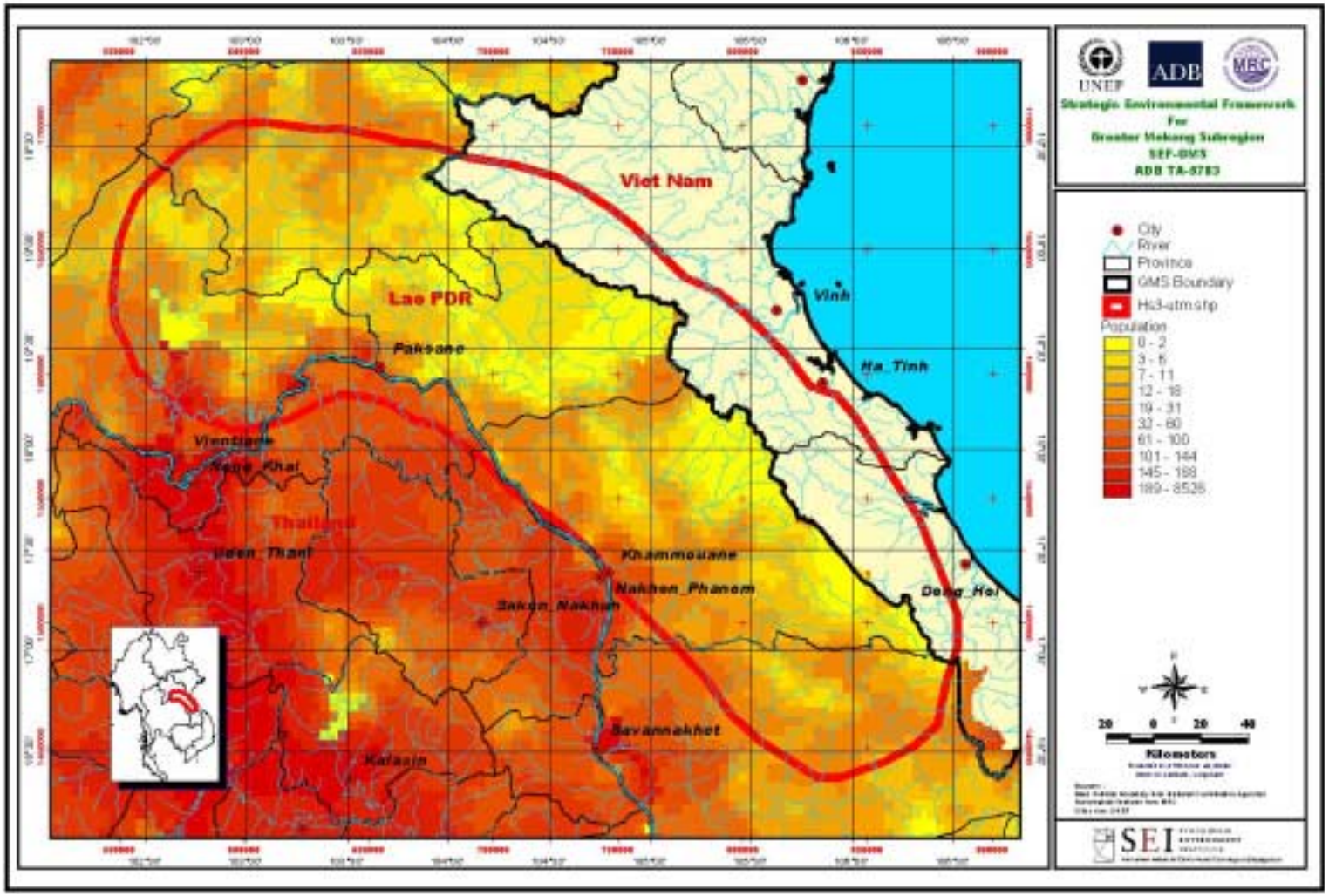

Figure 4.6 Population Density in the Central GMS Hotspot

4.4 Development Stresses

4.4.1 Transportation Projects

Existing Road Network

The Central GMS Hotspot is criss-crossed by several major roads. The main north-south highway in Lao PDR, Route 13 (R (6)), stretches along its western border from Vientiane to Savannakhet. Starting from Route 13 there are two main routes branching to the east. Lao PDR Route 8a (R2 (N)) leaves Route 13 north of Thakek and travels through karst limestone across the Annamite Mountains to Vinh.

Further south a district road links Thakek to Vietnam splitting into two routes on both sides of Xe Bang Fai River. This leads to two passes leading into Quang Nam Province on either side of the Hin Namno NBCA. Both end on Vietnam's route one near the port of Dong Hoi.

Other national roads include Lao PDR Route 1 which links Lao PDR route 8a with Phonsavan town in Xieng Khouang Province to the north. The development of this route has been plagued by security issues especially where is crosses Vienthong District in Bolikhamsai and the eastern portion of the Xaysomboun special zone.

There are no GMS program transport projects in this Hotspot.

Proposed National Road Projects and Status

There are a number of national roads that are being upgraded in the Hotspot. These include Lao PDR Route 1, and the two routes from Thakek to the Vietnam border in Khammouane Province. SIDA has funded the upgrading of a portion of the southern most Thakek/Vietnam route but resources for labour barter agreements between Lao PDR and Vietnam have supported subsequent road upgrades. This has especially been the case in linking Boualapha district to Vietnam (IUCN, 1997).

Table 4.3 National Road Projects in the Central GMS Hotspot

Name	Description	Status
Route 8a to Phonsavan	Upgrade	Ongoing
Thakek to Dong Hoi North	Upgrade	Ongoing
Thakek to Dong Hoi South	Upgrade	Ongoing

Figure 4.7 Existing Road Network, Central GMS Hotspot

4.4.2 Hydropower Projects

Existing Dams and Status

Many medium and large hydro projects have been planned for the portion of Lao PDR within the Hotspot. Three projects are currently operational.

Theun-Hinboun

The Theun-Hinboun, a 210 MW dam on the Theun River in central Lao PDR, was completed in January 1998 and is the first public/private hydropower project in Lao PDR for export of power to Thailand. Located in Bolikhamxai and Khammouane Provinces of central Lao PDR, the project is a trans-basin diversion scheme, which diverts water from the Nam Theun through a tunnel to a powerhouse within the Hinboun river basin.

The project makes advantageous use of a short diversion with a large drop in head from one river basin to another. Capital costs for this project in relationship to crudely measured benefits are low, so the project may be expected to be profitable for the owner, and for the Government of Lao PDR.

If Nam Theun 2, to be located further upstream, goes ahead, it will divert water out of the Theun River, resulting in a reduced power generation capacity for Theun-Hinboun.

The project is a joint venture between the Lao PDR electricity utility, Electricité du Lao PDR, a Thai company, GMS-Thailand, and two Nordic state-owned utilities, Vattenfall of Sweden, and Statkraft of Norway. The Asian Development Bank (ADB) gave a loan of US$60 million to finance the Lao PDR government's equity and the Norwegian aid agency NORAD gave a grant of US$7 million for the project. The remainder of the financing came from export credit agencies in Norway and Sweden, and a consortium of Thai commercial banks.

Theun-Hinboun has already had an impact on the livelihoods of thousands of Lao PDR villagers resulting in reduced fish catches, the destruction of vegetable gardens and dry season drinking water sources, and increased difficulties with transportation. Approximately 6,000 Lao PDR people live in the 25 villages near to the project site and are considered to be "especially vulnerable" to impacts from the project. Thousands of other people living in the Theun and Hinboun river basins are also now being affected by the project.

Existing mitigation and compensation measures are grossly inadequate, leading to a situation where those least able to afford it local villagers are in effect subsidising the power company's shareholders. Within the entire US$260 million project cost, a total of only US$50,000 was allocated for all resettlement and compensation costs for affected local people, most of which was spent on purchasing land for transmission line towers. Acting on advice from the ADB, the Lao PDR government signed an agreement limiting THPC's obligations to provide compensation and environmental mitigation and the government is now faced with meeting these costs (IRN, 1998). To date the Lao PDR government has spent over US$350,000 on resettlement and compensation (HPO in litt).

Nam Leuk

The Nam Leuk is a 60 MW peak power capacity hydroelectric project located within the Phou Khao Khouay National Biodiversity Conservation Area in Vientiane Province and the Xaysomboon Special Zone. Nam Leuk is the second of three Lao PDR government projects designed to increase water flow into the Nam Ngum reservoir, which has been affected by siltation and water shortages. The first diversion project, Nam Song, was completed in 1995 with ADB funding. The third project, Nam Mang 3, is currently on hold, although feasibility studies have been completed. Funding for the US$130 million Nam Leuk project, which is entirely owned by the Lao PDR government, has come mainly from loans issued by the Asian Development Bank and the Japanese government. Construction on Nam Leuk began in early 1997 and was completed in late 1999.

Low quality and biased environmental impact assessments have provided a poor basis for decision-making for both the Lao PDR government and project financiers. The original EIA, conducted by Lahmeyer/Worley in 1992, was rejected by the ADB following a review commissioned by the Lao PDR Department of Forestry, which called it "sloppy, unprofessional, inaccurate and incomplete." A subsequent study by the French firm Sogreah was marginally better, but also failed to properly address many important questions about the social and environmental consequences of the project. Both consultants had clear conflicts of interest due to their involvement in implementing hydropower projects in the Lao PDR and, in Sogreah's case, their on-going involvement in designing and supervising construction on the Nam Leuk project.

Although more than 9,500 people are expected to face direct impacts from Nam Leuk, almost no consultation with affected villagers occurred until long after the project was planned and approved. Initial consultation was extremely limited and did not appear to have met minimal ADB standards. Only recently, following sustained external criticism, are locally impacted communities starting to be consulted and their needs for assistance and compensation more formally recognised. A Social Action Plan for the project was completed in January 1998. This plan finally addresses some issues, such as the expected project impacts on Ban Nam Leuk that were downplayed or ignored in the project EIA.

The impacts on downstream and upstream fishing resources are likely to be substantial, and will affect thousands of people who depend on the river's fisheries for protein and income generation. Plans for directly compensating villagers in the upstream areas who stand to lose paddy and other productive land are apparently now moving forward. The Social Action Plan, which includes a budget of US$742,000, recommends fisheries monitoring for five years so that base lines for compensation become established. A total of US$40,000 is budgeted for fisheries loss compensation, but there is no explanation as to how this amount was calculated. At this stage procedures for determining and allocating compensation are unknown. At other hydropower projects in the country, the Lao PDR government and the ADB have thus far failed to provide direct compensation to local villagers in downstream areas for the loss of fishing resources and other harmful livelihood impacts. Whether the commitment exists at Nam Leuk to properly document future livelihood losses and to adequately and appropriately compensate villagers for these losses remains to be seen.

A central concern over the implementation of Nam Leuk is the potential for harmful impacts from logging and road building in the Phou Khao Khouay Protected Area; an important habitat for globally threatened animal species. The ADB made assurances that logging will be strictly controlled at Nam Leuk. Despite this, in early 1998 uncontrolled logging was initiated in and around the inundation area, including some incursions into the Protected Area

Based on its problematic recent history, careful monitoring of Nam Leuk will be required as it is implemented over the next few years - particularly its impacts on local communities and the steps that are being taken to address these impacts (IRN, 1998).

Nam Ngum 1

The Nam Ngum 1 is the oldest large hydroelectric project in Lao PDR, built in 1971 by the Government of Lao PDR. The supply reservoir is large (450 km^2 at full elevation), meaning that a substantial area of forestland was sacrificed to the project. The peak power production is 150 MW, and the full supply head is 75 m. The majority of the electricity is sold to Thailand. About 580 households were displaced by the project. Several projects on the Nam Ngum, immediately upstream of the reservoir, are short-listed for development in the next decade.

Several existing and proposed projects are classified as very high hazard for dam safety, based on the anticipated consequences of dam breakage, failure of spillway gates etc. For example:

- Nam Ngum dam, with a dam wall of 75 m and a reservoir storage area of 450 km^2, has a very large volume of stored water, even at the lowest operating level of the reservoir. The presence of several towns and villages downstream, plus other infrastructure such as roads, means that the dam is categorised as ***very high hazard***.
- The proposed Nam Ngiep dam, with the town of Muang Pakxan downstream, also falls into this category.
- Nam Leuk dam, with a dam wall of 45 m, and a reservoir storage area of 13 km^2, has a large volume of stored water. With the town of Ban Thabok immediately downstream of the reservoir, the project is categorised as ***very high hazard***.

Clearly the establishment and operation of a dam safety office, with guidelines for periodic dam safety reviews, and sufficiently trained staff to understand and follow-up on potential problems, is required.

A Theun-Kading river management board is needed with representation by all stakeholders, to help plan future developments in the basin. One of the roles of this board would be decision on the design and location of future projects, bearing in mind the full impacts of their construction and operation. A second role would be to initiate modelling for water use optimisation for fisheries, flood control, recreation, navigation and electric power production, to help ensure that operations at existing projects make the best use of the water resource. A third role would be to formulate agreements on minimum fisheries flows, and ramping rates of spillway gate opening/closure.

Water use fees presently being collected by Government of Lao PDR are directed to a central account, with little prospect of local and ethnic peoples benefiting from the projects. A separate tax, such as a property tax based on the assessed value of the project infrastructure, would be one mechanism for sending benefits to local/district level government.

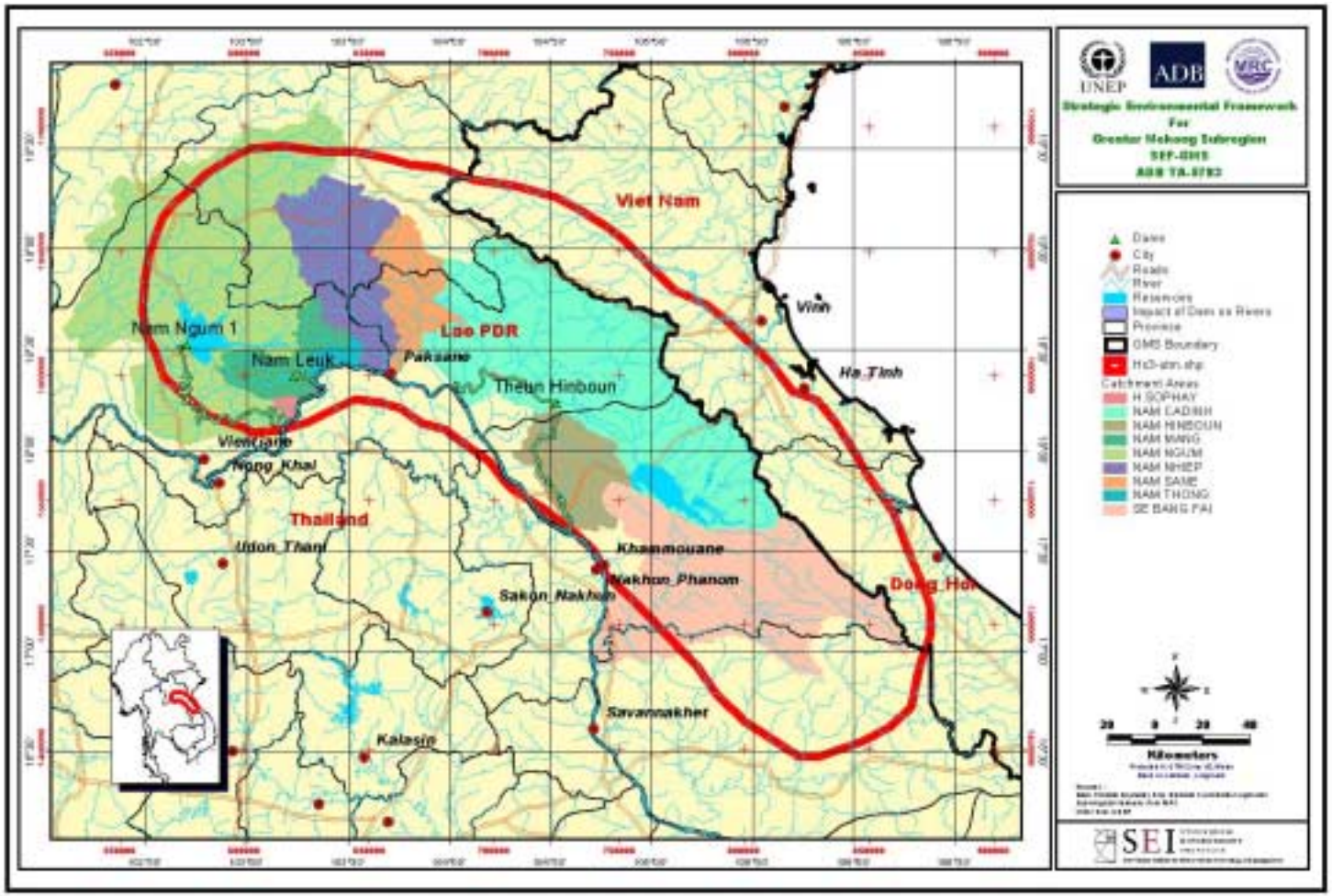

Figure 4.8 Existing Hydropower or Multipurpose Dams in Central GMS Hotspot

Proposed Hydroelectric Dams and Status

The GMS program is currently not supporting more Hydro-dams at the time being although it did fund a considerable portion of the Nam Leuk and Theun-Hin Boun projects that are now operational. At present the GMS portfolio contains **E6: Immediate Interconnection of Existing Power Systems in Cambodia, Lao PDR, Myanmar, Thailand, Vietnam, and Yunnan Province** This will include two powerline projects in the hotspot one from Nam Ngum to Udon Thani and the second from the Nam Theun 2 project (if built) to Roi et. The ADB is also providing direct support for the establishment of a National Grid Company in Lao PDR

There are however, more than twenty hydropower projects, in seven river basins, being proposed within the hotspot. These are all shown in the "Future" development scenario for the GIS mapping for the hotspot (Figure 4.9). These include:

- Five projects on the Theun/Kading Basin: Nam Theun 2 thru 5 and 5a.
- Two projects on the Mang river basin: Nam Mang 1 and 3
- Three on the Nam Nhiep basin: Nam Nhiep 1 thru 3
- One on the Sane river basin: Nam Sane 2
- Five in the Nam Ngum basin: Nam Ngum 2 thru 4, Nam Lik 1 and Nam Ting
- Three on the Nam Cha basin: Nam Bak 1 and 2 and Nam Cha
- And Two on the Ca basin: Nam Mo and Ban Mai

Some proposed projects, e.g. Nam Lik 2 are outside the hotspot, but the impact of the altered flows will be felt inside the hotspot.

Nam Theun 2

Nam Theun 2 is the largest and most controversial of all the hydropower projects planned for Lao PDR. Situated in Khammouane Province in central Lao PDR, and only 50 km upstream from the already completed Nam Theun-Hinboun Hydropower Project, the US$1.2 billion BOT scheme is being developed by Electricité de France, Transfield Holdings of Australia, and three Thai companies in association with the Lao PDR government. The project has recently started moving forward after a few years of inactivity. The Lao PDR Government has recently signed a power purchase agreement with EGAT and is now waiting on a decision from the World Bank on whether to grant guarantees and other financial assistance to the project.

The project consists of a 50-meter high dam on the Theun River, the fourth largest tributary of the Mekong, in central Lao PDR, and would flood approximately 450 square kilometers of the Nakai Plateau, an area of rich biological diversity. Water from the Nam Theun reservoir will drop more than 350 meters to a powerhouse with an installed capacity of 681 MW, almost all of which will be exported to Thailand. The water discharged from the powerhouse will then flow to the Xe Bangfai, which flows into the Mekong about 150 km south of the Nam Theun. The dam will necessitate the relocation of approximately 4,500 people.

A much greater number of families will be affected by the dam's construction without being directly displaced. Up to 40,000 people living along the banks of the Xe Bangfai could be significantly affected due to increased flooding and reduction in fish species. Thousands more people living upstream along the Nam Theun, and along the Mekong between the confluence of the Nam Kading and Xe Bang Fai, may also be affected. Many of these impacts cannot be mitigated. By all accounts this has been the least studied area in the project, and no procedures have been developed for consultation with these villagers.

Table 4.4 Proposed Hydropower or Multipurpose Dams in Central GMS Hotspot for which Feasibility/Pre-feasibility Studies Done (2020 Scenario in GIS Hotspot Map)

Name & location of dam Lat, Long	Stage of Development	Peak power, MW	Dam Height m	Reservoir surface area Ha	Developers	Notes:e.g .EIA done, fish flow release, number of people displaced	Power Sales To
Nam Ngum 2	Pre-F/S (1993)	320	169	5,750	Thai investor plus Bilfinger	EIA done 5778 people to be resettled	EGAT transmission grid
Nam Ngum 3	Pre F/S 1993 Feasibility and final design, construction start for 2001	700	220	3,830	GMS (MDX) Company	EIA study done	EGAT transmission grid
Nam Lik 1	Pre F/S						
Nam Mang 3	FS 1994, ADB	30	23	110	Chinese Company and EdL		EGAT transmission grid
Nam Ngiep 1	Pre-F/S (1991, France)	440	185	274			
Nam Ngiep 2,3	JICA grant, feasilibility study done	565			JICA and EdL		Local consumption
Ban Mai	Feasibility stage						
Nam Mo	Feasibility study (first stage)	366			JICA		Local consumption
Nam Theun 1	F/S 1993	540	163	7,800		EIA study Expecting an extensive resettlement	
Nam Theun 2	Final design finished and forest clearing partly done. Power purchase agreement to be signed by end of 2000, with EGAT	680	47	45,000	Thai-Australian-French (EDF) venture	EIA/SEAP 4500 people to be resettled	EGAT transmission grid
Nam Theun 3							

Data from:
1. *"Evaluation of radarsat Remote Sensing for Hydropower Reservoir Monitoring in Lao PDR"*, for Science, Technology and Environment Agency, Vientiane, by Hatfield Consultants Ltd., and RadarSat International, Vancouver, Canada, August 2000
2. Unpublished 1:2,000,000 Scale Map, MRC Water Resources and Hydrology Operating Division, 1999.

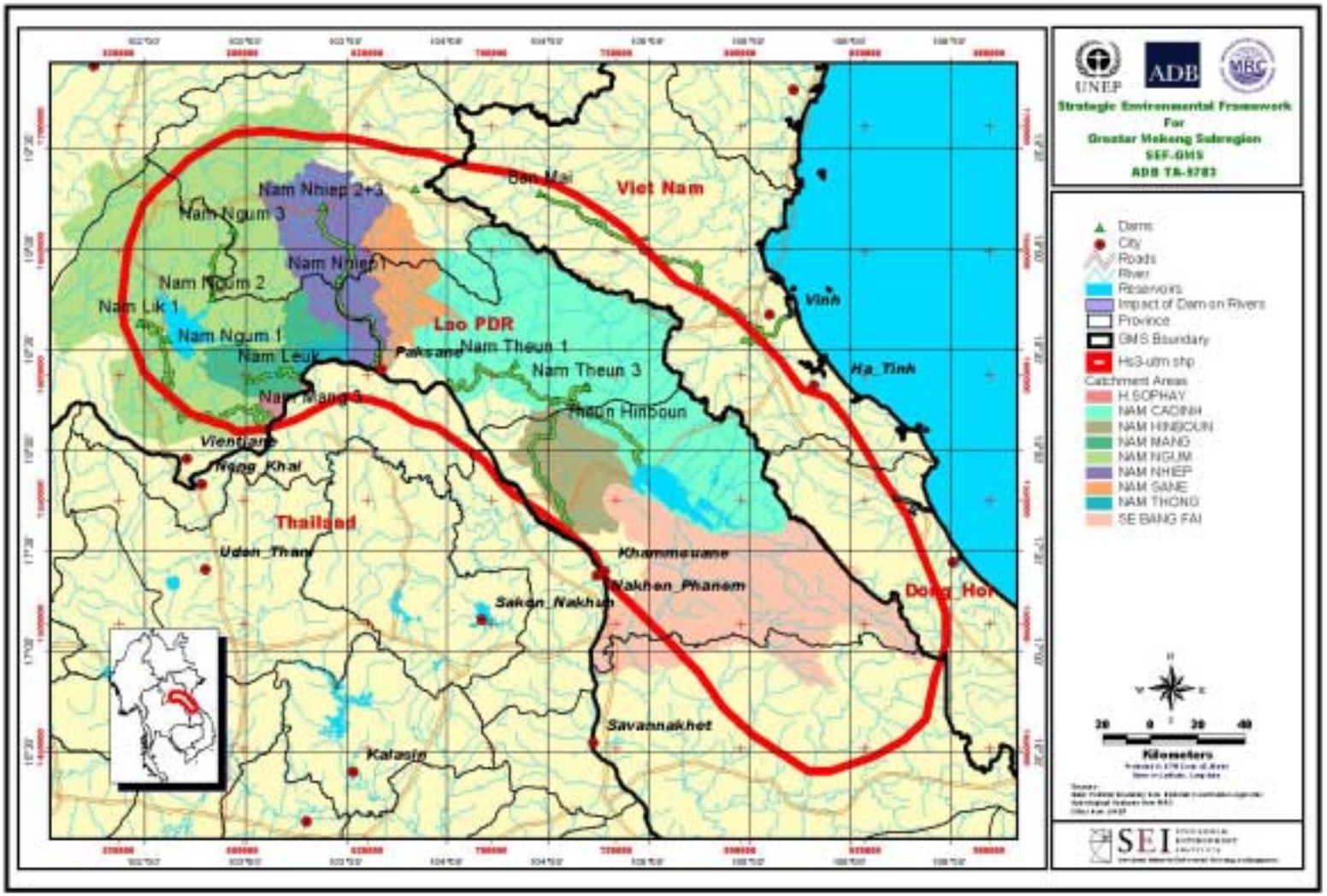

Figure 4.9 Proposed National Hydropower Projects or Multipurpose Dams, Central GMS Hotspot

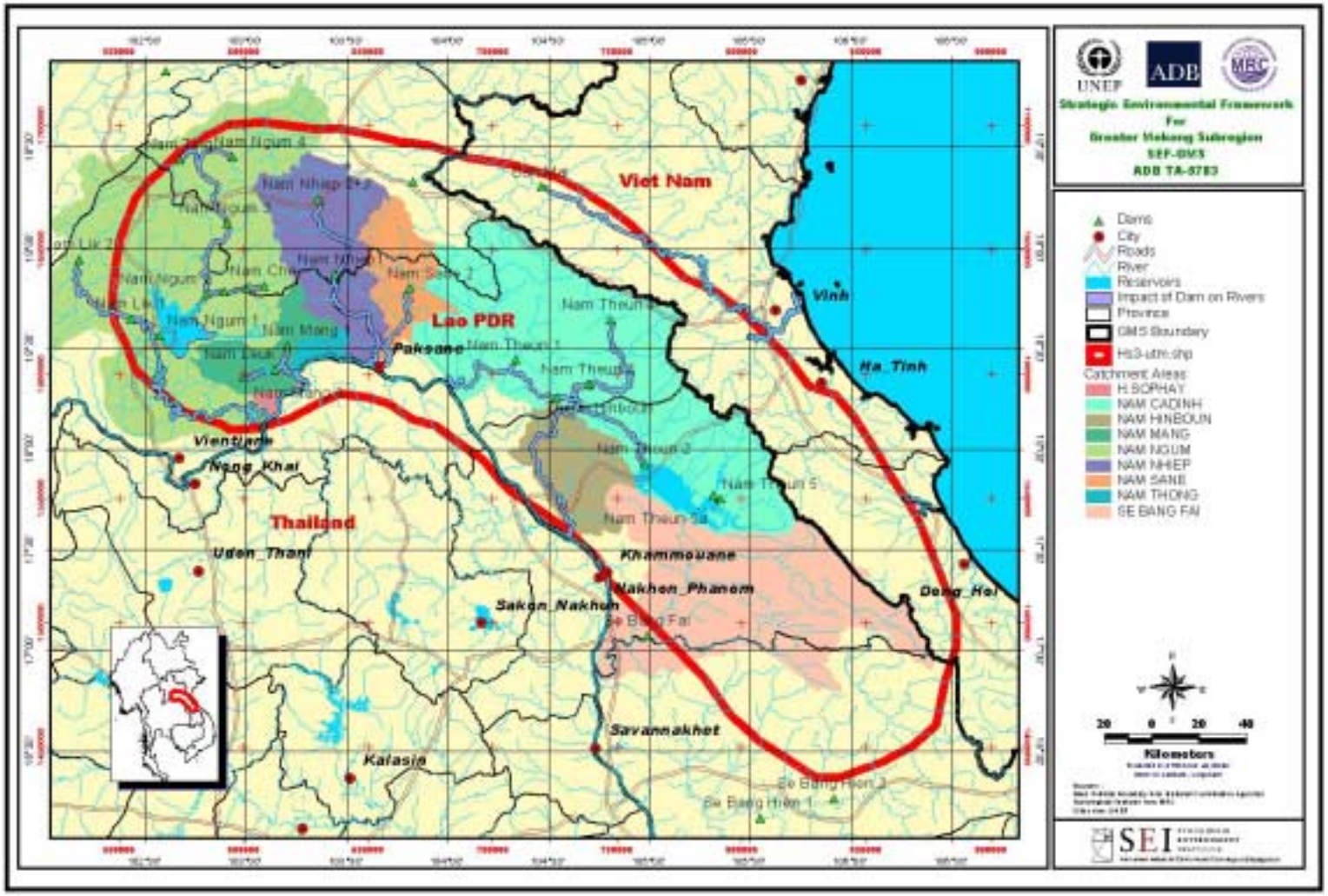

Figure 4.10 Full Scale Development

4.5 Vulnerable Areas and People

4.5.1 HVAs in the Central GMS Hotspot

HVAs in Hotspot 3 are located around the 5 key protected areas of the region and the corridors linking them. These include Nakai-Nam Theun NBCA, Phounhinpoun NBCA, Nam Kading NBCA, Hin Namno NBCA in Lao PDR, and Phong Nha and Vu Quang Nature Reserves in Vietnam. Areas of critical value include the Evergreen forests of the upper Nam Theun watershed and the forests associated with the belt of limestone karst stretching from the Mekong to the sea.

Although not ranked as critical the areas along the Lao PDR/Vietnam border north of Nakai-Nam Theun NBCA are of High value and clearly should be included within Lao PDR's Protected Area system as suggested by Berkmueller et. al. 1995.

Refer to Figures 4.11 and 4.12.

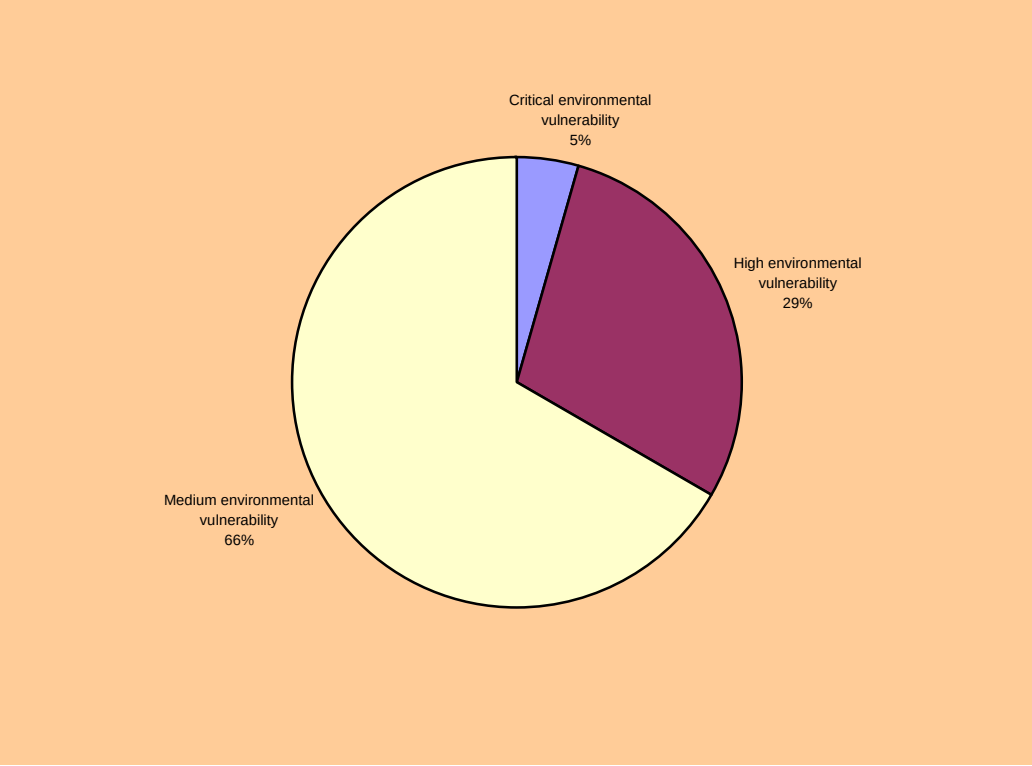

Figure 4.11 HVAs in the Central GMS Priority GMS Hotspot

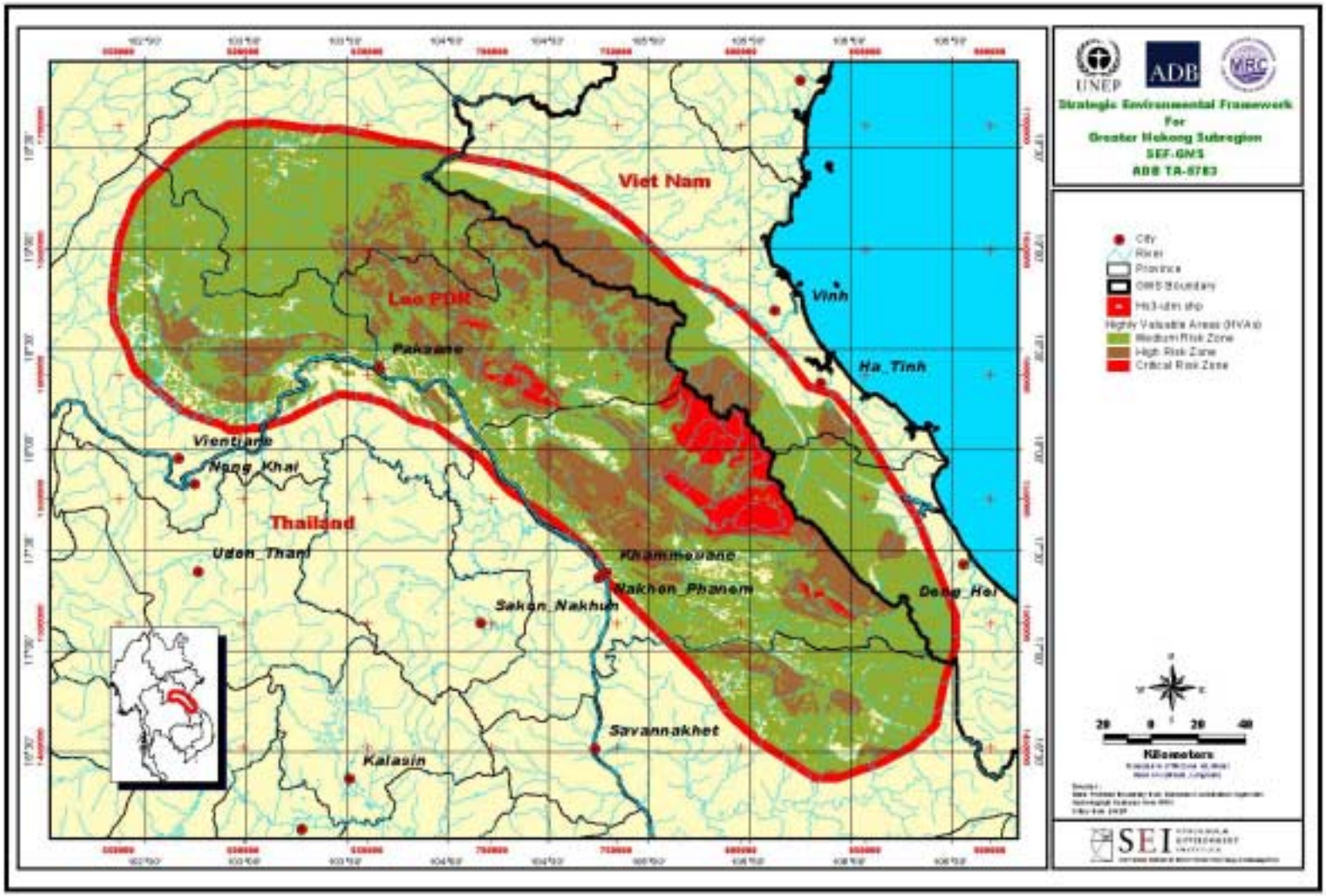

Figure 4.12 HVAs in the Central GMS Hotspot – All Classes

4.5.2 Indigenous People and Other Vulnerable Groups

The population in the area is also vulnerable in the sense that their livelihood options are few. Any intervention should therefore take due considerations to their current life style and basis of income with their participation and consent. Planning by developers and other outsiders has proven not to be able to secure a sustainable future livelihood for these peoples (IRN, 1998, NORPLAN, 1996).

4.5.3 Livelihood

The watershed areas in question (Nam Ngum, Nam Leuk, Nam Theun, Nam Hinboun and Xe Bang Fai) are greatly diverse when it comes to natural and human conditions. They encompass valleys with wet rice cultivation, hilly and mountainous areas with upland cropping and high plateaus where usually rice cultivation (wet and dry) are combined with gardening and livestock breeding. Forests are always a source for gathering and hunting and rivers are important for fisheries.

The hinterlands near the Vietnam border are populated primarily by groups practising shifting cultivation and harvesting forest products for sale to markets in Vietnam. A large percentage of the population relies on fisheries for their livelihood and this has been seriously affected by the construction of the Theun-Hin Boun and Nam Leuk Hydropower projects.

The Lao PDR government has also been actively relocating highland communities to the lowlands, especially from northern Bolikhamsay Province. These displaced communities can no longer rely on their traditional cultivation techniques and are gradually shifting towards a sedentary paddy rice system on marginal soils. The extensive studies in the area show that sustainable living is not feasible without major investments in irrigation, rehabilitation of fisheries, extension and credit services as well as in infrastructure including basic education and health facilities. These studies also confirm that structures need to be in place to allow the local population to actively take part in the design, planning, implementation and follow up of any development plan, whether this plan is caused by hydropower intervention or not (Chamberlain and Alton, 1996; Sparkes, 1997; 1998, Lahmeyer and Worley, 1998; IUCN, 1998; NTEC, 1998; NUOL, 1999).

4.6 Summary as a High-Risk Region

4.6.1 Transportation Projects

A set of three buffer zones has been mapped for the existing roads in Hotspot 3. These buffers represent risk from road construction and upgrading. The zones represent 1km from the road i.e. the area of easiest access in which resources will be extracted in the most immediate term; this is also the area likely to be settled. The second zone is 10km from the road; this area will become accessible from the road and can easily be visited within a day's walk. The third zone is 25km from the road this area will clearly feel the impact of the road either through overnight or longer expeditions for hunting and collecting or as an economic attraction for nearby communities.

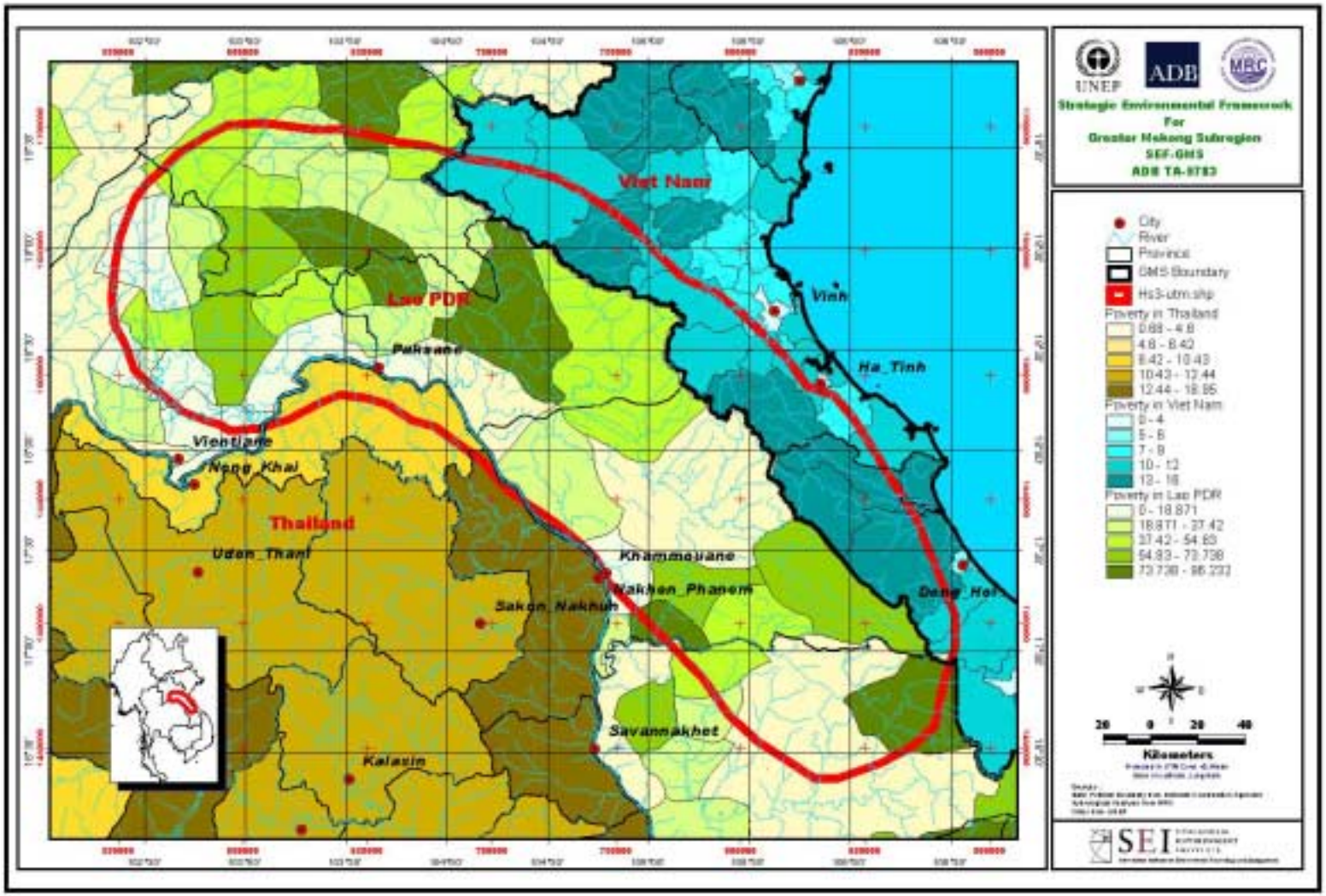

Figure 4.13 Poverty in the Central GMS Hotspot

As can bee seen in Figure 4.14 there are several large areas that are still further than 25km from the nearest road. This is not the case in the previous two Hotspots. These areas are accessible by travel by boat and are in some cases quite heavily populated. The eastern area coincides with the Nakai Nam Theun Protected Area one of the few true wilderness areas left in South East Asia. To the northeast the area around Khamkeut District, Bolikhamsai is one of the poorest areas in Lao PDR.

Table 4.5 Summary of Transportation Project Environmental Risk Zones, Central GMS Hotspot

Aggregated Social and Environmental Impact Zones		Area in Risk Zones km^2	Percent of Total Risk Zone Area	Percent of Total Hotspot Area
Category	**Risk Zone Ranking**			
High Environmental Risk	3	4,641	7.49%	6.30%
Moderate Environmental Risk	2	31,489	50.85%	42.71%
Low Environmental Risk	1	25,799	41.66%	34.99%
TOTAL		61,929	100.00%	84.00%

Table 4.6 Summary of HVAs in Transportation Project Risk Zones, Central GMS Hotspot

Highly Vulnerable Areas (HVAs)		Area in Risk Zones km^2	Percent of Total Risk Zone Area	Percent of Total Hotspot Area
Category	EVR			
Critical environmental vulnerability	3	3,333	4.96%	4.52%
High environmental vulnerability	2	19,564	29.13%	26.54%
Medium environmental vulnerability	1	44,257	65.90%	60.03%
TOTAL		67,154	100.00%	91.09%

Table 4.7 Detailed Classification of HVAs in Transportation Project Risk Zones, Central GMS Hotspot

HVAs		Environmental Risk Ranking			
Category	***SEVR***	***High (km^2)***	***Moderate (km^2)***	***Low (km^2)***	***Total***
Critical environmental vulnerability	3	2,554	15,863	38,629	57,046
High environmental vulnerability	2	765	6,601	25,183	32,549
Medium environmental vulnerability	1	15	432	3,343	3,790
TOTAL		782,554	454,464	67,155	

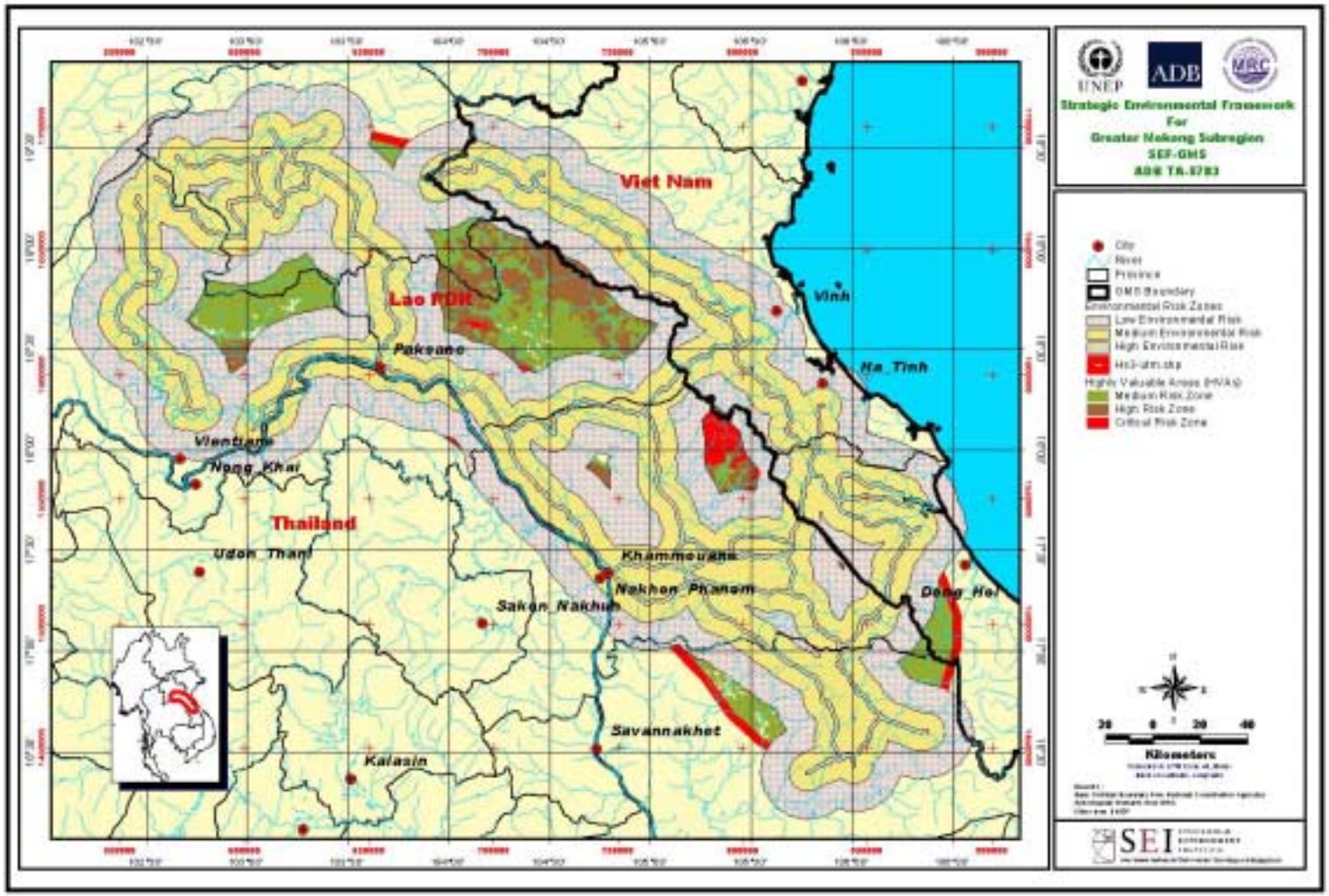

Figure 4.14 Road Project Risk Zones and HVAs in the Central GMS Hotspot

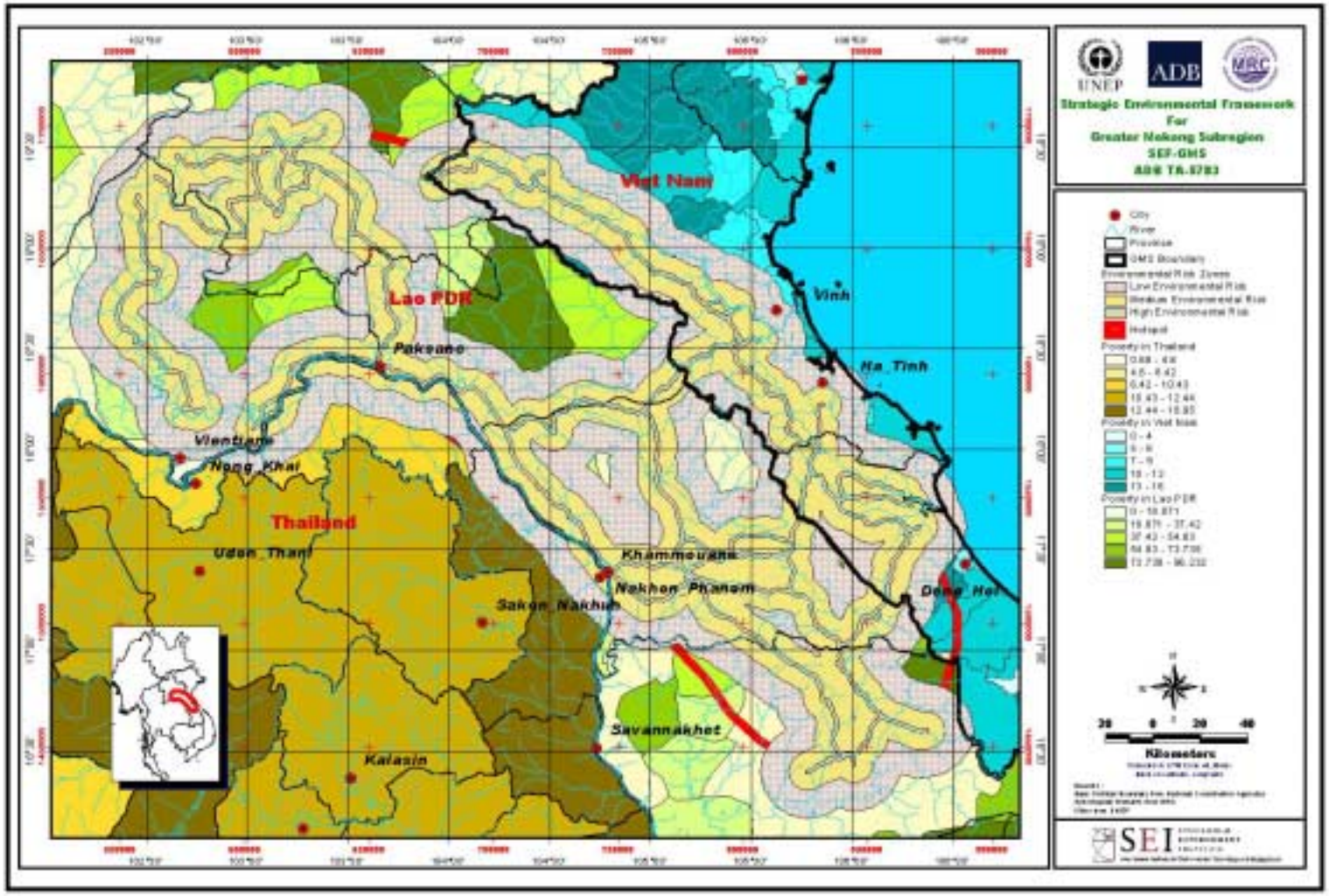

Figure 4.15 Road Project Risk Zones and Poverty in the Central GMS Hotspot

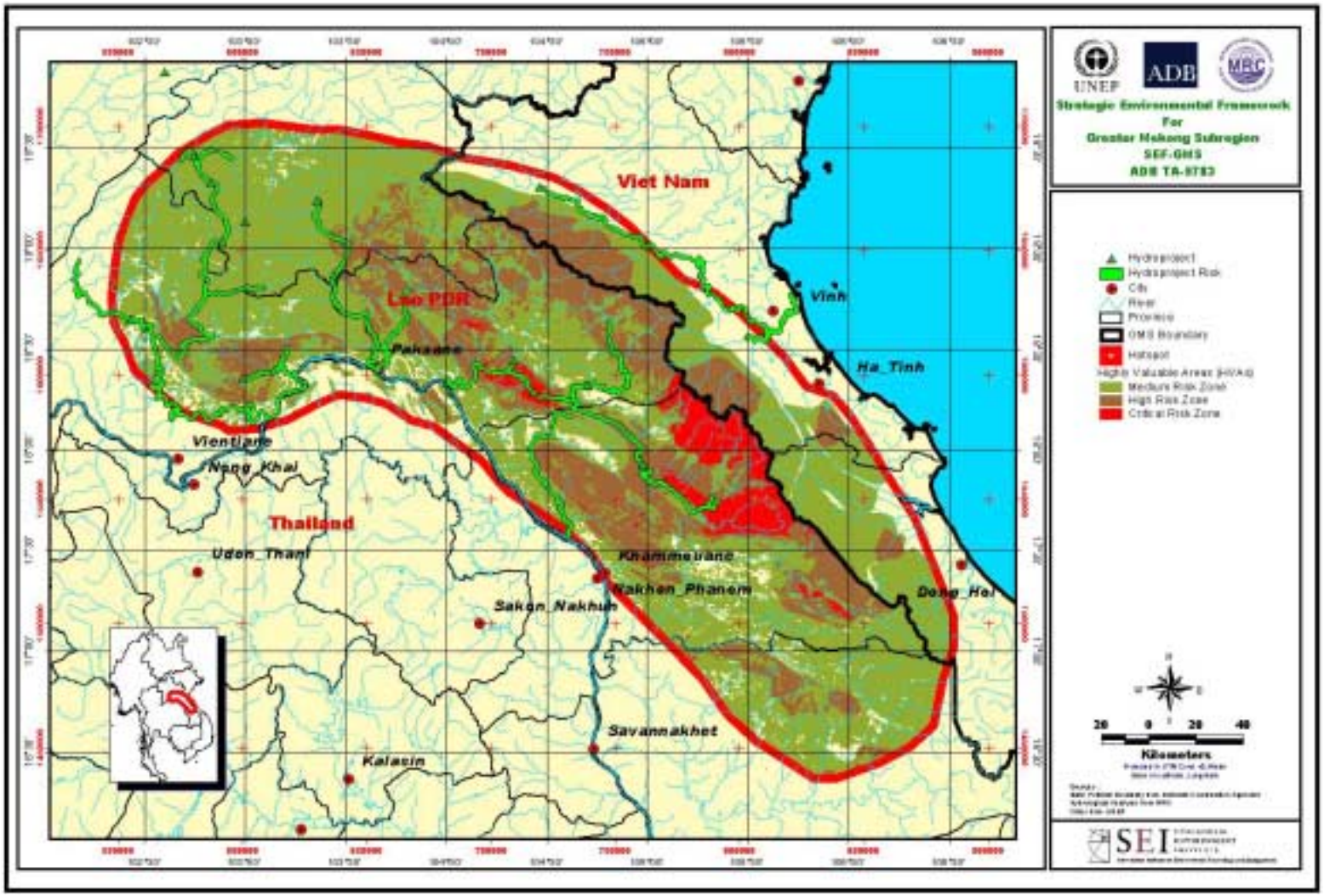

Figure 4.16 Hydro Project Risk Zones and HVAs in the Central GMS Hotspot

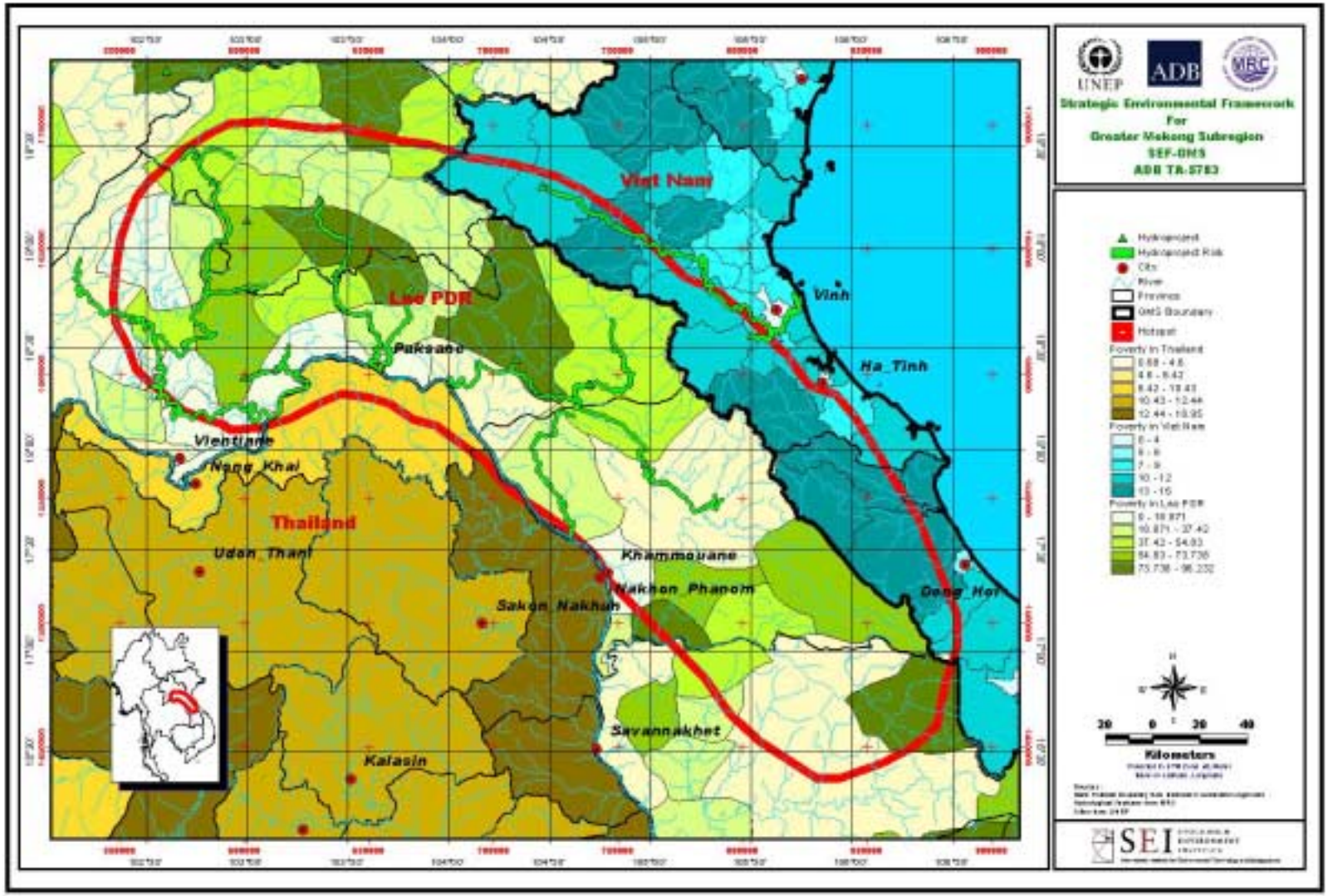

Figure 4.17 Hydro Project Risk Zones and Poverty in the Central GMS Hotspot

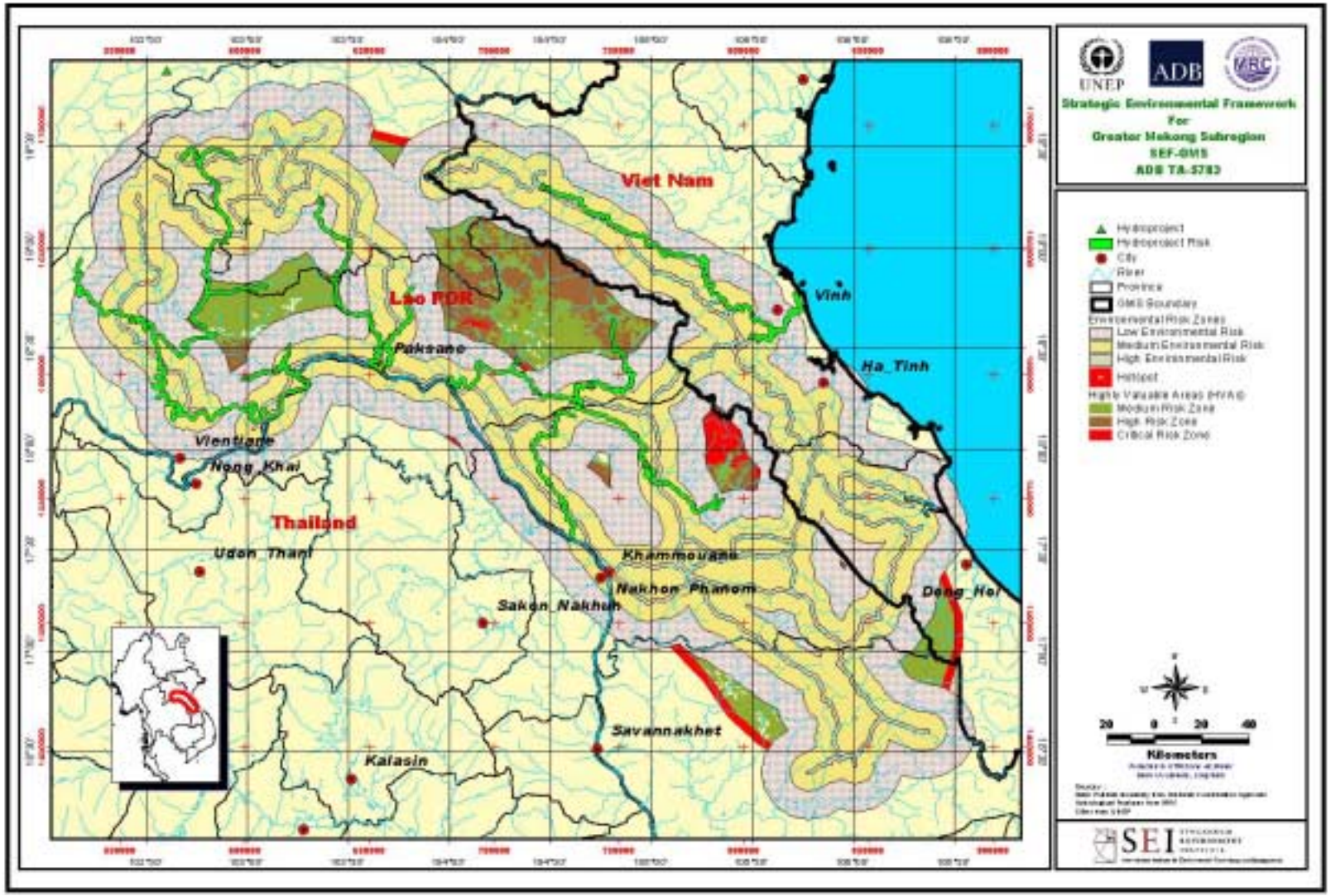

Figure 4.18 Road and Hydro Project Risk Zones and HVAs in the Central GMS Hotspot

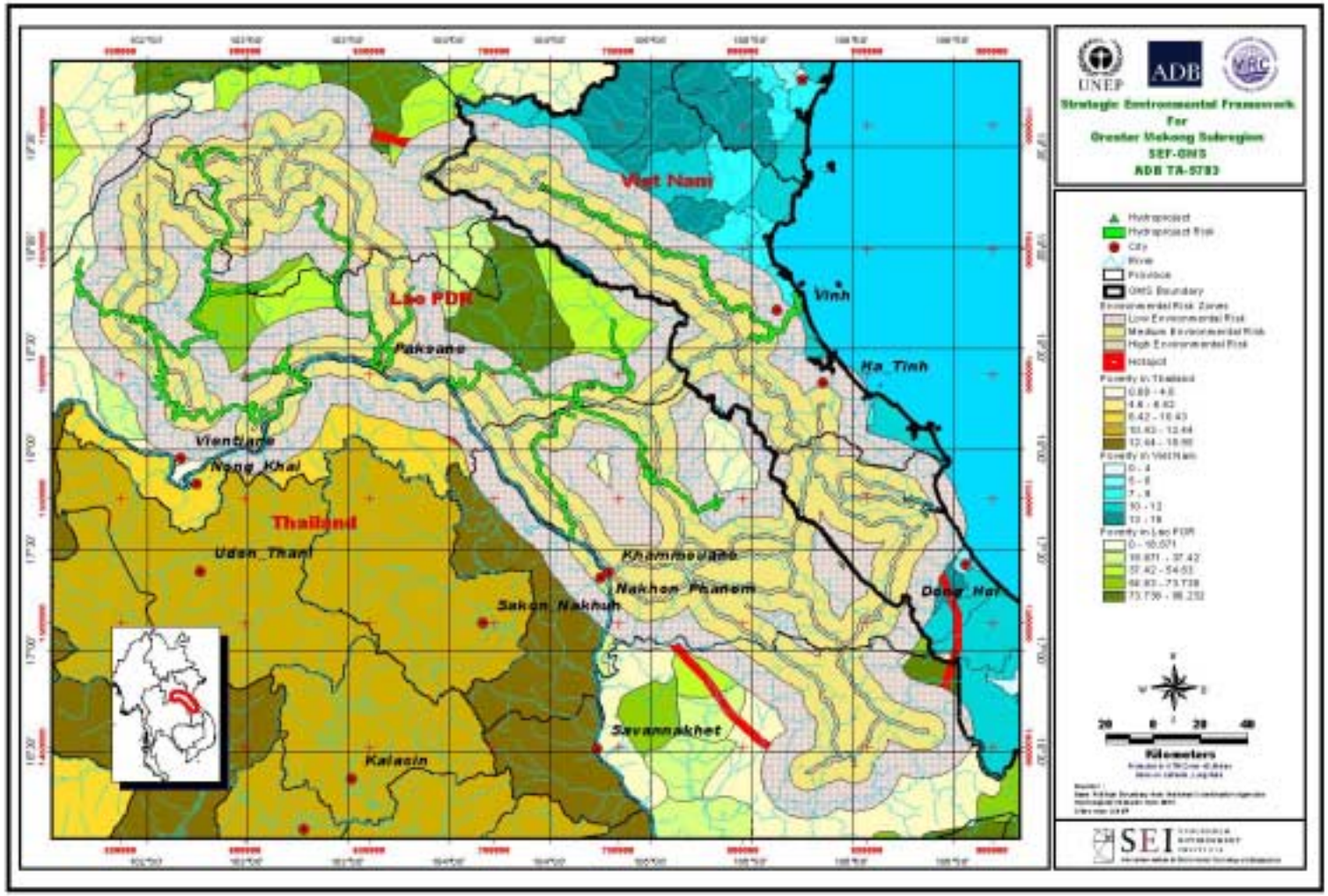

Figure 4.19 Road and Hydro Project Risk Zones and Poverty in the Central GMS Hotspot

4.6.2 Hydropower Projects

A proposed full development of Hydroprojects in the Hotspot has been overlaid onto the HVA map. This shows rivers affected by hydropower projects in the hotspot and highlights a 4km buffer on either side of the river.

Looking at Figure 4-16 the areas highlighted as HVAs is clearly at risk. Several of the most valuable areas in the Nam Theun/Kading basin are clearly bisected, fragmenting the larger of the existing forest blocks within Protected areas.

In relation to the broad scale poverty mapping several of the prime districts are lacking information. However several of the poorest districts will clearly be affected.

4.6.3 Cumulative Impacts - Transportation and Hydropower Projects

The combined impacts of both Hydropower and Transport on HVAs and Poverty are mapped in Figures 4.18 and 4.19.

4.6.4 How Important Overall

The Central GMS Hotspot, like the Se San/Se Kong Hotspot is at high risk from Habitat fragmentation and biodiversity loss due to potentially huge impacts associated with the planned hydropower projects.

The Hotspot supports a diverse flora and fauna unique to the northern Annamite Mountains and found nowhere else in the world. The discovery of several large mammals never before described by science in recent years highlights how little is truly known of the region.

While continued low living standard as well as investments for an improved living standard both seem to have a negative impact on the environment it is reasonable to put the question if people should be encouraged to live in the region at all.

4.7 Strategic Recommendations

Due to the presence of Hydropower projects the hotspot faces similar issues as Hotspots one and four. However in the situation of Hotspot three the problems are slightly simpler since the basins concerned are within a single country. This provides opportunity for quality planning without the complications associated with many transboundary considerations.

The area, especially the Nam Theun and Nam Ngum Basins are better studied than most other watersheds in the region however current information is still insufficient, for example consider recent controversies over fisheries and livelihood compensation.

Nam Theun and Nam Ngum Basin Models – with a large number of planned hydropower projects associated with these two basins there is a need to better understand the cumulative effects of continued project construction. A model capable of covering several development scenarios would be helpful in guiding decision-makers. Such a model could be designed in conjunction with the Mekong Basin model recommended for Hotspot one.

Nam Theun and Nam Ngum Basin Plans – as highlighted in SEF Principle number 5 continued financial support for Hydropower construction should not proceed without a basin development plan. Such a plan should include a strategy for Public Participation at all stages of the planning process. Basin Plans should be designed for all basins subjected to a

hydropower project. The Nam Theun and Nam Ngum basins are highlighted here as the two basins most in need of such planning.

Nam Theun and Nam Ngum Basin Management Authorities – in order to insure that the basin management plans are adhered to a management authority for each major basin will be needed. Such an entity would oversee that public participation occur at all levels of planning in perpetuity and ensure that the water and land resources would be used to maximise efficiency. This would be preferential to the situation of competing private interests currently envisioned.

Strengthen and connect existing system of protected areas – the current system of Protected Areas covering the spine of the Annamite Mountains between Lao PDR and Vietnam is of global importance for its Biodiversity and Ecological functions. These global values should be preserved in a series of connected protected areas and other compatible use zones. The financing of such a system could come in the short term from proceeds from limited Hydropower development through electricity sale as well as water use fees and in the longer term through eco-tourism and limited sustainable extractive uses such as community forestry or non-timber forest product harvesting.

This is only a short-lived opportunity for the GMS. If the protected areas remain weak, the resource extraction continues at unsustainable levels and the infrastructure projects proceed in their current poorly planned fashion; the GMS will lose the long lasting benefits of a well planned landscape where people continually benefit from development and their environment.

5. SE SAN/SE KONG PRIORITY GMS HOTSPOT OVERVIEW

5.1 Description

The Se San/Se Kong watershed is the second largest watershed in the Mekong drainage. The area holds some of the least disturbed forests in the entire GMS. These forests are home to a diverse range of indigenous people. These people in turn are reliant on a rich fishery that includes the Khone Falls area on the lower Mekong the most productive fishery in Lao PDR.

The area supports a number of globally important Protected Areas. These include: Dong Hua Sao NBCA, Xe Pian NBCA and Dong Ampham NBCA in Lao PDR, Virachay and Lomphat National Parks in Cambodia and Mom Ray Nature Reserve in Vietnam. These protected areas cover large areas of mixed deciduous forest in middle elevations while including lesser amounts of lowland evergreen forest. However, none provide protection to the broad sandy rivers that are unique to the area.

The area is also home to one of the few remaining areas that still support an almost complete assemblage of large mammals. The Se San River itself is the only river in the GMS outside of Myanmar that still supports an extensive variety of riverine sandbank dependent birds.

There are currently two major GMS road projects Routes 6 and 9 that will join the GMS through southern Lao PDR and northern Cambodia planned for the area.

There are twenty-five hydropower projects currently operating, being built or planned for the Hotspot. These include: Houay Ho, Se Pian/Se Namnoy, Lower Se San 1, 2, 3, Lower Sre Pok 2, 3, Upper Sre Pok, Prek Liang 1, 2, Upper Se San 4, Se San 3, Yali, Plei Krong, Dak Bla, Nam Kong 1, 2, 3, Huay Lam Phan, Se Katam, Se Kong 3, Se Kaman 1, 2, Xe Xou, and Stung Treng. For the planned projects, some will likely be infeasible, and some will certainly proceed to construction.

The Vietnamese part of the hotspot area covers the western part of the provinces of Gia Lai and Kon Tum. A majority of the people in this area is indigenous belonging to groups such as Gia Rai, Bana, and Sedang. The rest of the population is migrated Kinh. Generally, the closer to the border of Lao PDR and Cambodia the higher the rate of ethnic groups other than Kinh is.

In Cambodia the hotspot covers small parts of Kratie and Mondul Kiri Province, while it covers the greater part of Stung Treng Province and the whole of Ratanak Kiri Province. As in Vietnam this is also regarded as one of the most remote areas in the country. Beside the Khmer majority group, the two ethnic groups of Gia Rai and Radhe are traditionally living in the area.

The major part of the two provinces in southern Lao PDR, Champassak and Attapeu are located within the hotspot. The area is inhabited mainly by indigenous peoples and ethnic groups such as Katu and Bana who generally are known under their own ethnic name (Suay, Taliang, Alak, Ngae, Lawen, Oy, Chieng, Sapuan, Nyahon)

Table 5.1 Se San/Se Kong Priority GMS Hotspot Summary Characteristics

Location and Size	
Hotspot Area (km^2)	56,780 km^2
Percent of Total Area of GMS Priority Hotspots	24.2 %
Percent of Total Area of GMS	2.4 %
GMS Countries within Hotspot	Cambodia, Lao PDR, Vietnam
Area in Cambodia	25,964 km^2
Area in Lao PDR	20,492 km^2
Area in Vietnam	10,328 km^2
Biophysical	
Total Forest Cover[14] (km^2)	32,630 km^2
Percent of total Hotspot Area	57.5%
Wetlands (km^2)	4.4 km^2
Percent of total Hotspot Area	.008%
Protected Areas (km^2)	11,516.3 km^2
Percent of total Hotspot Area	20.3 %
Rare and Endangered Species [15]	Tiger, Elephant, Wild Cattle, Douc Langur, Large Waterbirds, Sand Bank Dependent Birds, Green Peafowl
Socio-economic	
Estimated Population[16]	2,047,124
Average GDP	Not Available
Ethnic Groups	Gia Rai, Bana, Rhade, Katu, (ethnic minority groups constituting a majority in the hotspot area) and Kinh, Khmer, Tai-Lao, who are the majority population in Vietnam, Cambodia and Lao PDR respectively
Agricultural Land (km^2)	4,242 km^2
Projects	
GMS Hydropower Projects[17]	Se San 3
GMS Road Project	Routes 6 and 9
National Hydropower Projects	Houay Ho, Se Pian/Se Namnoy, Lower Se San 1, 2, 3, Lower Sre Pok 2, 3, Upper Sre Pok, Prek Liang 1, 2, Upper Se San 4, Se San 3, Yali, Plei Krong, Dak Bla, Nam Kong 1, 2, 3, Huay Lam Phan, Se Katam, Se Kong 3, Se Kaman 1, 2, Xe Xou, and Stung Treng.
National Road Projects	Local secondary road upgrades

[14] Contiguous canopy covers with high or medium density (greater than 70 percent forest cover and over 20 percent crown cover with the forest cover).
[15] Partial list only
[16] Provincial Population Data
[17] Now removed from GMS Program

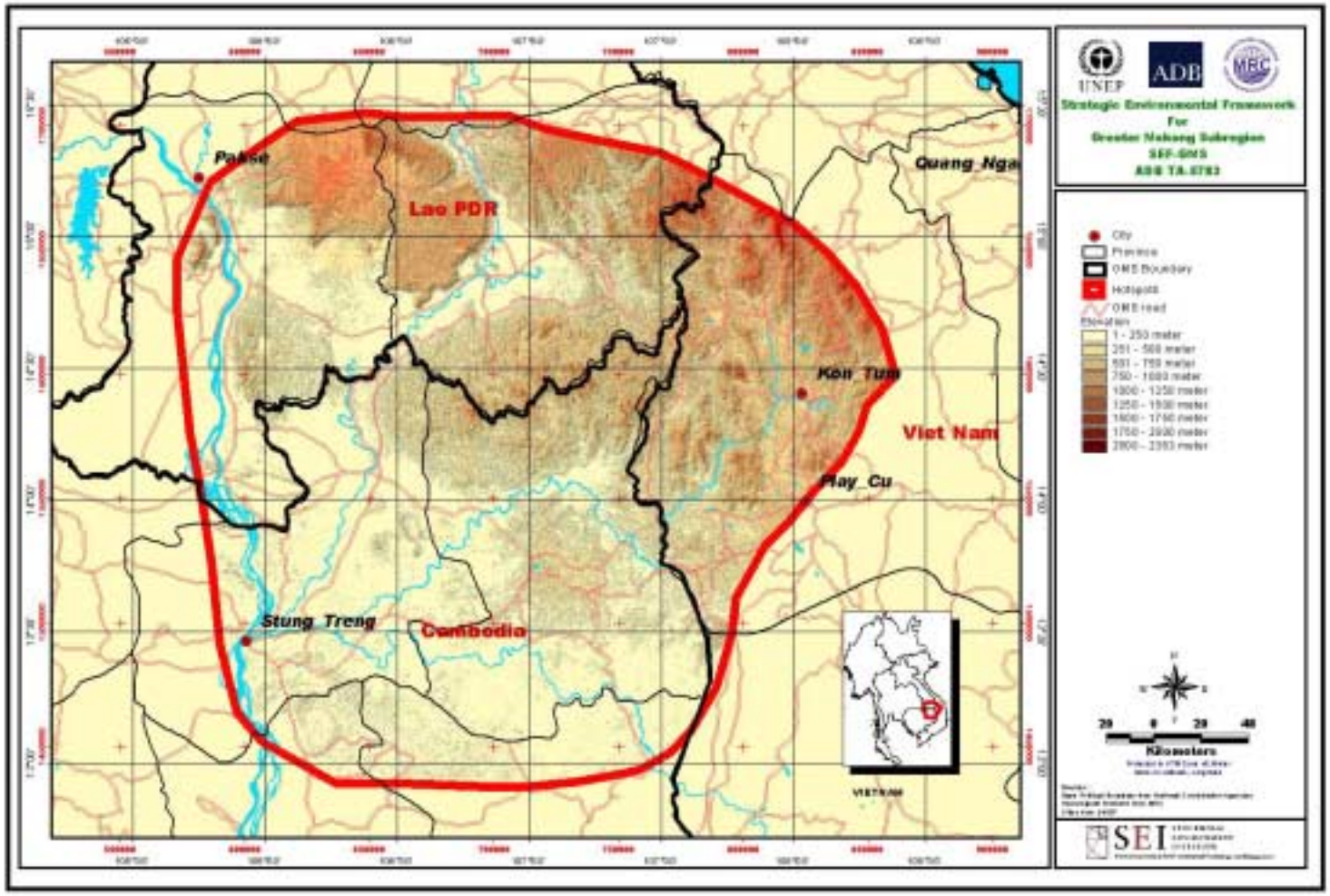

Figure 5.1 Overview Map of Hotspot (including political boundaries, roads, cities and town)

The Se San and Se Kong river basins are of high social and environmental value due to their cultural and biological diversity. This diversity is especially valuable along the rivers them selves and the associated riparian communities. These biological values are not sufficiently represented in Lao, Cambodia, or Vietnam's protected area system. It is these areas that are at the most risk from poorly planned hydropower development. The situation in Se Kong/Se San is exasperated due to the transboundary nature of both basins.

5.2 Biophysical and Natural Resources

5.2.1 Land Cover

Using UNEP's land cover data from 1992/1993 it is easy to see the large tracks of deciduous, dry mixed deciduous and evergreen forest found across the hotspot. Within these large forest blocks only small areas of land have been cleared for agriculture with most cropland concentrated along the Mekong plain in southern Lao PDR. The area of the Hotspot in Vietnam is characterised as scrubland, which is a result of the higher population pressures in Vietnam as well as the practice of shifting cultivation. Refer to Figures 5.2 and Figure 5.3.

The 1992 land cover data provides a snapshot of what was once a huge area of forested land. Recent in-migration and the sale of multiple logging concessions to foreign interests have further fragmented the remaining forest. This can be seen in Figure 5.4 , which is based on 1996 satellite imagery. The clearance of forest has only increased since then.

5.2.2 Forestry

The Se San / Se Kong Hotspot currently has a higher level of forest cover than any of the other hotspots. Unfortunately, most of the commercially valuable species of tree have been extracted since the end of the Indochina war. What remains is currently being extracted rapidly and in unsustainable quantities. Timber exports from Cambodia and Lao PDR represented 45 percent and 30 percent of foreign revenue earnings respectively in 1996 (Baker et. al., 2000). Thailand, Vietnam and China have all imposed bans on the felling of primary forest and are increasingly reliant on plantations and imports from neighbouring countries.

The nature of this extraction varies between countries. In Cambodia, parts of Ratanakiri, Stung Treng and Mondulikiri are currently held as concessions by a number of foreign companies such as Lansong International, Casotim Co., GAT International, Sam Ling International, etc. In Lao PDR, logging operations are undertaken by state companies and in some case the Vietnamese companies and military. Although all logging in Vietnam is currently on hold the large number of logs passing across the Cambodian and Lao PDR borders in the hotspot confuse the issue of how Vietnamese forests are being managed.

Recent work by the Asian Development Bank, the World Bank and several NGOs has promoted improved management on monitoring of the existing concessions in Cambodia as well as a heightened role for local communities in the management and benefits of sustainable forestry.

A recent review of forestry concessions in Cambodia, conducted by Fraser Thomas Consulting and funded by the ADB has recommended a moratorium on logging until competent management plans can be designed and implemented to insure sustainable harvests (Fraser Thomas, 2000).

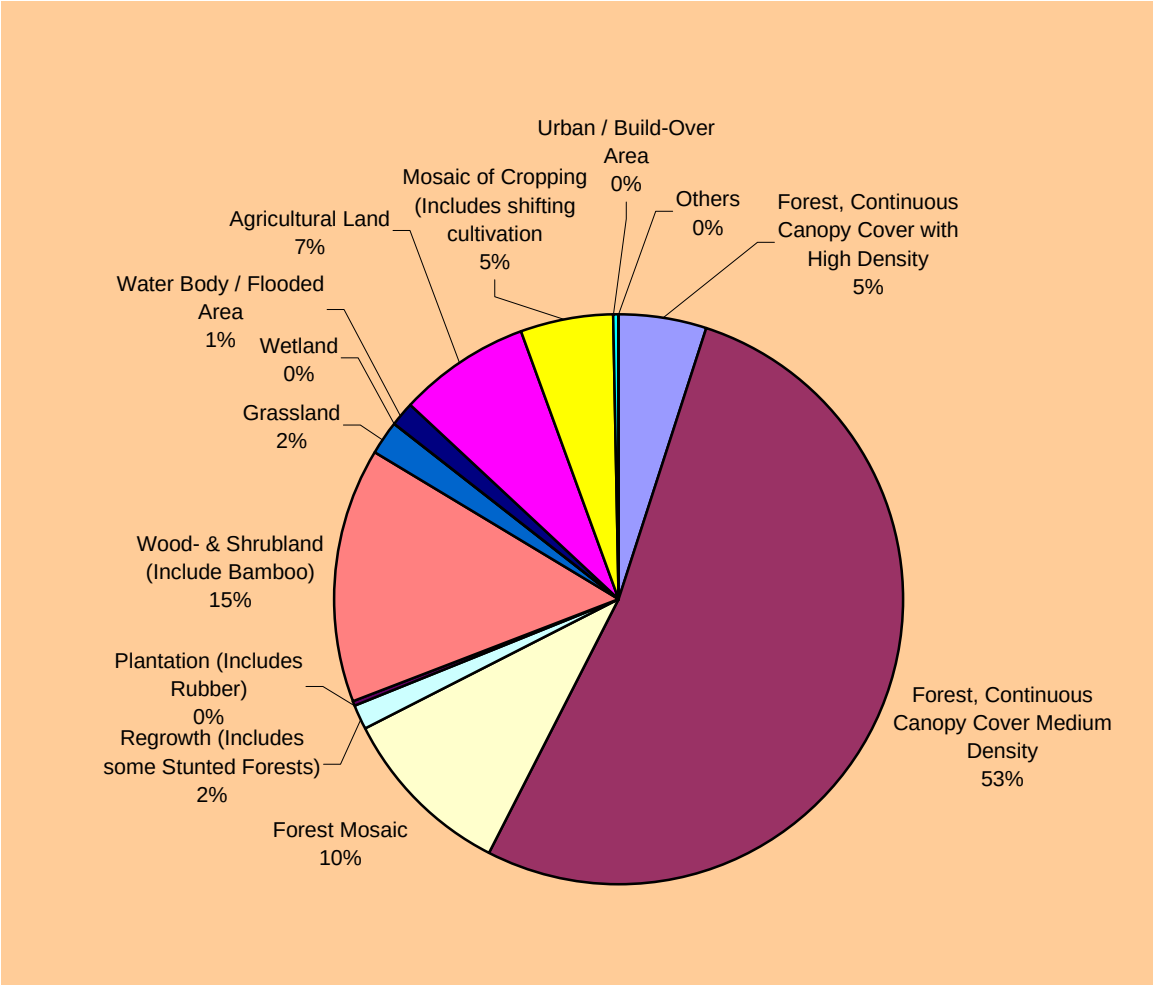

Figure 5.2 Forest and Land Cover in the Se San/Se Kong Priority Hotspot

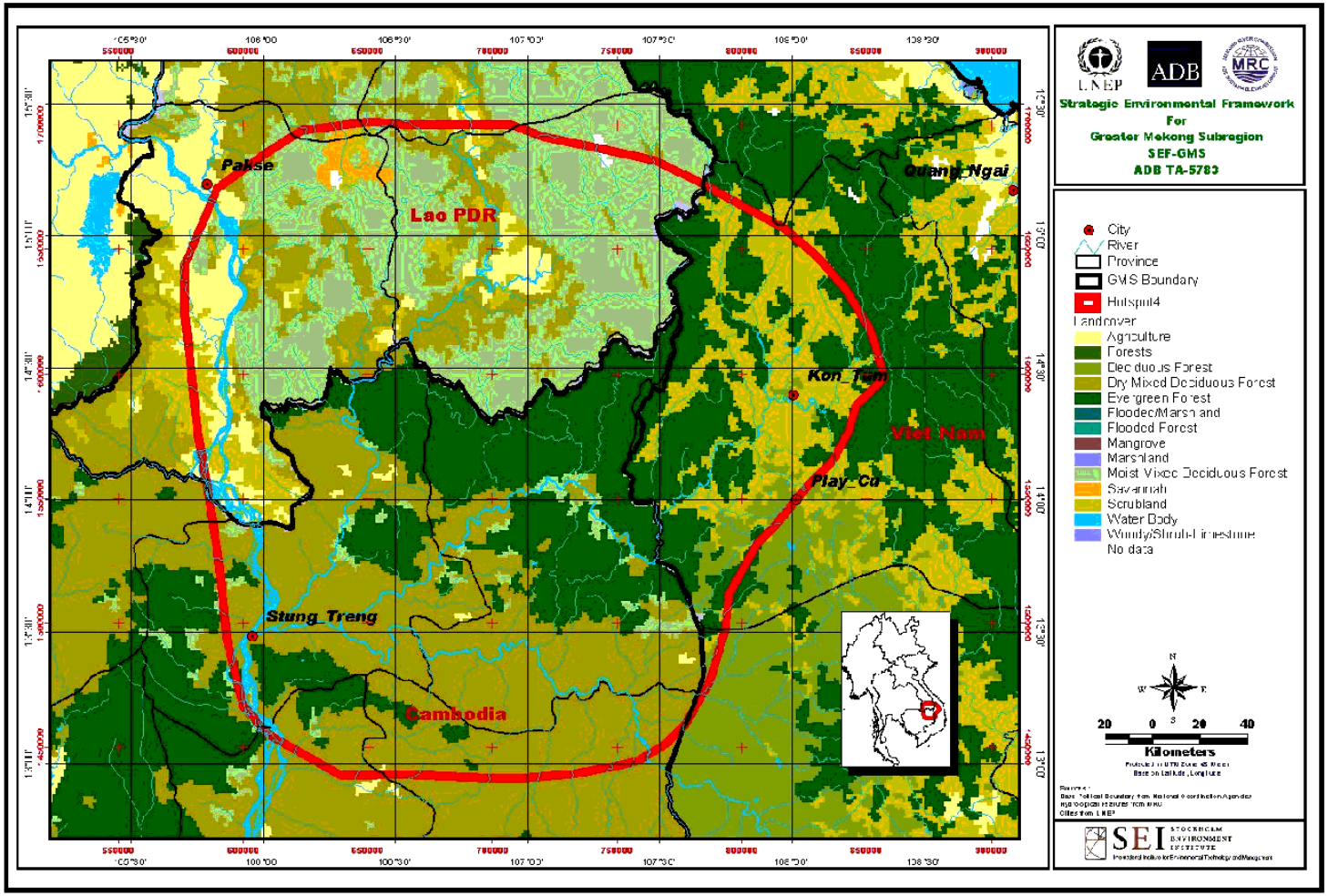

Figure 5.3 Land Cover in the Se San/Se Kong Priority Hotspot

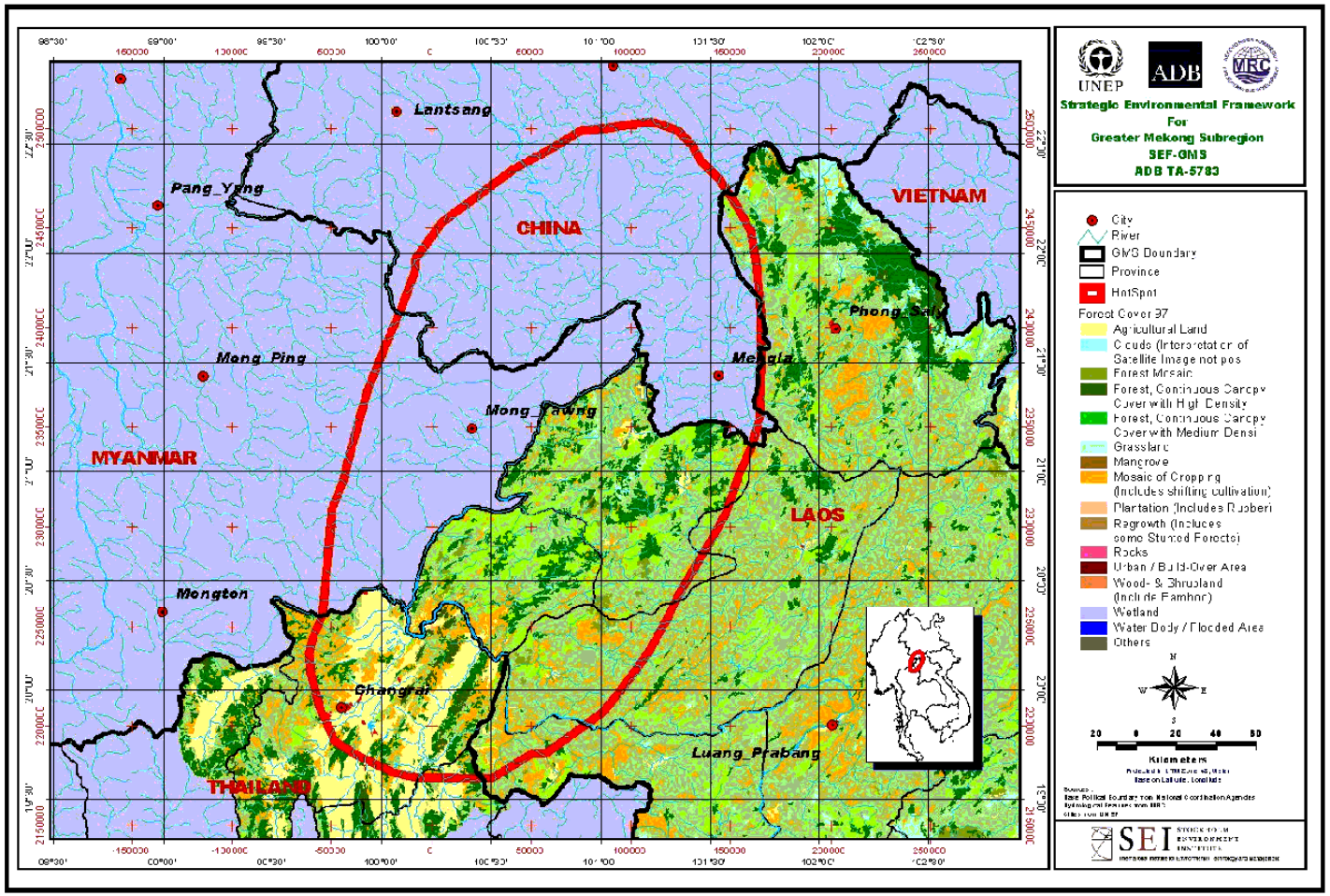

Figure 5-4 Forest Cover in the Se San/Se Kong Priority Hotspot

5.2.3 Fisheries

Hydroelectric and irrigation development is the greatest threat to the fish biodiversity and fisheries production of the Greater Se San and Se Kong hotspot area. Two hydropower projects are completed (Yali and Huay Ho), while another 30 have been proposed, including a Mekong River mainstream project at Khone Falls (Don Sahong) and several projects on the important Se San tributary. While is it unlikely that the Khone Falls project will be built (low head available, probable poor return on investment using the crudest indicators of environmental and social impact), a significant number of the other 29 proposed projects will likely be built in the next few decades.

The Khone Falls are a unique habitat and a site of exceptional biodiversity interest. The area below the falls is the most important fish production ground in Lao PDR (Roberts, 1993 and 1995). Many fish species migrate long distances up and down the Mekong during their life cycle, ranging from the Tonle Sap up to northern Lao PDR, and passing through the Khone Falls area. Important fish spawning grounds occur in the falls area. Some fish species have not been found elsewhere in the Mekong River and may be endemic to the Khone Falls. Significant fishing activity takes place almost all year round in and around the falls. Large deep pools in the mainstream Mekong below the Khone Falls are key dry season refuges for large fish species, some of which are endangered (Vannaren and Kin, 1999).

The Se San River is the most important tributary of the lower Mekong River basin, supplying 20.5 percent of annual flow. Large fish species (including rare and endangered species) migrate from the lower mainstream Mekong up into the Se San to spawn (Sam Nov, 1999).

The proposed proliferation of tributary dams in the hotspot area will likely have a major negative impact, both locally and transboundary. Because numerous species are known to migrate to, or through, the area, any blockage of migration routes will result in reproductive failure which will have consequences far up stream and downstream of the hotspot area. Deterioration of water quality downstream of planned dams due to deoxygenation could cause avoidance of the tailwater zone and thus interfere with normal migratory behaviour. In the worst-case scenario, hydrogen sulfide laden water discharges could result in mass mortality of traffic-jammed migrant fish below the dam. This will be particularly a problem during the first decade of operation of projects, as decomposition occurs of the inundated vegetation under the reservoir.

The hydropower projects, which are currently operational, have already had an impact on the fish biodiversity and fisheries production of the hotspot area. Given the high importance of the Khone falls area for the fish fauna of most of the lower Mekong basin, the threat posed by the planned hydropower development of the Greater Se San and Se Kong hotspot area should be given the highest priority rating of any potentially destructive development program in the GMS.

5.2.4 Protected Areas

There are six protected areas in the hotspot including: Dong Hua Sao NBCA, Xe Pian NBCA, Dong Ampham NBCA, Mom Ray Nature Reserve, Virachey National Park and Lomphat Wildlife Sanctuary. As with protected areas elsewhere in the GMS, there is limited management capacity and national funding for day-to-day operations. The World Bank is currently supporting management activities in Virachey NP and Mom Ray NR. WB funding for the Xe Pian NBCA has recently concluded but subsequent funding is likely to be provided by DANIDA. The Netherland's supported project in Dong Hua Sao NBCA will come to an end in early 2001. The other protected areas are currently receiving limited support from a variety of NGOs, including Birdlife International, WWF, Oxfam, and IUCN.

Table 5.2 Protected Areas in the Se San/Se Kong GMS Priority Hotspot

Name	Area (ha)	Location	National PA Category	IUCN PA Category[18]	Year Established
Dong Ampham	177,647	Lao PDR	NBCA[19]	VI	1994
Dong Hua Sao	94,724	Lao PDR	NBCA	VI	1993
Xe Pian	247,139	Lao PDR	NBCA	VI	1993
Virachey	347,348	Cambodia	National Park	II	
Mom Ray	10,000	Vietnam	Nature Reserve	IV	1986
Lomphat	249,674	Cambodia	Wildlife Sanctuary	IV	1960
Total	1,126,532				

5.2.5 Biodiversity

The Se San/ Se Kong Hotspot covers an area considered to be critically valuable by the recent WWF Eco-region prioritisation for the Forests of the Lower Mekong process (Baltzer et. al., 2000). Biological highlights include: A number of endemic birds as outlined by Birdlife International in their categorisation of Endemic Bird Areas (Statersfield et. al., 1998), a relatively intact assemblage of large mammals as outlined by Duckworth and Hedges (1998) and the only remaining full assemblage of riverine birds in the Mekong basin (Timmins et. al., 1998).

The area is unique florally for its large areas of dry deciduous forest, the unique floral regions of the Boloven and Kontum plateaux and the large remaining stands of globally endangered conifers along the Annamite range.

5.2.6 Water Resources

The Hotspot is entirely found within the Mekong drainage. Drainage is from high plateaux in the north (Bolovens Plateau), and the east (Kontum Plateau), in a southwesterly direction towards the Mekong River. Two rivers in the hotspot (Se San, 18,700 km^2 and Se Kong, 28,700 km^2) rank as large rivers in their own right. The area drains into the Xe Kong basin and its tributaries, the Se Xou, Se Kaman and Se San.

The residents of the hotspot are primarily reliant on wet season rice cultivation and fishing. In certain areas along the Se Kong, irrigation pumps have been introduced to support a dry season rice crop. This has met with limited success due to high prices for diesel fuel in comparison to the local prices for rice.

[18] See Annex 1 for IUCN protected area categories.
[19] NBCA – National Biodiversity Conservation Area

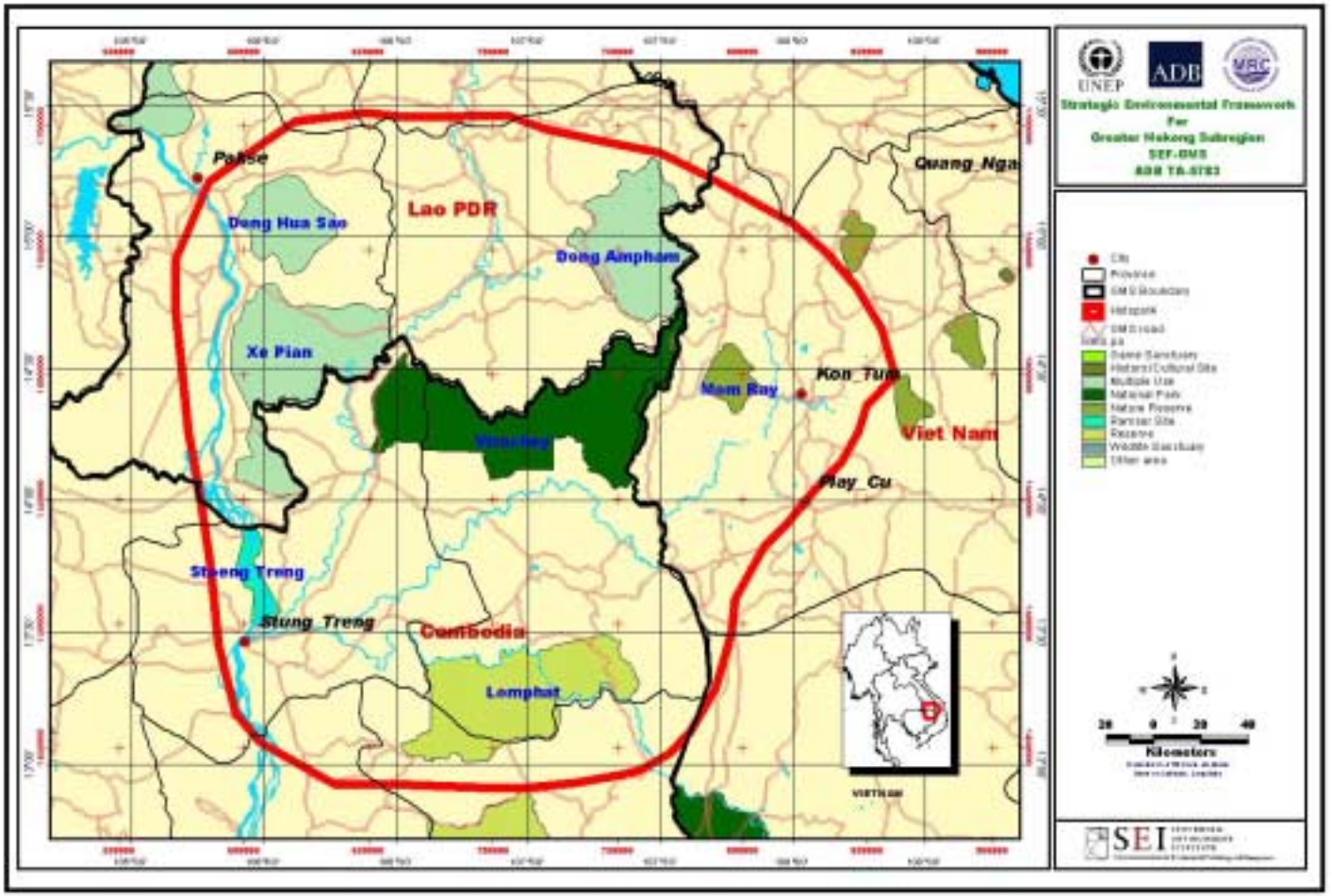

Figure 5.5 Protected Areas in the Se San/Se Kong GMS Priority Hotspot

Important development issues for water resources concern construction and operation of the two existing, and the many planned hydroelectric projects in the river basins of Se Kong and Se San (mainly within the hotspot). In addition the construction and operation of planned reservoirs in Vietnam outside the hotspot, on the Srepok River and its tributaries, will affect flows in the lower Srepok River (inside the hotspot). This poses a pressing need for a transboundary water agreement between 1). Vietnam and Cambodia, and 2). Lao PDR and Cambodia, concerning management of the river basins. Examples of such international agreements for other countries are described in MRC (1998).

Operation of spillway gates on large hydroelectric projects needs careful regulation, because of the potential for causing flooding in the downstream river and its floodplain by inadvertent opening of the gates. This situation happened in March 2000 at Yali, and resulted in large flows passing down the Se San River, causing unnecessary flooding, loss of irrigation weirs and loss of life in the river floodplain area in Cambodia. No mechanism was in place to notify local inhabitants about the onset of flood conditions.

As a result of this deliberate action/accident, an international agreement has been prepared to regulate releases from the spillway, and to give local inhabitants adequate notification. Under the agreement, a minimum flow of 200m^3/s will be maintained, two weeks advance notice will be given to Cambodia via MRC and CNMC, and four monitoring stations will be installed to check on flow rates in the Se San.

The existence of large reservoirs in the river system poses an additional threat, associated with the possibility of dam breakage/collapse.

For Hotspot 4, it is important to work towards international agreements and rules for water flows in the Se Kong, Se San and Sre Pok rivers, as a step in the direction of beneficial use of these rivers from the environmental and social view point.

5.3 Population

The Se San/Se Kong Hotspot contains the Vietnamese provinces of Kontum and Gia Lai, the Cambodian provinces of Ratanakiri, Mondulukiri, and Stung Treng; the Lao PDR provinces of Attapeu, Champassack, and Sekong with small portions of Kratie and Salavane.

Table 5.3 Population Density in Se San/Se Kong Hotspot

Province	Population	Year	Area km^2	Density Persons per km^2
Kon Tum	269,000	1997		
Gia Lai	844,400	1997		
Ratanakiri	94,243	1998		
Mondulikiri	32,407	1998		
Stung Treng	81,074	1998	11.092	7
Attapeu	97,000	1999	10.320	9
Champassack	558,000	1999	15.415	36
Sekong	71,000	1999	7.665	9
Total	2,047,124			

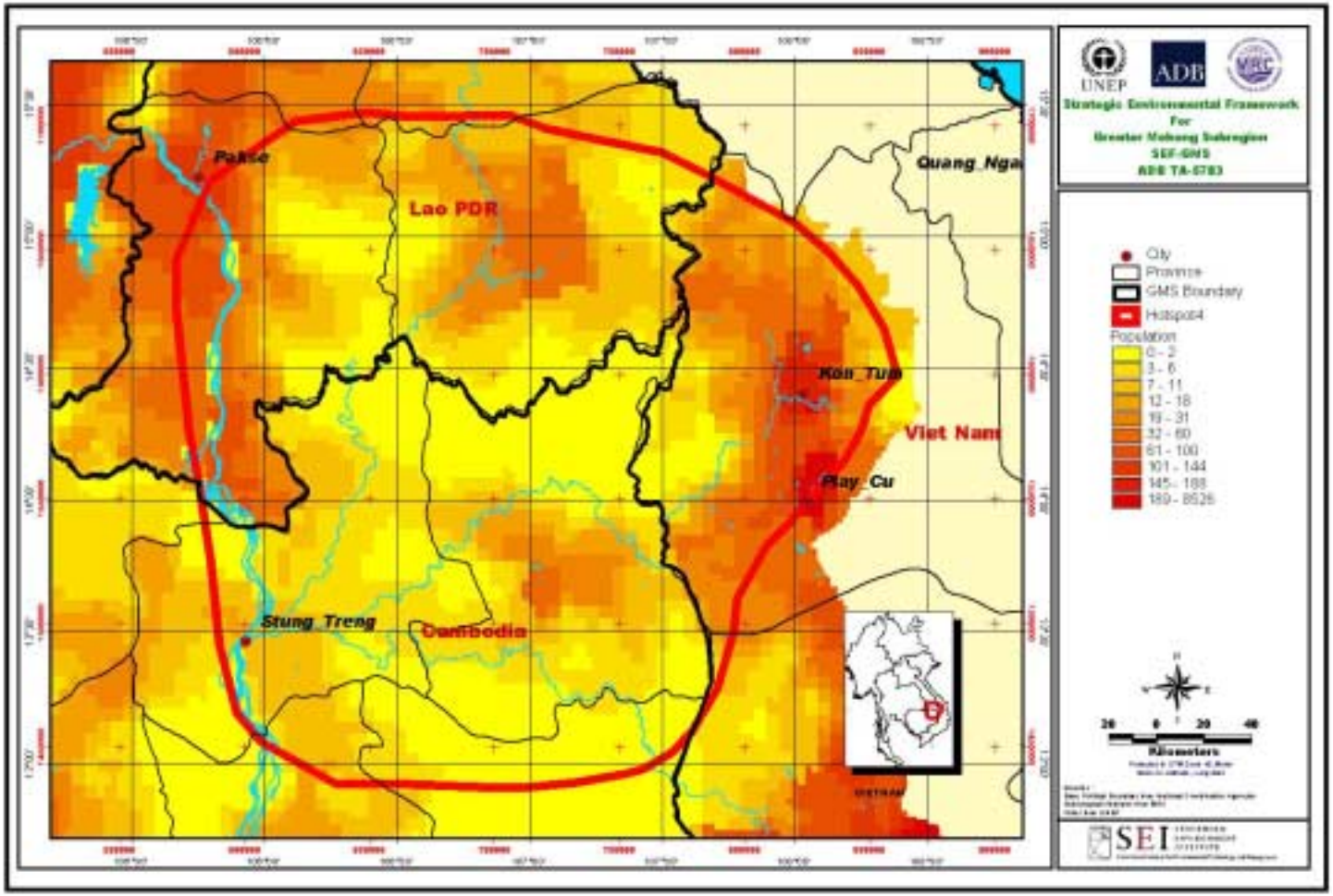

Figure 5.6 Population in the Se Kong/Se San Priority Hotspot

Although many urban dwellers in the GMS will benefit from "low cost" electricity, it is estimated that about 800,000 to one million people will be directly or indirectly impacted if all the hydropower plans are to be carried out. Most of them are indigenous peoples and belong to different ethnic groups such as Gia Rai, Bana, Rhade and Katu (Statistical Publishing House, 1998; National Institute of Statistics, 1999;: State Planning Committee, 2000).

5.4 Development Stresses

5.4.1 Transportation

Existing Road Network

The Se San/Se Kong Hotspot is located at one of the largest crossroads in the region, the connection between Cambodia, Lao PDR and Vietnam. Although not as high a priority as the East-West Corridor further north, the recent completion of a bridge over the Mekong River at Pakse has increased the potential of southern Route 9 to become a major transport artery in the GMS.

Current work on upgrading the remaining portion of the road through Attapeu Province to Kontum town is currently being conducted at the national level by Lao PDR and Vietnamese contractors. It is unclear how the financing for this road upgrade is being conducted. A portion of the road is being constructed as part of a barter agreement with the Vietnamese government in exchange for timber (Tizard pers. obs.). Other parts of the road have been supported by Thai business interests in exchange for access to logs and have sited a potential concession for duty free stores at the border. Previous plans had relied on the road developed for the Xe Kaman 1 hydro project and the clearing of the inundation area, the current status of that project is currently unclear but appears to be suspended.

The construction of Route 6 from Pakse to the Cambodian Border has recently been completed; this was funded by the Asian Development Bank. There are now plans to continue this link along the Mekong to Phnom Penh. Some stretches of the road are already receiving ADB assistance to upgrade. The border crossing between Lao PDR and Cambodia along this route has also recently been opened for tourism. This same route would also be followed by RW-4 and RW-6, the proposed GMS railway project aiming to link Vientiane with Phnom Penh. Refer to Figure 5.7.

Proposed GMS Road Projects and Status

There are two GMS road projects proposed for the area.

Route 6: Southern Lao PDR- Sihanoukville Road Improvement project

> The project would focus on upgrading the 486 km portion between the Lao PDR-Cambodia border and a point 16-km south of Skun; upgrading would involve Routes 7, 13 and 6. The actual routing is still being discussed.

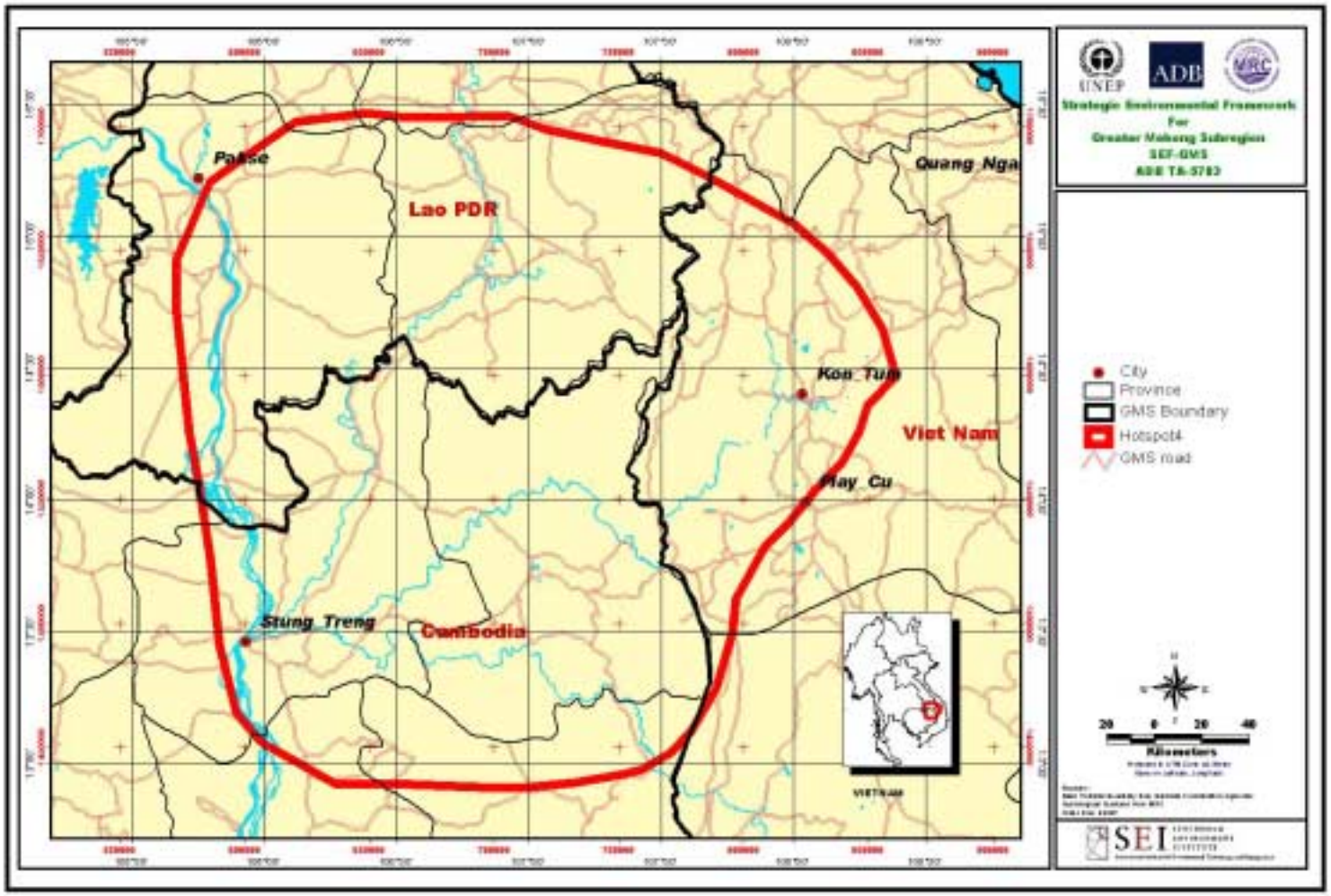

Figure 5.7 Existing Road Network, Se San/Se Kong GMS Priority Hotspot

Route 9: Northeastern Thailand – Southern Lao PDR – Northeastern Cambodia – Central Vietnam Corridor Project

The project would consist of upgrading Route 78 in Cambodia and Routes 19, 14 and 14B in Vietnam, leading to the deep sea ports at Quy Nhon and Da Nang; considering the relatively low traffic over much of the route, the project would be restricted to comparatively low-cost improvements.

National Roads

The **Truong Son Highway** is planned to link Hanoi with Ho Chi Minh City passing through the western part of Vietnam and provinces such as Kon Tum and Gia Lai. While it has not been possible to obtain a map for detailed analysis, private communication with representatives of the Ministry of Planning and Investment (August 2000) indicate that the highway will have a major impact on both natural and human resources in the area.

5.4.2 Hydropower Projects

Existing Dams

Only two Hydropower projects have been constructed in the hotspot. However many more are planned. The two built to date are:

Houay Ho

Houay Ho is a 150 MW trans-basin diversion scheme considered the first privately financed joint venture Build Operate Transfer (BOT) hydropower project in Lao PDR. The project diverts water from the Houay Ho stream on the eastern edge of Champassak Province of southern Lao PDR through a powerhouse located in Attapeu Province and is then released into the Xe Kong River. Houay Ho was built and funded by the Korean company Daewoo. Although the dam and power production facilities were completed, the portion of the transmission line inside Thailand has not yet been built, so the project is presently unable to operate.

It has been reported that Houay Ho has been plagued by cost overruns, is not believed to be profitable, and is understood to be for sale by Daewoo (Financial Times, 1998). The project is expected to be particularly hard hit by foreign exchange losses as a result of the depreciation of the Thai Baht. Reports that the reservoir is leaking raise questions about the structural integrity of the dam and the project's ability to store enough water to achieve projected power generation levels.

It is now widely acknowledged by both government sources and outside observers that the Lao PDR Government will receive few benefits from the project as a result of inequitable contractual agreements which heavily favour the foreign investors in the project. Foreign hydropower consultants report that the Lao PDR government had no legal representation while negotiating the concession agreement (IRN, 1998).

Yali Falls

The 720 MW Yali Falls dam began construction in 1993. The dam is located on the Se San River in Gia Lai Province, central Vietnam, approximately 70 km upriver from the international border with Cambodia. The cost of the dam, which is the largest ever built in the lower Mekong basin, has been estimated to be USUS$ 1 billion. This is not a low price for a project of this power magnitude and the profitability of the project will be sensitive to the repayment rates on borrowed capital and to the price of electricity. The Russian and Ukraine Governments are the main financiers of the project, along with the Government of Vietnam. Other countries, such as Switzerland, Sweden, Japan and Canada have provided technical support, and the Interim Mekong Committee helped plan and co-ordinate the project.

The main dam was closed and its 64.5 km^2 reservoir began filling up in 1998. However, the hydropower facility has only just begun operating, and all four of its turbines are not expected to be fully functional until 2001.

The closing of the dam, and subsequent irregular releases of large amounts of water from its reservoir down river, have seriously altered the hydrological regime and the water quality of the Se San River downstream. Unusual and dramatic fluctuations in river levels along the Se San River have caused major downstream environmental and socio-economic impacts in Cambodia. These impacts have been especially serious for the many indigenous peoples living along the Se San River in Ratanakiri Province (Baird, 2000).

Se Pian/ Se Namnoy

Se Pian-Se Namnoy Hydropower Project is in a remote area of the southeastern Bolovens Plateau in Champassak Province. South Korea's Dong Ah Construction Industrial Group has been the main partner in this joint venture BOT project with a 45 percent stake, with the Lao PDR government and unspecified Thai partners making up the rest. Currently, the 438 MW project is stalled and Dong Ah has withdrawn all of its personnel from the site.

The Xe Pian-Xe Namnoi project consists of multiple dams and stream diversions. The Houay Makcham stream is diverted into the Xe Pian River. The Xe Pian, together with the Houay Liang River, is then dammed and the water diverted through an eight-kilometer long canal into the Xe Namnoi River. A 78-meter high dam is to be constructed on the Xe Namnoi creating a reservoir in excess of 30 square kilometres. Water in the reservoir will be diverted through a canal and headrace tunnel down to a powerhouse at the base of the escarpment in Attapeu Province. The water then enters the Houay Pouk, which flows on into the Xe Kong River a few kilometres downstream from Attapeu provincial town.

Even though the project may never be completed, between two and three thousand extremely vulnerable ethnic "Nya Heun" minority people have been forced to move to the Ban Chat San Unit 8 site. Some observers believe that the project is being used to expedite the province's objectives of resettling ethnic minority people out of upland areas (IRN, 1998).

Although not completed, the construction of Se Pian/Se Namnoy Dams began in 1996. However due to the Asian Economic Crisis , the project was suspended. It is included here since construction has begun, it is unclear when if ever it will be completed.

Table 5.4 Existing Hydropower or Multipurpose Dams in the Se San/Se Kong Hotspot

Name	Funding Source	Stage of development	Peak Power Output MW	Dam Height M	Reservoir Surface Area Km^2	Reservoir Storage Volume Mm^3	Notes e.g. fish flow release, number of people to be resettled?
Huay Ho	Daewoo	Complete	150				
Yali Falls	Ukraine and Russian Governm ent	Complete	720		64.5	$779x10^6$	
Se Pian/Se Namnoy	Dong Anh, Lao Gov't., Thai Partners	Construction stalled	438	78	30		Resettling vulnerable Ethnic Minority

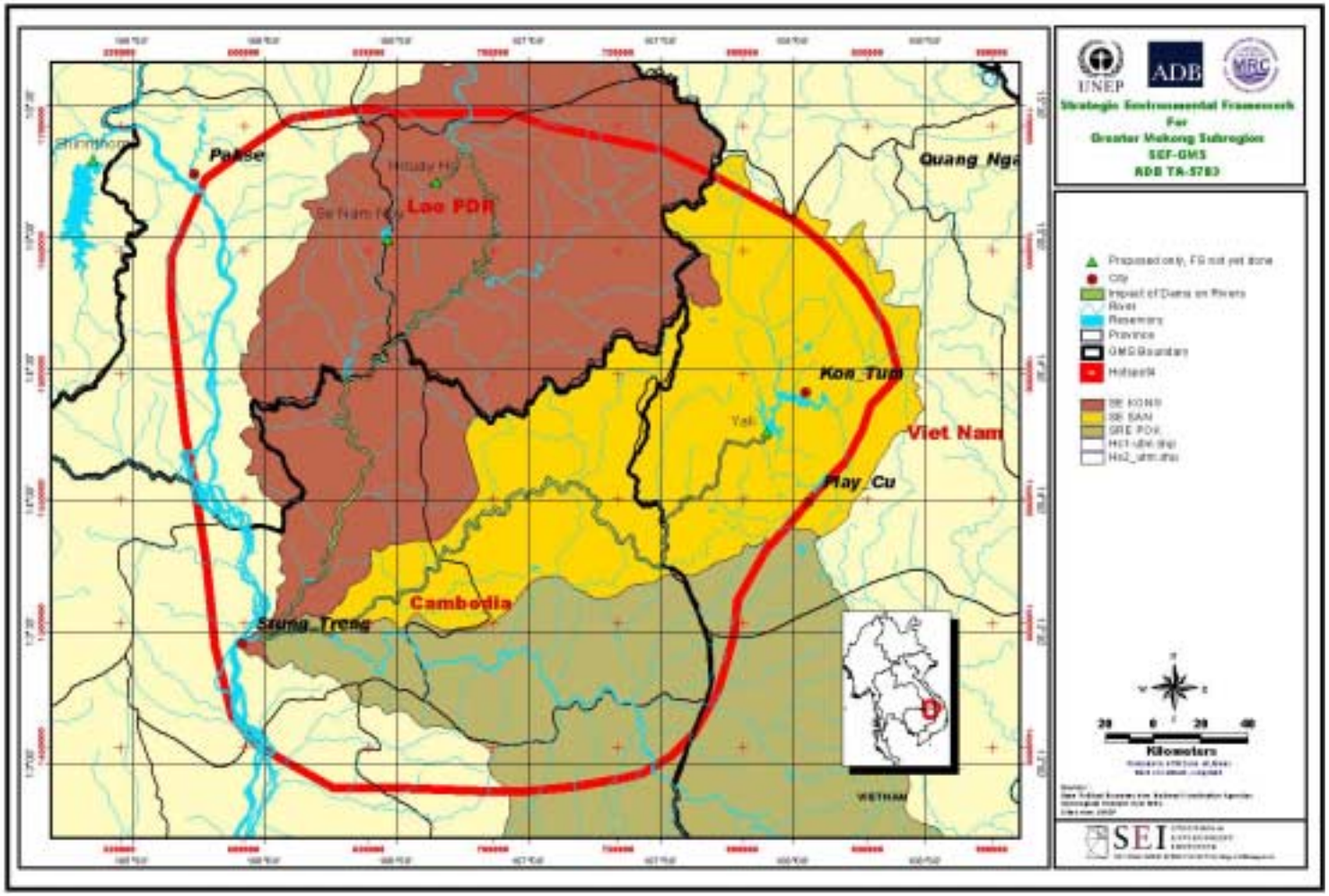

Figure 5.8 Existing Hydropower or Multipurpose Dams in Se San/Se Kong Priority GMS Hotspot

Proposed GMS and National Dams and Status

Several projects have been recommended for funding through ADB's GMS Program. However at present no dams in the hotspot are in the GMS portfolio.

Se San 3

The Se San 3 Hydropower Project will involve the construction of a 260 MW hydropower station on the Se San river, which was planned to be fully commissioned by the end of 2000. This proposed TA (PPTA: VIE31362-01) was listed under the GMS program but has now been removed after the Vietnamese government removed its request for funding for the EIA. It has been confirmed that the Vietnamese government will pursue separate financing for the project or fund it themselves.

Although not currently on the GMS schedule of projects, the GMS program supported a review of Hydropower Projects in the Se San, Se Kong and Nam Theun River basins. The following projects were recommended for future consideration (Halcrow, 1999).

Upper Se San 4

This proposed project has unique challenges and difficulties for a future bi-national agreement, as the dam would span the border between Vietnam and Cambodia. The Upper Se San 4 dam was considered to have the highest net present value (NPV) of the projects considered by the Halcrow study. They state that the best economic returns would come from its use as a 6-hour peaking scheme. It would be designed as a composite RCC/embankment dam incorporating a gated spillway and intake structure. A medium head powerhouse would be located on the riverbank downstream of the dam.

The reservoir would be of modest size and would benefit from the seasonal regulation provided by the Yali reservoir. They also state that it would benefit from the Se San 3 reservoir, if built.

The project as currently designed does not include downstream re-regulation facilities. If such re-regulating facilities were considered the economic return provided by the project would be reduced. However in the absence of the re-regulation, the effect of the 6-hour peaking flows through the turbines would be to cause continuous and un-natural fluctuations in flow downstream, which would upset the river ecology, and limit fishing prospects. The project would also resettle approximately 1000 people although it would flood only limited areas of productive land.

Nam Kong 1

Nam Kong 1 is a small proposed hydro project located in southern Lao PDR. The project would involve a storage reservoir, a tunnel and penstock to a medium-head powerhouse, downstream of the dam. The stream could economically produce 6-hour peaking capacity throughout the year and could also supply full emergency short-term output at almost any time.

The Halcrow study states that benefits in future Hydropower development and possible irrigation could increase the project's financial performance. It also states that the possible negative effects on fisheries and historical relicts were not assessed.

Lower Sre Pok 2

"The Lower Sre Pok 2 scheme is financially and economically more attractive than any other scheme found in the lower Se San River basin in Cambodia" (Halcrow, 1999).

This finding is surprising, as low head projects are normally not cost effective due to the very high price of penstock and turbines due to their very large size per unit power produced.

The project would consist of a low-head gated barrage with integral powerhouse on either side of an existing island. The scheme would be a run-of-river making energy output seasonally variable. The study states that its small reservoir size (120km^2) will cause fewer environmental impacts than the larger Lower Se San 2 project and because of this its associated relocation of local inhabitants will also be smaller.

Lower Se San 2

The Lower Se San 2 project would provide the lowest financial return of the projects studied by Halcrow. Two locations for the project were considered with the lower site just above the confluence of the Se San and Sre Pok rivers being chosen.

The design as it now stands would be a gated barrage with an integral low head powerhouse located in the existing river channel. This design returns a negative financial net present value. The lower site would create a 355 km^2 reservoir.

Environmental consequences would include impacts on navigation, fish migration, inundation and subsequent resettlement for a 'significant' amount of people and possible impacts on basin fisheries.

The bulk of the Hydroschemes proposed for the Hotspot will be built with private funding and negotiated directly with the respective governments. The following hydropower projects have been proposed for construction either through national or private interests. Although it is unlikely that all will be built, a large portion of them may be. They are listed in likely hood of completion.

Se Kaman 1

The 468 MW Se Kaman 1 Hydropower Project would be located in eastern Attapeu Province in the far southeast of the Lao PDR on the Se Kaman River. The dam would be located near the border with Vietnam. At 187-meters tall, the dam would be the second highest concrete-faced rockfill dam in the world, if it is built.

The US$500 million project is being developed by Austral-Lao Power (ALP); a company spun off from HECEC, a former Tasmanian state-owned company that was recently privatised. As of April 1998, no construction work had started on the project although resettlement has already commenced in both the watershed and inundation zones and preparations for logging and road building were underway.

Plei Krong

The Plei Krong project in Vietnam would be located on the Krong Poko River 3km upstream from its confluence with the Dak Bla River. The Plei Krong project is designed for considerable active storage and would raise the power production of Yali and other downstream projects such as Se San 3 and 4.

There are a number of other sources (JICA Hydropower Master Plan, 1995; CPEC WRMP Cam., 1995; and SWECO & PIDC1, 1997) that have proposed Hydropower development in the hotspot. These projects have for one reason or another not been developed to the pre-feasibility stage yet. They include: Lower Se San 1, Lower Se San 3, Upper Se San 4, Lower Sre Pok 3, Upper Sre Pok, Prek Liang 1and 2, Dak Bla, Huay Lam Phan, Se Katam, Se Kong 3, Se Kaman 2, Xe Xou, Don Sahong and Stung Treng.

Table 5.5 Proposed GMS and National Hydropower or Multipurpose Dams in the Se San/Se Kong Hotspot

Name	Funding Source	Stage of development	Peak Power Output MW	Dam Height M	Reservoir Surface Area Mm^2	Reservoir Storage Volume Mm^3	Notes e.g. fish flow release, number of people to be resettled?
Se San 3		Draft EIA	295			6	
Se San 4		Pre-feasibility	255			471	1000 people to be resettled Access to buffer zone of Mom Ray National Park
Upper Kontum		Pre-feasibility	210			151	1000+ people to be resettled Out of basin transfer impact on Dak Lo catchment
Se Kaman 3		Pre-feasibility	120				Access into remote area with potential Biodiversity conservation area Possible cross border biodiversity conservation area with Quang Nam Province
Nam Kong 1		Pre-feasibility	95				Approx. 200 people to be resettled
Lower Sre Pok 2		Pre-feasibility					Up to 1000 people requiring resettlement
Lower Se San 2		Pre-feasibility					Up to 2000 people requiring resettlement
Plei Krong					1,131		
Dak Bla							
Huay Lam Phan			58				
Se Katam			120				
Se Kong 3							Rejected because town floods
Se Kaman 1	ALP	Feasibility	300				Thought to be an excuse for a logging concession MOU exists

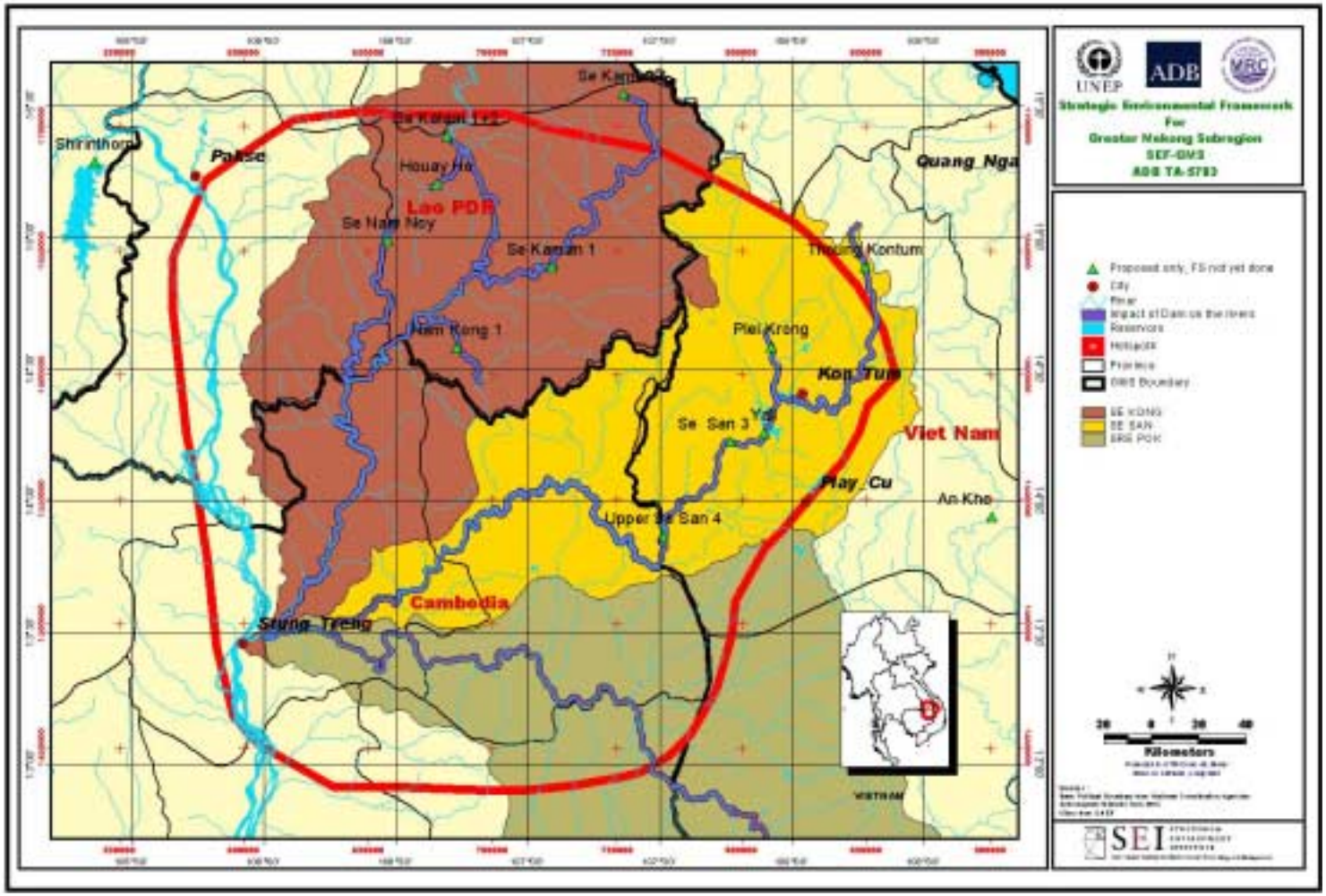

Figure 5.9 Proposed GMS and National Hydropower Projects or Multipurpose Dams in the Se San/Se Kong Hotspot

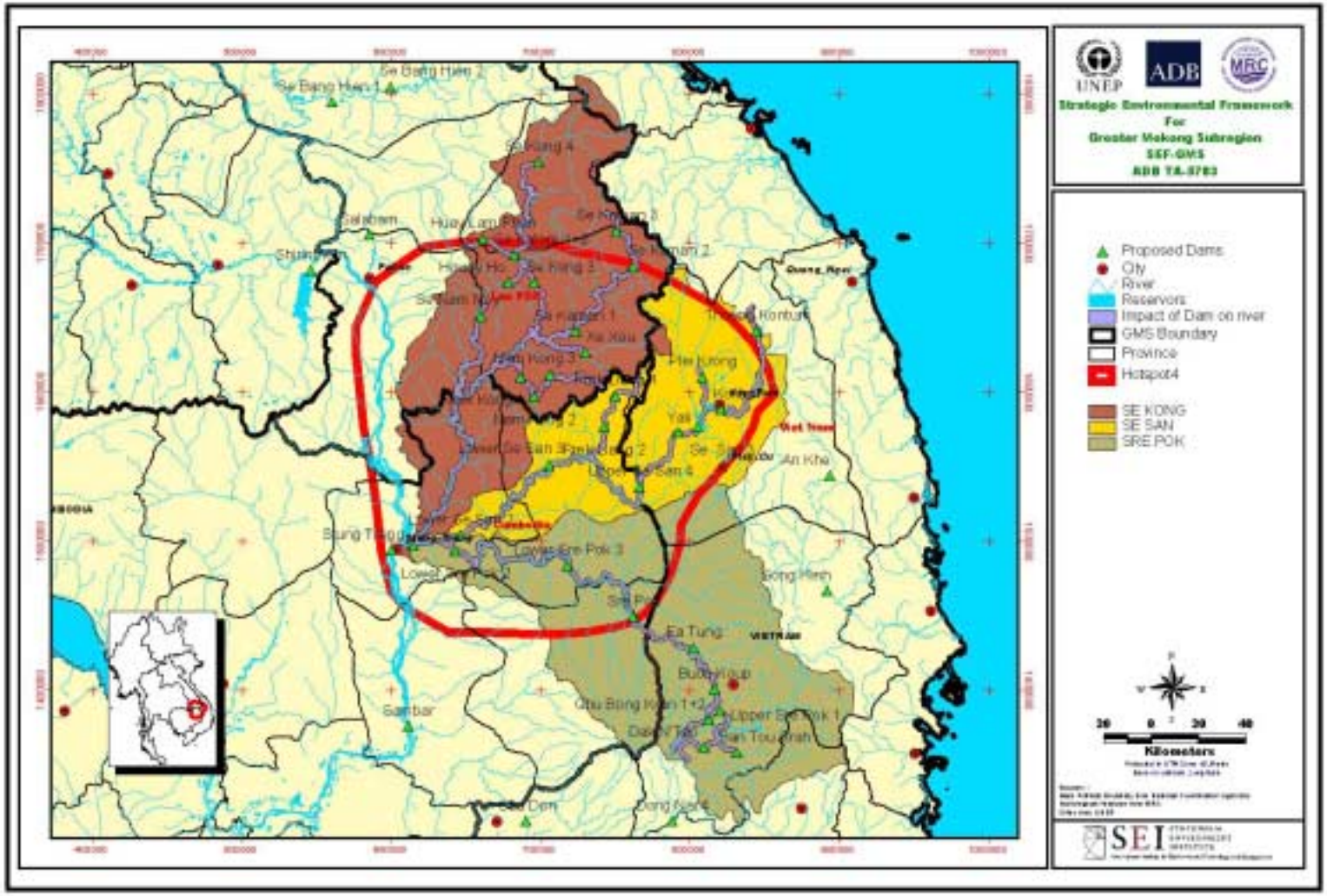

Figure 5.10 Future Hydro Scenario

5.5 Vulnerable Areas and People

5.5.1 HVAs in the Se San/Se Kong Hotspot

HVAs for Environmental Indicators have been ranked and mapped. Refer to Figures 5.11 and 5.12 for HVAs in the Se San/Se Kong Hotspot.

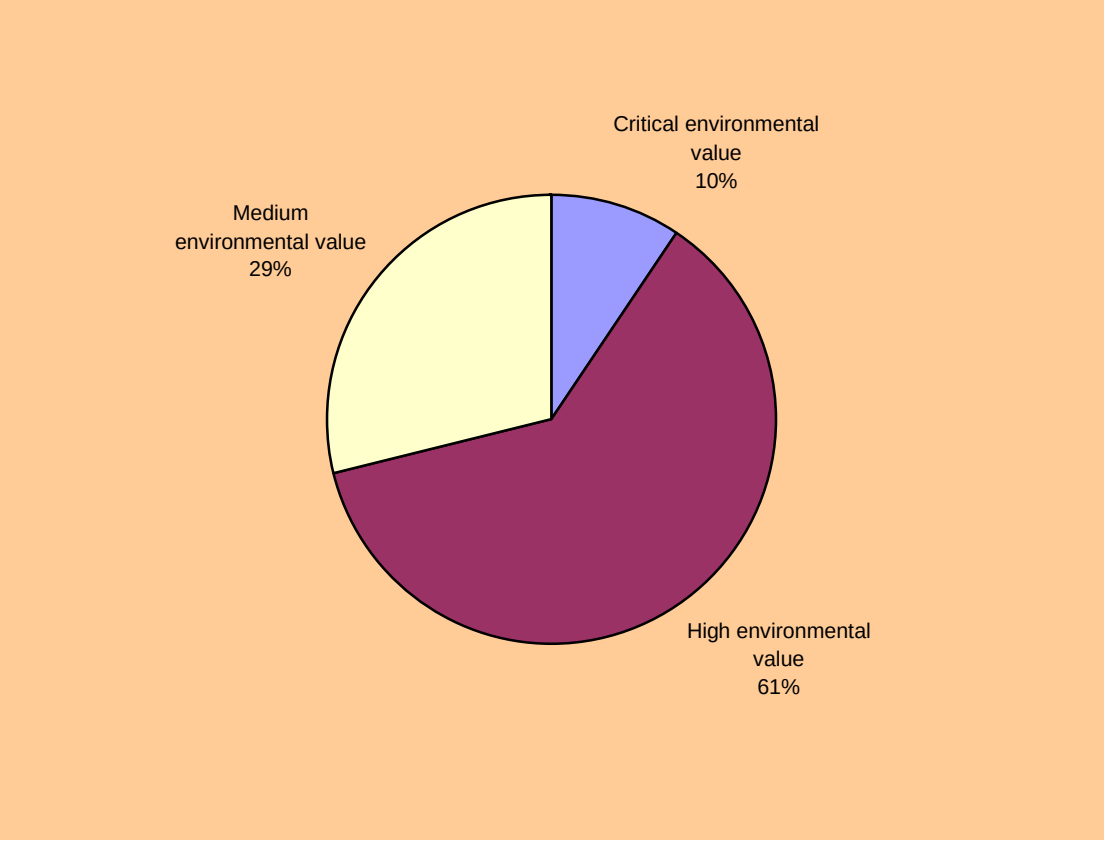

Figure 5.11 HVAs in the Se San/Se Kong Priority GMS Hotspot

As shown in Figure 5.11, the bulk (61 percent) of the hotspot is considered to be of High Environmental Value while (9 percent) is ranked as critical. These critical sites tend to be situated along major rivers or in key protected areas. The ranking for forest type and size is based on MRC forest cover data from 1997.

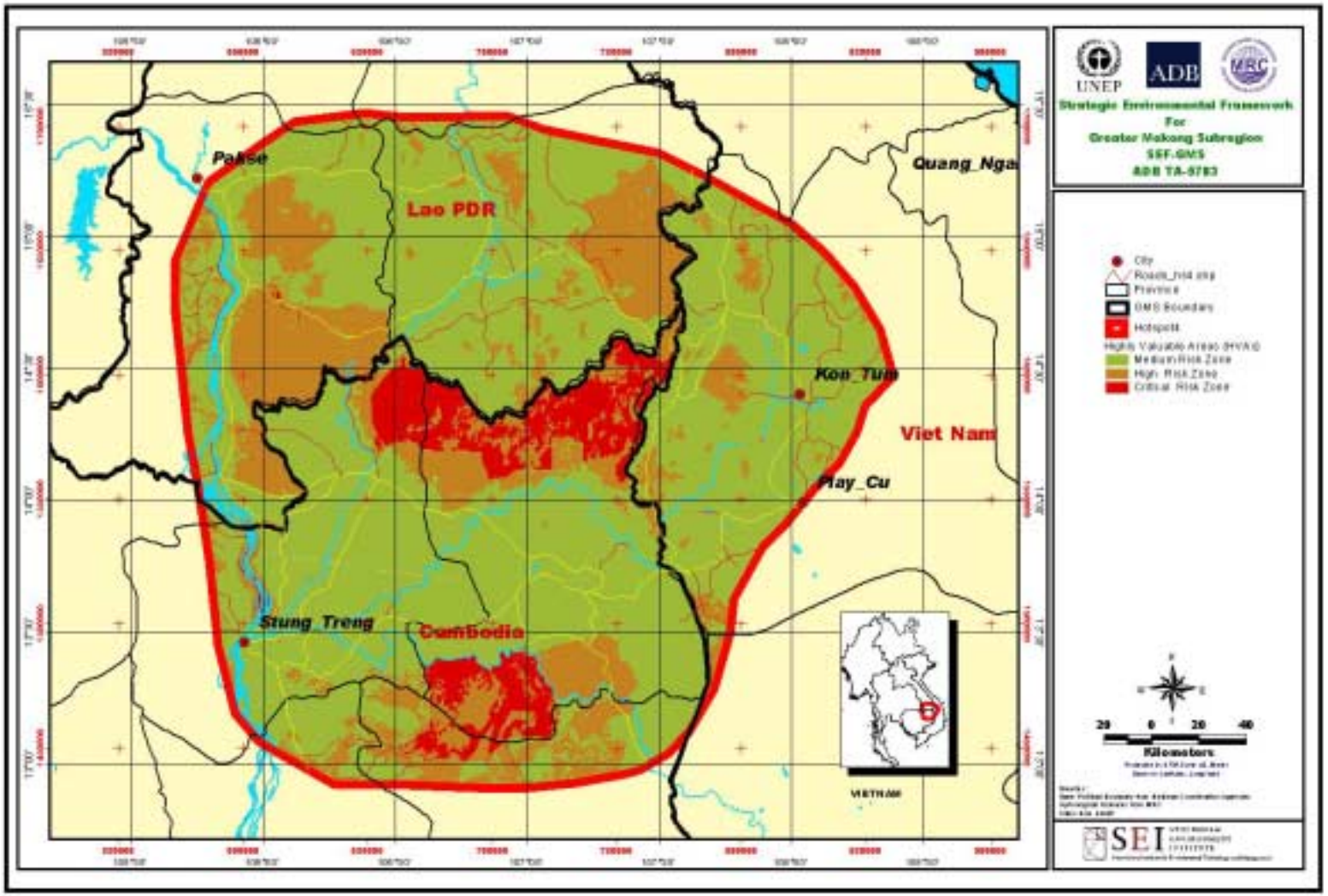

Figure 5.12 HVAs in the Se San/Se Kong Priority GMS Hotspot – All Classes

5.5.2 Indigenous Peoples and other Vulnerable Groups

The Vietnamese part of the hot spot area covers the western part of the provinces of Gia Lai and Kon Tum where a great part of the population are either indigenous peoples such as Gia Rai, Bana, Sedang ethnic groups including two of the smallest ethnic groups in Vietnam, Brau and R'Mom (250 individuals each) or migrated Kinh ethnic groups who constitutes less than 50 percent of the population. Generally, the closer to the border of Lao PDR and Cambodia the higher is rate of ethnic groups other than Kinh.

In Cambodia the hotspot covers small parts of Kratie and Mondul Kiri, while it covers the greater part of Stung Treng Province and the whole of Ratanak Kiri Province. In Cambodia this is regarded as one of the most remote areas in the country. Beside the Khmer majority group, the two other main ethnic groups of Gia Rai and Radhe are traditionally living in the area.

The major part of the two provinces in southern Lao PDR, Champassak (excluding the area west of the Mekong) and Attapeu are located within the hotspot. Most people are of Katu and Bana ethnic origin.

Other indicators of vulnerability are remoteness which means limited access to education and health services, extension facilities, markets and credits and information and a general requirement from the central governments to change their livelihoods and thus cultural habits and customs related to these livelihoods. This vulnerability may increase with hydropower and road projects if special precautions and support are not available.

5.5.3 Livelihood

In Vietnam the indigenous peoples live mainly from upland rice cultivation, (using burnt over techniques) gathering of forest and non-forest products, fishing and hunting but also from cash cropping (coffee, tea, pepper) although the Kinh dominate as cash crop cultivators, including rice, and traders.

All districts in the area include communes that have been classified as being among the poorest communes in Vietnam (Anon., 1998). One of the criteria for being poor was made in the rice equivalent of <15 kg rice per capita per month. Hunger was defined as <13 kg rice per capita and month. If more than 60 percent of the households in a commune were fulfilling these criteria, the commune was classified as poor.

In a poverty assessment made by the UNDP (1998), the Central Highlands had the highest rate of households below the poverty line, 34,7 percent (poverty line defined as <15 kg rice per capita per month) and highest rate (7,7 percent) of the very poor (or starving) measured from the minimum daily calorie intake of 2,100 per capita.

Although being one of the poorest areas in Vietnam, it has options for development such as cash cropping, industry (mainly in the provincial capitals of Pleiku and Kon Tum), and other income generating activities. The Se San River has and will be exploited for hydropower production, although this has become a controversial issue since the Yali dam caused flooding in the Se San River in Cambodia in March 2000.

Another project, which will cause environmental and social concern, is the Truong Son Highway who is planned to cut through one of the few remaining forests covered areas in Vietnam and nearby the nature reserve of Chu Mom Ray. While a new road could support local economic development, the social drawback is usually an increase in so called "social evils" (prostitution, development of HIV/AIDS and other STDs).

Stung Treng is rich in natural resources and rivers, with more forestry, wildlife, minerals and aquatic resources than other parts of Cambodia. Four rivers (Mekong, Sekong, Se San and

Srepok) pass through Stung Treng creating a rich environment for fishing. The province is sparsely populated although in-migration is very high. About 90 percent of the population of which are indigenous peoples such as Kavet, Lun, Kachok, Kuey, Pnong, Tampuen, Kreung and Brao live along the rivers and streams. The wetlands include naturally flooded forests (categorised as a Ramsar site) supporting the people with food, water, aquatic products, timber and non-timber products.

The main threats to people's livelihood are the reduced areas of flooded forests and the fact that local authorities have granted fishing concessions to private companies depriving the local people their main sources of income. Villagers opinion as expressed during a workshop (see below) were that they expected that dam construction would bring cheap electricity and industrial development but they also feared damage to fisheries and destruction of forests due to logging (NGO Forum, 2000; UN ESCAP, 1997).

The release of water from the Yali Falls dam in March 2000 caused major flooding along the Cambodian part of the Se San River in Ratana Kiri Province. Except for the affected people, it aroused concern within MRC as well as ADB. A recent study of the downstream impacts of the Yali Falls Dam in the Se San River Basin, prepared by the Fisheries Office, in co-operation with the Non-Timber Forest Products (NTFP) Project, Ratana Kiri Province, May 2000, the study estimates that about 20,000 people in 3,500 families have experienced serious ecological and socio-economic impacts (people and livestock drowned, riverbank erosions, dry season gardens flooded and dry seasons activities disrupted, water quality deteriorated, health problems, fish catches have declined drastically), as a result of the dam. Disturbances started in 1996 but the release of water in March 2000 was the most damaging according to the Study. There are nine different ethnic groups living in the area including Jarai, Kachok, Tampuan, Brao and Kreung.

According to the Study the local people strongly oppose the existing dam and any further exploitation of the Se San river and so do the authors of the Study even if they acknowledge that more research is needed in particular with regards to water quality, human and animal health, as well as impacts on wildlife and fisheries. Furthermore, additional research is needed regarding the impacts of the Yali Falls dam in the Se San River basin in Stung Treng Province and parts of Vietnam downstream from the dam.

The main production systems follow mainly the elevation of land. Thus in the lowlands indigenous groups have cultivated rainfed lowland paddy for generations while groups residing in the more mountainous areas would use burnt over techniques. Most groups also live from cattle breeding, fishing, gathering and hunting. In the Boloven plateau some groups have turned to cash crop cultivation. Some groups desire to preserve their cultural entity and live among themselves, some have been isolated with little contact with other ethnic groups (including Lao PDR) while others have been adapting to the Lao PDR majority society for quite some time. (Ratanakiri Fisheries Office and NTFP Project, 2000).

5.5.4 Poverty

The Se San Se Kong Hotspot is clearly one of the poorest areas in the GMS. The poverty mapping for each country indicates that most of the districts in the hotspot fall into the poorest category. This is most likely due to a number of factors relating to their involvement with local economies. For the most part the area is remote and comprises groups of people who are ethnically different from each countries majority. These people need to be paid special attention to in relation to economic and development planning.

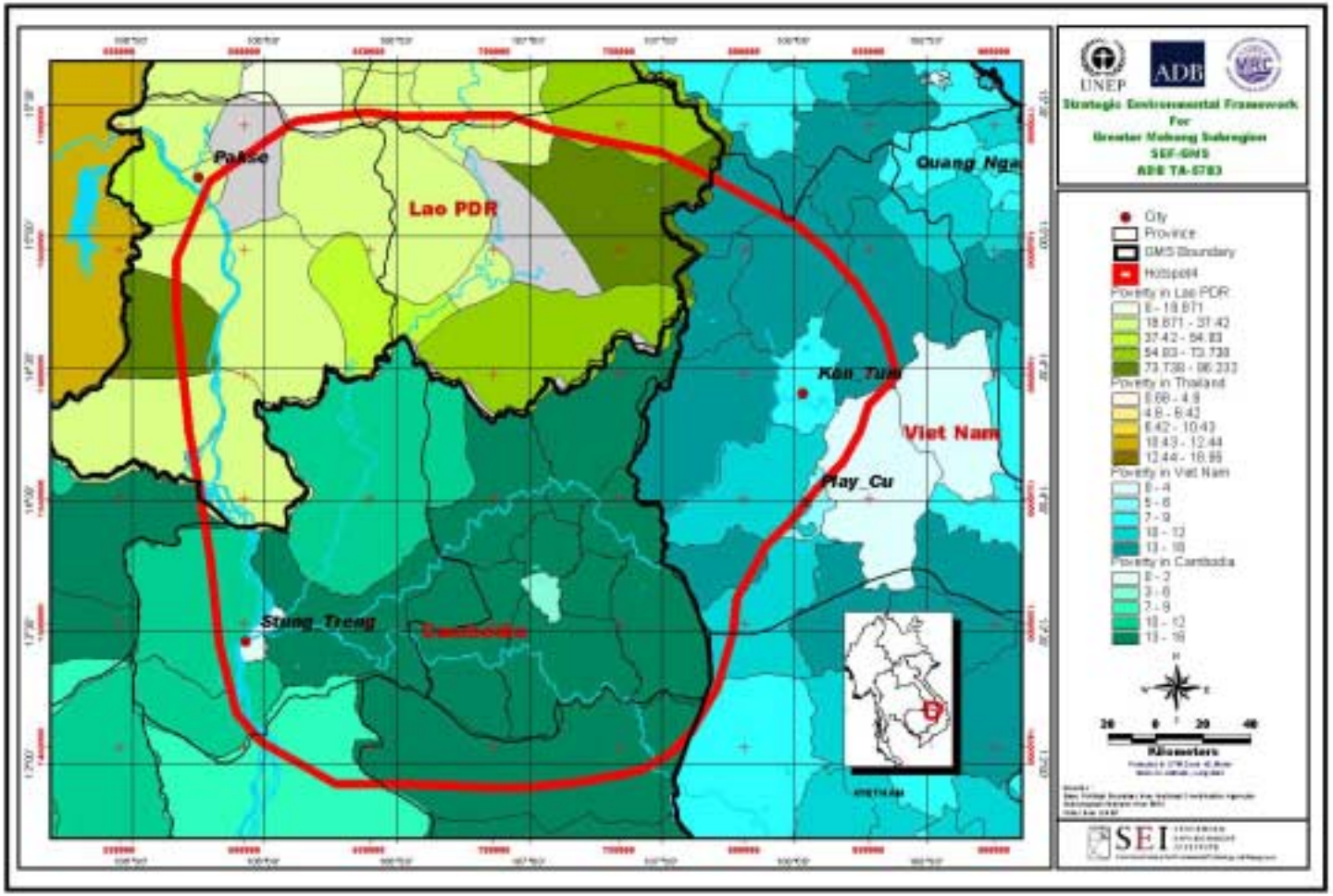

Figure 5.11 Poverty in the Se San / Se Kong Hotspot

5.6 Summary as a High-Risk Region

5.6.1 Transportation Projects

Approximate risk has been mapped as a three-tiered buffer along major road corridors in Hotspot 4. These buffers represent 1, 10 and 25km distances from each road. The cumulative effect of this buffering highlights the few remote areas in Hotspot 4. These areas are also considered as of critical importance in relation to the Highly Valuable Areas mapped in Figure 5.12.

Table 5.6 Summary of Transportation Project Environmental Risk Zones, Se San/Se Kong Hotspot

Environmental Risk Zones		Area in Risk Zones km^2	Percent of Total Risk Zone Area	Percent of Total Hotspot Area
Category	*Risk Zone Ranking*			
High Environmental Risk	3	3,366	6.87%	5.93%
Moderate Environmental Risk	2	23,781	48.50%	41.88%
Low Environmental Risk	1	21,884	44.63%	38.54%
TOTAL		49,031	100.00%	86.35%

Table 5.7 Summary of HVAs in Transportation Project Risk Zones, Se San/Se Kong Hotspot

Highly Valuable Areas (HVAs)		Area in Risk Zones km^2	Percent of Total Risk Zone Area	Percent of Total Hotspot Area
Category	EVR			
Critical environmental value	3	4,887	8.62%	8.61%
High environmental value	2	26,419	46.46%	46.40%
Medium environmental value	1	25,474	44.92%	44.86%
TOTAL		56,78	100.00%	99.87%

Table 5.8 Detailed Classification of HVAs in Transportation Project Risk Zones, Se San/Se Kong Hotspot

HVAs		Environmental Risk Ranking			
Category	**EVR**	***High (km^2)***	***Moderate (km^2)***	***Low (km^2)***	***Total***
Critical environmental value	3	39	1,177	3,671	46,848
High environmental value	2	1,839	16,494	30,835	51,168
Medium environmental value	1	1,488	9,469	14,516	26,473
TOTAL		42,327	27,14	49,022	

5.6.2 Hydropower Projects

Risk has been mapped in association with Hydropower projects as a 4-km buffer on either side of the affected river. For a more detailed analysis of each Hydropower project much more information would need to be compiled and analysed. For the moment the overlay of the buffer with HVAs highlights that all major rivers in the Hotspot will be changed. The buffer also covers several critical HVA areas that are found along these important lowland rivers.

In relation to poverty the poorest districts will be affected through these projects. As had already been seen in relation to the Yali Falls dam, fisheries, drinking water and produce gardens will all be negatively impacted as a result of hydro development. The cumulative effects of these projects will be even more serious.

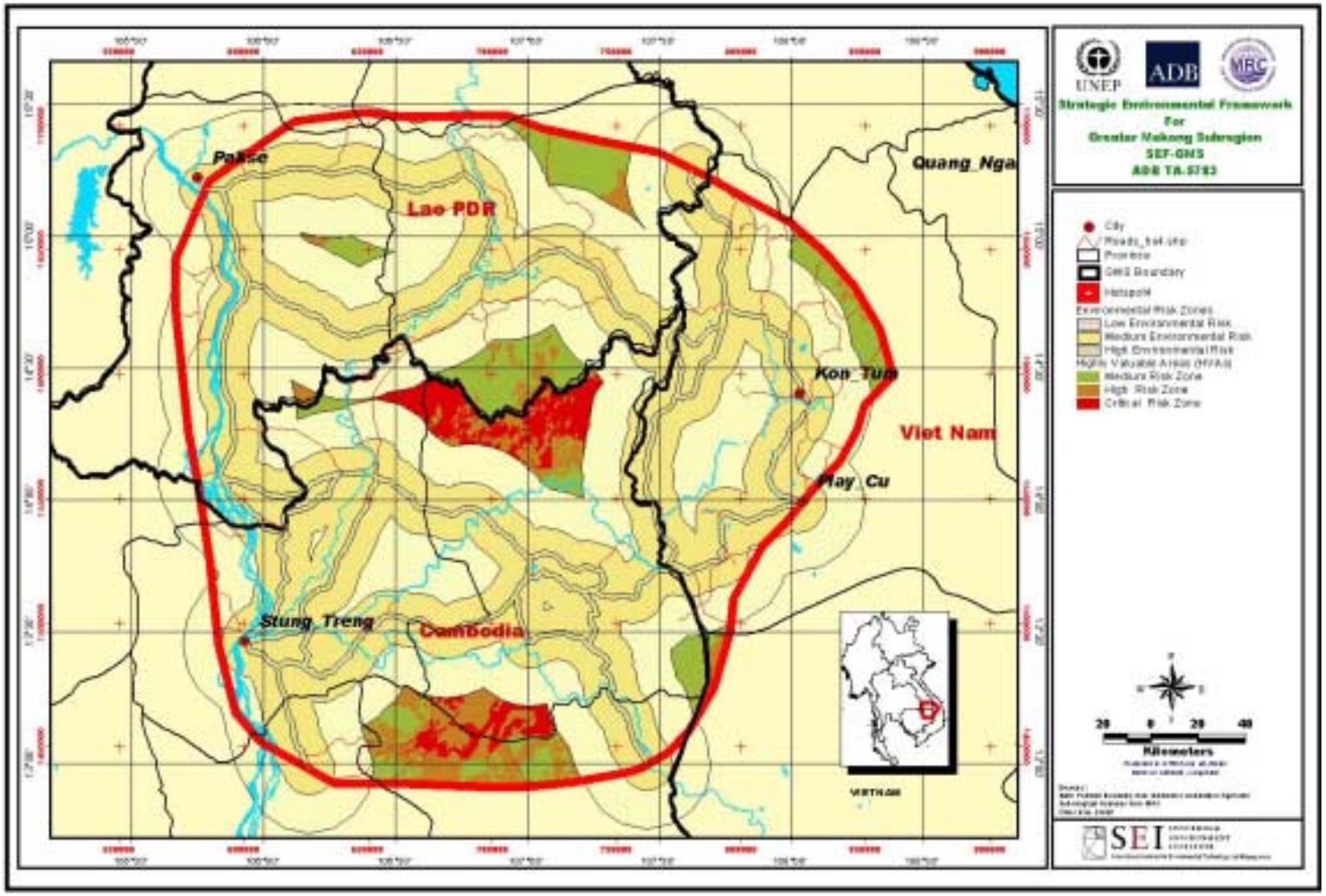

Figure 5.14 Road Projects Risk Zones and HVAs in the Se San / Se Kong Hotspot

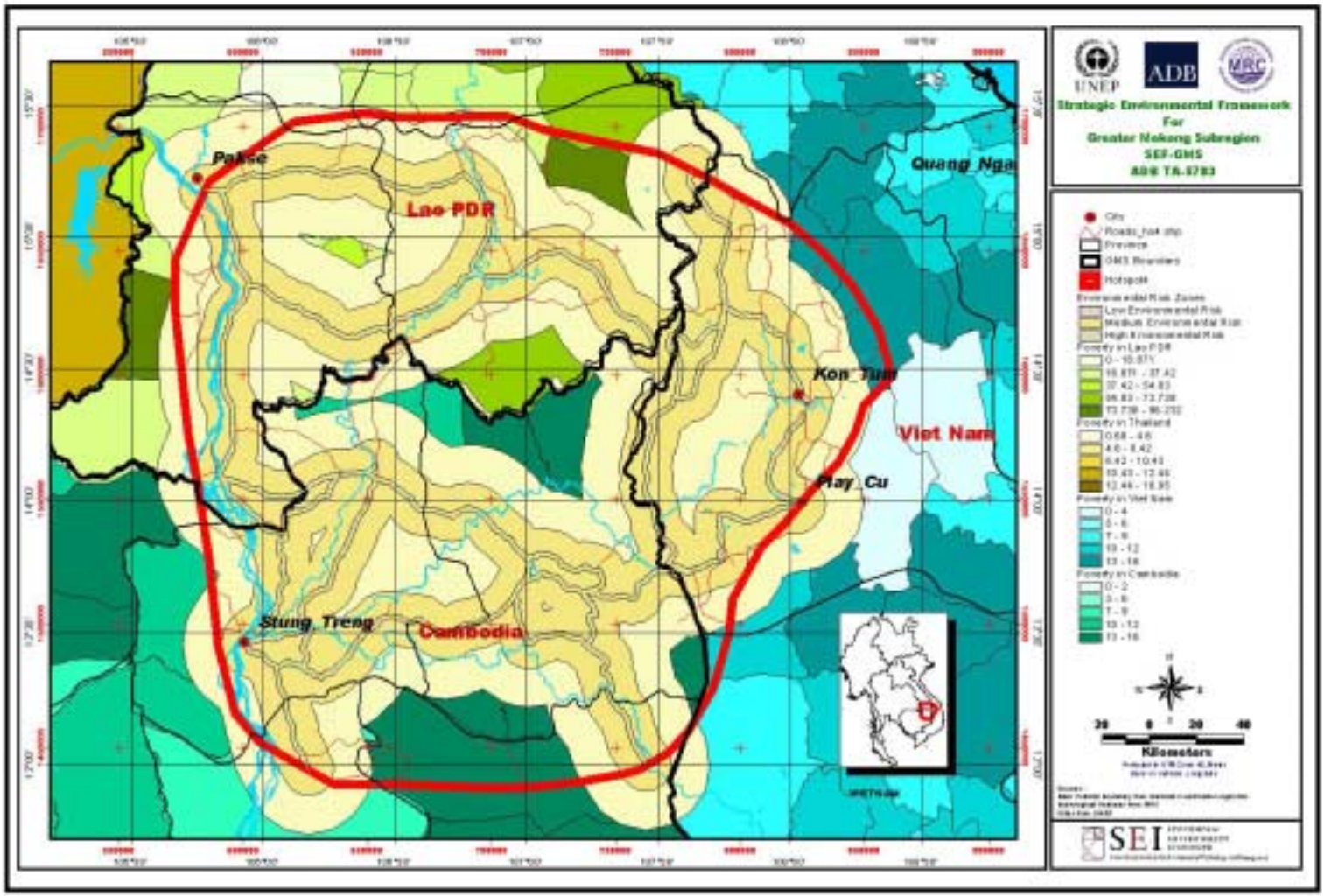

Figure 5.15 Road Project Risk Zones and Poverty in the Se San / Se Kong Hotspot

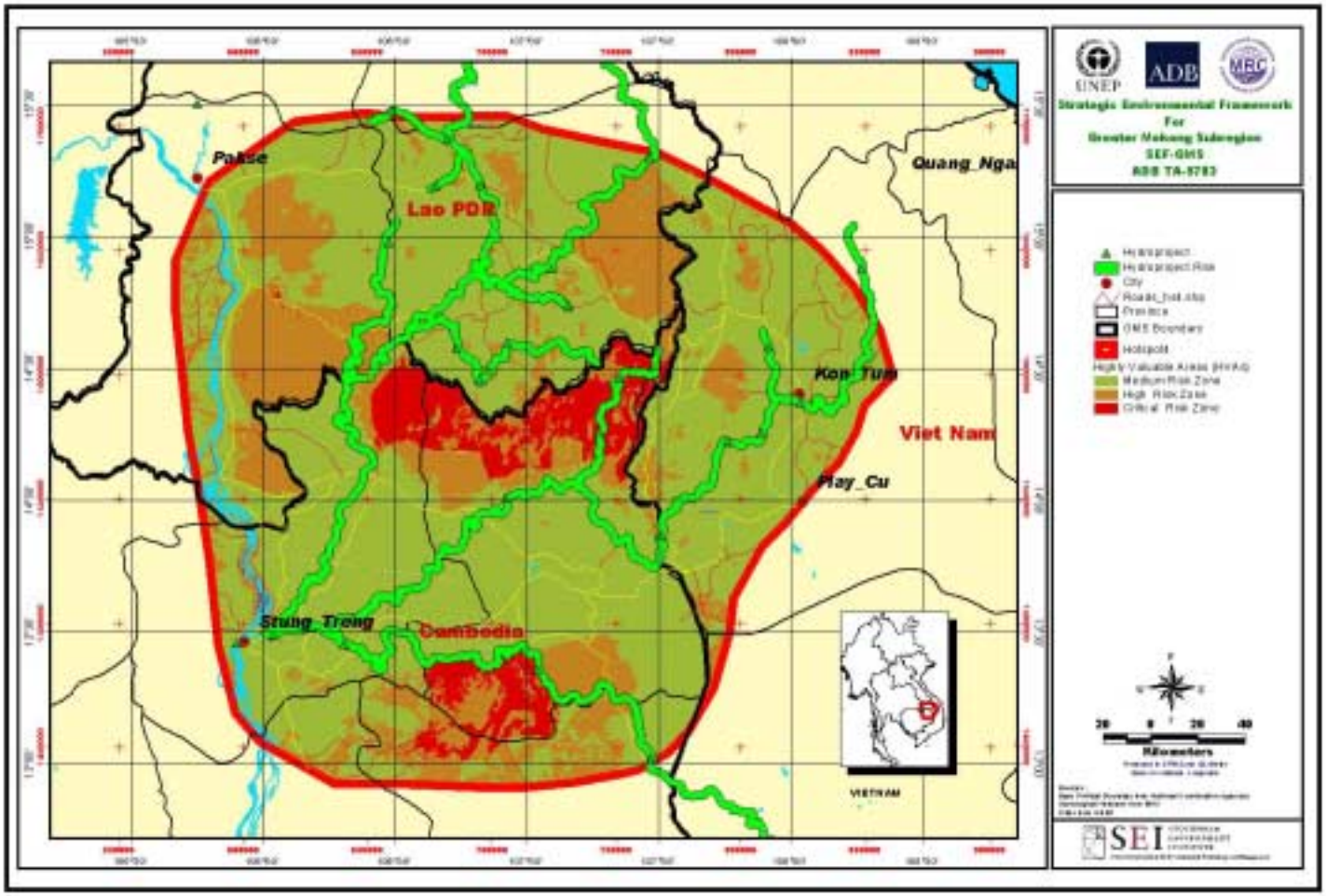

Figure 5.16 Hydro Project Risk Zones and HVAs in the Se San / Se Kong Hotspot

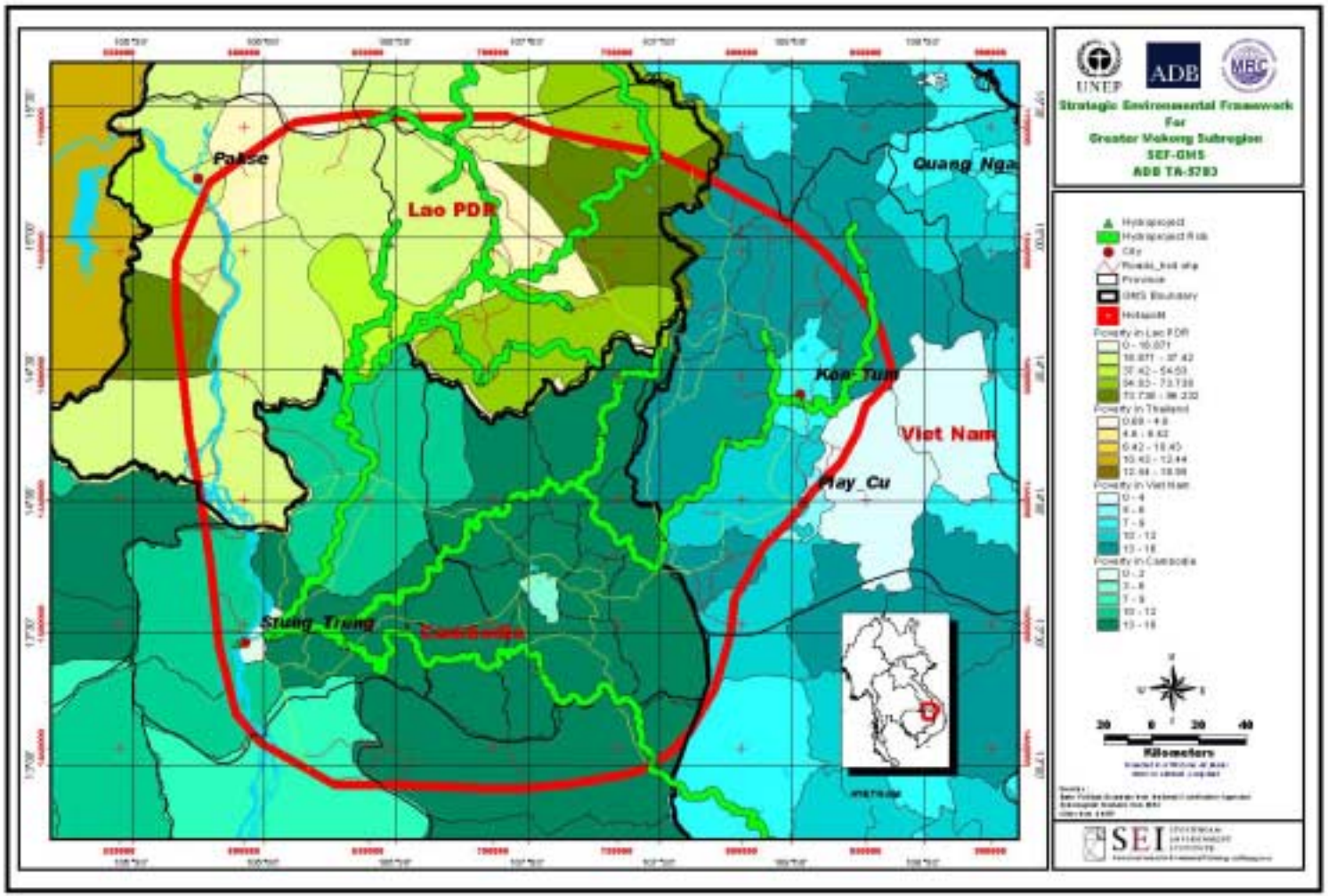

Figure 5.17 Hydro Project Risk Zones and Poverty in the Se San / Se Kong Hotspot

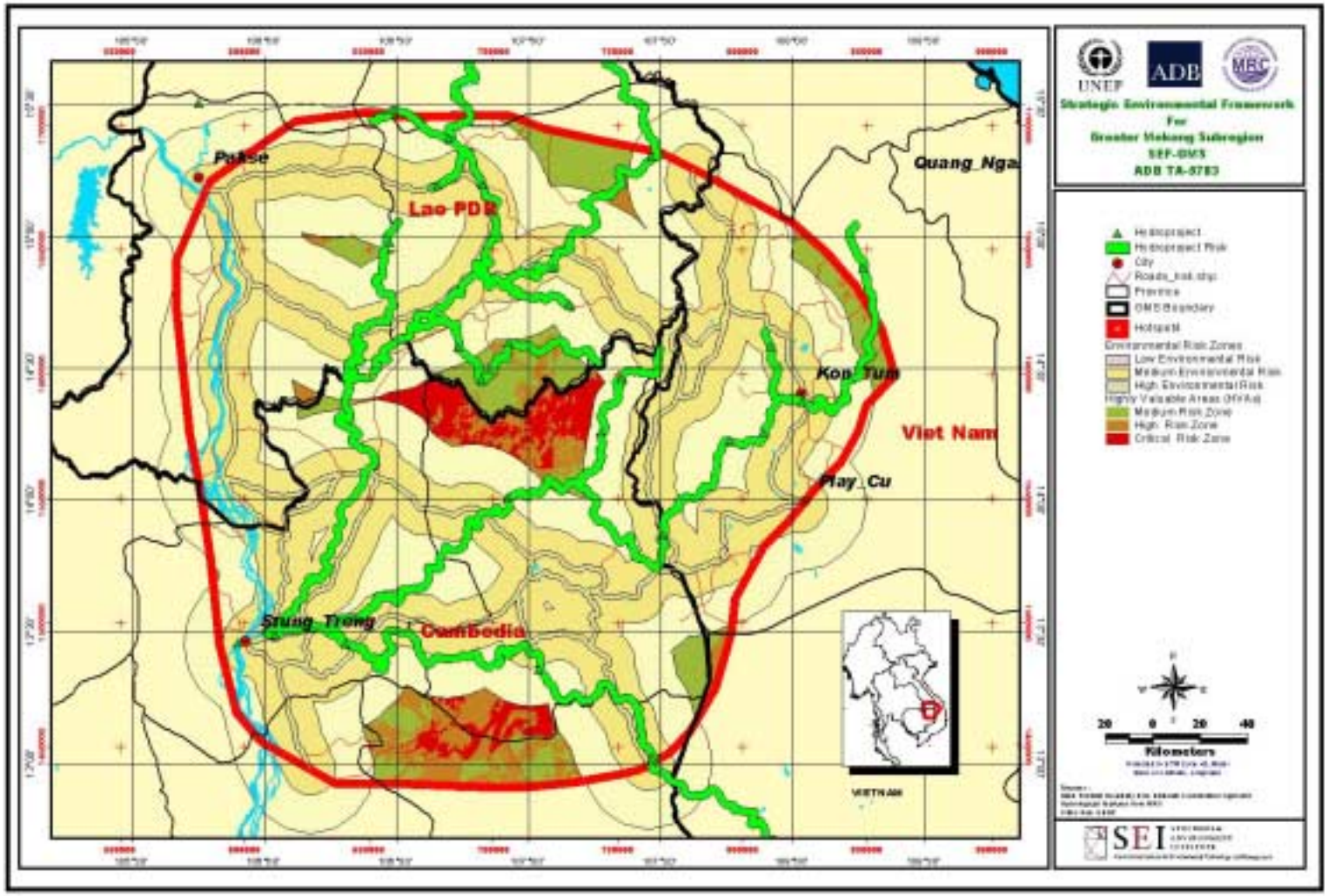

Figure 5.18 Road Project and Hydro Project Risk Zones and HVAs in the Se San / Se Kong Hotspot

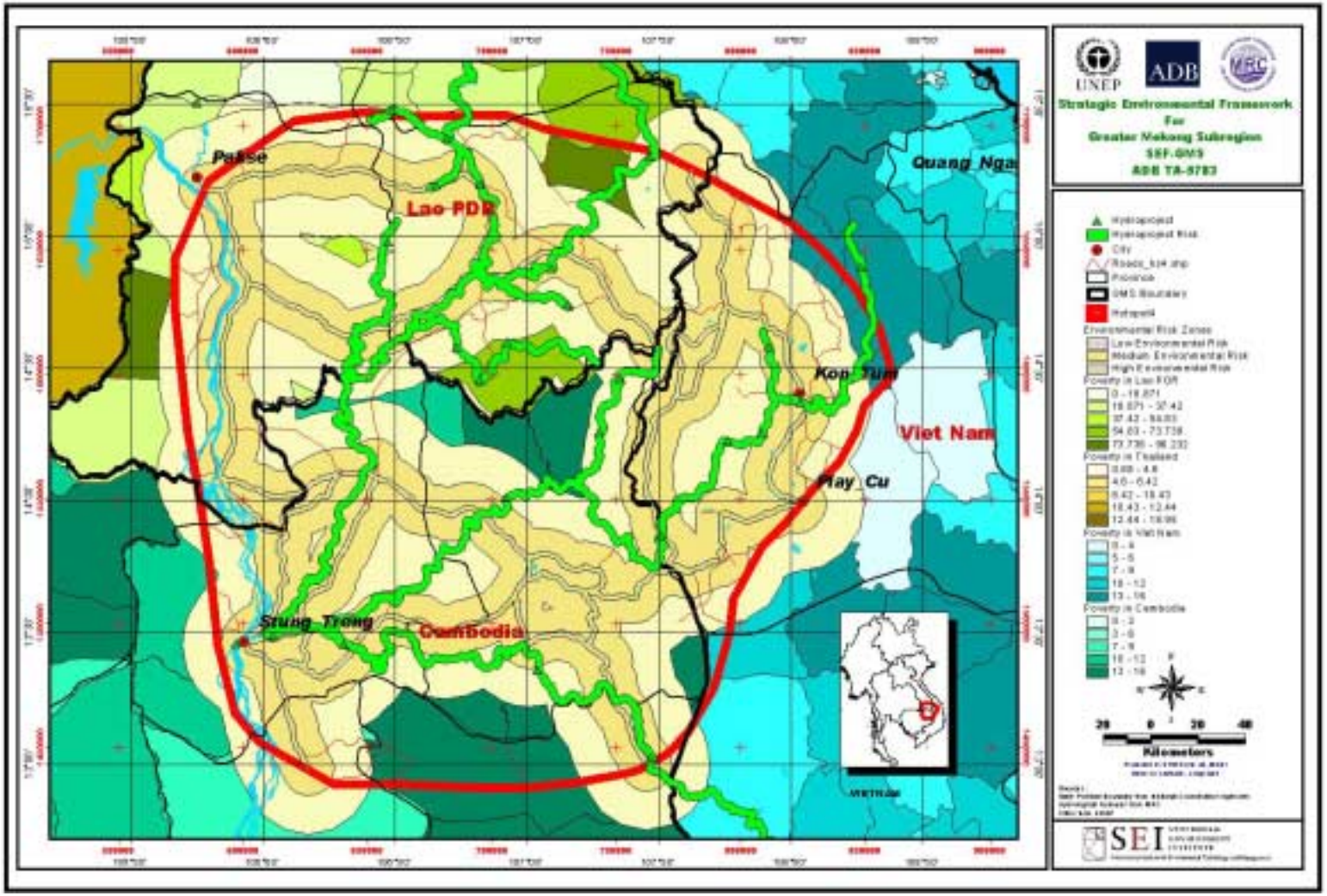

Figure 5.19 Road Project and Hydro Project Risk Zones and Poverty in the Se San / Se Kong Hotspot

5.6.3 Multiple Risks, Transportation and Hydropower Projects

The cumulative risk associated with the twenty plus hydropower projects planned for the hotspot are immense. These combined with the ongoing and proposed upgrades will seriously alter the future of the communities and ecological systems in Hotspot 4. If these changes are going to be managed for maximum benefit development plans will need to highlight a multi sectoral approach as well as concentrate on large areas such as river basins. For this to proceed a series of transboundary agreements will need to be put in place to ensure that all three countries are working together for the economic benefit of the region.

5.6.4 How Important Overall

The Se San/Se Kong Hotspot supports the most pristine river system left in the Mekong Watershed. It is highly threatened by large scale Hydropower Development that will undoubtedly have serious negative effects on local livelihoods and environmental conditions. The area's relatively intact ecosystems combined with a low population density of indigenous people still supporting themselves with traditional and sustainable livelihoods provides a unique opportunity for well planned Sustainable development initiatives to succeed. This will clearly need to address the issues presented in the following section.

5.7 Strategic Recommendations

Although not as well studied as Hotspot three the Se San/Se Kong area has received relatively substantial amounts of research especially since the Yali falls incident in March 2000. The situation in Hotspot four although not as complex as that in Hotspot one is complicated by the transboundary nature of the Se San and Se Kong basins.

Information Collection and Modelling – as in all the hotspots more information concerning flows, sedimentation and the ecology of the river basins is needed to informed planning of infrastructure development. A Hydrological Model while not providing all the answers will be a necessary planning tool to inform decision makers. This could be carried out in conjunction with the model development mentioned for Hotspot one and three.

Transboundary Basin Development Plans – all future development should be guided by a Basin Development plan. Such a plan should be developed with a clear public participation strategy, a focus towards poverty alleviation through sustainable development and with an ultimate goal of improving the livelihoods of all affected peoples especially ethnic minorities and women.

Water Utilisation Plan – an important component to the Basin Development Plan should specifically address water use. This should be similar to the MRC's current WUP, which is currently formulating rules for water quantity. As highlighted by the WUP any future basin plan in the Se Kong/Se San area should consider the following:

- Recognition that it is important to maintain the general pattern of seasonal flows in the river, including the timing of the high and low flows, the relative size of high and low flows, the duration of the high and low flow periods, and the rate of change of flow in the periods between high and low flows.
- Recognition that some changes in the flow pattern are acceptable, but that there should be equity in the way these acceptable changes are shared between countries
- Under the scope of work for WUP Rules, Task 3 is "to review the factors relevant to determining equitable sharing of the acceptable change in the flow quantities and patterns at specified locations on the Mekong mainstream".

Transboundary Basin Management Authorities – the transboundary nature of the Se San and Se Kong basins dictates that any authority with mandate for the development of the basins will need members from both countries concerned. The establishment of a river basin authority with a transboundary mandate should be considered to maximise the productivity of basin development. This authority would oversee the implementation of the Basin Development Plan as well as co-ordinate public participation at all stages of the management of the basin.

Strengthen Protected Area Systems – as with the other hotspots Protected Areas play a key role in the sustainable development of the area. In regard to the Se San and Se Kong Basins the existing system of PAs plays an important role in protecting biodiversity, watershed values and other ecological processes. These PAs are currently under staffed, under funded and in many cases powerless to enforce any rules within their boundaries. It is imperative that Protected Areas are included within any comprehensive basin plan and that they are properly staffed, funded and given the legal mandate to protect the resources they contain.

Poverty Alleviation Activities – the Se San and Se Kong Basins support some of the most remote communities remaining in the GMS. It is clear that the areas in which they live are to be developed for the good of the country and the region that they too should benefit. Any future infrastructure project should outline a strategy for Public Participation form the very beginning of the planning process, that access to social services is enhanced and that local people sharing in the benefits of development are ensured.

6. TONLE SAP PRIORITY GMS HOTSPOT OVERVIEW

6.1 Description

The Great Lake of Tonle Sap is the largest lake in Southeast Asia and one of the most productive freshwater fisheries on the planet. The area has been designated a multiple use area (IUCN IV) by the Government of Cambodia and has been given Biosphere Reserve status by UNESCO. In addition the area is adjacent to the ancient temples of Angkor Wat, a World Heritage site of global cultural importance.

Tonle Sap is hydrologically unique in that water flow reverses seasonally based on the flow of the Mekong River. This unique hydrology makes the entire Tonle Sap ecosystem sensitive to changes in the flow of the Mekong. The most well known of these being the changes in timing, and losses of annual flow expected in the future due to hydropower dams on its tributaries or the Mekong mainstream itself.

However, in the immediate term, it is likely that the effect of proposed irrigation projects on the Tonle Sap ecosystem would likely be more severe than the effect of expected changes in seasonal fluctuations in lake levels from the impact of hydro projects on the Mekong river and tributaries. These irrigation projects have not been looked at in detail in this process but appear to be a more serious threat in the short term.

The area is also threatened by increasing local population, which exacerbates the needs for protein consumption leading to potential over harvesting of fish. Another threat is increased use of pesticides and the resultant runoff into the lake and its tributaries poisoning the fish and the people that live on them.

The flooded forests of the Tonle Sap are an integral part of the ecosystem providing an area for millions of fish to spawn and providing nest sites to the largest population of globally threatened water birds left in Southeast Asia.

The greater watershed area covers the six provinces of Kompong Chhang, Pursat, Battambang, Kompong Thom, Banteay Meanchey and Siem Reap. The total population of these provinces is 3.4 million, approximately one third of the population of Cambodia. It is estimated that about 340,000 people are living in the immediate area of the lake (MRC/UNDP, 1999).

The Tonle Sap Hotspot is ecologically globally unique and the area is also clearly a jewel in the crown of the GMS. It is however under serious pressure from both within Cambodia and from without. Within Cambodia the key to the sustained development of the Tonle Sap area is to maintain the balance between the fisheries interests and agricultural interests while keeping the system ecologically intact.

Table 6.1 Tonle Sap Hotspot Summary Characteristics

Location and Size	
Hotspot Area (km^2)	13,593 km^2
Percent of Total Area of GMS Priority Hotspots	0.59 %
Percent of Total Area of GMS	5.82 %
GMS Countries within Hotspot	Cambodia
Biophysical	
Total Forest Cover[20] (km^2)	239 km^2
Percent of total Hotspot Area	1.8 %
Wetlands (km^2)	12,649 km^2
Percent of total Hotspot Area	93.05%
Protected Areas (km^2)	5,418 km^2
Percent of total Hotspot Area	39.87 %
Rare and Endangered Species	Siamese Crocodile, Greater Adjutant, Spot-billed Pelican, White-winged Duck, Hairy-Nosed Otter
Socio-economic	
Estimated Population	340,0000
Population density	96 persons/km^2
Average GDP	US$ 110 for fishing households and US$ 180 for non-fishing households
Ethnic Minorities Present[21]	-
Agricultural Land (km^2)	4,058 km^2
Projects	
GMS Hydropower Projects	None
GMS Road Project	None
National Hydropower Projects	Tonle Sap, Stung Pursat 1 and 2
National Road Projects	Local Rural Road Upgrades

[20] Contiguous canopy covers with high or medium density (greater than 70 percent forest cover and over 20 percent crown cover with the forest cover).

[21] Ethnic minorities in this area are comparatively few and do not distinguishing themselves in form of any particular approach to production systems or cultural preferences.

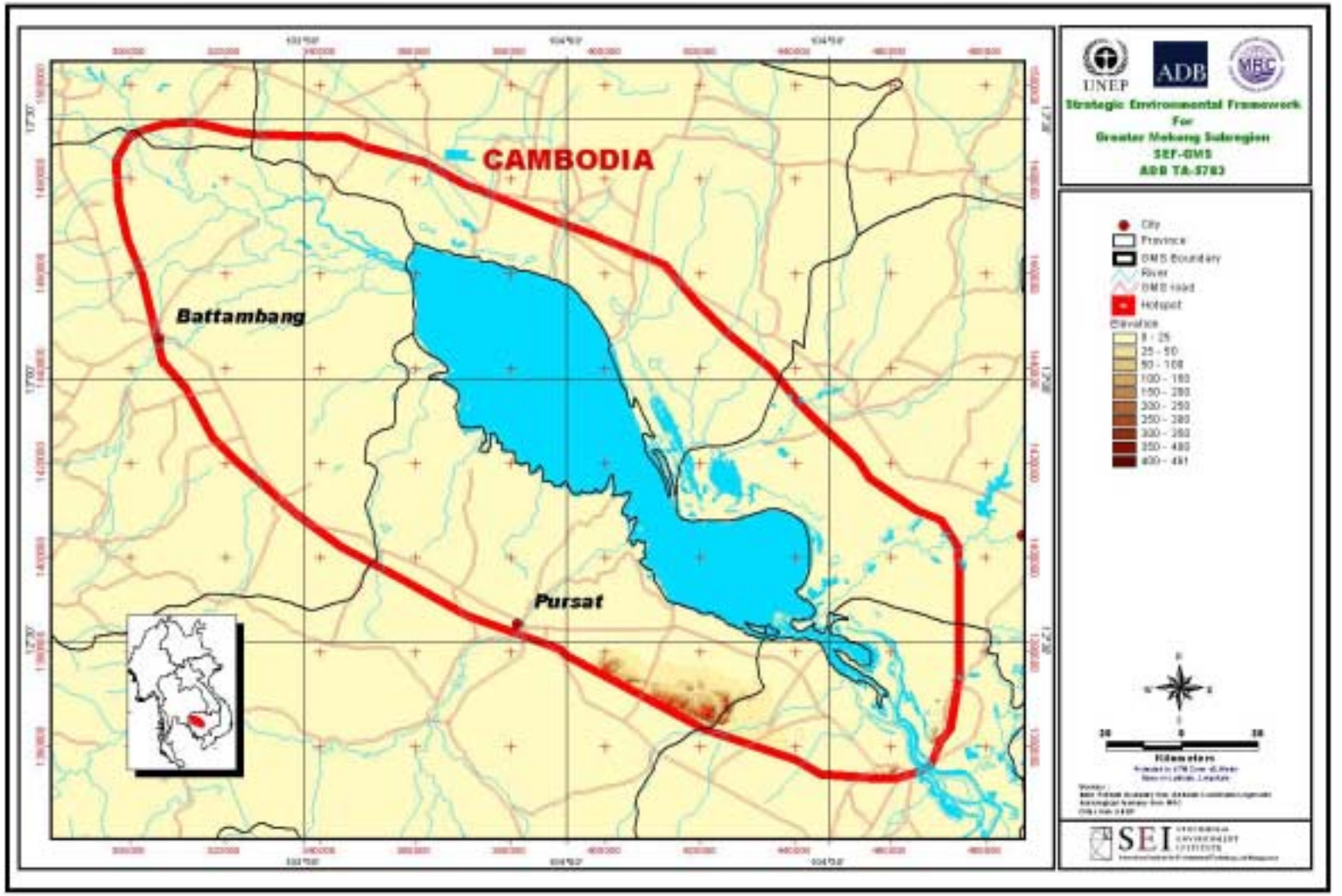

Figure 6.1 Overview Map of Hotspot (including political boundaries, cities and towns)

6.2 Biophysical and Natural Resources

6.2.1 Land Cover

The Tonle Sap Lake and its resultant ecosystem of flooded forests; paddy land and associated wetlands are the focus of the Hotspot. The Hotspot is not heavily forested. The largest land cover types identified by UNEP are Agricultural land (23.44 percent) and Woody Shrub land (22.47 percent) with 19.55 percent being taken up by open water.

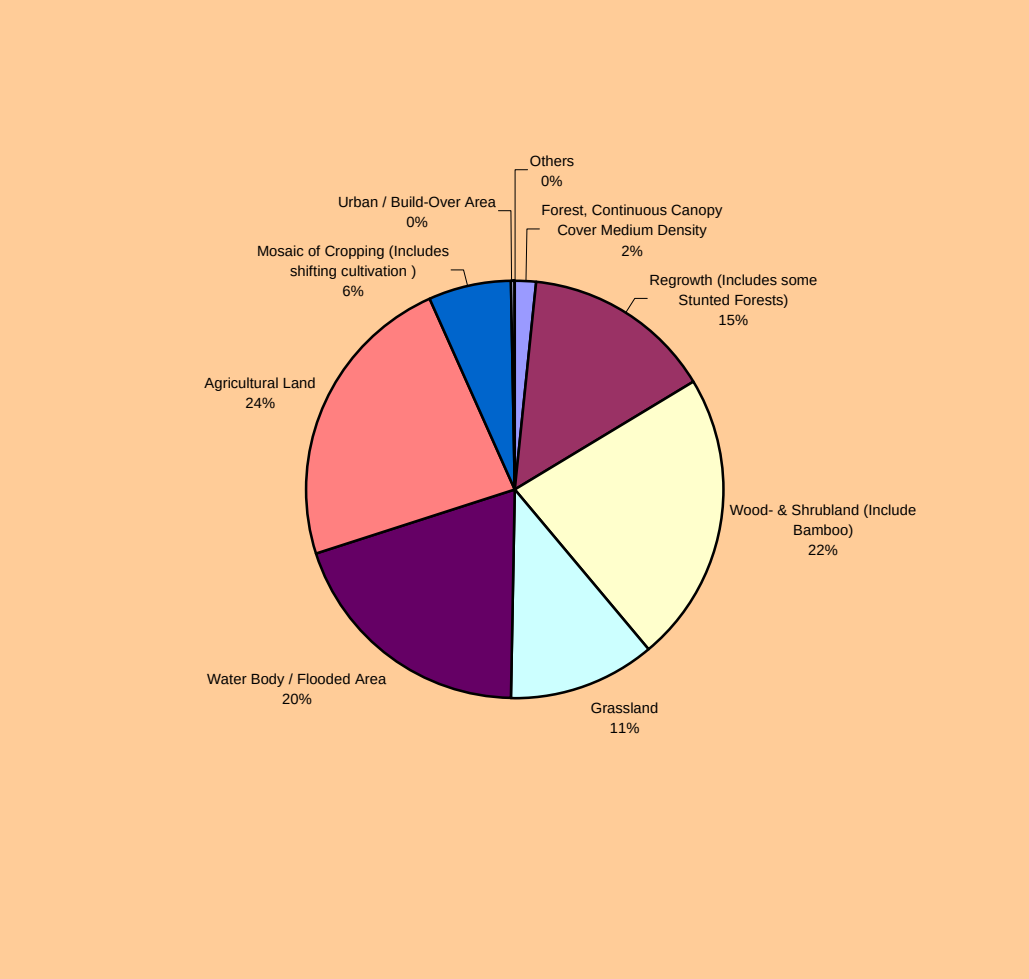

Figure 6.2 Forest and Land Cover in the Tonle Sap Hotspot

6.2.2 Forestry

There is little forest cover in the hotspot and no privately held forest concessions. The prime threat to the remaining forest cover is clearance for agricultural expansion and local use for charcoal and fuel wood. The later is a growing problem as the lake's rich fisheries are attracting a growing number of migrants and there are little other fuel options for cooking and heating.

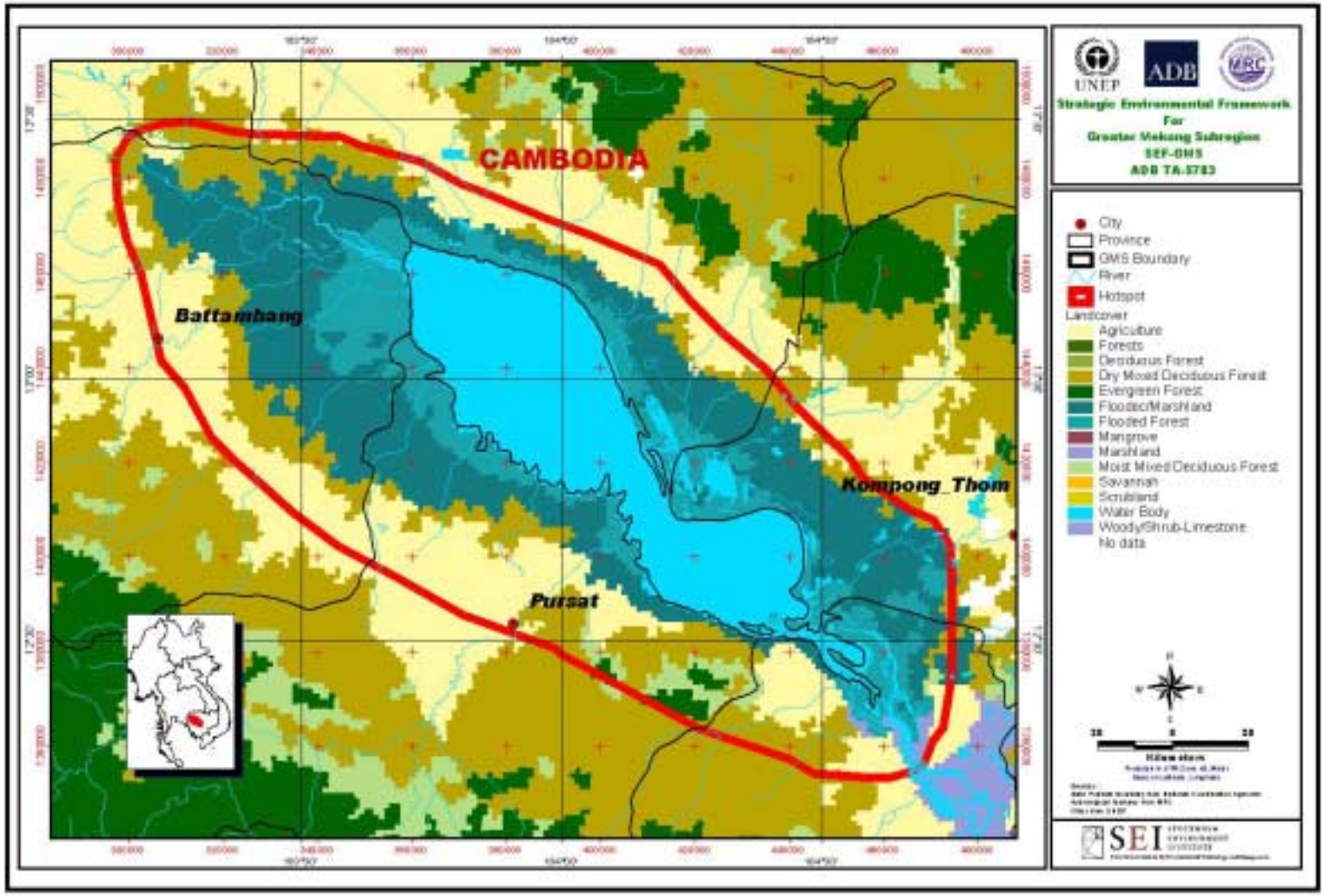

Figure 6.3 Land Cover in the Tonle Sap Hotspot

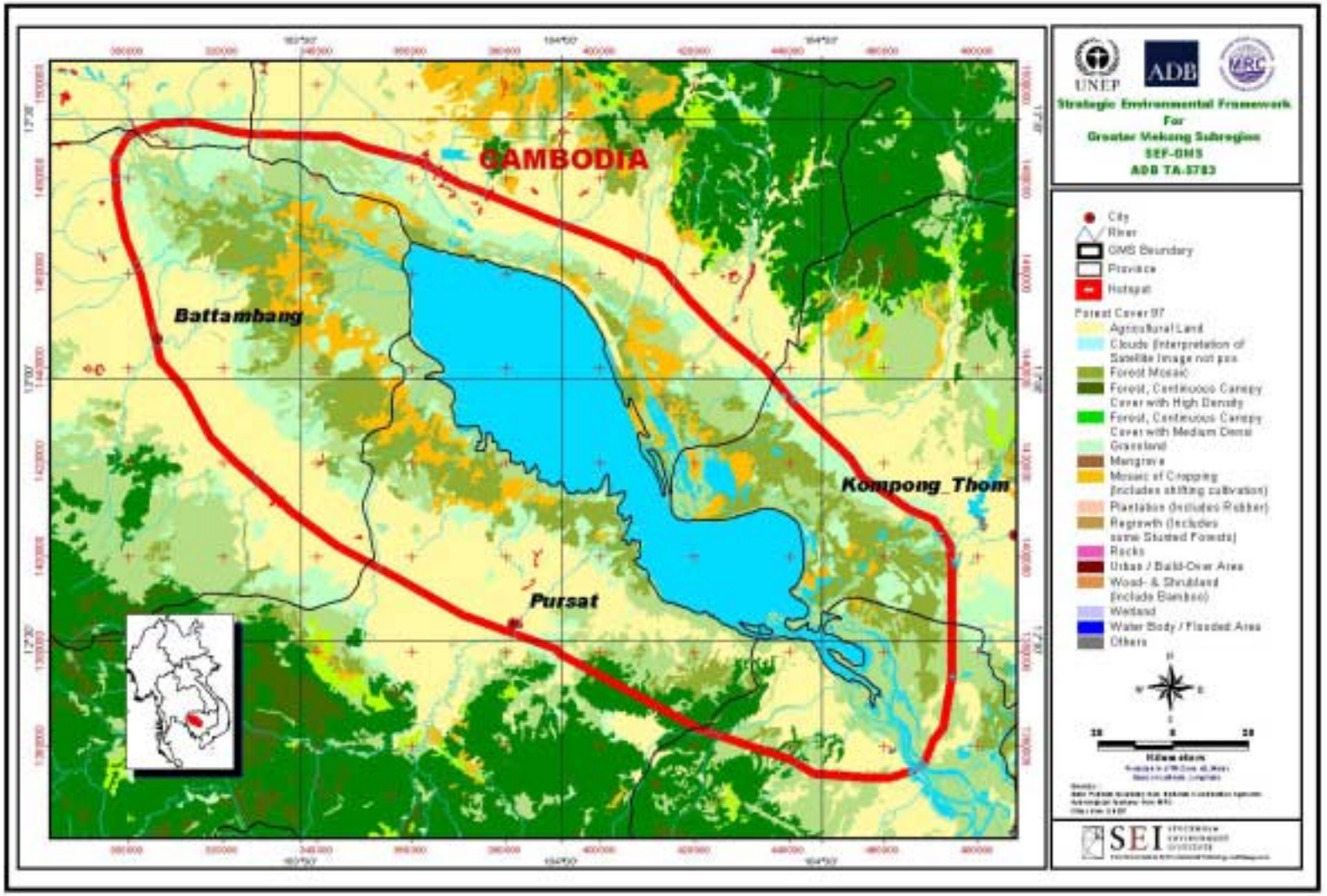

Figure 6.4 Forest Cover in the Tonle Sap Hotspot

6.2.3 Fisheries

There is a rich diversity of fish in the Mekong system, with approximately 1,200 species identified, of which about 850 were found in the Lower Mekong and 215 in the Tonle Sap (Kottelat, 1985)[22]. Many species resident in the Tonle Sap for part of the year make long distance migrations upstream or downstream in the Mekong river system (Baird, 1996; Matics, 1996; Kimchhea, 1999; Phallavan and Bun, 1999; Sokheng, 1999; and Tung, 1999). The fish are a vital source of nutrients to the people of the Tonle Sap and the surrounding area (Ahmed et. al., 1998), in addition to being the highest value component of the cash economy. The pressure on the fishery is increasing.

Estimates of the productivity of the freshwater capture fisheries vary widely. Official statistics provided by the provincial DoF from 1989-1996 put the commercial catch from fishery operators in the six provinces surrounding Tonle Sap at average 38,000 tonnes. However, it is generally accepted that this data reflects chronic under-reporting.

Even more recent data now estimates the national catch, including rice field fisheries and other family-scale subsistence fishing, at 290,000-430,000 tonnes (Van Sealing and Thou, 1999) depending on the season. However, acknowledging the still remaining deficiencies of the data, they state that the total catch "might easily be 500,000 tonnes or higher" which Degen et. al. (2000) estimate could be worth in the order of US$300 million. If the general estimate that the Tonle Sap provides approximately 40 percent (Gum, 1997; MRCS et. al., 1998: Volume 1: 27) or 50 percent (Van Zalinge, 1997 in MRCS et. al., 1998: Volume 3: 66) of the national catch held true this would infer that the annual catch from Tonle Sap could – in a successful year – be as high as 200,000-250,000 tonnes. A lower figure of 120,000-150,000 tonnes, excluding rice field fisheries but including other family-scale subsistence fishing, was used in deriving a US$70 million per annum estimate of gross value being widely distributed (MRCS et. al., 1999) [also based on 1995 data]. The more recent data indicates that this could be a significant underestimate of the catch and hence an undervaluation of the currently harvested wealth of the fisheries.

6.2.4 Protected Areas

The area surrounding Tonle Sap has been designated as a controlled use zone by the government of Cambodia. It has also been listed as a Biosphere Reserve by UNESCO and the water bird nesting colonies at Prek Toal are designated a Ramsar Site. 39.87 percent of the hotspot is considered as protected area.

The management of the Tonle Sap protected areas is quite unique within the region. Both the controlled use and Biosphere designation for Tonle Sap do not exclude human activities from a large portion of the area, although there are several core zones where extractive activities are excluded.

Table 6.2 Protected Areas in the Tonle Sap Hotspot

Name	Area (ha)	Location	National PA Category	IUCN PA Category[23]	YEAR
Tonle Sap		Cambodia	Multiple Use Management Area/Man and the Biosphere reserve	VI	1993

[22] Woodsworth (1994:104) whilst acknowledging these figures as the best source, notes that "the taxonomy" is still in a very confused state".

[23] See Annex 1 for IUCN protected area categories.

6.2.5 Biodiversity

It is widely agreed that Tonle Sap is globally a high priority for Biodiversity. The area has been listed as a Ramsar site, and a Biosphere Reserve. It was also selected as an area of critical importance by regional scientists at a workshop recently held by WWF for Eco-regional planning in the forests of the Lower Mekong (Baltzer et. al., 2001).

Other than its globally important fishery, the area holds some of the most important populations in the world for Siamese Crocodile, Greater Adjutant, Spot-billed Pelican and White-winged Duck. It also holds the healthiest remaining populations in Southeast Asia of a number of other water birds and perhaps Hairy-nosed Otter.

6.2.6 Water Resources

Rainfall in the Tonle Sap hotspot area is in the range 1250 to 1875 mm, with more precipitation towards the mountainous region to the southwest of the hotspot. Winter (NE) monsoons are weak, and the precipitation is mainly in the summer months from the SW monsoon, which brings rain from the Gulf of Thailand. Runoff amounts are high, particularly in good rainy seasons, which means that there is potential for irrigation, and for hydroelectric projects.

The Tonle Sap is one of the greatest water resources in the Mekong basin. The Lake annually expands from its dry season surface area of 250,000 ha to a massive 1,400,000 ha at the height of the wet season. This provides water for 12 percent of Cambodia's rice production and 40 percent of their freshwater fish production. The seasonal expansion and contraction of the surface area of the lake is accompanied by changes in water level of more than 5 m. During the rising stage of the Mekong river, water floods into Lake Tonle Sap via the Tonle Sap channel. The channel is wide and unconstricted, so that any water surface level fluctuations in the Mekong river near Phnom Penh manifest themselves as water level changes in Lake Tonle Sap. During falling stage in the Mekong river, water leaves Lake Tonle Sap, and flows out by way of the channel into the Mekong river. There is sufficient storage in Lake Tonle Sap that significant flood peak reduction is achieved in the Mekong and Bassac rivers, from Phnom Penh to the sea.

One of the main aspects of this for water and fisheries management is that any systematic change in water flows and water levels in the Mekong river will show directly as changes in level in Lake Tonle Sap. Although the effect of many hydroelectric projects in the Mekong basin will have modest impact on the reduction of flood flows, there will be a significant change in flows during the low flow period, January to June. The magnitude of this impact has been explored in a preliminary way, in MRC Water Utilisation Program (WUP) Preparation Project (MRC, 1998). In the report, analyses were done for 10-year proposed hydropower development, and for ultimate hydropower development. These were for total constructed reservoir, live storage volumes of 24,000 Mm^3, and 78,000 Mm^3 respectively.

For the 10-year scenario, whether or not reservoirs of this combined live storage will be in operation during this time period, the WUP analysis still gives a good idea of impact. For example in the key low flow month of April, the present situation in an average year is that the monthly average discharge of the Mekong river immediately downstream of the Tonle Sap is 2500 m^3/s. Under the 10-year development scenario, this April average monthly flow would increase to about 3800 m^3/s, a large increase (52 percent). Under the ultimate development scenario, the April monthly flow would increase to about 7200 m^3/s, an enormous increase (188 percent). These flow increases in the low season discharges in the Mekong river imply higher future water levels during this season, which in turn imply higher dry season levels in Lake Tonle Sap, with less future movement in and out of the Lake during the annual fill and empty cycle.

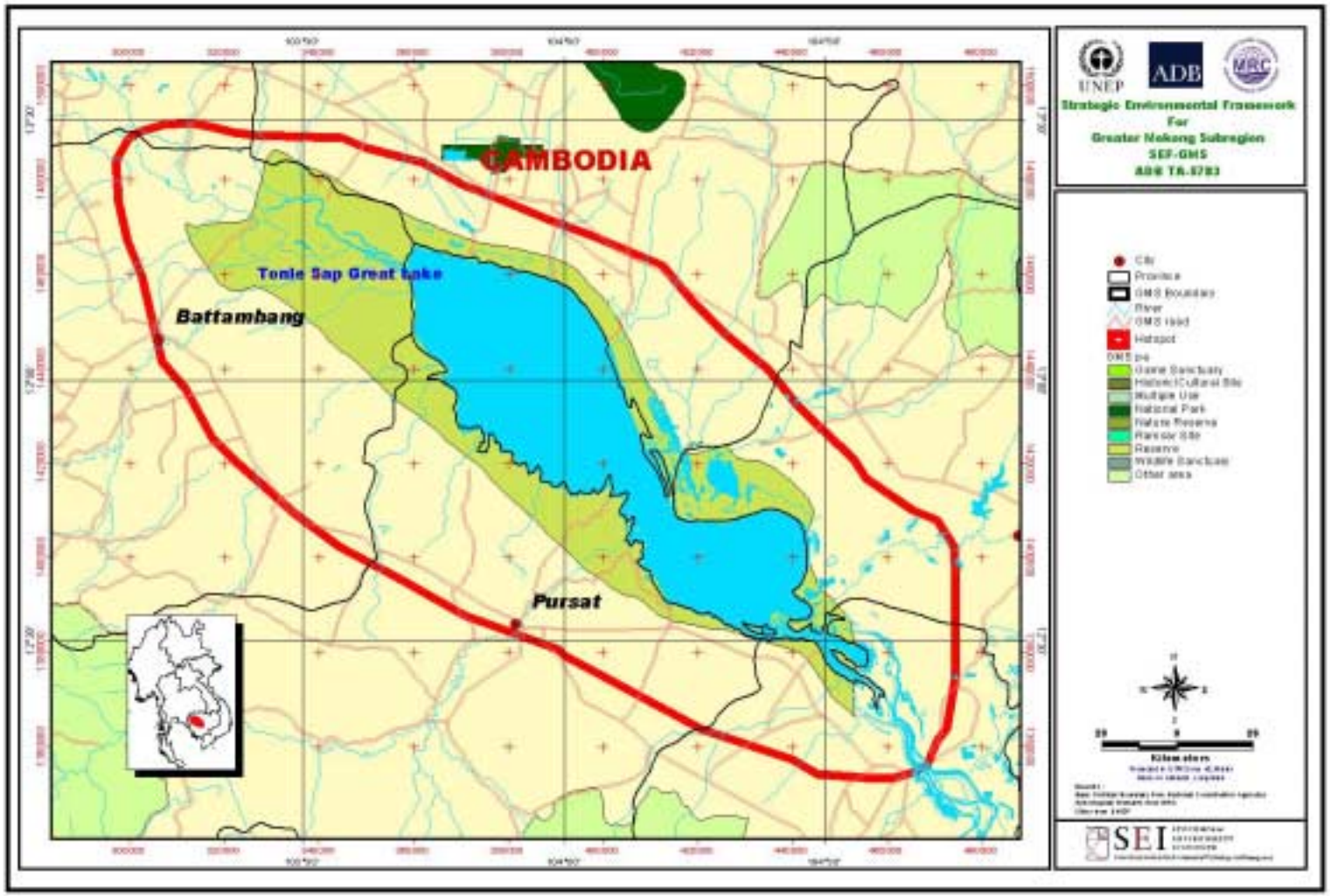

Figure 6.5 Protected Areas in the Tonle Sap Hotspot

Other water resources issues include management and operation of proposed irrigation projects, some of which have minor but useful hydropower potential. Concern is for the high consumptive losses for water from the proposed irrigation projects, which would affect flows into vital delta areas around the edges of the Lake. This is discussed further in Section 2.4.2.

6.3 Population

Approximately 340,000 people are living in the immediate area of the lake deriving their main income from fishing and rice cultivation. However, in order to understand the magnitude of people dependent on income generating activities in the whole watershed area and also to illustrate the links between the lake itself, its flooded (forest) areas, the areas under low-midland rainfed agricultural cultivation and the upland dry burnt over cultivation and forestry activities, it has been useful to collect data of the total population of the six provinces. The national census from 1998 included the following figures:

Table 6.3 Provincial Population in the Tonle Sap Hotspot

Province	Population
Kampong Chhang	417,693
Pursat	360,445
Battambang	793,129
Kompong Thom	569,060
Banteay Meanchey	577,772
Siem Reap	696,164
Total	**3,414,263**

Thus over 3,4 million people are living in the greater watershed area of Tonle Sap which constitutes 1/3 of the total population of Cambodia suggesting that protection and development activities are highly important for the future of the whole country.

Another estimation suggests that a majority of 1.2 million (living within the border areas of the highways surrounding the lake) is deriving their main income from the area (MRC/UNDP, 1999). Over 50 percent of the population are younger than 20 years of age indicating a continued high rate of population growth in the next decades. This will increase the demographic pressure in the area and may cause competition for its natural resources, unless dependency on the natural resources is decreased through new income generating opportunities outside the primary sectors of fishery and agricultural production.

Studies indicate that about 20 percent of the households are female headed

However, ethnic origin is not a decisive factor for particular living conditions in this area, as in the other four Hotspots. Two other groups originating from majority populations in neighbouring countries residing in the area are Hoa (from China) and Kinh (from Vietnam). They would be classified as economic migrants and thus not qualify as typical ethnic minorities or even vulnerable groups. Although it is known that a certain in-migration into the area is taking place, it has not been possible to obtain any figures to access the magnitude of this.

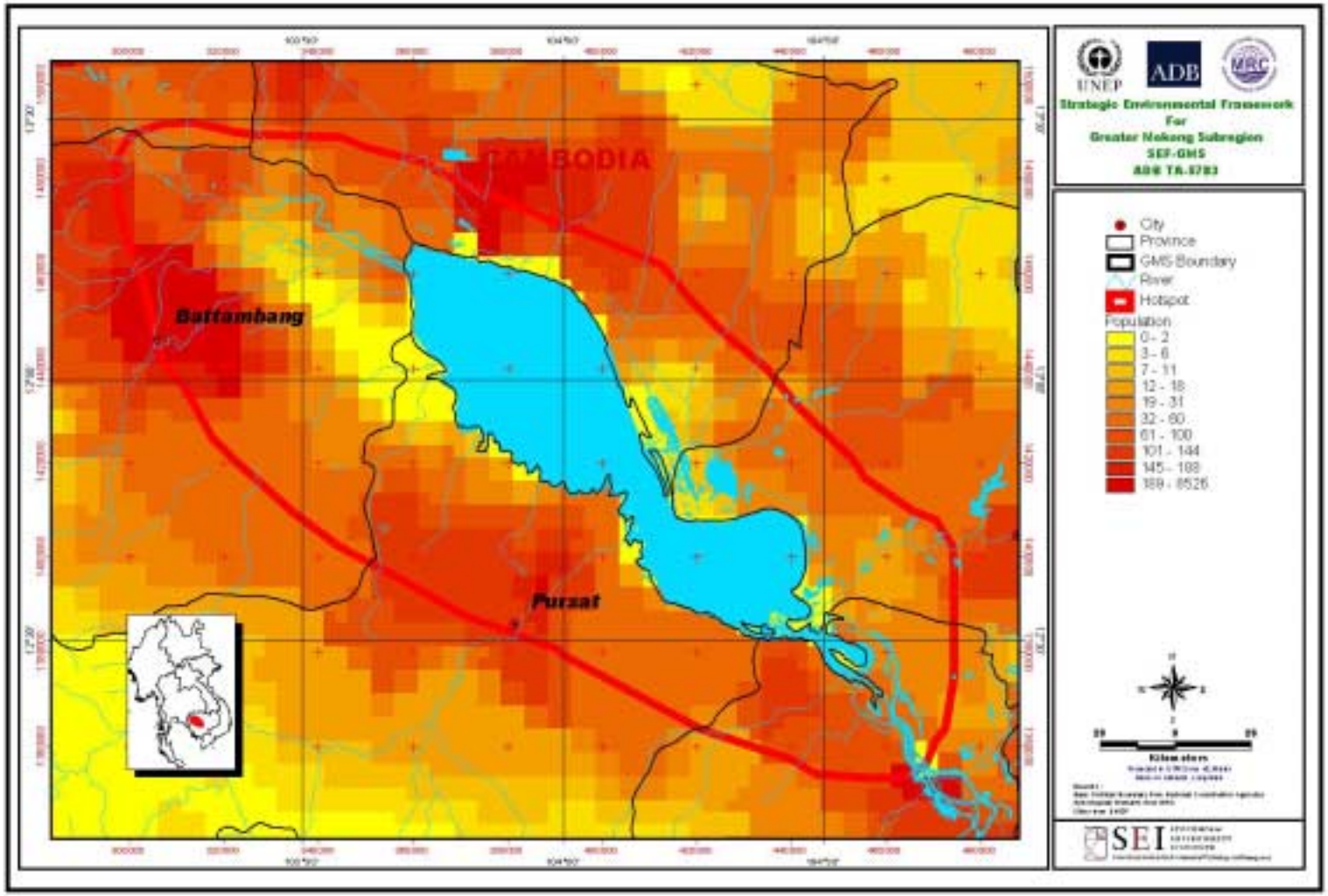

Figure 6.6 Population Density in the Tonle Sap Hotspot

6.4 Development Stresses

6.4.1 Transportation Projects

Existing Road Network

The area has few roads and most transport is by boat. The routes 6 and 9 closely follow the edge of the hotspot. There are a large number of small rural roads that's stretch seasonally from the main highways to the edge of the lake.

In addition the planned Bangkok to Ho Chi Minh Railway (RW 3) passes through the eastern edge of the hotspot. Refer to map of existing road network Figure 6.7.

Proposed GMS Road Projects and Status

Route 6 the Bangkok to Ho Chi Minh Highway passes to the east of the Tonle Sap. This major artery will clearly support stronger trade links between the Great Lake and the major urban centres of Bangkok and Ho Chi Minh City. It is unclear how this will effect in-migration since the Tonle Sap is already a major centre for immigrants.

Table 6.4 GMS Program Road Projects in the Tonle Sap Hotspot

Name	Description	Status
Route 6	Bangkok to Ho Chi Minh	Upgrade

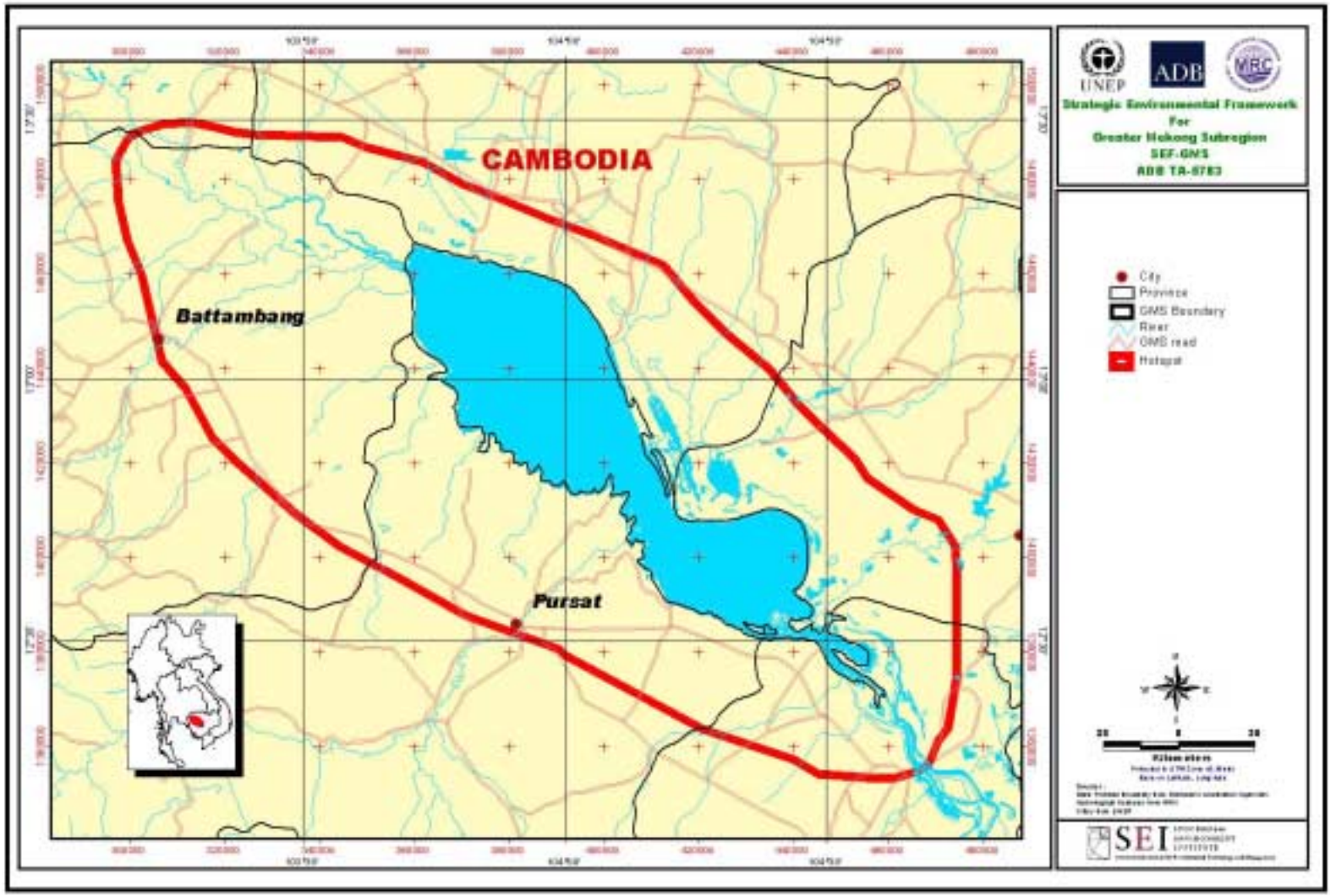

Figure 6.7 Existing Road Network in the Tonle Sap Hotspot

6.4.2 Hydropower Projects

Existing Dams

There are no existing Hydropower projects in the Hotspot

Proposed GMS and National Dams and Status

The GMS program has no proposed Hydropower projects in the Hotspot. Hydro is however a concern for Tonle Sap. The lake's sensitive ecology is reliant on the reversal of water flow in the Mekong mainstream. This flow would be seriously reduced by the cumulative impacts of Hydro production on the Mekong's tributaries and the main stem itself. For the most part, these projects are being constructed by other riparian nations such as Lao PDR and China.

There are a number of proposed dam sites in or near the Tonle Sap hotspot.

One of these is the Tonle Sap dam, which would produce energy by controlling flow in and out of the lake itself. This is shown on old maps of potential water projects for the region, as the "Stung Baribo" project. This project would be extremely damaging to the Tonle Sap ecosystem, and would be a low head project. The chances of its being cost effective, even on the basis of very crude cost/benefit studies is low, and this project will likely not be built.

A plethora of irrigation projects around the Tonle Sap were proposed in old reports (Mekong Committee, 1994). Although these projects are not in the Hotspot, they would have a profound effect in the water flows and ecology of the Tonle Sap, if they were built and operated. These projects, and the dams that would supply them, form a ring around the entire Tonle Sap.

Specific projects presently in the construction-planning cycle are:

The Stoeng Chinit irrigation project, whose river enters the Tonle Sap channel at the southeast edge of the hotspot, is being rehabilitated. This river was dammed for irrigation use during the 1970's but the irrigation weirs fell into disrepair. The Government of Cambodia plans to see these rebuilt and the water used for a multipurpose small hydro (4 MW) and irrigation project (up to 25,000 ha). Work on the irrigation project is already underway, with a US$24 million loan from ADB.

Several rivers draining into the hotspot area from the north have been listed in a desk study in an old MRC report (1973), and are presently being considered by Ministry of Water Resources and Meteorology as sources of water for irrigation projects.

Examples include:

Stoeng Sen a 40 MW peak production of electricity, and up to 130,000 ha of irrigated agriculture with a large area (800 km^2) flooded by proposed reservoir.
Stoeng Stoung up to 20,000 ha of irrigation
Stoeng Chikreng up to 10,000 ha of irrigation
Stoeng Sreng up to 25,000 ha of irrigation
Stoeng Mongkol Borey up to 10,000 ha of irrigation

Storage in smaller reservoirs in the mountains to the south-east of the Hotspot, for the proposed Stoeng Pursat irrigation project would likely have small scale hydro-electric possibilities, but these projects are not under active consideration by the Ministry.

The impact of development of these projects on vital delta areas of Tonle Sap Lake, e.g. Tonle Chhma Lake and wetland areas, would be severe, as the flows in these streams would be permanently impaired by loss of water to the proposed irrigation projects.

Proposals based on desk studies for multiple use projects on the Sang Ke River, in the Battambong area have been made. For example Battambong No.1 project would provide 24 MW of peak electricity production, and up to 68,000 ha of irrigated agriculture. The reservoir surface area would be substantial (approx. 200 km^2). Severe impacts on the river delta where it enters the Lake are expected if the project were to proceed, with the majority of the impact coming from the water lost by evaporation from the irrigation project and the reservoir.

In our opinion, it is likely that the effect of all these proposed irrigation projects on the Tonle Sap ecosystem would likely be more severe than the effect of expected changes in seasonal fluctuations in Lake levels from the impact of hydro projects on the Mekong river and tributaries.

6.5 Vulnerable Areas and People

6.5.1 HVAs in the Tonle Sap Hotspot

Almost the entire Hotspot is considered to be of critical importance since this includes Tonle Sap Lake and the existing reliant ecosystems. The edges of the hotspot are clearly covered by lower valued areas that have primarily been cleared for Agricultural Development. Refer to Figures 6.8 and 6.9.

Table 6.5 HVAs in the Tonle Sap Hotspot[24]

Environmental Areas		**Area (km^2)**	**Percent of Total Hotspot Area**	**Percent of total HVA** **Area in GMS**
Category	EVR Rank			
Critical environmental vulnerability	3			
High environmental vulnerability	2			
Medium environmental vulnerability	1			
TOTAL				

[24] Note: this analysis is based on a preliminary analysis only and has not included Biodiversity data categories.

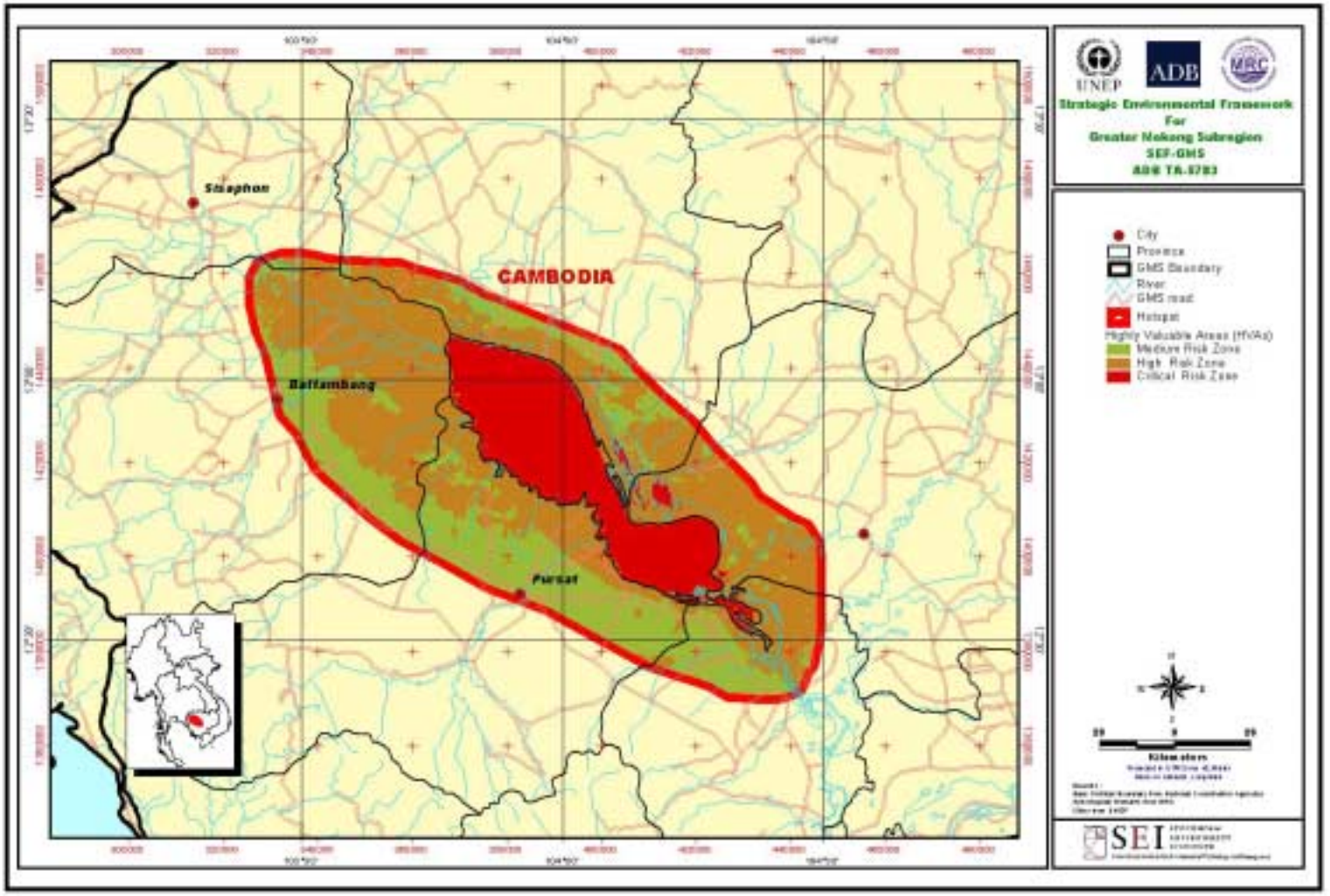

Figure 6.8 HVAs in the Tonle Sap Hotspot – All Classes

6.5.2 Indigenous People and other Vulnerable Groups

In the Tonle Sap area the majority of the indigenous peoples are Khmer i.e. the same ethnic group as the majority population in Cambodia. Thus indigenous peoples here are not identical with the ethnic minority groups who are the dominant groups in the other four hotspot areas. However, being indigenous and in majority, many people in the Tonle Sap areas still qualify as vulnerable. This is explained by the fact that most households living from rice farming and fishing are generally poor of which many depend on the products and benefits derived from common property or publicly owned resources in flooded forests, big rivers and lakes, flooded rice fields and river banks.

It is estimated that nearly 16,000 people are living in so called floating communes on the lakes.[25]Another group of people resides in the low-and midland areas near the flooded forests. They earn their income mainly from agricultural cropping but are also part-time fishermen. A third group of people lives in the upland forest, which is hilly and mountainous and is dependent on burnt over land and forest concessions for their living.

The issue in the area is that not only do different interests compete for fishery concessions, but also farmers are cutting down forest (flooded forest and other types) to open it up for agricultural cropping. The flooded forest however, is highly important to protect the fisheries of the lake (especially for fish spawning). Besides it contains other valuable resources such as wood and wildlife.

Another issue is that if restrictions are imposed on access to and exploitation from the common property resources, there will be a significant negative effect on the livelihood opportunities especially for the subsistence households whose alternatives are extremely limited. The decision by the Royal Government of Cambodia to nominate the Tonle Sap Lake as a Biosphere Reserve has put further constraints to the use of the lake and its watershed.[26]

With a growing population living on diminishing resources the risk of an increase of vulnerable groups is high.

6.5.3 Livelihood

The main economic activities in the lake area are agriculture and fisheries. Each generating about US$ 70 million annually (see Table 6.6). Although still minor activities, it is expected that navigation and tourism both have growth potential. GDP per capita indicate that non-fishing households are better off than fishing households (US$ 180 and US$ 110 respectively). This seems to be confirmed by the fact that land and jobless tend to drift into the open access fisheries as a last resort.

[25] Regional Workshop on Strategies for the Sustainable Management of the Natural Resources, Tonle Sap Region; Biological and Socioeconomic Baseline Information on the Tonle Sap Region with Special Reference to the Flood Plain; by Jorge Malleux, April 1998).

[26] Nature Resource management in the Tonle Sap; Biosphere Reserve in Battambang Province; consultancy Report for the European Commission Support Programme to the Environmental Sector in Cambodia, SPEC, prepared by Wayne Gum, August 1998.

Table 6.6 Gross Value of Economic Activities in the Tonle Sap area

Economic activity	Gross value; million US$/year
Agriculture	70
Other wetland activities	1
Fisheries	70
Navigation	3
Tourism	1
Others and rounding	5
Total	**150**

Source: MRC/UNDP, 1999

There are two types of agriculture in the area, wet season cropping and dry season cropping. Paddy production amounts to 440,000 tones per year and accounts for 12 percent of the national production (MRC/UNDP, 1999). In recent years, all provinces have produced a small surplus. An average yield reported in 1999 for deep water rice (or floating rice) areas is some 1.75 tones per ha and yields of rain-fed wet season rice about 1.3 tones per ha. (Source as above). However, it is expected that the average yields per ha from floating rice will go down in the future due to lower farm gate prices per ton than that of rain fed rice cultivation.

With an annual fishery production estimated at between 120,000 and 150,000 tones the area yields about 40 percent of Cambodia's inland fisheries. About half of the production is consumed locally, while the other half is transported to Phnom Penh markets, or exported mainly to Thailand. In addition, the area is a spawning and nursing ground of a large number of species that migrate to the Mekong River and delta.

As is pointed out in the report socio-economic Assessment of Freshwater Capture Fisheries of Cambodia; Report on a Household Survey, by Mahfuzuddin Ahmed, Hap Navy, Ly Vuthy and Marites Tiongco, 1998, "it would be a great mistake to think of Cambodia's food security in terms of rice alone. For many generations, fish and many other aquatic products (plant and animal) have supplied a sizeable portion of protein and nutrition to Cambodians. The degree of dependence on fishing and farming varies according to the topographic situation and endowment of land and water resources within each locality."

While the two main staples in Cambodia are fish and rice, it has been argued[27] that the fishery component has not been given due consideration by the government and by international donors. It concerns both internal conflicts between lot/concession owners and those without as well as the fishery in relation to other income generating activities. This same paper also shows the importance of protecting the flooded forest from further transformations something that put constraints to further expansion of rice cultivation areas.

[27] Present Status of Cambodia's Freshwater Capture Fisheries and Management Implications, Department of Fisheries; MRC/DANIDA Project for Management of the Freshwater Capture Fisheries of Cambodia, January 1999 .

6.5.4 Poverty

Poverty around the Great Lake is not as severe as that found in the more remote areas of Cambodia. Since the area is a rich fishery and key tourist attraction for the country there are more opportunities for economic gain. This pattern can clearly be seen in the relative wealth of the main provincial centres, notably Pursat and Siem Reap. The poorest districts are clearly found the north and east of the Great Lake where road access is limited.

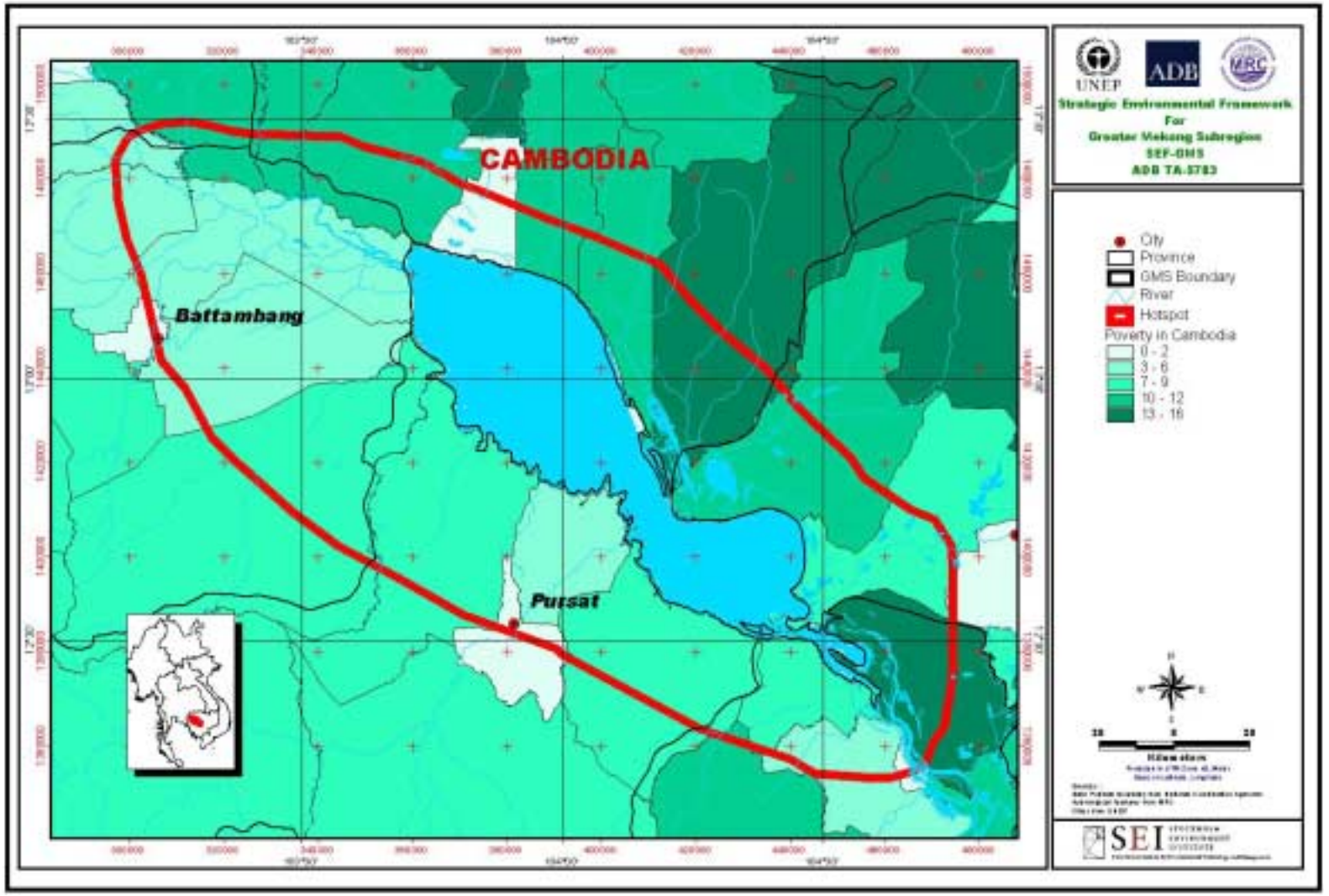

Figure 6.9 Poverty in the Tonle Sap Hotspot

6.6 Summary as a High-Risk Region

6.6.1 Transportation Projects

The existing transport network around the Tonle Sap is quite well developed and the existing roads will continue to be upgraded over the next few years. In Figure 6.10, a 1, 10 and 25km buffer have been mapped to show risk in relation to the Hotspot. These buffers clearly show that two of the most important areas of the Great Lake, the Prek Toel Area and the wetlands in the southeast are outside of this buffer. They are clearly near some minor roads but for the most part they remain as the most 'remote' areas on the lake by access from land. They also correspond to two of the most important areas for nesting waterbirds, flooded forest and as a result fish productivity.

The relationship of road risk and poverty is less clear. Poverty may be effected slightly by road quality and perhaps the current upgrading of Route 9 to the northeast will improve market access, reducing poverty in the long term.

Table 6.7 Summary of Transportation Project Environmental Risk Zones, Tonle Sap Hotspot

Environmental Risk Zones		**Area in Risk Zones km^2**	**Percent of Total Risk Zone Area**	**Percent of Total Hotspot Area**
Category	***Risk Zone Ranking***			
High Environmental Risk	3			
Moderate Environmental Risk	2			
Low Environmental Risk	1			
TOTAL				

Table 6.8 Summary of HVAs in Transportation Project Risk Zones, Tonle Sap Hotspot

Highly Vulnerable Areas (HVAs)		**Area in Risk Zones km^2**	**Percent of Total Risk Zone Area**	**Percent of Total Hotspot Area**
Category	**EVR**			
Critical environmental vulnerability	3			
High environmental vulnerability	2			
Medium environmental vulnerability	1			
TOTAL				

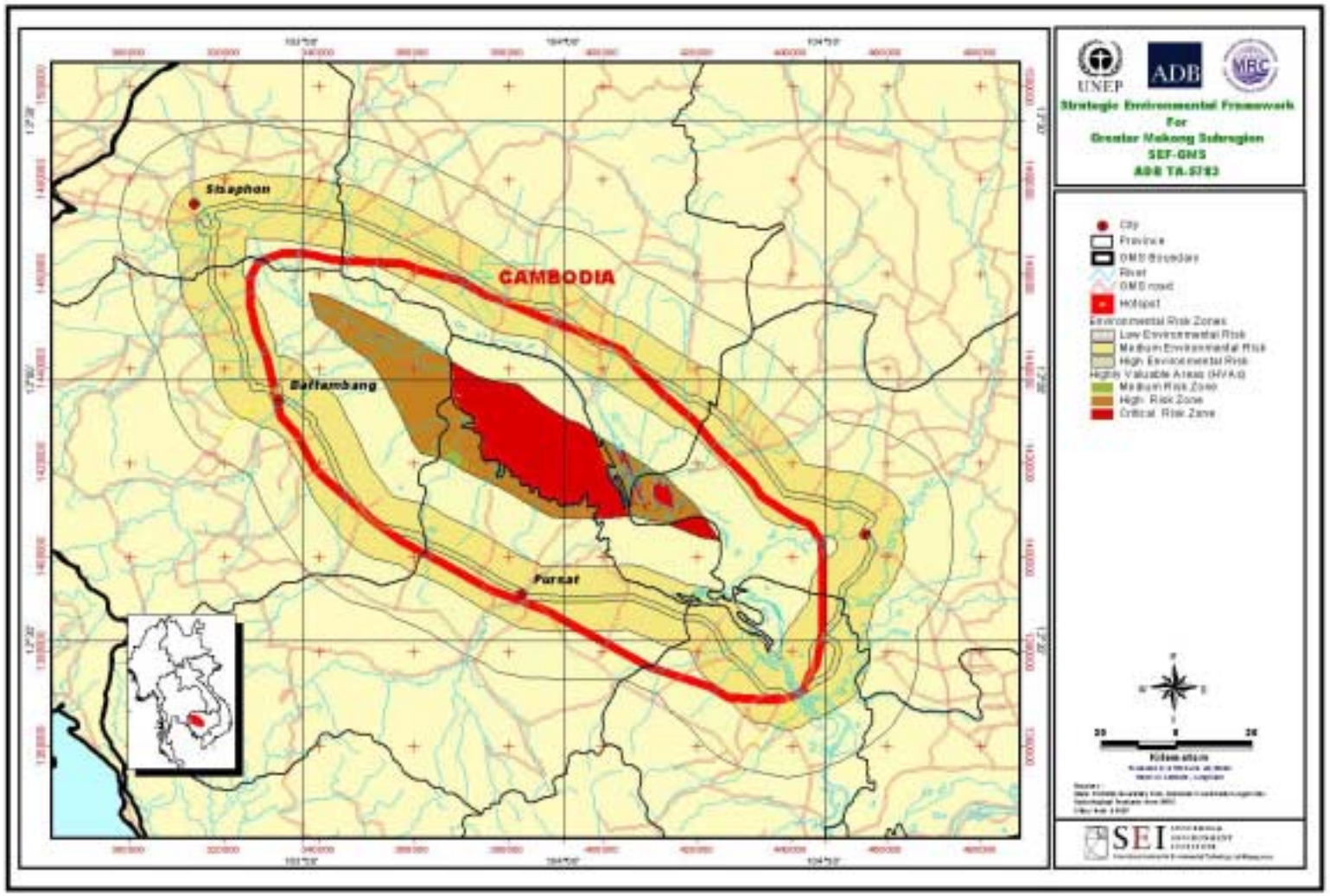

Figure 6.10 Risk Zones, Road Projects, Tonle Sap Hotspot

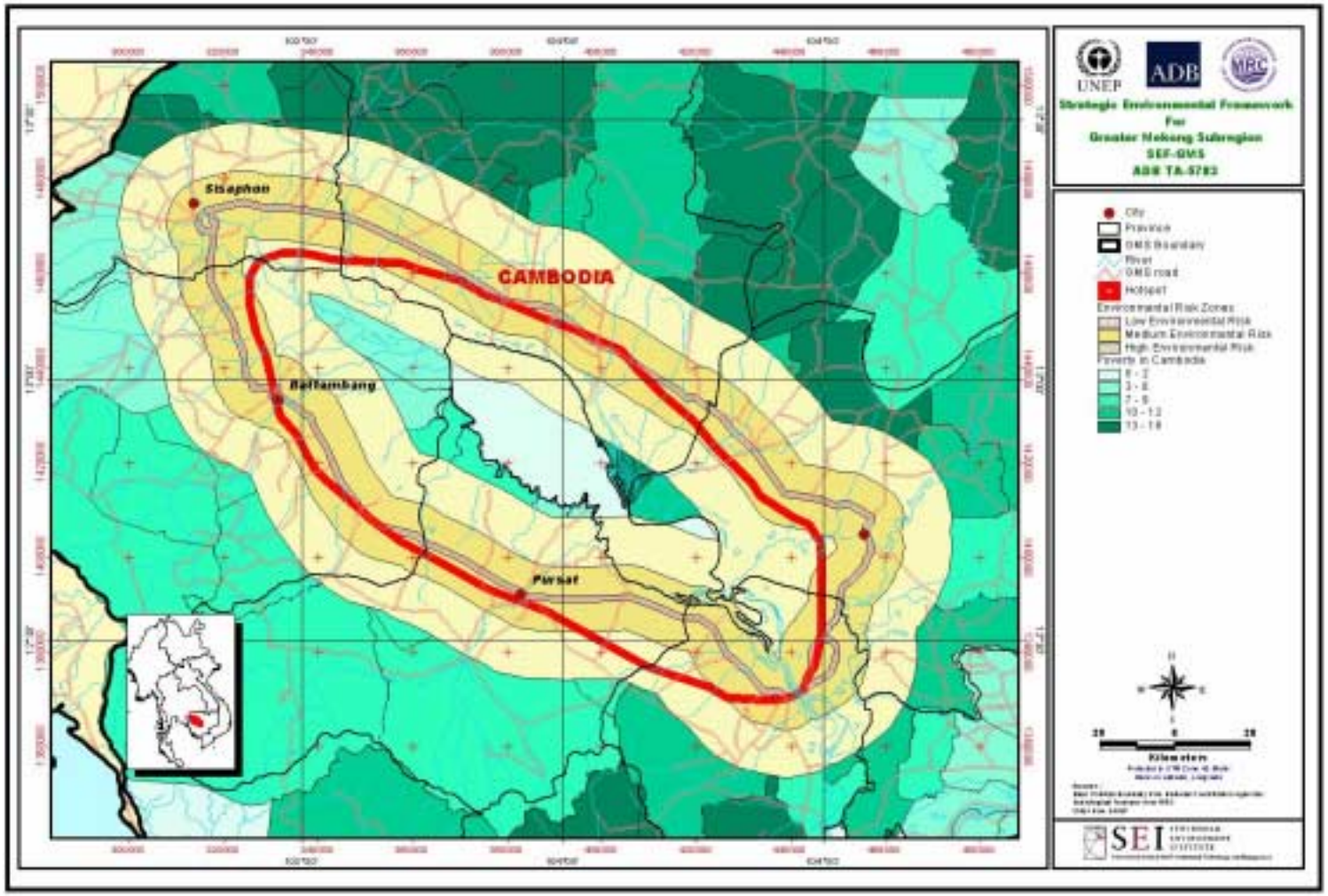

Figure 6.11 Road Projects Risk Zones and HVAs in the Tonle Sap Hotspot

6.6.2 How Important Overall

The Tonle Sap is important as a hotspot because of its unique ecology and the large proportion of Cambodia people rely on its resources. The area although threatened with local degradation and over harvesting is at huge risk of ecological collapse as a result of the actions of other riparian countries and the needs of assessing transboundary threats as well as creating the mechanisms for discussing and resolving these issues will be mandatory to preserve the Great Lake.

6.7 Strategic Recommendations

Clarification of the Biological Situation and Modelling– as highlighted in Hotspot one the Tonle Sap is an integrated part of the Greater Mekong Ecosystem. Changes in flows resulting from dam impoundment upstream on the Mekong and its tributaries could have serious effects on the ecology of the Tonle Sap. There is clearly a need for improved understanding of these processes. The development of a hydrological model that could inform decision-makers in relation to multiple development scenarios should be undertaken. Such a model should be able to address the Mekong mainstream as well as its main tributaries.

Basin Management Authority – similar to the Management Authorities recommended for other basins, a Tonle Sap Management Authority should be established. This in part already exists through the establishment of a subcommittee overseen by the Cambodian National Mekong Authority in regard to the Biosphere reserve. This subcommittee could form the basis for a more extensive body that overseas the entire Tonle Sap basin.

In regard to the role of the Basin Management Authorities mandate there are several key threats that need to be dealt with immediately.

Limitation and Improved Planning of Irrigation Projects – The GoC is beginning to revitalise proposed irrigation projects from the 1970s. The US Army Corps of Engineers originally proposed these projects at a time when environmental and social equity received scant attention from developers. For these projects to be reconsidered today they should be re-evaluated for their potential environmental and social effects before being developed. All projects should conduct and EIA and SIA prior to any construction with special attention paid to the cumulative effects of reduced water flows on the ecology of the Tonle Sap Lake.

Control of Pesticide Use – as rice production intensifies in the Tonle Sap basin and more farmers are using pesticides on their fields the potential threats to the people and wildlife living in the basin has intensified. These pesticides are likely to enter the Tonle Sap through erosion and runoff and collect in the fish and other aquatic species in the lake. This could create a long-term heath hazard and lead to the crash of the fishery.

Control of Population Growth – the Tonle Sap gold rush is attracting entrepreneurs and landless poor from all corners of the GMS and beyond. As the population increases the demand for the finite resources of the lake are coming under more pressure of over exploitation. In the long run this growth will need to be staunched in order for a sustainable system to operate.

Control of Forest Loss – the flooded forests surrounding the Tonle Sap Lake are integral to fisheries production in the role that they play as spawning grounds. These forests are increasingly lost for building materials and for fuel wood, if flooded forest in going to continue to play its existing role alternatives for building and fuel need to be found. The Strategic Environmental Framework project has discussed other recommendations related to the Tonle Sap Great Lake in its volume on case studies.

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ANNEX 1. IUCN PROTECTED AREA CATEGORIES

Ia. Strict Nature Reserve – science	Area of land and/or sea possessing some outstanding or representative ecosystems, geological or physiological feature and/or species, available primarily for scientific research and/or environmental monitoring.
Ib. Wilderness Area – wilderness protection	Large area of unmodified land, and/or sea, retaining its natural character and influence, without permanent or significant habitation, which is protected and managed so as to preserve its natural condition.
II. National Park – ecosystem protection and recreation	Natural area of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for present and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.
III. Natural Monument – conservation of specific natural features	Area containing one, or more, specific natural or natural/cultural features which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.
IV. Habitat / Species Management Area – conservation through management intervention	Area of land and/or sea subject to active intervention for management purposes so as to ensure the maintenance of habitats and/or to meet the requirements of specific species
V. Protected Landscapes / Seascapes – landscape / seascape conservation recreation	Area of land, with coast and sea are appropriate, where the interaction of people and nature over time has produced an area of distinct character with significant aesthetic, ecological and/or cultural value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.
VI. Managed Resource Protected Area – sustainable use of natural ecosystems	Area containing predominantly unmodified natural systems, managed to ensure long term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Source: *Guidelines for Protected Area Management Categories* (IUCN 1994).

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